OPTIMISM

SAFETY@SEA

Effective Implementation of ISM Code

Enhancing Maritime Safety Through Knowledge and Innovation

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Foreword

Maritime safety is built on hard lessons. Many of the rules, procedures, and systems used today exist because something went wrong in the past. Yet despite clear regulations, modern technology, and extensive training requirements, serious accidents continue to occur at sea. In many cases, the causes are familiar. Procedures were bypassed, risks were underestimated, communication failed, or commercial pressure took priority over safety.

The OPTIMISM programme was developed in response to this reality. Its purpose is not to repeat what seafarers already know, but to address the gap between written procedures and real behaviour on board. Safety management systems are only effective when they are understood, applied, and supported by a strong safety culture. This book is designed to help turn safety from a document into a daily practice.

Chapters 1 to 6 follow a clear and logical structure. The book begins with the foundations of the ISM Code and the responsibilities it places on companies and individuals. It then examines what can be learned from accidents, inspections, and audits, using real data to highlight recurring weaknesses in maritime operations. Risk assessment is presented as a practical decision-making tool rather than a paperwork exercise, with a strong focus on the human element and operational realities.

The later chapters move from analysis to application. The use of structured assessment frameworks and immersive virtual reality training allows safety lessons to be experienced rather than simply described. By placing learners in realistic scenarios, the programme encourages correct decision-making, procedural discipline, and hazard awareness under conditions that closely reflect real life at sea. Mistakes can be made, understood, and corrected without real-world consequences.

This book is intended for seafarers, ship managers, trainers, auditors, and regulators who understand that safety cannot rely on compliance alone. Real safety depends on competence, leadership, and the willingness to learn from past failures. By combining regulatory knowledge, practical analysis, and modern training methods, the OPTIMISM programme offers a grounded and practical contribution to improving safety at sea.

It is hoped that this work will support individuals and organisations in strengthening their safety practices and, ultimately, in preventing accidents that are too often repeated and too often avoidable.

Summary

The Maritime Safety section of the OPTIMISM training programme provides a structured, competence-based progression from regulatory foundations to advanced, immersive safety training. Chapters 1 to 6 are designed to build a deep, practical understanding of how maritime safety is governed, how failures occur, how risks are managed, and how lessons from real incidents are transformed into behavioural competence.

Chapter 1 introduces the International Safety Management (ISM) Code and its role in ensuring the safe operation of ships and the protection of the marine environment. It establishes the regulatory context by explaining how international conventions, company policies, audits, and certification processes combine to form an effective Safety Management System (SMS). This chapter ensures learners understand compliance requirements, management responsibilities, and the importance of monitoring and continuous improvement.

Chapter 2 focuses on learning from accidents by analysing real maritime incidents and investigation reports. Using validated accident analysis frameworks, this chapter identifies recurring root causes such as procedural non-compliance, inadequate supervision, poor risk assessment, human error, and weak safety culture. Learners develop the ability to assess whether incidents are ISM-related and to translate accident findings into preventive actions that strengthen the SMS.

Chapter 3 builds on this by examining inspections and audits as proactive safety tools. It analyses Port State Control data, audit non-conformities, and key performance indicators to reveal systemic weaknesses in maintenance, navigation, training, and organisational oversight. Learners gain the competence to interpret audit findings, distinguish between isolated errors and systemic failures, and use inspection results to drive continuous improvement.

Chapter 4 introduces a comprehensive risk-based approach to maritime safety. It covers hazard identification, multi-level risk assessments, critical equipment management, emergency preparedness, and human element considerations. The chapter integrates concepts such as just culture, leadership, communication, and knowledge management, demonstrating how risk controls must be embedded into daily operations and the SMS to be effective in practice.

Chapter 5 applies these principles through a structured Tanker Management and Self-Assessment (TMSA) gap analysis. It guides learners through the full TMSA framework, covering management commitment, personnel competence, vessel reliability, navigation, cargo operations, security, environmental protection, management of change, incident investigation, and audit systems. This chapter equips learners with the ability to benchmark organisational performance, identify gaps, and develop targeted improvement actions across all operational areas.

Chapter 6 translates the analytical and procedural learning into immersive virtual reality (VR) training. Real accident data is converted into high-fidelity VR scenarios covering enclosed space entry, gas detection, PPE use, firefighting, and emergency response. Through experiential learning and performance feedback, learners develop procedural discipline, hazard awareness,

and decision-making skills under pressure. The VR application reinforces safety culture by eliminating shortcuts and enabling data-driven assessment of competence.

Together, Chapters 1 to 6 form an integrated maritime safety framework that moves from regulation and analysis to risk management and applied competence. The programme ensures that safety is not treated as a theoretical requirement, but as a lived, practiced capability embedded within individual behaviour and organisational systems.

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Chapter 1: Introduction to ISM Code

1. Quality System in Shipping Industry

The maritime industry is directly influenced by the policies of International Maritime Organisation (IMO) and its international conventions. IMO has established three major pillars, viz., SOLAS (Safety Of Life At Sea), MARPOL (Maritime Pollution) and STCW (Standards of Training, Certification and Watchkeeping. In addition there are several international organisations such as ILO which regulate the labour rules and regulations. Maritime sector is very sensitive on two topics safety at sea and environment. These two concepts can be found in almost every shipping company's mission statement. Despite of the existed sensitivity accidents in Maritime Sector especially on vessels still continue.

IMO was monitoring and working on a quality system which can be accepted by all the member countries in order to be sure that every shipping company in the world is obliged to apply same basic safety rules and to the same standards. For this reason, the ISM (International Safety Management) Code was developed to provide an International standard for the safe management and operation of ships and for pollution prevention.

The purpose of ISM Code is:

- To ensure Safety at Sea
- To prevent human injury or loss of life
- To avoid damage to the environment and to the ship.

SOLAS adopted the ISM Code in 1994 and incorporated it into the main body of the legislation (what is known as Chapter IX). By 1998 much of the commercial shipping community was required to be in compliance with the ISM code. By 2002 almost all of the international shipping community was required to comply with the ISM Code.

In order to comply with the ISM Code, each ship class must have a working Safety Management System (SMS). Each SMS consists of the following elements:

- Commitment from top management
- A Top Tier Policy Manual
- A Procedures Manual that documents what is done on board the ship
- Procedures for conducting both internal and external audits to ensure the ship is doing what is documented in the Procedures Manual
- A Designated Person to serve as the link between the ships and shore staff
- A system for identifying where actual practices do not meet those that are documented and for implementing associated corrective action
- Regular management reviews

Another part of the ISM is the mandatory Planned Maintenance System which is used as a tool maintaining the vessel according to the specified maintenance intervals.

Each ISM compliant ship is audited, first by the Company (internal audit) and then each 2,5 to 3 years by the Flag State Marine Administration to verify the fulfilment and effectiveness of their Safety Management System. Once SMS is verified and it is working and effectively implemented, the ship is issued with The Safety Management Certificate. Comments from the auditor and/or audit body and from the ship are incorporated into the SMS by headquarters.

The full requirement of ISM Code 2002 is given later in this Appendix. In creating the family business knowledge framework the ISM code are carefully consider as it plays an important role and needs to be fully included in the intended knowledge framework.

ISO 9000 - Quality Standard

To ensure that there are procedures to implement a set of basic quality system, industry is encouraged to apply ISO 9001 which is internationally recognised standard for the quality management of businesses.

- it applies to the processes that create and control the products and services an organisation supplies
- prescribes systematic control of activities to ensure that the needs and expectations of customers are met
- is designed and intended to apply to virtually any product or service, made by any process anywhere in the world
- ISO 9001 is one of the standards in the ISO 9000 family.
- The benefits of implementing ISO 9001

Implementing a Quality Management System will motivate staff by defining their key roles and responsibilities. Cost savings can be made through improved efficiency and productivity, as product or service deficiencies will be highlighted. From this, improvements can be developed, resulting in less waste, inappropriate or rejected work and fewer complaints. Customers will notice that orders are met consistently, on time and to the correct specification. This can open up the market place to increased opportunities.

How do you start to implement ISO 9001? What is involved?

- Identify the requirements of ISO 9001 and how they apply to the business involved.
- Establish quality objectives and how they fit in to the operation of the business.
- Produce a documented quality policy indicating how these requirements are satisfied.
- Communicate them throughout the organisation.
- Evaluate the quality policy, its stated objectives and then prioritise requirements to ensure they are met.
- Identify the boundaries of the management system and produce documented procedures as required.
- Ensure these procedures are suitable and adhered to.
- Once developed, internal audits are needed to ensure the system carries on working.

ISO 14000 Environmental Management Systems

The shipping industry is also encouraged to apply the ISO 14001 2004 which is an environmental management standard. It specifies a set of environmental management requirements for environmental management systems. The purpose of this standard is to help all types of organizations to protect the environment, to prevent pollution, and to improve their environmental performance.

ISO 14001 is now implemented in more than 159 countries and has provided organizations with a powerful management tool to improve their environmental performance. More than 223 149 organizations have been certified worldwide against ISO 14001 at the end of 2009, which is an increase of 18 % compared to 2008. Many companies have improved their operations and reduced the impact of their activities, processes, products and services on the environment by using a systematic approach that seeks continual improvement.

The benefits of positively addressing environmental issues not only cover the preservation of the environment, but are also linked to business performance and profitability while improving the corporate image, enhancing access to export markets, providing a common reference for communicating environmental issues with customers, regulators, the public and other stakeholders, etc.

Despite of all the efforts in maritime industry all these quality tools while they apply to regulatory activities they do not solve the family problems faced in many family owned shipping companies. These quality tools do not address shareholders' structures, business governance, succession planning or the position of the shareholders who are active in the business.

2. International Safety Management (ISM) Code 2002

Preamble

The ISM Code is a set of rules set by the International Maritime Organisation (IMO) Assembly which is the legislative body for the shipping industry. The following describes the purpose of, and the reasons, for the Code.

1 The purpose of this Code is to provide an international standard for the safe management and operation of ships and for pollution prevention.

2 The Assembly adopted resolution A.443 (XI), by which it invited all Governments to take the necessary steps to safeguard the shipmaster in the proper discharge of his responsibilities with regard to maritime safety and the protection of the marine environment.

3 The Assembly also adopted resolution A.680(17), by which it further recognized the need for appropriate organization of management to enable it to respond to the need of those on board ships to achieve and maintain high standards of safety and environmental protection.

4 Recognizing that no two shipping companies or ship-owners are the same, and that ships operate under a wide range of different conditions, the Code is based on general principles and objectives.

5 The Code is expressed in broad terms so that it can have a widespread application. Clearly, different levels of management, whether shore-based or at sea, will require varying levels of knowledge and awareness of the items outlined.

6 The cornerstone of good safety management is commitment from the top. In matters of safety and pollution prevention it is the commitment, competence, attitudes and motivation of individuals at all levels that determines the end result.

Part A - Implementation

1 General

1.1 Definitions

The following definitions apply to parts A and B of this Code.

1.1.1 "International Safety Management (ISM) Code" means the International Management Code for the Safe Operation of Ships and for Pollution Prevention as adopted by the Assembly, as may be amended by the Organization.

1.1.2 "Company" means the owner of the ship or any other organization or person such as the manager, or the bareboat charterer, who has assumed the responsibility for operation of the ship from the ship owner and who, on assuming such responsibility, has agreed to take over all duties and responsibility imposed by the Code.

1.1.3 "Administration" means the Government of the State whose flag the ship is entitled to fly.

1.1.4 "Safety management system" means a structured and documented system enabling Company personnel to implement effectively the Company safety and environmental protection policy.

1.1.5 "Document of Compliance" means a document issued to a Company which complies with the requirements of this Code.

1.1.6 "Safety Management Certificate" means a document issued to a ship which signifies that the Company and its shipboard management operate in accordance with the approved safety management system.

1.1.7 "Objective evidence" means quantitative or qualitative information, records or statements of fact pertaining to safety or to the existence and implementation of a safety management system element, which is based on observation, measurement or test and which can be verified.

1.1.8 "Observation" means a statement of fact made during a safety management audit and substantiated by objective evidence.

1.1.9 "Non-conformity" means an observed situation where objective evidence indicates the non-fulfilment of a specified requirement.

1.1.10 "Major non-conformity" means an identifiable deviation that poses a serious threat to the safety of personnel or the ship or a serious risk to the environment that requires immediate

corrective action and includes the lack of effective and systematic implementation of a requirement of this Code.

1.1.11 "Anniversary date" means the day and month of each year that corresponds to the date of expiry of the relevant document or certificate.

1.1.12 "Convention" means the International Convention for the Safety of Life at Sea, 1974, as amended.

1.2 Objectives

1.2.1 The objectives of the Code are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property.

1.2.2 Safety management objectives of the Company should, inter alia:

- 1 provide for safe practices in ship operation and a safe working environment;
- 2 establish safeguards against all identified risks; and
- 3 continuously improve safety management skills of personnel ashore and aboard ships,
- including preparing for emergencies related both to safety and environmental protection.

1.2.3 The safety management system should ensure:

- 1 compliance with mandatory rules and regulations; and
- 2 that applicable codes, guidelines and standards recommended by the Organization, Administrations, classification societies and maritime industry organizations are taken into account.

1.3 Application

The requirements of this Code may be applied to all ships.

1.4 Functional requirements for a safety management system

Every Company should develop, implement and maintain a safety management system which includes the following functional requirements:

- 1 a safety and environmental-protection policy;
- 2 instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant international and flag State legislation;
- 3 defined levels of authority and lines of communication between, and amongst, shore and shipboard personnel;
- 4 procedures for reporting accidents and non-conformities with the provisions of this Code;
- 5 procedures to prepare for and respond to emergency situations; and
- 6 procedures for internal audits and management reviews.

2 Safety and Environmental-Protection Policy

- 2.1 The Company should establish a safety and environmental-protection policy which describes how the objectives given in paragraph 1.2 will be achieved.

-2.2 The Company should ensure that the policy is implemented and maintained at all levels of the organization, both ship-based and shore-based.

3 Company Responsibilities and Authority

-3.1 If the entity/person who is responsible for the operation of the ship is other than the owner, the owner must report the full name and details of such entity should be given to the Administration.
-3.2 The Company should define and document the responsibility, authority and interrelation of all personnel who manage, perform and verify work relating to and affecting safety and pollution prevention.
-3.3 The Company is responsible for ensuring that adequate resources and shore-based support are provided to enable the designated person or persons to carry out their functions.

4 Designated Person(s)

To ensure the safe operation of each ship and to provide a link between the Company and those on board, every Company, as appropriate, should designate a person or persons ashore having direct access to the highest level of management. The responsibility and authority of the designated person or persons should include monitoring the safety and pollution-prevention aspects of the operation of each ship and ensuring that adequate resources and shore-based support are applied, as required.

Master's Responsibility and Authority

5.1 The Company should clearly define and document the master's responsibility with regard to:

-1 implementing the safety and environmental-protection policy of the Company;
-2 motivating the crew in the observation of that policy;
-3 issuing appropriate orders and instructions in a clear and simple manner;
-4 verifying that specified requirements are observed; and
-5 reviewing the safety management system and reporting its deficiencies to the shore-based management.

5.2 The Company should ensure that the safety management system operating on board the ship contains a clear statement emphasizing the master's authority. The Company should establish in the safety management system that the master has the overriding authority and the responsibility to make decisions with respect to safety and pollution prevention and to request the Company's assistance as may be necessary.

Resources and Personnel

6.1 The Company should ensure that the master is:

-1 properly qualified for command;
-2 fully conversant with the Company's safety management system; and
-3 given the necessary support so that the master's duties can be safely performed.

6.2 The Company should ensure that each ship is manned with qualified, certificated and medically fit seafarers in accordance with national and international requirements.

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarization with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

6.4 The Company should ensure that all personnel involved in the Company's safety management system have an adequate understanding of relevant rules, regulations, codes and guidelines.

6.5 The Company should establish and maintain procedures for identifying any training which may be required in support of the safety management system and ensure that such training is provided for all personnel concerned.

6.6 The Company should establish procedures by which the ship's personnel receive relevant information on the safety management system in a working language or languages understood by them.

6.7 The Company should ensure that the ship's personnel are able to communicate effectively in the execution of their duties related to the safety management system.

Development of Plans for Shipboard Operations

The Company should establish procedures for the preparation of plans and instructions, including a family business knowledge framework as appropriate, for key shipboard operations concerning the safety of the ship and the prevention of pollution. The various tasks involved should be defined and assigned to qualified personnel.

Emergency Preparedness

8.1 The Company should establish procedures to identify, describe and respond to potential emergency shipboard situations.

8.2 The Company should establish programmes for drills and exercises to prepare for emergency actions.

8.3 The safety management system should provide for measures ensuring that the Company's organization can respond at any time to hazards, accidents and emergency situations involving its ships.

3. *Reports and Analysis of Non-Conformities, Accidents and Hazardous Occurrences*

9.1 The safety management system should include procedures ensuring that non-conformities, accidents and hazardous situations are reported to the Company, investigated and analysed with the objective of improving safety and pollution prevention.

9.2 The Company should establish procedures for the implementation of corrective action.

Maintenance of The Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

10.2 In meeting these requirements the Company should ensure that:

-1 inspections are held at appropriate intervals;
-2 any non-conformity is reported, with its possible cause, if known;
-3 appropriate corrective action is taken; and
-4 records of these activities are maintained.

10.3 The Company should establish procedures in its safety management system to identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The safety management system should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.

10.4 The inspections mentioned in 10.2 as well as the measures referred to in 10.3 should be integrated into the ship's operational maintenance routine.

Documentation

11.1 The Company should establish and maintain procedures to control all documents and data which are relevant to the safety management system.

11.2 The Company should ensure that:

-1 valid documents are available at all relevant locations;
-2 changes to documents are reviewed and approved by authorized personnel; and
-3 obsolete documents are promptly removed.

11.3 The documents used to describe and implement the safety management system may be referred to as the Safety Management Manual. Documentation should be kept in a form that the Company considers most effective. Each ship should carry on board all documentation relevant to that ship.

Company Verification, Review and Evaluation

12.1 The Company should carry out internal safety audits to verify whether safety and pollution-prevention activities comply with the safety management system.

12.2 The Company should periodically evaluate the efficiency of and, when needed, review the safety management system in accordance with procedures established by the Company.

12.3 The audits and possible corrective actions should be carried out in accordance with documented procedures.

12.4 Personnel carrying out audits should be independent of the areas being audited unless this is impracticable due to the size and the nature of the Company.

12.5 The results of the audits and reviews should be brought to the attention of all personnel having responsibility in the area involved.

12.6 The management personnel responsible for the area involved should take timely corrective action on deficiencies found.

4.2 PART B - CERTIFICATION AND VERIFICATION

Certification And Periodical Verification

13.1 The ship should be operated by a Company which has been issued with a Document of Compliance or with an Interim Document of Compliance in accordance with paragraph 14.1, relevant to that ship.

13.2 The Document of Compliance should be issued by the Administration, by an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government to the Convention to any Company complying with the requirements of this Code for a period specified by the Administration which should not exceed five years. Such a document should be accepted as evidence that the Company is capable of complying with the requirements of this Code.

13.3 The Document of Compliance is only valid for the ship types explicitly indicated in the document. Such indication should be based on the types of ships on which the initial verification was based. Other ship types should only be added after verification of the Company's capability to comply with the requirements of this Code applicable to such ship types. In this context, ship types are those referred to in regulation IX/1 of the Convention.

13.4 The validity of a Document of Compliance should be subject to annual verification by the Administration or by an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government within three months before or after the anniversary date.

13.5 The Document of Compliance should be withdrawn by the Administration or, at its request, by the Contracting Government which issued the Document when the annual verification required in paragraph 13.4 is not requested or if there is evidence of major non-conformities with this Code.

13.5.1 All associated Safety Management Certificates and/or Interim Safety Management Certificates should also be withdrawn if the Document of Compliance is withdrawn.

13.6 A copy of the Document of Compliance should be placed on board in order that the master of the ship, if so requested, may produce it for verification by the Administration or by an organization recognized by the Administration or for the purposes of the control referred to in regulation IX/6.2 of the Convention. The copy of the Document is not required to be authenticated or certified.

13.7 The Safety Management Certificate should be issued to a ship for a period which should not exceed five years by the Administration or an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government.

The Safety Management Certificate should be issued after verifying that the Company and its shipboard management operate in accordance with the approved safety management system. Such a Certificate should be accepted as evidence that the ship is complying with the requirements of this Code.

13.8 The validity of the Safety Management Certificate should be subject to at least one intermediate verification by the Administration or an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government. If only one intermediate verification is to be carried out and the period of validity of the Safety Management Certificate is five years, it should take place between the second and third anniversary dates of the Safety Management Certificate.

13.9 In addition to the requirements of paragraph 13.5.1, the Safety Management Certificate should be withdrawn by the Administration or, at the request of the Administration, by the Contracting Government which has issued it when the intermediate verification required in paragraph 13.8 is not requested or if there is evidence of major non-conformity with this Code.

13.10 ,Notwithstanding the requirements of paragraphs 13.2 and 13.7, when the renewal verification is completed within three months before the expiry date of the existing Document of Compliance or Safety Management Certificate, the new Document of Compliance or the new Safety Management Certificate should be valid from the date of completion of the renewal verification for a period not exceeding five years from the date of expiry of the existing Document of Compliance or Safety Management Certificate.

13.11 ,When the renewal verification is completed more than three months before the expiry date of the existing Document of Compliance or Safety Management Certificate, the new Document of Compliance or the new Safety Management Certificate should be valid from the date of completion of the renewal verification for a period not exceeding five years from the date of completion of the renewal verification."

Interim Certification

14.1 An Interim Document of Compliance may be issued to facilitate initial implementation of this Code when:

- 1 a Company is newly established; or
- 2 new ship types are to be added to an existing Document of Compliance,

following verification that the Company has a safety management system that meets the objectives of paragraph 1.2.3 of this Code, provided the Company demonstrates plans to implement a safety management system meeting the full requirements of this Code within the period of validity of the Interim Document of Compliance. Such an Interim Document of Compliance should be issued for a period not exceeding 12 months by the Administration or by an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government. A copy of the Interim Document of Compliance should be placed on board in order that the master of the ship, if so requested, may produce it for verification by the Administration or by an organization recognized by the Administration or

for the purposes of the control referred to in regulation IX/6.2 of the Convention. The copy of the Document is not required to be authenticated or certified.

14.2 An Interim Safety Management Certificate may be issued:

-1 to new ships on delivery;
-2 when a Company takes on responsibility for the operation of a ship which is new to the Company; or
-3 when a ship changes flag.

Such an Interim Safety Management Certificate should be issued for a period not exceeding 6 months by the Administration or an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government.

14.3 An Administration or, at the request of the Administration, another Contracting Government may, in special cases, extend the validity of an Interim Safety Management Certificate for a further period which should not exceed 6 months from the date of expiry.

14.4 An Interim Safety Management Certificate may be issued following verification that:

-1 the Document of Compliance, or the Interim Document of Compliance, is relevant to the ship concerned;
-2 the safety management system provided by the Company for the ship concerned includes key elements of this Code and has been assessed during the audit for issuance of the Document of Compliance or demonstrated for issuance of the Interim Document of Compliance;
-3 the Company has planned the audit of the ship within three months;
-4 the master and officers are familiar with the safety management system and the planned arrangements for its implementation;
-5 instructions, which have been identified as being essential, are provided prior to sailing; and
-6 relevant information on the safety management system has been given in a working language or languages understood by the ship's personnel.

Verification

15.1 All verifications required by the provisions of this Code should be carried out in accordance with procedures acceptable to the Administration, taking into account the guidelines developed by the Organization.

Forms Of Certificates

16.1 The Document of Compliance, the Safety Management Certificate, the Interim Document of Compliance and the Interim Safety Management Certificate should be drawn up in a form corresponding to the models given in the Code. If the language used is neither English nor French, the text should include a translation into one of these languages.

16.2 In addition to the requirements of paragraph 13.3, the ship types indicated on the Document of Compliance and the Interim Document of Compliance may be endorsed to reflect any limitations in the operations of the ships described in the safety management system.

Although ISM code brings all the industry to a minimum standard for safety, leading shipping companies adopt further quality management standard as well as environmental standards.

Chapter 2: Learning from Accidents

1. Introduction

The maritime industry operates within a stringent regulatory framework to ensure safety, environmental protection, and operational efficiency. The International Safety Management (ISM) Code, a pivotal component of this framework, demands the implementation of robust safety management systems by shipping companies. These systems are subjected to regular audits to verify compliance and effectiveness.

The ISM emanated from the ISO 9000. ISO's own origin was the British Standards (BS). BS were instrumental in the formation of ISO standards and in 1947, of its European equivalent EN soon after the formation of CEN in 1961. The reason for developing BS was for help companies to improve their procedure in design, production, and service processes. This facilitated the path for the companies to have a better knowledge of their processes and hence allowed them to become more efficient. Whilst having a more in-depth knowledge of one's processes is expected to lead to improved quality of designs, products and services the standards were not developed for this purpose in short to medium terms. C4FF, as the initiator of Factories of the Future, installed many BS and later ISO/EN systems in industry and promoted its application worldwide through the ManTec, IMS initiatives, Factories of the Future and within ManuFuture[1] platform. The latter embraces almost every major manufacturing centre worldwide including governmental agencies and their research bodies. BS/ISO/EN strength lies in its two principles viz., 'Compliance with specification' and 'Fitness for purpose (Gozacan and Ziarati et al., 2010)[2]. The latter publication demonstrated that ISO systems developed for design and manufacturing processes can successfully be applied in other sectors such as the higher education; as has been in case of ISM Code.

Marine accidents have a profound impact on the maritime industry, prompting meticulous investigations. For the analysis in this chapter, a comprehensive review of over 130 accidents occurring since 2010 was undertaken by C4FF. From this initial pool, some 100 accident investigation reports were studied, and 40 of these cases were selected for a detailed micro-analysis. These accidents provide invaluable insights into the multifaceted dynamics of maritime safety and accident prevention

[1] https://www.manufuture.org/

[2] Gozacan, N., and Ziarati, R. (2010), Developing quality criteria for application in the higher education sector in Turkey, 2010.

2. Frameworks for Analysing Root Causes

A review of accidents done by De Melo Rodriguez et al (2024) led to identifying root causes of and contributing factors to accidents at sea. As shown in figure 2.1., this taxonomy breaks down causes into five main domains: Quality Assurance (QA) Errors, non-QA Errors (Mistake), System Work Environment Errors, Nature, and Psychological/Physiological/Behavioural (PPS) Factors. Each of these categories is broken down into specific areas such as policy failures, procedural lapses, supervisory issues, and operational or personal vulnerabilities. For example, QA errors are often associated with inadequate documentation, poor planning, or missing procedures, while non-QA mistakes frequently arise from personal or leadership shortcomings. By mapping out these interconnected causes, the C4FF taxonomy enables a holistic understanding of how safety breakdowns occur and where preventive interventions can be most effective.

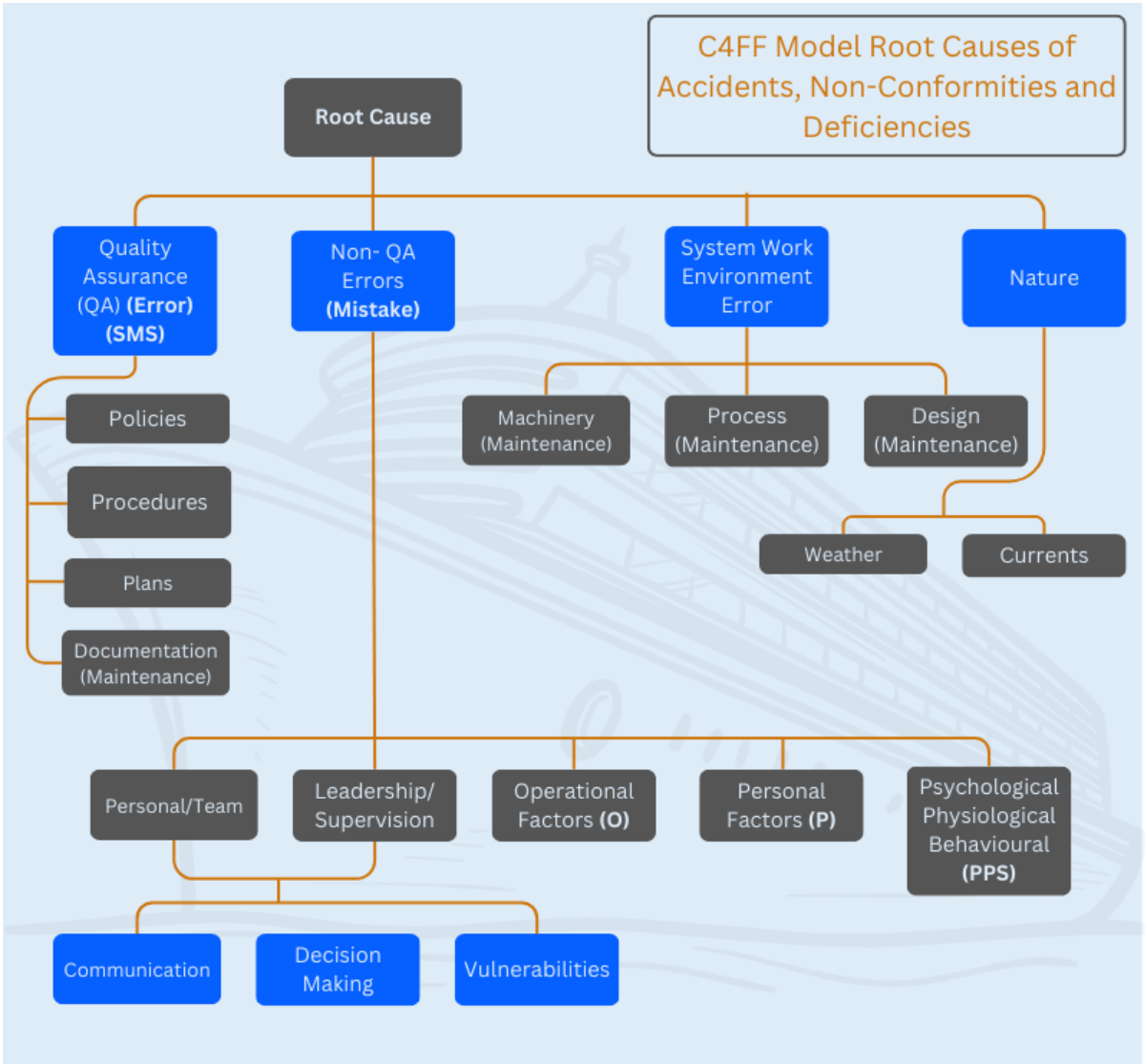

Figure 2.1. Root Causes of Accidents (Source: M'aider 2010, ACTs 2015 and ACTS Plus 2017 & OPTIMISM 2024 – www.mairfuture.org).

A - Work Environment

1. Lack of visibility, excessive noise or vibration, hot/cold working environment, bad weather, sudden movements.
2. Inappropriate work environment/ergonomics, poor human–machine interface, automation issues, maintenance and equipment misfunctions.
3. Inadequate system design
4. Issues with procurement/purchasing

B - Personal

1. Inadequate personal fitness
2. Inadequate mental fitness (including bullying and harassment)
3. Inadequate Knowledge
4. Inadequate competence/skills
5. Lack of motivation or complacency
6. Ineffective communication, language differences, non-standard (Non SMCP) or complex communication and the impact of differences in rank.
7. Poor team operation, working towards different goals, no cross-checking, no means of reporting or speaking-up, no quality circles.
8. Incorrect perception, motion illusion, visual pretention/illusion and the misperception of changing environments or instruments.
9. Lack of focus/incorrect awareness leading to misinterpretation of the operation by a crew member – lack of attention, confusion, distraction, discoordination, stress/poor mental perception.
10. Forgetfulness, inaccurate recall or using outdated information.

C - Leadership

1. Inadequate leadership and personnel management,

including no personnel measures against regular risky behavior, a lack of feedback

on safety reporting, no role model and personality conflicts.

2. Inadequate risk assessment, inadequate team composition, inappropriate pressure to

perform a task and a directed task with inadequate qualification, experience or

equipment.

3. Inadequate leadership of operational tasks, including a lack

of correction of unsafe practices, no enforcement of existing rules, allowing unwritten

policies to become standards and directed deviations from procedures.

4. Inadequate manning (intentional or unintentional disregard for the guidelines).

D - Organizational

1. Inappropriate policy manual
2. Inappropriate/inadequate procedures
3. Inadequate supervision
4. Problems with safety culture, lack of culture of reporting, learning or just culture, social and status barriers causing misunderstandings.
5. Unsuitable documented policy or procedures, limitations of proactive risk management, reactive safety assurance, lack of safety promotion and training
6. Insufficient resources for safe operations, including personnel, budgets, equipment, training programs, operational information and lack of operational manual of ship installations.
7. Commercial Pressures, business and competition affecting safety, including relations with contractors, trade pressure to keep the plans and costs.

When analysing the accident investigators' reports two methodologies were considered. Figure 2.1. shows Baines Simmons method.

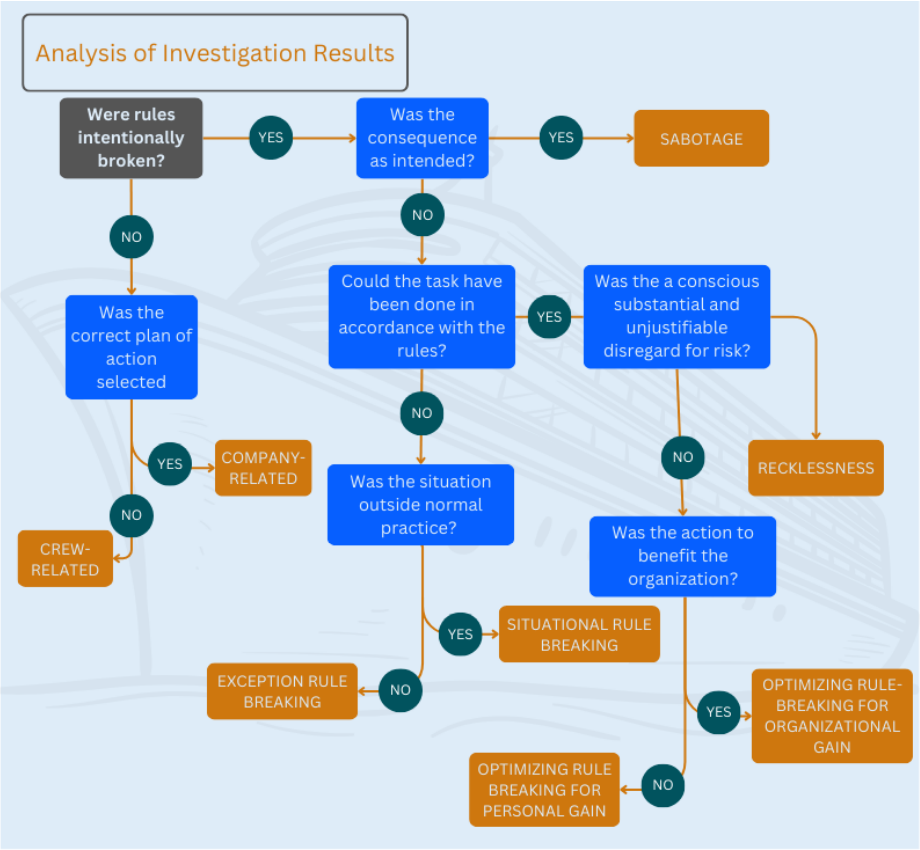

Figure 2.2: Flowchart Analysis of Investigation Results – Error vs Mistake

Figure 2.3 depicts the method developed by C4FF. This method first establishes if the main cause of accident is ISM related and if so, identifies the element/sub-element of ISM. If the ISM element cannot be identified then an attempt is made to identify any management faults and/or manning issues or any other. However, if the accident is not ISM related, then an

assessment is made to assess compliance issues and if so, the analysis tries to identify a problem with policy or procedure or an action plan. If compliance is not an issue, management and non-management issues are taken into consideration.

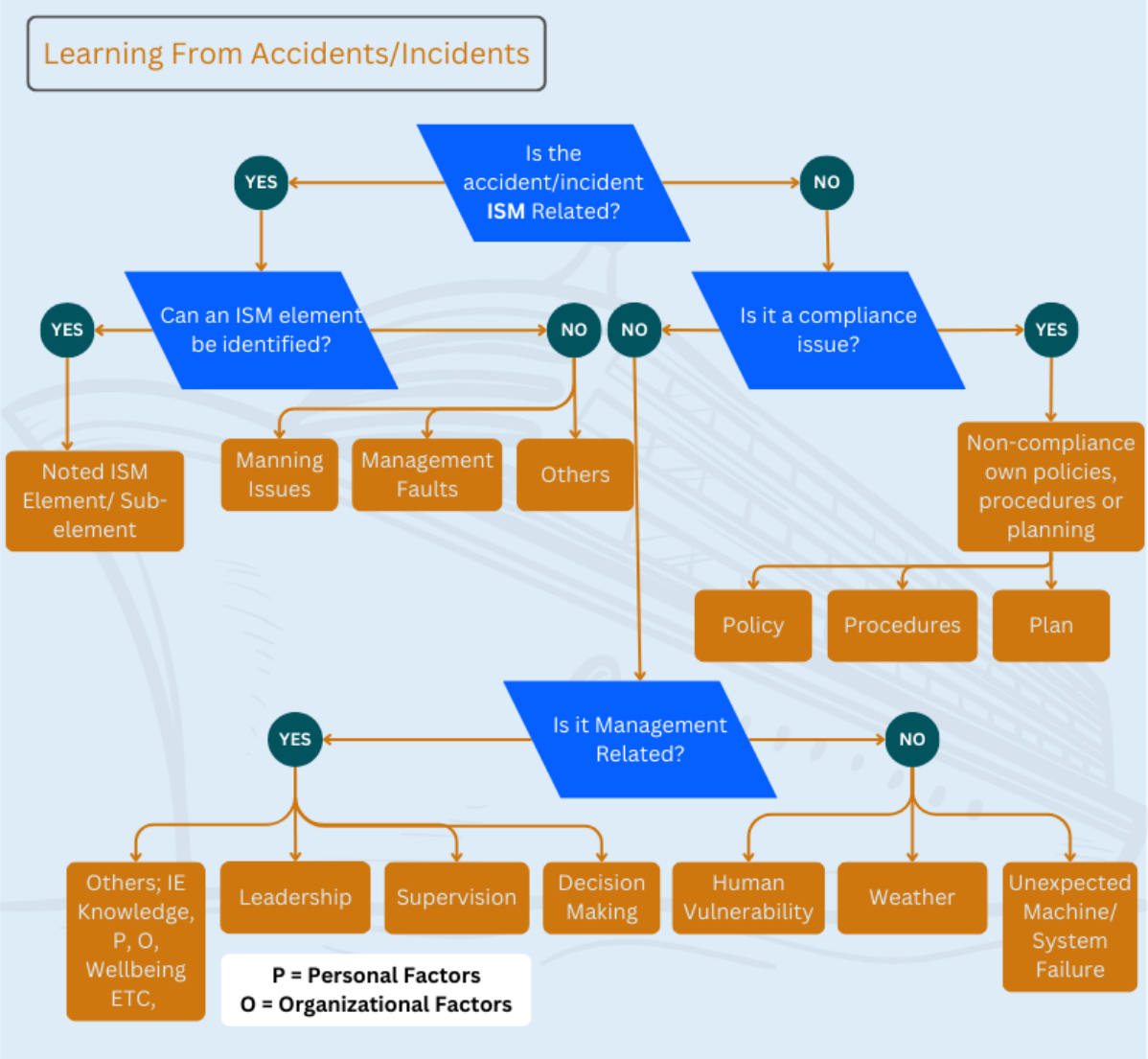

Figure 2.3 - Flowchart Analysis of Investigation Results – C4FF's Chart for IMO Study

If it were due an error, then the blame is primarily on the company's QA. If it is a mistake, it could have been due to the deficiencies that are non-QA related which could highlight more training or lack of knowledge by a crew member or that the failure was a system/machinery failure; a good account of these is given in Horck (2007)[3].

3. Findings from Accident Report Analysis

Using the developed taxonomy (De Melo Rodrguez, G., et al. 2024) as shown in figure 2.1., 25 top root causes and contributing factors to accidents were identified. As shown in table 1,

[3] Horck, J., (2007), The ISM Code versus the STCW Convention-MET challenges convene, Proceedings of the 8th Annual General Assembly and conference of the International Association of Maritime Universities (IAMU)(AGA 8).

the analysis of 40 case studies from a pool of over 200 maritime accidents revealed recurring patterns in non-conformities and deficiencies observed in both ISM Code audits and Port State Control (PSC) inspections.

In tables 1 and 2, it is interesting to note that the majority of safety issues are QA related while non-QA plays a major role either as the main root cause of accidents or as a contributing factor to it. In almost all cases there were deficiencies due to Human Vulnerabilities, Decision Making and Communication. In almost half of the accidents, it was noted that knowledge/skills/competence to be an issue. This clearly indicates that quality assurance of shipping companies is a problem area needing attention.

Table 1 - The First Set of Micro Analysis of Accident Reviews

Type	Accident	Mistake	Error	Human vulnerability	Decision making	Communication
Container	Collision	x		x	x	x
Gas Carrier	Collision	x		x	x	x
Ro-Ro Ferry	Grounding	x		x		x
Cement Carrier	Capsize/Sinking		x	x	x	
Bulk Carrier	Grounding	x	x		x	
RoRo Passenger		x				
Ro-Ro Ferry	Grounding		x		x	x
Chemical tanker	Explosion		x		x	
ULCC	Grounding		x		x	x
Ro-Ro Ferry	Collision	x		x		x
Cruise Ship	Grounding	x		x		x
Oil Tanker	Fatal accident		x	x		
Bulk Carrier	Fatal accident	x	x		x	x
Bulk Carrier	Fatal accident		x	x		x
Gas Carrier	Fatal accident		x	x		
Bulk Carrier	Fatal accident	x	x		x	x
General Cargo	Collision	x	x		x	x
General Cargo	Collision	x	x		x	X
Chemical Tanker	Grounding		x	x		
Bulk Carrier	Grounding	x	x		x	x
General Cargo	Fatal accident		x	x		
Bulk Carrier	Fatal accident		x		x	

Table 2 - The Second Set of Micro Analysis of Accident Reviews

Type	Accident	Mistake	Error	Human vulnerability	Decision making	Communication
RoRo Cargo	Grounding	x		x	x	x
RoRo Cargo	Fire	x		x	x	x
Bulker	Collision	x		x	x	x
Offshore supply vessel	Sinking	x		x	x	x
Container vessel	Overboard	x		x	x	x
Car Carrier/ RoRo Cargo	Collision	x		x	x	x
Bulker	Lifeboat falling	x		x	x	x
RoRo Passenger	Lifeboat falling		x			
RoRo Passenger	Lifeboat falling		x	x	x	
Tanker	Engine room fire	x		x	x	x
General cargo	Drowning	x		x	x	x
Container vessel	Collision	x		x	x	x
General cargo	Fall and death	x		x	x	x
Bulker	Fall and death	x		x	x	x
Reefer	Fall and death	x		x	x	x
Bulker	Mooring rope death	x		x	x	x
Bulker	Drowning of bosun	x		x	x	x
Container vessel	Oiler died	x		x	x	x
Passenger vessel	OS drowned	x		x	x	x
RoRo Passenger	Passenger died	x		x	x	x

A review of table 1 shows the leadership concern, "Inadequate risk assessment, inadequate team composition, inappropriate pressure to perform a task and a directed task with inadequate qualification, experience or equipment." was discovered to be the main reason for mishaps.

The analysis revealed that in the majority of accidents, three key areas were consistently the main cause or a primary contributing factor: leadership, supervision, and person-to-person communication. Table 3 below presents the full taxonomy of the 25 root causes and contributing factors, grouped by category, that were identified and used for the analysis. Effective communication is still a major cause or contributing factor to accidents and incidents at sea. In a study carried out by Ziarati (2008), it was established that one third of the accidents are caused or impacted by poor linguistic deficiencies

Legend	•	=	Applies

NO	Vessel	Accident type	Working Environment				Personal										Leadership				Organisation						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1		Loss of Stability								•	•	•	•		•		•	•	•	•		•	•	•	•		•
2		Human Factor			•	•									•		•	•	•				•			•	
3		Collision			•						•						•	•	•		•	•	•	•	•	•	•
4		Operational Accident		•	•					•			•				•	•	•		•	•	•		•	•	
5		Operational Accident		•	•									•				•	•		•	•	•				•	
6		Collision		•			•											•			•	•	•				•	•
7		Grounding		•									•				•	•			•	•	•	•		•	•
8		Collision		•						•			•		•			•			•	•	•			•	
9		Grounding								•			•	•				•	•		•	•		•			
10		Capsize		•			•	•	•	•	•		•	•	•		•	•	•	•	•	•		•			•
11		Capsize and Grounding							•	•	•						•	•	•		•	•	•	•	•		
12		Fall from 18m height	•		•					•			•	•			•	•									
13		Overflow and Pollution		•	•					•	•				•			•	•	•			•				
14		Collision		•	•					•			•					•	•				•				
15		Ent. Into enclosed space							•	•	•		•	•	•		•	•	•		•	•	•	•			
16		Ent. Into enclosed space							•	•				•			•	•	•			•	•				
17		Operational Accident		•						•			•		•		•	•	•		•	•	•	•			
18		Operational Accident		•			•			•			•	•	•		•	•	•	•	•	•	•		•	•	
19		Operational Accident		•						•				•				•						•			
20		Grounding					•	•	•	•	•			•			•	•	•	•	•	•	•	•			•
21		Fire in Engine Room		•					•			•						•			•	•	•	•			
22		Collision			•							•	•														
23		Sinking while Towage	•	•	•				•	•	•										•	•	•				
24		Container over board	•	•								•	•	•							•	•	•	•			
25		Collision		•								•	•	•			•										
26		Accident in Drills							•	•								•	•			•	•				
27		Lifeboat Failed			•																						
28		Lifeboat Failed			•																						
29		Engine Room Accident						•	•		•																
30		Overboard Accident	•	•					•	•							•	•			•	•	•	•	•	•	
31		Collision										•	•	•	•												
32		Crew Member Died	•									•	•									•		•			
33		Man fell overboard																									
34		Man fell from height																									
35		Operational Accident		•					•									•	•								
36		Operational Accident	•							•			•					•							•		
37		Operational Accident	•	•					•	•		•							•								
38		Operational Accident		•					•	•			•				•	•	•			•	•				
39		Death of Passenger			•																		•			•	
40		Operational Accident							•				•		•			•	•		•	•	•	•			
TOTAL			7	19	12	1	4	3	14	21	9	8	19	12	10	0	16	27	20	5	18	23	24	16	7	9	6

Table 3. Taxonomy of the Top 25 Root Causes and Contributing Factors to Accidents

4. Wider Context: Organisational and Human Pressures

Maritime safety is profoundly affected by organizational, personal, and behavioural factors, which often serve as root causes of accidents and non-conformities in the case of audits and deficiencies in case of port inspections. The caveat that the company could be deficient in providing the support to the crew members to gain knowledge/skills/competence needed to operate its systems and machinery. There are also a list all other possible areas which could have an impact on the accident happening or making it worse, such as human vulnerability, decision making, communication including language issues and so forth which could company

related to crew related. Some 25 possible causes were found based on past studies[4] and some more recent studies by Strathclyde University, such as Stroeve et al (2023)[5].

It needs to be noted that a survey of 2,800 maritime employees by recruiter Halcyon Recruitment and training provider Coracle reveal a decreasing confidence in shipping industry job security, as volatile market conditions continue to impact. Over half of shore-based employees surveyed are actively looking to change jobs with nearly two thirds worried about job security. Crew costs are a soft factor in what is a cost-conscious industry. This will be an area to note as ship owners face the increased cost of operating under the International Maritime Organization's pollution prevention treaty MARPOL Annex VI emissions cap. The fear is that there could be an increase in human errors and hence claims related to fatigue or a lack of crew engagement. It was also noted that as part of client risk analysis, insurers such as AGCS now routinely dig deeper into the quality of crewing to see if operators are doing more than the required minimum qualification set by IMO." When considering manning, it is important to note that this minimum should also differentiate between crew members and the officers needed for the passage.

5. Accident Investigation Report Analysis

The primary focus of this section is to present a comprehensive overview of the Accident investigation report review process and findings, structured under the headings of Introduction, Background, Methodology, Investigation, Findings, Observations, and Comments. This structured approach allows for a systematic exploration of each accident, facilitating a thorough understanding of the complexities involved.

The Reviews presented herein are grounded in rigorous methodologies. A comprehensive approach is undertaken, involving thorough accident investigation reports and meticulous data collection.

This accident investigation report reviews containing the first batch of 20 accident's details, take into consideration details presented in the accident investigation reports focusing on root cause of accidents and any other contributing factors.

The twenty accident investigation reports conclude with some observations drawing attention to noteworthy insights garnered from each investigation. It emphasizes recurring patterns, identifies systemic issues, and presents lessons learned from each case. This section aims to offer a holistic view of the overarching themes emerging from these accidents.

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[4] Projects M'aider, SURPASS and ACTs and ACT Plus https://www.marifuture.org/Publications/Papers/maider_maritime_aids_development_for_emergency_responses.pdf; https://www.marifuture.org/Publications/Papers/SURPASS_A_Response_to_the_Increasing_Automation_Failures_at_Sea_and_in_Ports.pdf ; https://www.marifuture.org/Publications/Papers/surpass_short_course_programme_in_automatedsystems_in_shipping.pdf ; https://www.marifuture.org/Publications/Papers/April2019Paper.pdf

[5] Stroeve, S., et al. (2023) Shield Human Factors Taxonomy and Database for Learning from Aviation and Maritime Safety Occurrences, Safety, MDPI 2023.

The conclusion, labelled "Comments," provides a platform for critical analysis and reflection. It encourages discussion on potential improvements to safety management systems, audit practices, and regulatory oversight.

Table 1: Micro Presentation of a Review of an Accident – Review 1

IMO Number/Reference Number	90611306 / RZ-GDMR1
Description	Containers not weighed - Stability criteria not met
Key Root Causes	ISM non-conformity (Based on the actions recommended by investigators there was a lack of policy/procedures for weighing the container and lack of supervision - Unsuitable documented policy and procedures, bridge officers were inexperienced) Management fault (Crew overloaded and fatigued - There was evidence of complacency and commercial pressures, inappropriate manning, ineffective communication and poor team operation - Unsuitable documented policy and procedures). Manning issue (fatigue). Crew related (Recklessness (crew should have known that the containers should be weighed).
Casualties	2 injured
Action taken	Action to carry out an internal audit to ensure the weights specified in BAPLIE and weights in Bills of Lading are the same. To review the procedures for weighing of containers - To ensure there are sufficient deck officers that guarantee adequate supervision and that the officers are trained in loading and loading of containers.
Would it happen again?	Yes, unless containers are weighed and loaded correctly and double checked and safe working practices are in place.

Title: An investigation into ISM Audit and PSC MoU Inspection and the subsequent accident

Accident Investigation Review 1 - Ship Stability

1. Introduction

In this investigation the Audit carried out by an ISM qualified Auditor employed by a leading Recognized Organization (RO) is reviewed in light of a subsequent PSC MoU inspection

followed by a catastrophic accident. The focus of the earlier assessment (ISM Audit) was to evaluate the effectiveness of the company's ISM safety management system.

The investigation aimed to evaluate the effectiveness, or effective implementation, of the ISM Code with the ultimate goal of enhancing safety and marine environment protection.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The ISM auditor was responsible for assessing the extent to which shipping companies adhere to these The Code requirements and ensuring compliance with the ISM Code.

3. Methodology

The verification by RO Auditor involved a comprehensive review of documentation, interviews with key personnel, and on-site inspections of the vessel. The Auditor employed a systematic approach to evaluate the verification and certification practices against the requirements set forth in the ISM Code. C4FF reviewed the information available primarily from accident investigation report with a view to find out the main root causes of the accident more rigorously.

4. Investigation

C4FF Accident 1 (90611306) - A container ship was capsized due to a lack of stability because the crew failed to weigh the containers, which is a must for this type of vessel. The weights specified in BAPLIE and the corresponding weights in Bills of Lading were not the same. There were two injuries which could have been much worse.

Findings

4.1) Verification/Audit Practice

The verification/audit took place in accordance with the recognized organization (RO) practice. The Auditor examined the safety management system manual containing policies, procedures, and records/documents to assess the extent of compliance with the ISM Code. The review identified instances where documentation lacked clarity, specificity or failed to address specific safety and environmental concerns adequately but did not recommend withdrawal or suspension of the SMC or DOC.

4.2) Certification Practices

The auditor assessed the validity and adequacy of companies SMS and examined the SMC and DOC issued. The company had the required certificates and argued well against some of the concerns raised by the Auditor, which allowed the ship to continue its planned passages.

4.3) Accident investigation

Based on the actions recommended by Investigators, there was a lack of policy/procedures for weighing the container and lack of supervision. There was evidence of bridge officers being inexperienced, overloaded, and fatigued. There could have been commercial pressures, and the accident could have been due to complacency. Other root causes were inappropriate manning, ineffective communication, and poor team operation.

Inadequate Knowledge, training, and competence: The investigation revealed discrepancies in training records, suggesting that some crew members lacked appropriate training and qualifications for their assigned duties. The officers were not trained in loading and the loading of containers considering the type of vessel they were working on. This finding raised concerns regarding the shipping company's commitment to continuous professional development and ensuring a competent workforce.

Further review of the accident by C4FF identifies a series of 'Mistakes' as contributing to the accident not only the documented policy and procedures were inadequate, but this accident could have been due to 'Recklessness' as the crew should have known that the containers had to be weighed. The accident could have been avoided if the containers were weighed, loaded correctly and double checked.

4.4) PSC MoU Inspection

The MOU inspection took place in April 2011, some 3.5 years after the ISM audit by the RO. The following deficiencies were found:

- Crew fatigue, rest and work periods were not met - Error
- Labels with safety signs - Error
- Personal firefighting equipment - Error
- Rescue radio equipment - Error
- The ship complied with the minimum number of crew members, but not with their qualifications - Error
- The minimum crew certificate in the section on special requirements and conditions.

It was noted "The grades and number of personnel listed above reflect the minimum number of persons necessary for the safety of navigation and operation. Additional personnel as may be considered necessary for cargo handling and control, maintenance or watch keeping and as needed for required rest periods are the responsibility of the owner and the master"

5. Observations

This investigation highlights the crucial role of ISM qualified auditor plays in verifying the ISM Code practice within the company. By identifying non-conformities/deficiencies and areas for improvement, the auditor contributed to the overall enhancement of safety and marine environment protection in the shipping industry. Implementing the recommended improvements while may have helped the company align its practice with ISM requirements and ensured adequate levels of safety and compliance, the clear evident from the PSC MoU inspection shows that either the ISM audit was ineffective which considering the quality and

reputation of the RO which carried out the audit is unlikely or that the length of the SMC and DOC validity period is too long without additional an oversight. While it can be argued that commercial pressure could have played a role in the accident it is clear that the key root cause was inadequate knowledge/skill/competence of the crew members in charge of loading and unloading the containers.

6. Findings:

Of the interest to the company

Based on the findings of the audit, it has been identified several deficiencies in the company's SMS practice: a) Documentation, ensuring clarity, specificity, and alignment with the ISM Code requirements. b) Competence, ensuring all crew members possess the necessary qualifications for their assigned roles. c) The quality of internal ISM audit, ensuring identified deficiencies are rectified. d) Protecting the crew and ship, enduring commercial pressure does not compromise the safety of the crew and the ship.

Of interest to the IMO

PSC MoU inspection draws serious concerns about ISM Code effectiveness in this investigation. Whilst the vessel had valid SMC and DOC, the PSC inspectors found serious deficiencies/ISM non-conformities. This is a clear case of questioning the period of SMC and DOC validity and subsequent processes of verifying actions including preventive measures agreed to address deficiencies/concerns and their implementation.

Table 2: Micro Presentation of a Review of an Accident – Review 2

IMO Number/Reference Number	19244386 / (RZ-GDMR)
Description	While chief officer (C/O) was checking the cleanliness of the empty tanks prior to loading cargo at the next destination port, he discovered dampness and residue remaining inside one of the tanks and decided to remove them with support from the bosun and two ordinary seamen (OS), A and B without having conducted gas freeing or checking oxygen and gas levels beforehand and without carrying a portable detector or wearing personal protective equipment (PPE). The OS A felt drowsy and dizzy and noticed OS B lying on the floor at the bottom of the tank. Bosun was informed and the incident was reported to C/O. Later, OS B recovered but the C/O did not.
Key Root Causes	ISM non-conformity (Inappropriate policy manual - Inappropriate procedures, Inadequate risk assessment). Management fault (Inadequate supervision - Problems with safety culture - Inadequate leadership of operational tasks, including a lack of correction of unsafe practices - Inadequate team composition -

	Inadequate Knowledge - Inadequate competence/skills - Incorrect perception. Crew related (Without having conducted gas freeing or checking oxygen and gas levels beforehand and without carrying a portable detector or wearing personal protective equipment (PPE)).
Casualties	1 Fatality
Action taken	Shipping companies must constantly provide training programs for crewmembers so that they do not let their experience, practices, and work efficiency concerns override the need to be safe in confined spaces. The shipping companies, too, need to maintain strict guidance and supervision through internal audits.
Would it happen again?	No, if SMS is enforced and the crew are trained and have access to a detector and wear the correct PPE.

Title: An Investigation into Root Causes of Accident – Entering Enclosed Spaces

Accident Investigation Review 2 - Enclosed Spaces

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by a leading Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed a systematic approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

C4FF Accident 2 (9244386) - While chief officer (C/O) was checking the cleanliness of the empty tanks prior to loading cargo at the next destination port, he discovered dampness and residue remaining inside one of the tanks and decided to remove them with support from the bosun and two ordinary seamen (OS), A and B without having conducted gas freeing or checking oxygen and gas levels beforehand and without carrying a portable detector or wearing personal protective equipment (PPE). The OS A felt drowsy and dizzy and noticed OS B lying on the floor at the bottom of the tank. Bosun was informed and the incident was reported to C/O. Later, OS B recovered but the C/O did not.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator's Report

The investigation report identified instances where Shipping company must constantly provide training programs for crew members so that they do not let their experience, practices, and work efficiency concerns override the need to be safe in confined spaces. The shipping companies, too, need to maintain strict guidance and supervision through internal audits.

5. Observations

A review of the investigators report show that there was a non-compliance viz., entering enclosed spaces without having conducted gas freeing or checking oxygen and gas levels beforehand and without carrying a portable detector or wearing personal protective equipment (PPE) – There was an inappropriate policy manual, inappropriate procedures, inadequate supervision, problems with safety culture and inadequate leadership of operational tasks, including a lack of correction of unsafe practices. Furthermore, there was evidence of inadequate risk assessment, inadequate team composition, inadequate leadership, inadequate Knowledge, inadequate competence/skills and incorrect perception.

6. Comments

It is difficult to imagine that all these deficiencies were the result of a mistake. How would it be obvious to an observer that there was a means available for checking oxygen and gas levels and were the crew trained on freeing gas and using a portable detector, and the latter properly maintained and the crew were trained on using it correctly and in accordance with the Manufacturer's instructions. The same can be stated about the PPEs.

Table 3: Micro Presentation of a Review of an Accident – Review 3

IMO Number	9036430 / RZ-HK3
Description	Shortly before noon, the bulk carrier collided with a moored tugs port, the tugs, which were unmanned at the time, sustained significant damage and subsequently sank. Authorities ashore initiated pollution control and oil spill recovery measures and the ensuing loss of fuel and other oils from the tugs were largely contained. Goliath sustained minor damage to its bow while the tugs were both subsequently declared a constructive total loss.
Key Root Causes	ISM nonconformity (Inadequate SMS - Inadequate crew training to ensure BRM requirements are met in full) Management fault (Master and 2nd Chief did not have any BRM training.
Casualties	None
Action-Recommendation	To provide training on BRM to all deck officers and supporting crew. All deck officers serving on board, on both duty rosters should be provided with bridge resource management (BRM) training ashore. A new dynamic navigation audit was instituted to allow for regular audits focused on the effective implementation of BRM on board. The crew training schedule for ships across the fleet to be updated to reflect the safety management system's requirement for BRM training. The technical modifications to be made to VecTwin joystick system panels to incorporate a positive visual indication that the correct steering mode had been selected at the steering console. The checklist for the transfer of controls was also to be updated to include this additional check. The amendments be made to ship's safety management system procedures for navigation, passage planning, watch keeping, master/pilot exchange and the bridge arrival and departure checklists. The amendments include a requirement for watch handovers during pilotage to be planned and agreed upon by the master in advance and for safe areas to be identified for such handovers to take place.
Would it happen again	No if the Master and 2nd Officer trained on BRM.

Title: An Investigation into Root Causes of Accident - Collision

Accident Investigation Review 3 - Collision

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators evaluated the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

Shortly before noon, the bulk carrier collided with the moored tugs. The tugs, which were unmanned at the time, sustained significant damage and subsequently sank. Authorities ashore initiated pollution control and oil spill recovery measures and the ensuing loss of fuel and other oils from the tugs were largely contained. The vessel sustained minor damage to its bow while the tugs were both subsequently declared a constructive total loss.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

In light of the investigation report findings, it has been recognized that BRM training is crucial and has been mandated for all deck officers and supporting crew on board regardless of duty roster to undergo the training ashore. To monitor and evaluate the effective implementation of BRM on board, new dynamic navigations audit has been introduced. This audit will focus specifically on assessing how well BRM practices are being incorporated into the ship’s operations. In order to ensure compliance with the safety management system’s requirements, the crew training schedules for all ships in the fleets must be updated to include BRM training. Technical modifications are needed for the VECTwin joystick system panels to show the selected steering mode, improving navigation awareness. The transfer control checklist will be enhanced, and SMS procedures will be updated to promote effective BRM implementation. This includes changes in passage planning, watchkeeping, master/pilot exchange, and bridge arrival/departure checklists. During pilotage, watch handovers will be pre-planned, ensuring safe transitions between bridge team members in designated safe areas.

5. Observations

A review of the investigators report highlights significant deficiencies in the safety management system, particularly concerning the lack of BRM training for the Master and 2nd Chief. Addressing these issues is of utmost importance to ensure the safety of the crew, passengers, and vessels, and to promote a proactive safety culture throughout the fleet. Proper corrective actions must be taken immediately to rectify these inadequacies and prevent potential accidents or incidents in the future.

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The accident investigation, carried out by a qualified investigator, aimed to identify the root causes of the vessel. It emphasized the importance of implementing the ISM Code and maintaining effective SMS. Findings highlighted the need for BRM training for deck officers and crew to ensure safe navigation. The report proposed measures such as dynamic navigations audits, technical modifications, and amendments to SMS procedures to enhance safety. Addressing deficiencies in the SMS was emphasized, particularly the lack of BRM training for certain crew members. Significance of proactive safety measures were stressed to prevent potential accidents in the future.

Table 4: Micro Presentation of a Review of an Accident – Review 4

Reference Number	C0013564
Description	The crew on a bulk carrier were carrying out a free-fall lifeboat drill at Port when the wire rope slings holding the lifeboat failed and it fell approximately 14 m to the water. There were 2 crew members in the lifeboat at the time. Both crew members were seriously injured and were transferred to hospital.
Key Root Causes	ISM non-conformity/Management fault (Lifeboat drills are not conducted in accordance with SOLAS regulations – Inadequate maintenance and not familiar with lifeboat operations). Lack of knowledge with life boat maintenance. Inadequate knowledge of lowering life boats.
Casualties	2 Casualties
Action-Recommendation	Training crew on carrying out free-fall life boat operations. Actions taken: Replaced the failed sling assembly and the failed lifting brackets - Sent a safety management system circular to all vessels operated by the company requesting a safety meeting with all crews to update them on the occurrence and avoid a recurrence as follows: All information about the maintenance of lifeboats and associated equipment – Full maintenance of - Health and safety requirements applied to drills in the same way that they are to real procedures – Lifeboat drills are conducted in accordance with applicable International Convention for the Safety of Life at Sea (SOLAS) regulations viz., any personnel carrying out maintenance or repair is qualified for the job - Lifeboat inspections are regular and thorough - All equipment is easily accessible and durable in rough conditions; and all tests for safety and life-saving equipment are conducted to International Maritime Organization guidelines. Unscheduled internal audit of the vessel carried out - Completed an incident investigation report, which was sent to all vessels and masters operating under the company - Established that the slings and wires associated with the lifeboat be replaced during the lifeboat's 5-year dynamic load testing regardless of their condition; and established an annual safe working test of the slings by an authorized lifeboat technician, free-fall life boat operations.
Would it happen again	No.

Title: An Investigation into Root Causes of Accident – Freefall Lifeboat

Accident Investigation Review 4 - Freefall Lifeboat

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed an approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

The crew on the bulk carrier were carrying out a free-fall lifeboat drill at Port when the wire rope slings holding the lifeboat failed and it fell approximately 14 m to the water. There were 2 crew members in the lifeboat at the time. Both crew members were seriously injured and were transferred to hospital.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

Recommendations have been produced by the accident investigator to have trainings for the crew on carrying out free-fall life boat operations. According to the report the failed sling assembly and the failed lifting brackets have been replaced with a newly manufactured, load tested, and certified sling assembly and the vessels. Lifeboat sling assembly was also included

in the ship’s wires and ropes inspection log. An SMS circular was utilized for the vessels in which includes an extra safety meeting to be carried out with all crew participating to avoid recurrence. Fully trained personnel are utilized to regularly carry out inspections and maintenance of lifeboats and associated equipment in adherence with approved practices. Lifeboat drills are conducted in accordance with applicable International Convention for the Safety of Life at Sea (SOLAS) regulations. All equipment is easily accessible and durable in rough conditions. All tests for safety and life-saving equipment are conducted to IMO guidelines. Unscheduled internal audits of the vessel have been carried out.

5. Observations

The investigators' report on lifeboat safety compliance has raised significant concerns regarding the maintenance and operational practices on board. The report identified an error in the maintenance of lifeboats, emphasizing the critical importance of having qualified personnel carry out these tasks in strict adherence to approved practices. Additionally, the report highlights the need to apply health and safety requirements to lifeboat drills, which must be conducted in accordance with the Safety of Life at Sea (SOLAS) regulations. Furthermore there was evidence of specific mistake concerning inadequate knowledge of lowering lifeboats.

6. Comments

Accident investigation on the bulk carrier highlighted the importance of effective implementation of the ISM Code for safe ship operations. Deficiencies in lifeboat maintenance and operational practices were identified, emphasizing the need for qualified personnel and adherence to approved procedures. Health and safety requirements for lifeboat drills, in accordance with SOLAS regulations, were emphasized to prevent accidents. The investigation underscored the challenges in determining root causes and recommended continuous improvement and crew training to enhance ISM Code effectiveness.

Table 5. Micro Presentation of a Review of an Accident – Review 5

Reference Number	C0013490
Description	The ship bosun and second officer were repairing a leak on the deck's fire main. Having completed the task took a break. Shortly thereafter, work on deck was suspended due to deteriorating weather conditions. But despite this, after the break, the bosun and second officer went back on deck to collect tools when a heavy wave struck the deck and washed the bosun overboard. Bosun was not recovered.
Key Root Causes	ISM non-conformity (Inadequate risk-assessment - Lack of knowledge - Not compliant with ISM procedures).
Casualties	1 fatality
Action-Recommendation	Company's SMS procedures were updated: - to include the requirement for when the work on the ship's deck should be terminated in event of adverse weather conditions and - to include the requirement to carry out a risk assessment for work to be carried out on the ship's deck in adverse weather conditions, including the use of PPE in the case it is required to access the deck in adverse weather conditions when deemed necessary for the safety of crew and/or ship - To ensure that all crew members are familiar with these procedures, a campaign will be run on the precautions and hazards of working on deck in adverse weather conditions and ensuring compliance with ISM procedures. - to share the Company's investigation report along with the lessons learned from the incident with all ships within the fleet. - to ensure the heavy weather warnings and bulletins are closely monitored and timely actions are taken to terminate any ongoing task during heavy weather. - to review the Company's heavy weather procedure to include: - Allowable safe weather limits and guidance for the master to terminate tasks which unnecessarily expose the crew to heavy weather. - to carry out a thorough risk assessment and using appropriate PPE in case it is required to access the deck in heavy weather when deemed necessary for the safety of crew and ship. - to ensure the crew is trained and familiar with the requirements of the Company's heavy weather procedures once established and how to implement it.
Would it happen again	No.

Title: An Investigation into Root Causes of Accident – Man Over Board

Accident Investigation Review 5 - MOB

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed an approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

The ship bosun and second officer were repairing a leak on the deck's fire main. Having completed the task took a break. Shortly thereafter, work on deck was suspended due to deteriorating weather conditions. But despite this, after the break, the bosun and second officer went back on deck to collect tools when a heavy wave struck the deck and washed the bosun overboard. Bosun has not recovered.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator's Report

The company has taken the necessary actions, including, updating company's SMS procedure to ensure the requirements for instances where the work on the ship's deck should be terminated due to adverse weather conditions and to carry out a risk assessment for work to be carried out on the ship's deck in adverse weather conditions, including the use of appropriate PPE when the access to the ship's deck is inevitable. A campaign will be run on the precautions and hazards to ensure crew members are familiar with the heavy weather procedures. It is also recommended to monitor heavy weather warnings closely and take time actions to terminate works on deck in

5. Observations

The investigators' report highlights critical deficiencies onboard, including inadequate risk assessment, lack of knowledge, and non-compliance with ISM procedures. These issues

underscore the urgent need to address safety protocols, improve knowledge and competence, and ensure adherence to established procedures ensuring compliance with ISM procedures.

6. Comments

This accident investigation aimed to identify the root causes of the incident involving a ship bosun washed overboard. The investigation revealed deficiencies in risk assessment, knowledge, and compliance with ISM procedures. To prevent similar accidents, the company updated safety procedures and emphasized crew awareness of heavy weather protocols. Adherence to safety measures and ISM procedures is crucial to prevent such incidents in the

Table 5: Micro Presentation of a Review of an Accident – Review 6

6Reference Number	C0013582
Description	When the ship was carrying out operations cargo, after the port crane loaded the last container listed on the deck in the loading plan, the ship began to list to starboard without stopping, so the company's personnel stevedore and the crew members who were on board went to the dock or jumped into the water.
Key Root Causes	ISM non-conformity (the cargo plan was incorrect and the captain and ship mate did not know how to do the stability calculations. The crew was fatigued - The work days were not complied - Inappropriate policy manual, inappropriate procedures; Inappropriate work environment inadequate risk assessment). Management fault (Inadequate Knowledge; Inadequate competence/skills; Lack of motivation or complacency - Inadequate leadership; Inadequate supervision; problems with safety culture. Manning issue (working hours not logged (fatigue).
Casualties	2 Injured and 2 fatalities
Action-Recommendation	The captain to undergo training in stability calculations and company to address policy/procedures deficiencies.
Would it happen again	Maybe unless ship's stability is ensured. And safety such as working hours/fatigue are addressed.

Title: An Investigation into Root Causes of Accident – Ship Stability

Accident Investigation Review 6 - Ship Stability Man Over Board

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain

effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed an approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

Accident C0013582: When the ship was carrying out operations cargo, after the port crane loaded the last container listed on the deck in the loading plan, the ship began to list to starboard without stopping, so the company's personnel stevedore and the crew members who were on board went to the dock or jumped into the water.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

One of the main issues in this case was the lack of knowledge of the Captain in stability calculation. Therefore, he has to undergo training in stability calculation. Moreover, the company needs to take the necessary actions regarding policy/procedures deficiencies.

5. Observation

The investigators' report reveals numerous shortcomings: an incorrect cargo plan, lack of stability calculation knowledge, crew fatigue, inappropriate policy manual, procedures, and work environment, inadequate knowledge and competence, lack of motivation, inadequate risk assessment, leadership, and supervision, and problems with safety culture.

6. Comments

The accident investigation in this report seems to have followed the required procedures and practices. It identified several factors contributing to the incident, including the lack of knowledge of the captain in stability calculation and deficiencies in company policies and procedures. The findings suggest that training the captain in stability calculation and addressing policy/procedure deficiencies are essential steps to prevent similar accidents. Failure to address the identified issues could lead to a reoccurrence of a similar incident in the future.

Table 6: Micro Presentation of a Review of an Accident – Review 7

Reference Number	C0012731
Description	Temperature of Styrene Monomer not monitored, and Temperature alarm not set. The vessel was vetted by a CDI inspector in USA. One of the questions included in the CDI questionnaire was: Are officers aware of the documentation and handling requirements for cargoes and inhibitors, and if the cargo carried is required to be inhibited, is the required information available? No deficiencies were recorded, and the vetting report noted the vessel to be in compliance with IBC and company procedures and observed the cargo handling and monitoring equipment in good condition overall.
Key Root Causes	ISM non-conformity (Inadequate risk assessment - Instructions and guidance were clear that inhibited cargoes should not be stowed adjacent to heated cargoes but no problems noted before and crew had been carrying these cargoes for some time without problem. Management fault: (non-compliance with instructions for inhibited cargoes – ineffective communication - Language could have been an issue, Russian officers and Filipino crew).
Casualties	1 injury on one vessel and one on the other one and, 15 shore workers/officials were also reported to have been injured.
Action-Recommendation	The internal audit report noted that the SMS was well implemented, the senior officers were diligent, and that the tanker was very well maintained. Two non-conformities and 11 observations were recorded. The non-conformities concerned the absence of records of atmospheric checks when tank cleaning, and the recording of working hours. The observations were related to minor errors and omissions in documentation
Would it happen again	Yes, as despite the Inspector asking the right question and considering the underlying problem the accident happened. Also, the vessel was considered to be in compliance of IBS and company procedures.

Title: An Investigation into Root Causes of Accident - Explosion

Accident Investigation Review 7 - Explosion

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed an approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

Temperature of Styrene Monomer not monitored and Temperature alarm not set. The vessel was vetted by a CDI inspector in USA. One of the questions included in the CDI questionnaire was: Are officers aware of the documentation and handling requirements for cargoes and inhibitors, and if the cargo carried is required to be inhibited, is the required information available? No deficiencies were recorded, and the vetting report noted the vessel to be in compliance with IBC and company procedures and observed the cargo handling and monitoring equipment in good condition overall. As a result, this accident ended up as an explosion causing 2 injuries and 15 shore workers/officials injured.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

According to the investigation, the internal audit reports noted that the SMS was well implemented, the senior officers were diligent, and that the tanker was very well maintained. However 2 non-conformities concerned the absence of records of atmospheric check when tank cleaning was in process and the recording of working hours.

5. Observations

The investigators' report identifies two main errors that contributed to the incident. Firstly, there was a failure to adhere to clear instructions against stowing inhibited cargoes next to heated cargoes, although there were no previous issues with this practice. Secondly, potential communication challenges arose due to language differences between officers and crew members.

6. Comments

The accident investigation focused on an explosion caused by a failure to monitor the temperature of Styrene Monomer and set temperature alarms. Despite the vessel being in compliance with IBC and company procedures, the accident resulted in injuries to crew members and shore workers. The investigation revealed non-conformities related to atmospheric checks during tank cleaning and working hour recordings. The report emphasizes the need to address SMS procedures and highlights two contributing factors: failure to follow instructions on stowing inhibited cargoes near heated cargoes and potential communication challenges. It is worth mentioning that the accident could happen again since the inspectors asked the right questions and the vessel was considered to be in compliance of IBS and company procedures.

Table 7: Micro Presentation of a Review of an Accident – Review 8

Reference Number	C0013524
Description	Recklessness by the ship management and Mistake by the two Stevedores who did not follow the shipboard enclosed space entry procedures and entered a cargo hold without authorization from ship officers - The access hatch only maintained marking “Restricted Area Authorized”, which did not fully meet the requirement of the Code.
Key Root Causes	ISM non-conformity (The Code of Safe Working Practices for Merchant Seafarers requires that all the entrances to unattended dangerous spaces on a ship should be kept locked or secured against entry and any hatches to readily accessible enclosed spaces should be marked as the entrance to a dangerous space - The enclosed cargo hold loaded with logs required all entrance accesses to be properly locked or secured against unauthorized entry - The entrance accesses should also be marked as dangerous space - The access hatch only maintained marking “Restricted Area Authorized”, which did not fully meet the requirement of the Code) Management fault (Lack of supervision)
Casualties	2 fatalities (stevedores workers died).
Action-Recommendation	The ship crew must be trained on procedures/requirements for entering enclosed

	space and seek permission to entry such spaces. Markings for restricted areas should be in line with requirements of the Code.
Would it happen again	No, if the two stevedores followed the ship board enclosed space entry procedures and the access hatch was correctly marked.

Title: An Investigation into Root Causes of Accident – Enclosed Spaces

Accident Investigation Review 8 - Enclosed Spaces

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed an approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

Recklessness by the ship management and Mistake by the two Stevedores who did not follow the shipboard enclosed space entry procedures and entered a cargo hold without authorization from ship officers - The access hatch only maintained marking “Restricted Area Authorized”, which did not fully meet the requirement of the Code.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

It is the required to have the ship crew to be trained on procedures and requirements for entering enclosed space and seek permission to entry such spaces. Markings for restricted areas should

be in line with requirements of the ISM code to prevent reoccurrence of the incident in the future.

5. Observations

The investigators' report uncovers a critical Error involving the non-compliance of the Code of Safe Working Practices for Merchant Seafarers. Specifically, the report highlights that the entrances to unattended dangerous spaces on the ship, such as the enclosed cargo hold loaded with logs, were not properly locked or secured against unauthorized entry as required. Additionally, the necessary markings designating these entrances as dangerous spaces were missing.

6. Comments

The accident investigation report reveals a serious safety lapse in the compliance with the Code of Safe Working Practices for Merchant Seafarers. The failure to properly lock or secure entrances to dangerous spaces, such as the enclosed cargo hold, and the absence of required markings were key factors in the tragic incident. It emphasizes the importance of comprehensive training for ship crew on procedures and requirements for entering enclosed spaces and the necessity of adhering to ISM code regulations. Implementing the recommended safety measures is crucial to prevent similar accidents in the future and ensure the well-being of the crew onboard ships.

Table 8: Micro Presentation of a Review of an Accident – Review 9

Reference Number	C0013526
Description	In the accident, AB1 might have no sufficient time or have the skill to control the tag line and keep the tag line clear from himself. It was likely that AB1 might fail to release the tag line in time or suddenly be tangled by the tag line when the latter was abruptly tensioned by the fast-slewing crane without any warning.
Key Root Causes	ISM non-conformity (ineffective communication among the lifting team members - Training on lifting operation and safety awareness of the lifting team were inadequate). Management fault (on-site supervision was inadequate).
Casualties	1 fatality
Action-Recommendation	The main contributory factors causing the accident were that the risk assessment and planning of the lifting operation did not meet the requirements of the Code of Safe Working Practices.
Would it happen again	No if the requirements of the Code of Safe Working Practices were met and there was an effective risk assessment and planning of the lifting operation.

Title: An Investigation into Root Causes of Accident – Fall from Height

Accident Investigation Review 9 – Case Study 9 Fall from Height

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed an approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

In the accident, AB1 might have no sufficient time or have the skill to control the tag line and keep the tag line clear from himself. It was likely that AB1 might fail to release the tag line in time or suddenly be tangled by the tag line when the latter was abruptly tensioned by the fast-slewing crane without any warning which is clear sign of Recklessness.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

The risk assessment and planning of the lifting operations must be addressed in order to be perfectly aligned with the Code of Safe Working Practices.

5. Observations

The investigators' report reveals a critical error in the lifting operation, primarily stemming from the lack of effective communication among the lifting team members. Additionally, on-site supervision was inadequate, and the training on lifting operation and safety awareness for the lifting team was insufficient.

6. Comments

The accident investigation report points out the importance of effective communication, proper risk assessment, and adequate training in lifting operations to prevent similar incidents. Addressing these issues and aligning with the Code of Safe Working Practices is crucial to ensure safety and prevent accidents during lifting operations.

Table 9: Micro Presentation of a Review of an Accident – Review 10

Reference Number	C0011070
Description	Under harbour pilot guidance, the bulk carrier experienced an electrical blackout resulting in loss of propulsion and steering control. As a result, the ship exited the channel and ran aground. The ship was recovered into the channel with the aid of tugs, before being taken out the channel, to anchor, for further investigation.
Key Root Causes	ISM non-conformity (Inappropriate policy/procedures for monitoring procurement - Inadequate risk assessment) – Management fault (Grounding occurred due to blackout and that the emergency generator was not able to run for required time, since the fan belt was not present. The belt was ordered by the crew 9 months before, but was not delivered since 9 ports visits).
Casualties	None
Action-Recommendation	The company has undertaken a fleetwide program of continual improvement of its safety management and operating systems, and staff education and training processes. This included updating SMS and actions directed at identification, operation, maintenance and spare parts management relating to critical plant and machinery.
Would it happen again	No if the fan belt chased and was fitted and communication issues ashore and aboard addressed.

Title: An Investigation into Root Causes of Accident - Grounding

Accident Investigation Review 10 Grounding

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties of establishing the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accidents using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed an approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to finding out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

Under harbor pilot guidance, the bulk carrier experienced an electrical blackout resulting in loss of propulsion and steering control. As a result, the ship exited the channel and ran aground. The ship was recovered into the channel with the aid of tugs, before being taken out of the channel, to anchor, for further investigation.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

The company has taken the necessary actions, including program of continual improvement of its safety management and operating systems, and staff education and training processes which involved the whole fleet. As a result, SMS was updated as well as actions directed at

identification, operation, maintenance and spare parts management relating to critical plant or machinery.

5. Observations

The investigators' report highlights critical deficiencies onboard, including inadequate risk assessment, lack of knowledge, and non-compliance with ISM procedures. These issues underscore the urgent need to address safety protocols, improve knowledge and competence, and ensure adherence to established procedures ensuring compliance with ISM procedures.

6. Comments

The investigators' report highlights significant errors that contributed to the grounding incident. Firstly, inappropriate policy and procedures for monitoring procurement led to the failure to obtain a critical component, the fan belt, for the emergency generator. Additionally, there was an inadequate risk assessment, as the consequences of not having the fan belt available were not properly addressed. These deficiencies in procurement and risk assessment procedures significantly impacted the vessel's ability to respond effectively to a blackout and resulted in the unfortunate grounding incident.

6. Annex

Additional Micro Analysis of Accident Reports – Reviews 11 to 25

Micro Presentation of a Review of an Accident – Review 11

1Reference Number	C0010024
Description	The vessel collided in restricted visibility with a refrigerated cargo. The bridge team on each ship were aware of the other ship's presence in the channel, but both misjudged their own and the other ship's position. When the actual situation was acknowledged on both ships, it was too late to manoeuvre to avoid the collision.
Key Root Causes	ISM non-conformity (Inadequate risk assessment). Management fault (Incorrect Perception/knowledge - Poor team operation/decision making). A safety margin that was based on whether the ships were positioned 50-100 meters to each side of the channel. The factors contributing to the collision: restricted visibility, navigating in a narrow channel, the north-easterly current, a pilot boat being alongside the two vessels making a large course alteration. Individually these factors did not constitute a recognizable significant risk, but in conjunction they created a small margin between success and failure. .
Casualties	None
Action-Recommendation	Action taken: Master attended additional BRM training; a fleet wide navigation safety campaign discussions on the collision and measures to prevent similar collisions in the future. I t also conducted a review of ship board risk assessments as well as ship management's navigation procedures for sailing in similar situations which included a pre-appointment briefing program for on signing officers.
Would it happen again	No but navigating in a narrow channel with adverse currents and poor visibility is a high risk which could have been avoided with more in-depth training.

Title: An Investigation into Root Causes of Accident – Collision in Narrow Channel

Accident Investigation Review 11 - Collision in Narrow Channel

1. Introduction

The accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

This investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed an approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

The vessel collided in restricted visibility with a refrigerated cargo. The bridge team on each ships was aware of the other ship's presence in the channel, but both misjudged their own and the other ship's position. When the actual situation was acknowledged on both ships, it was too late to maneuver to avoid the collision.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator's Report

The company has taken the necessary actions. This accident was caused by human error. Therefore, additional BRM trainings were conducted for the master. Additionally, a fleet-wide navigation safety campaign has been implemented. Shipboard risk assessment and ship management's navigation in similar situation have been reviewed as well.

5. Observations

The investigators' report reveals a significant error in the inadequate risk assessment process, along with a notable mistake involving incorrect perception and knowledge. Poor team operation and decision-making further compounded the situation. The collision incident was influenced by several factors, including restricted visibility, navigating in a narrow channel, the north-easterly current, and a pilot boat being alongside the two vessels during a large course alteration. Although individually these factors may not have been recognized as significant risks, their combined effect created a narrow margin between success and failure, ultimately leading to the collision.

6. Comments

The accident investigation report attributes the collision to human error and underscores the importance of effective risk assessment, teamwork, and decision-making. The company's response included additional BRM training, a fleet-wide safety campaign, and reviews of shipboard risk assessments. The report stresses that chances of collisions are high while navigating in a narrow channel with adverse currents and poor visibility. However, comprehensive training can aid to mitigate this challenge.

Micro Presentation of a Review of an Accident – Review 12

Reference Number	RZ/JU1
Description	A bulk carrier was at anchor when an ordinary seafarer collapsed in a cargo hold containing soya beans. The alarm was raised and the chief officer who entered to help also collapsed. Both the chief officer and ordinary seafarer were recovered from the hold by a team wearing breathing apparatus. Both were transferred to hospital ashore where the chief officer made a full recovery. The ordinary seafarer died as a result of exposure to lethal levels of phosphine gas.
Key Root Causes	ISM non-conformity (The cargo holds were identified as "enclosed spaces" but enclosed space procedures were not followed). It was assumed the space was safe, and PPE was not required, as the vessel was in possession of a gas free certificate hence Phosphine gas detection equipment which was onboard was not considered necessary. The vessel's multi-gas meter used for "enclosed space" entry did not have phosphine sensors. No risk assessment form S-18 nor SM-15-01/02 Enclosed spaces (General) were completed as part of the management of risk protocols). Management fault (Inadequate procedures and inadequate training, safety culture issues).
Casualties	I fatality and 1 injury
Action-Recommendation	Reviewed and amended procedures regarding enclosed and dangerous spaces and circulated and implemented a series of additional safety training on working in enclosed or dangerous spaces for all persons prior to joining vessels. Training on safety culture onboard. Implemented a company policy on the donning of Breathing Apparatus when entering holds where fumigant has been present. Reviewed IMO recommendations on safe use of pesticides on ships and provided new forms for the appointment of responsible person in charge. The Flag State should also consider a review of the effectiveness of the ISM audits carried out by ROs pertaining to the adequacy of risk assessments for the safe carriage of fumigated cargoes.
Would it happen again	No if there was discussion around the assessment for potential hazards, risks or testing the spaces prior to entry. Gas free certification for the type of cargo needs reassessment.

Title: An Investigation into Root Causes of Accident – Enclosed Spaces

Accident Investigation Review 12 - Enclosed Spaces

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by an Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed an approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

The bulk carrier was at port when an ordinary seafarer collapsed in a cargo hold containing soya beans. The alarm was raised and the chief officer who entered to help also collapsed. Both the chief officer and ordinary seafarer were recovered from the hold by a team wearing breathing apparatus. Both were transferred to hospital ashore where the chief officer made a full recovery. The ordinary seafarer died as a result of exposure to lethal levels of phosphine gas.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

Procedures regarding enclosed and dangerous spaces have been reviewed and amended. Additional safety training on working in enclosed or dangerous spaces have been implemented for all the personnel before joining the vessel as well as a training on safety culture onboard. Moreover, company policy has been implemented on the donning of breathing apparatus when entering holds with presence of chemical pesticides. To align with the International Maritime Organization (IMO) recommendations, new forms have been provided for the appointment of the person in charge (PC). It is recommended to The Flag State to review the effectiveness of the ISM audits carried out by ROs with a focus on assessing the adequacy of risk assessments for the safe carriage of fumigated cargoes.

5. Observations

The investigators' review uncovers a significant mistake and recklessness in handling enclosed spaces. Although the cargo holds were identified as "enclosed spaces," proper procedures were not followed. Assumptions were made about the space's safety due to the possession of a gas-free certificate, and personal protective equipment (PPE) was not considered necessary. However, the vessel lacked phosphine gas detection equipment, which was crucial for ensuring safety. Moreover, essential risk assessment protocols, such as forms S-18 and SM-15-01/02 for enclosed spaces, were not completed.

6. Comments

The accident investigation report identifies mishandling of enclosed spaces and the absence of safety precautions as the root causes of the incident. The report recommends revised procedures, enhanced safety training, and improved risk assessment protocols to prevent similar accidents as discussion around the assessment for potential hazards, risks or testing the spaces prior to entry could avoid the incident from occurring. The company has promptly taken essential actions, aligned with IMO recommendations. Further, the report highlights the need for the Flag State to review ISM audits' effectiveness, particularly in assessing risk assessments for safe cargo carriage.

Micro Presentation of a Review of an Accident – Review 13

Reference Number	GDMR3
Description	A ship with a history of having problems with automated systems developed faults with a data control device leading to a blackout and failure of one of the propulsion engines.
Key Root Causes	ISM non-conformity (Inadequate procedures and lack of action to take note of earlier problems and inadequate manning) - Inadequate system design - Issues with preventive maintenance - Inadequate risk-assessment - Inadequate policy/procedures - insufficient resources – Management fault (commercial pressures - poor decision-making).
Casualties	None and spillage of fuel into the sea
Action-Recommendation	In appropriate safety management system and procedures and inadequate manning. To review the existing procedures to include management of failure in the ship machinery systems and indicate responsibilities, communication and additional measures to be taken in such cases.
Would it happen again	Maybe, due to complexities of automated systems but preventive maintenance could reduce the risk of such accidents.

Title: An Investigation into Root Causes of Accident - Collision

Accident Investigation Review 13 - Collision

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by a leading Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed a systematic approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

A ship with a history of having problems with automated systems developed faults with a data control device leading to a blackout and failure of one of the propulsion engines.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

It is recommended to include management of failures in the ship machinery systems in the existing procedures. Subsequently specify responsibilities, necessary communications, and additional measures to be taken in such cases.

5. Observations

The investigators' report highlights a series of errors and recklessness that contributed to the incident. Inadequate procedures and a lack of response to earlier problems, combined with insufficient manning, underscore the deficiencies. The system design, preventive maintenance, and leadership was also inadequate. Furthermore, there were issues with risk assessment, policy and procedures, as well as insufficient resources, commercial pressures, and poor decision-making. These factors collectively led to the incident.

6. Comments

The accident investigation report attributes the collision to human error and recklessness. Additionally, it underscores the need for enhanced safety measures and effective implementation of the ISM Code and a effective risk assessment by the management. The incident involving automated system failures and blackout highlights the importance of including management of machinery system failures in procedures. Due to the complexities of automated system it is difficult to certainly mitigate the risk, but preventive maintenance as well as addressing responsibilities, communication, and additional measures during such events can significantly prevent reoccurrences.

Micro Presentation of a Review of an Accident – Review 14

Reference Number	GDMR4
Description	This is a hydraulic mooring anchoring incident. It occurred due to entrapment of a sailor's leg in a rope, that was being stowed using a windlass; later the leg was amputated.
Key Root Causes	ISM non-conformity (Inadequate policy/procedures) - Poor human-machine interface Inadequate risk-assessment). Management fault (Inadequate skill/competence - Inadequate leadership/supervision).
Casualties	1 Injury (limb amputation)
Action-Recommendation	To carry out a more effective risk-assessment and continuous training accompanied by effective operational procedures that highlights safe working practices on board the ship. The procedure should ensure the need for supervision and extra care when working with or near moving rope or chains.
Would it happen again	No, if there is a precise procedure to ensure no crew member works with or near any system with moving parts including ropes and chains unless fully trained and supervised.

Title: An Investigation into Root Causes of Accident – Anchoring

Accident Investigation Review 14 - Anchoring

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by a leading Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed a systematic approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

This is a hydraulic mooring anchoring incident. It occurred due to entrapment of a sailor's leg in a rope, that was being stowed using a windlass; later the leg was amputated.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

More effective risk assessment and continuous training has to be carried out. Additionally, effective operational procedures that highlights safe working practices on the board the ship needs to be implemented. Extra care and supervision must be embedded in the procedures when working with or near moving ropes and chains.

5. Observations

The investigators' report underscores a critical error stemming from complacency and overconfidence, which led to non-compliance with vital safety measures. Inadequate policy and procedures, coupled with a poor human-machine interface, further exacerbated the situation. The incident also reveals shortcomings in skill and competence, inadequate leadership and supervision, and an ineffective risk assessment.

6. Comments

The accident investigation report highlights the importance of vigilant adherence to safety protocols and the ISM Code. The hydraulic mooring incident underscores the need for continuous risk assessment, robust training, and effective operational procedures. Addressing complacency and overconfidence through careful supervision and improved policies is crucial to prevent similar incidents. The report's findings reveal multiple deficiencies, emphasizing the significance of a comprehensive approach to safety management, competence building, and proper risk assessment.

Table 15. Micro Presentation of a Review of an Accident – Review 15

Reference Number	GDMR5
Description	Falling from height of less than 2.5/3.0 meters. Under the chief mate's supervision, the crew were in the process of moving a tweendeck; the ship's crane was used to hoist the tweendeck pontoon out of the hold so that it could be turned. The chief mate, who was standing on a fixed ladder near the hatch fell overboard and found dead.
Key Root Causes	ISM non-conformity (Inappropriate policy manual, inappropriate procedures. The crew did not hold a safety meeting and the working practice on board did not coincide with the procedures of the Safety Management System (SMS). The available instructions were considered 'unworkable' by the crew). Management fault (The crew did not hold a safety meeting).
Casualties	1 fatality (Chief Mate)
Action-Recommendation	To revise instructions and learn from similar accidents. The vessel's sister ship used a safer method and the company was aware of this but failed to minimize risk.
Would it happen again	Maybe not, if a safety meeting was held and the CM had a harness he would not have died.

Title: An Investigation into Root Causes of Accident – Falling from Height

Accident Investigation Review 15 - Falling from Height

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by a leading Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accidents using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed a systematic approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to finding out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

Falling from height of less than 2.5/3.0 meters. Under the chief mate's supervision, the crew were in the process of moving a tweendeck; the ship's crane was used to hoist the tween deck pontoon out of the hold so that it could be turned. The chief mate, who was standing on a fixed ladder near the hatch fell overboard and found dead.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator's Report

Instructions must be continually revised. Safety meetings should be regularly held. Appropriate PPE such as harness must be utilized in this type of task. Learn from similar accidents and methods used by other ships to mitigate the risk.

5. Observations

The investigators' report reveals a significant error originating from an inappropriate policy manual and inappropriate procedures. The crew's failure to conduct a safety meeting and the inconsistency between onboard working practices and the SMS procedures were key issues. The crew's perception of the available instructions as 'unworkable' made the situation worse.

6. Comments

The accident investigation report highlights a tragic incident involving a fall from a relatively low height during a tween deck movement operation. The report underscores the need for regular instruction revisions, safety meetings, and proper PPE usage, such as harnesses. Learning from past accidents and adopting effective risk mitigation methods is crucial. The findings point to inadequate policies, procedures, and crew training. The report emphasizes the importance of aligning onboard practices with SMS procedures, conducting safety meetings. Despite the crew's incompetency in not adhering to SMS procedures and available instructions, the management could have implemented strict policies to ensure that procedures and instructions are followed as they should be.

Micro Presentation of a Review of an Accident – Review 16

Reference Number	GDMR6
Description	With the clam open, there was a failure in the propulsion system that caused the gate to strike against the quay and the bulb of the ship against one of its pillars, causing minor damage to the Quay.
Key Root Causes	ISM non-conformity (Inappropriate policy/procedures - Machine interface, automation issues, maintenance and equipment malfunctions. Crew related/Management fault (The accident occurred due to a malfunction of the propulsion control system accompanied by human error in the execution of the propulsion control transfer procedure from the bridge to the engine room, and in the subsequent return of control to the bridge.
Casualties	None
Action-Recommendation	To examine the propulsion control system between the Bridge and the Engine room and ensure additional training in the execution of such control transfers.
Would it happen again	Maybe not, if automation issues effectively resolved and propulsion control procedure from the Bridge to engine room and vice versa.

Title: An Investigation into Root Causes of Accident Collison with Quay

Accident Investigation Review 16 - Collision with Quay

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by a leading Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed a systematic approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

With the clam open, there was a failure in the propulsion system that caused the gate to strike against the quay and the bulb of the ship against one of its pillars, causing minor damage to the Quay.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

Propulsion control system between the Bridge and the Engine room needs to be examined. To ensure similar accident won’t reoccur, additional training in the execution of such control must be conducted.

5. Observations

The accident stemmed from a propulsion control system malfunction compounded by human errors during the execution of propulsion control transfer procedures between the bridge and the engine room. These errors were followed by inappropriate policy and procedures and inadequate supervision. Machine interface, automation issues, maintenance, and equipment malfunctions also played a role. Rectifying these issues is essential to prevent similar accidents by ensuring robust procedures, enhanced supervision, improved human-machine interaction, and more effective maintenance protocols.

6. Comments

The accident investigation report highlights a propulsion system failure that led to a collision with the quay. The findings emphasize the importance of examining the propulsion control system and providing additional training for its execution. The incident reveals a combination of technical and human factors, including improper procedures, inadequate supervision, and automation issues.

Micro Presentation of a Review of an Accident – Review 17

Reference Number	C0013781
Description	When securing the drums stacks onto the poop deck in order to prepare for the severe weather conditions reported by the weather forecast an AB, OS A and OS B were facing one another to lift a toolbox; this is when OS B lost his balance and fell towards the chain railings, plunging about 18 meters onto the upper deck and later died.
Key Root Causes	ISM non-conformity (Inadequate risk - assessment - Inadequate system design - Inadequate competence/skills; Management fault (Inadequate team operation; Incorrect perception; Inadequate leadership). Bad weather.
Casualties	1 Fatality
Action-Recommendation	Training on hazards of working on the deck specially when there is a bad weather.
Would it happen again	No if training is provided on risk assessment.

Title: An Investigation into Root Causes of Accident – Man Over Board

Accident Investigation Review 17 – MOB

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by a leading Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed a systematic approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

When securing the drums stacks onto the poop deck in order to prepare for the severe weather conditions reported by the weather forecast an AB, OS A and OS B were facing one another to lift a toolbox; this is when OS B lost his balance and fell towards the chain railings, plunging about 18 meters onto the upper deck and later died.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

Trainings on hazards including risk assessment focusing on bad weather should be provided to the personnel of the ship.

5. Observations

The error arose from inadequate system design, compounded by insufficient competence, teamwork, and leadership. Incorrect perception and inadequate risk assessment further contributed, followed by challenging weather conditions.

6. Comments

The accident investigation report highlights a tragic incident resulting from inadequate safety measures during severe weather preparations. The findings emphasize the need for hazard-specific training, particularly focused on risk assessment for adverse weather conditions. The incident underscores deficiencies in system design, competence, teamwork, and leadership. Addressing these factors through targeted training and improved safety protocols is essential to prevent similar accidents and ensure the well-being of crew members during challenging conditions.

Micro Presentation of a Review of an Accident – Review 18

Reference Number	C0013289
Description	A CCTV footage from the shore, which captured most of the accident, showed that the Hatch Cover was lifted by the ship's Gantry Crane, operated by the Chief Officer, which then disconnected from the crane and fell onto the closed hatch cover beneath, where two crew members were laying out supports for it. One of the two crew members, managed to escape, the other one was crushed and declared dead. The Danish Maritime Authority detained the ship. Personnel should not be permitted to work if the Gantry Crane had any malfunction according to Procedures No.36 & No.37, in the case in which it was permitted to work, a "Specific Risk Assessment", should have been carried out and the malfunction taken into consideration.
Key Root Causes	ISM non-conformity (Inadequate risk assessment - Gantry Crane was malfunctioning – Noting that the Procedures 36 and 37 were violated as the specific risk-assessment was carried out by not considering the particular circumstances of the work to be done, specifically the hydraulic deficiency of the Gantry Crane) Management fault (Personnel were permitted to work, i.e., the two ABs went under the Hatch Cover, in order to place the supporting wooden stanchions, despite the fact that the Gantry Crane was malfunctioning. Crew related (Safety Management System Procedures violation was a contributing factor to the accident).
Casualties	1 fatality
Action-Recommendation	Had procedures in place for operating the Gantry Crane as well as Gantry Crane Manufacturer's instructions, been implemented and a Specific Risk Assessment been carried out, the accident would have been avoided. under no circumstances personnel pass beneath a load that is being lifted where the operator of the lifting equipment does not have a clear view, and an effective system of radio or other contact to be implemented.
Would it happen again	No, if procedures respected and an effective risk-assessment had taken place.

Title: An Investigation into Root Causes of Accident – Falling Weight

Accident Investigation Review 18 - Falling Weight

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by a leading Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed a systematic approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

A CCTV footage from the shore, which captured most of the accident, showed that the Hatch Cover was lifted by the ship's Gantry Crane, operated by the Chief Officer, which then disconnected from the crane and fell onto the closed hatch cover beneath, where two crew members were laying out supports for it. One of the two crew members, managed to escape, the other one was crushed and declared dead. The Danish Maritime Authority detained the ship. Personnel should not be permitted to work if the Gantry Crane had any malfunction according to Procedures No.36&No.37, in the case in which it was permitted to work, a "Specific Risk Assessment", should have been carried out and the malfunction taken into consideration.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator's Report

Conduct proper oversight to ensure adherence to procedures and the instructions provided by the Gantry Crane Manufacturer, particularly emphasizing the prohibition of personnel passing beneath a lifted load when the operator lacks a clear view. This should be accompanied by a detailed risk assessment aimed at preventing the recurrence of such accidents. Implement a robust communication system, such as radios, to facilitate effective communication.

5. Observations

The investigation report reveals a clear violation of procedures (36 and 37) involving inadequate risk assessment, which neglected to consider specific work circumstances, notably the malfunctioning Gantry Crane's hydraulic deficiency. This allowed personnel to proceed with work under the Hatch Cover, placing wooden stanchions, despite the crane's malfunction. The lack of proper risk assessment and violation of Safety Management System Procedures both significantly contributed to the accident.

6. Comments

The accident investigation report reveals a tragic incident involving a Gantry Crane malfunction during hatch cover operations. The findings emphasize the critical need for strict adherence to procedures, including prohibiting personnel from working beneath a lifted load without clear operator visibility. Robust oversight, detailed risk assessments, and effective communication systems are recommended to prevent similar accidents. The report underscores the significance of proper risk assessment to ensure the safety of crew members during crane operations.

Micro Presentation of a Review of an Accident – Review 19

9Reference Number	C0012821
Description	The vessel while at a floating Berth during an emergency mooring operation at the aft mooring station, the outgoing length of a double breast line "jumped over" a roller fairlead and severely injured the vessel's Third Officer on his legs. The vessel's Chief Officer was also injured on his left hand in his attempt to assist the Third Officer. First aid was provided. Third Officer's both lower legs were subsequently amputated. The Chief Officer suffered three broken fingers in his left hand.
Key Root Causes	ISM non-conformity (Inadequate risk assessment – Lack of training in mooring operations as per SMS requirements). Management fault (Inappropriate implementation of SMS: failure to follow the safety best practices for mooring operations (e.g., non-implementation of the guidelines in "Effective Mooring" publication). Unsafe decision to transfer the outgoing length of the aft double breast line to an adjacent roller fairlead by hand, when the vessel was moving in and out from the berth. Ignoring hazards and being inattentive to risks such as shifting a line when the line is under strain, standing on a line or in a closed bight of line).
Casualties	2 injuries, one crew's legs amputated.
Action-Recommendation	For the Management Company to provide training in mooring operations as per SMS requirements and include realistic hazards and consequence - Proper implementation of the emergency checklists, as per SMS requirements - Mooring plans to be prepared and retained as evidence of the mooring arrangement/agreement with the port's authorities, as required by SMS. The management to consider the typical minimum mooring requirements for cape size (e.g., 4 headlines and 4 stern lines) provided by the industry and the SMS to be revised accordingly.
Would it happen again	No, if risk assessed effectively and training in mooring operation given.

Title: An Investigation into Root Causes of Accident – Mooring operation

Accident Investigation Review 19 - Mooring Operation

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by a leading Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed a systematic approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

The vessel while at a floating Berth during an emergency mooring operation at the aft mooring station, the outgoing length of a double breast line "jumped over" a roller fairlead and severely injured the vessel's Third Officer on his legs. The vessel's Chief Officer was also injured on his left hand in his attempt to assist the Third Officer. First aid was provided. Third Officer's both lower legs were subsequently amputated. The Chief Officer suffered three broken fingers on his left hand.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator's Report

It is highly recommended for Management Company to provide training in mooring operations as well as the proper implementation of the emergency checklists as per SMS requirements and include realistic hazards and consequence. As it is required by SMS the mooring plans must be prepared and retained as evidence of the mooring arrangement/agreement with the port's authorities. The management is considering the typical minimum mooring requirements for cape size provided by the industry and the SMS to be revised accordingly.

5. Observations

The investigation report highlights a critical mistake rooted in the inappropriate implementation of the Safety Management System (SMS), notably neglecting safety best practices for mooring operations outlined in the "Effective Mooring" publication. Inadequate risk assessment and lack of supervision compounded the situation. A hazardous decision was made to manually transfer the aft double breast line to an adjacent roller fairlead while the vessel was manoeuvring in and out of the berth. Hazards were overlooked, and risks associated with shifting a strained line, standing on a line, or being in a closed bight of line were disregarded.

6. Comments

The investigation report underscores a grave accident during an emergency mooring operation, revealing failures in SMS implementation and risk assessment. The findings stress the need for comprehensive training, strict adherence to emergency checklists, and proper mooring plans. The incident's roots lie in neglecting safety protocols and oversight, leading to severe injuries. Rectifying these deficiencies and aligning practices with industry standards are crucial to preventing similar accidents, prioritizing crew safety and effective mooring operations. The accident could have been avoided if risk assessed was effective and training in mooring operation was given.

Micro Presentation of a Review of an Accident – Review 20

Reference Number	C0013465
Description	After disembarking the pilot and given the Ready for engines1, the ship suffered a fault from the electrical plant and the control of the engine and rudder on the bridge and later the ship was stranded in a sandy shoal area. The systems for the generation and distribution of electrical energy, and the control of the propulsion and government of the vessel were poorly managed, in view of the set of technical failures revealed during the accident.
Key Root Causes	ISM non-conformity (Inappropriate policy manual - Inappropriate procedures - Inadequate risk assessment Management fault (Inadequate supervision; Problems with safety culture - Poor team operation; Working towards different goals; Incorrect perception).
Casualties	None
Action-Recommendation	An inappropriate policy manual and procedures, inadequate supervision, and problems within the safety culture are evident. Additionally, there are issues related to inadequate risk assessment, poor team operation, divergent goals, and incorrect perception.
Would it happen again	Yes, if propulsion system not managed effectively.

Title: An Investigation into Root Causes of Accident - Grounding

Accident Investigation Review 20 - Grounding

1. Introduction

In this accident investigation was carried out by a qualified accident investigator employed by a leading Accident Investigation Agency.

The investigation aimed to demonstrate the difficulties to establish the root causes of accidents.

2. Background

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), establishes a framework for safe operation and management of ships and the prevention of pollution. Shipping companies are required to implement and maintain effective safety management systems that comply with the ISM Code. The accident investigators were responsible for proposing remedies to ensure the accident does not happen again and in the process identify any other contributing root causes.

3. Methodology

The investigation by the accident Investigators involved a comprehensive review of accident using any documents forwarded to them to carry out the investigation according to the Agency rules and practice. The Investigators employed a systematic approach to evaluate the accident and its root causes against the requirements set forth by the Agency. C4FF reviewed the information available primarily from accident investigation report with a view to find out if ISM can be more effectively implemented or its effectiveness improved.

4. Investigation

After disembarking the pilot and given the Ready for engines1, the ship suffered a fault from the electrical plant and the control of the engine and rudder on the bridge and later the ship was stranded in a sandy shoal area. The systems for the generation and distribution of electrical energy, and the control of the propulsion and government of the vessel were poorly managed, in view of the set of technical failures revealed during the accident.

Findings

4.1) Investigation Practice

The Investigation took place in accordance with the Accident Investigation Agency procedures and practice. The Investigators examined various aspect of the accident and SMS Manual containing policies, procedures, and records/documents as well as non-Quality Assurance and Control deficiencies to ensure their findings would stop this accident from happening again.

4.2) Accident investigator’s Report

It is recommended for the shipping company to prioritize several key areas for safety enhancement. First, a comprehensive review and improvement of the maintenance procedures for the ship's electrical plant is crucial, including regular inspections and training for crew

members. Also, implementing redundancy and backup systems for critical components can minimize the impact of technical failures. Crew training and competency should be regularly reinforced, particularly focusing on electrical plant operations and emergency responses.

5. Observations

The investigators' report reveals a critical error stemming from multiple sources. An inappropriate policy manual and procedures, inadequate supervision, and problems within the safety culture are evident. Additionally, there are issues related to inadequate risk assessment, poor team operation, divergent goals, and incorrect perception. Addressing these shortcomings is imperative to establish a robust safety framework, enhance team collaboration, align goals, and ensure accurate risk assessment to prevent similar incidents in the future.

6. Comments

The investigation underscores a significant accident resulting from technical failures and inadequate management of the ship's systems. The recommendations emphasize the importance of enhancing maintenance procedures, crew training, and implementing backup systems. The report highlights a series of deficiencies in policy, procedures, supervision, and safety culture. Addressing these gaps is vital to prevent future incidents and foster a safer maritime environment through improved systems management, crew competence, and effective risk assessment.

Chapter 3: Learning from Inspections and Audits

1. Introduction: The Evidence from Port State Control

An analysis of Port State Control (PSC) inspections reveals a clear and concerning trend: a significant and increasing number of deficiencies are being recorded under codes related to the International Safety Management (ISM) Code. This evidence suggests potential weaknesses in the implementation of the ISM Code, either ashore or on board, and raises questions about the effectiveness of the Code itself. When multiple ISM-related deficiencies are found during a single inspection, it can indicate a systemic failure within the company's Safety Management System (SMS), often resulting in the vessel's detention.

Data from the Paris MoU provides a clear snapshot of this issue. Between 2019 and 2021, of the 104,306 total deficiencies recorded, approximately 11% were due to ISM Code non-conformities, making it the single most frequent category of deficiency noted in the top ten (see Figure 3.1).

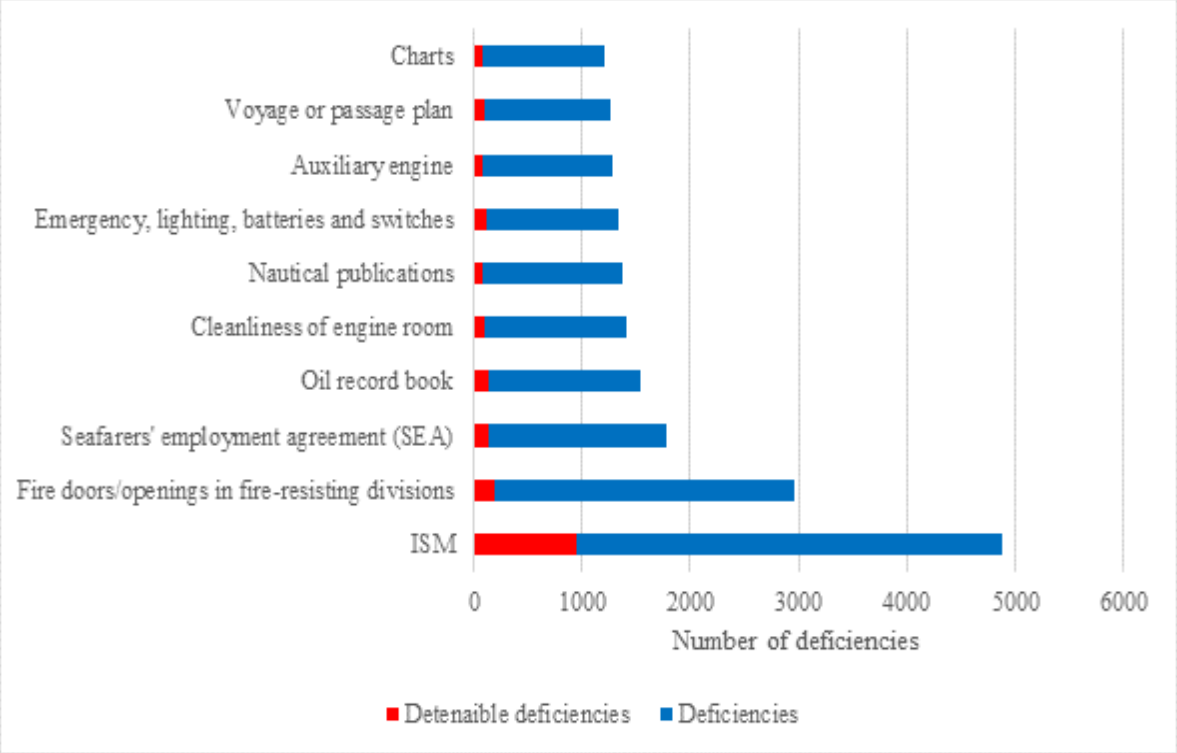

Figure 3.1: The ten most frequent deficiencies detected on ships during by Paris MoU 2019-2021

Over this three-year period, more than 46,000 inspections were conducted, leading to thousands of detentions annually (see Table 3.1). The high frequency of ISM-related issues points to a persistent challenge within the industry to maintain effective compliance.

Table 3.1: PSC Paris MoU Observed deficiencies – Review of Inspections 2019 - 2021

Year	2019	2020	2021
Number of inspections	17,916	13,168	15,387
Number of individual ships inspected	15,447	12,092	13,797
Number of deficiencies	39,821	28,372	36,113
Number of detainable deficiencies	3,015	2,182	3,274
Detentions in % of the total number of inspections	2.98	2.92	3.43
Number of refusals of access to ports	25	8	11

The latest data from the Paris MoU 2024 Annual Report indicates that this challenge not only persists but has evolved. The MoU has expressed concerns regarding persistently high average detention rates over the past few years. After a rate of 4.25% in 2022 and 3.81% in 2023, the rate unfortunately increased again to 4.03% in 2024.

In 2024, the Paris MoU conducted 16,508 inspections, which resulted in 665 detentions. The general ISM deficiency remains one of the most frequently recorded issues, accounting for 4.6% of all deficiencies in 2024. This continued high frequency of ISM-related findings underscores the critical importance of analysing audit and inspection data to identify and address the root causes of non-compliance.

2. Pinpointing Core Problems: Pareto Analysis of ISM Audits

To identify which factors, if corrected, would provide the maximum impact, a Pareto analysis of non-conformities (NCs) observed during ISM audits was conducted. This method helps to distinguish the "vital few" problems from the "trivial many," allowing for a focused approach to corrective action. Data from both the International Association of Classification Societies (IACS) and Lloyd's Register (LR) reveals a consistent pattern. Between 2018 and 2022, IACS members recorded approximately 70,000 non-conformities.

The analysis shows that a few key areas account for the majority of issues. The top ten most frequent non-conformities are detailed in Table 3.2.

Table 3.2 Pareto Analysis of Top 10 ISM Audit Non-Conformities (Source: Lloyd's Register):

ISM Code - Non-conformities observed	Years							Grand			Pareto	CoR vs.	ISM
Row Labels	2017	2018	2019	2020	2021	2022	2023	Total		%	Ranking	CrR	Element
1.2.2.1 - Safe Working Practices	4	43	25	26	24	22	5	149		1.87%	14	CoR	
1.2.2.2 - Safeguards against identified risks	25	70	58	60	109	83	37	442		5.53%	5	CoR	
1.2.2.3 - Safety Management skills & preparing for emergencies	1	2	3	2	4	1	2	15		0.19%		CoR	1
1.2.3.1 - Compliance with rules & regulations	48	217	168	151	206	189	84	1063		13.31%	1	CrR	
1.2.3.2 - Taking into account of codes, guidelines & standards	7	22	24	17	18	23	6	117		1.47%		CrR	
1.4 - Functional Requirements	2	6	7	6	7	8	2	38		0.48%		CoR	
10.1 - Establish procedures to maintain the ship	31	103	124	83	102	109	50	602		7.54%	3	Cor	
10.2.1 - Inspections held at the proper interval	19	101	76	85	91	92	45	509		6.37%	4	Cor	
10.2.2 - Deficiencies reported	8	37	30	44	32	53	25	229		2.87%	12	CoR/CrR	
10.2.3 - Appropriate action on deficiencies taken	11	45	48	36	34	53	30	257		3.22%	11	Cor/CrR	
10.2.4 - records of activities maintained	5	33	32	25	32	38	20	185		2.32%	13	CoR	
10.3 - Identification & Measures for critical equipment	11	35	17	11	19	24	21	138		1.73%		CoR	
10.4 - Inspection routines & follow up incorporated in the maintenance routines	8	35	21	17	13	29	15	138		1.73%		CoR	10
11.1 - Establishing document & data control	16	54	52	39	33	48	39	281		3.52%	9	CoR	
11.2.1 - Valid documents available on relevant locations	15	53	53	53	65	54	19	312		3.91%	8	CoR	
11.2.2 - Review & approval of (changes to) documentation	2	8	7	4	1	6	1	29		0.36%		CoR	
11.2.3 - Obsolete documents promptly removed	2	19	7	8	9	9	3	57		0.71%		CoR	
11.3 - Suitable & effective SMS maintained		3	2	3	2	6	1	17		0.21%		CoR	11
12.1 - Internal audits at 12 month intervals	14	35	46	39	43	36	16	229		2.87%		CoR	
12.2 - Personnel undertaking tasks in conformity with Companys responsibilities	1	2	3	1	3	6		16		0.20%		CrR	
12.3 - Management review	2	8	4	12	7	14	4	51		0.64%		CoR	
12.4 - Audits and corrective actions in accordance with procedures	3	10	21	24	9	10	6	83		1.04%		Cor/CrR	12
12.5 - Independence of internal auditors	1	4		1	2	2		10		0.13%		Cor/CrR	
12.6 - Reporting results of internal audits and reviews	3	5	3	4	3	3		21		0.26%		Cor/CrR	
12.7 - Timely corrective action on findings noted	2	6	10	8	13	8	4	51		0.64%		Cor/CrR	
2.1 - Establishing a safety & environmental policy	3	5	4	4	1	8	2	27		0.34%		CoR	
2.2 - Implementing the SMS Policy		13	10	4	6	7	5	45		0.56%		CrR	2
3.1 - Ship owner assigning ISM responsibility		1	5	1	5	1		13		0.16%		CoR	
3.2 - Defining & documenting responsibilities	1	4	5	4	6	11	3	34		0.43%		CoR	
3.3 - Adequate resources for the DPA	3	3	3	4	5	4	1	23		0.29%		CoR	3
4 - Role of the DPA	2	1	2		2	7		14		0.18%		CoR	4
5.1.1 - Master implementing the SMS Policy		4	1		1		2	8		0.10%		CoR	
5.1.2 - Master motivating the crew		1	1		1	1		4		0.05%		CoR	
5.1.4 - Master verifying SMS related activities	1	7	6	3	3		4	24		0.30%		CoR	
5.1.5 - Master periodically reviewing the SMS	4	20	16	13	19	18	13	103		1.29%		CoR	
5.2 - Use and knowledge of the overriding authority	1		1	1				3		0.04%		CoR/CrR	5
6.1.1 - Master properly qualified for command		1						1		0.01%		Cor/CrR	
6.1.2 - Master fully conversant with SMS	1	2	3	3	5	1		15		0.19%		CoR/CrR	
6.1.3 - Master given necessary support		3	1	5	1	5		15		0.19%		CoR	
6.2.1 - Ship manned with qualified and medically fit personnel	7	23	22	23	28	28	11	142		1.78%		CoR/CrR	
6.2.2 - Ship appropriately manned to safely cover all operations	8	19	17	16	21	16	7	104		1.30%		CoR	
6.3 - Crews familiarisation on board	2	26	18	26	34	39	24	169		2.12%		CoR/CrR	
6.4 - Adequate knowledge of rules and regulations	9	15	19	13	16	9	9	90		1.13%		CoR/CrR	
6.5 - Identification of training needs	4	21	21	22	24	24	10	126		1.58%		CoR	
6.6 - Working language used		3	2	5	2	3	2	17		0.21%		CoR/CrR	
6.7 - Effective communication used	1	8	10	4	6	6	5	40		0.50%		CoR/CrR	6
7 - Shipboard Operations	23	155	104	114	131	139	72	738		9.24%	2	CoR/CrR	7
8.1 - Identification of contingency plans	3	17	21	8	8	10	5	72		0.90%		CoR/CrR	
8.2 - Drills & exercise planning for emergencies	14	57	55	45	45	71	27	314		3.93%	7	CoR/CrR	
8.3 - Companys ability to respond to emergencies	7	19	20	21	13	23	9	112		1.40%		CoR/CrR	8
9.1 - Reporting, investigating, analysing accidents, NCs, etc.	19	75	70	69	64	68	50	415		5.20%	6	CoR/CrR	
9.2 - Implementation of corrective actions	10	52	43	51	48	43	32	279		3.49%	10	CoR/CrR	9
Grand Total	**364**	**1511**	**1321**	**1218**	**1376**	**1468**	**728**	**7986**		**100.00%**			

Notably, the most frequent non-conformity is 'Non-Compliance with rules and regulations', which is classified as a Crew-related Mistake. This is followed by issues in 'Shipboard operations' and deficiencies related to 'Ship maintenance'. This is supported by a pareto analysis

of the data obtained from LR, representing 15% of the IACS data. The top ten most frequent non-conformities are listed below:

- 1.2.3.1 - Non-Compliance with rules and regulations.
- 10.2.1 - Inspections not held at the proper interval; 10.1 - Establish procedures not in place to maintain the ship; 10.3 - Identification & Measures not in place for critical equipment; 10.4 - Inspection routines & follow up not incorporated in the maintenance routines.
- 12.1 - Internal audits not held at 12-month intervals; 12.3 - Management review not conducted; 12.4 - Audits and corrective actions not in accordance with procedures; 12.7 - Timely corrective action not taken on findings noted.
- 5.1.5 - Master not periodically reviewing the SMS
- 7 - Shipboard operations
- 1.2.2.2 - Inadequate safeguards against identified risk
- 9.1 - Lack or inadequate reporting, investigating, analysing accidents, NCs, etc.
- 8.2 - Inadequate drills & exercise planning for emergencies
- 11.2.1 - Valid documents not available on relevant locations
- 9.2 - Non-implementation of corrective actions.

3. Audit Data vs. Accident Analysis

The insights from ISM audits are powerfully reinforced when compared with the findings from accident investigation reviews. As shown in Table 3.3, there is a remarkable correlation between the top-ranking non-conformities from audits and the most common root causes of accidents.

Table 3.3: Pareto Analysis of ISM Audit Non-conformities vs. Analysis of Accident Report Non-conformities

Pareto Analysis of ISM Non-conformities: Accident reviews vs ISM Code Audits			
Non Conformities Observed/Noted	**ISM Code Pareto Ranking**	**Accident Analyses/Reviews Pareto Ranking**	**Notes**
1.2.2.1 - Safe Working Practices	16		The Pareto analysis of findings from accidents show that ISM requirements for compliance with the 'rules and regulations', 'management and decision making' and 'establishing procedures to maintain the ship and identification of measures for systems and machinery' ranked respectively 1. 2 and 3 that if resolved expected to make the most impact in effectiveness and the effective implementation of the ISM Code. Ranked 4, 5 and 6 were 'shipboard Operations', 'safeguard against identified risks' and 'Ineffective communication/language issues'. 'Emergency planning' ranked 7 and 'Crew familiarization on board' ranked 8. Human Vulnerabilities ranked 9 and 'lack of knowledge' ranked 10. Dividing the root causes of accident into ErrorCompany related/ISM Non-comformity and Mistake (Crew related/management fault and machine failure/System Error did help in classifying areas of concern and the intended opportunities for making targeted improvements. Our limited review of accidents tallied well with ISM Audits by IACS/LR on like for like basis.
1.2.2.2 - Safeguards against identified risks	5	5	
1.2.3.1 - Compliance with rules & regulations	1	1	
1.2.3.2 - Taking into account of codes, guidelines & standards	18		
10.1 - Establish procedures to maintain the ship plus 10.3 - Identification & Measures for critical equipment plus 10.4 - Inspection routines & follow up incorporated in the maintenance routines	3	3	
10.2.1 - Inspections held at the proper interval Plus 12.1 - Internal audits at 12 month intervals Plus 12.3 - Management review Plus 12.4 - Audits and corrective actions in accordance with procedures Plus 12.7 - Timely corrective action on findings noted Plus 5.1.5 - Master periodically reviewing the SMS	2	2	
10.2.2 - Deficiencies reported	13		
10.2.3 - Appropriate action on deficiencies taken	11		
10.2.4 - records of activities maintained	15		
11.1 - Establishing document & data control	10		
11.2.1 - Valid documents available on relevant locations	8		
6.2.1 - Ship manned with qualified and medically fit persons Plus 6.2.2 - Ship appropriately manned to safely cover all operations	12		
6.3 - Crews familiarisation on board	14		
6.4 - Adequate knowledge of rules and regulations	20		
6.5 - Identification of training needs	17	7	
7 - Shipboard Operations	4	4	
8.2 - Drills & exercise planning for emergencies	7		
8.3 - Companys ability to respond to emergencies	19	6	
9.1 - Reporting, investigating, analysing accidents, NCs, etc.	6		
9.2 - Implementation of corrective actions	9		
Grand Total			

'Compliance with rules and regulations', 'management and decision making', and 'procedures for ship maintenance' rank as the top three issues in both datasets. This strong alignment confirms that the deficiencies being flagged during audits are the same systemic weaknesses that contribute to major maritime accidents, validating the focus on these areas for improvement.

4. Systemic Issues and the Limits of Procedural Compliance

The persistence of these non-conformities points to deeper, systemic issues. Many shipping companies are family businesses with varied levels of maritime experience and knowledge of specific ship types. Some may adopt another company's safety system without a full understanding of its implementation, leading to a gap between documentation and practice. As the UK's Marine Accident Investigation Branch (MAIB) noted, audits should consider factors like recent changes in ownership, the company's maritime experience, and its familiarity with implementing an SMS.

Furthermore, the ISM Code itself, while based on the sound principles of ISO 9000, has limitations. A procedural quality system does not inherently improve safety overnight, especially if it is not embraced by the entire organisation. The ISM Code is a generic framework, and without a commitment to continuous improvement and feedback from all personnel, it can lead to a culture of "paper compliance" rather than genuine safety enhancement.

5. Guidelines for Internal Audit of ISM Code

IMO ISM Code: Before Audit Checklist

The objectives of the IMO ISM Code[6] are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular, to the marine environment, and to property.

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[6] ISM Code Part A contains 12 elements related to implementing the code. These prescriptive elements place responsibility for the safe and clean operation of ships on the Master, the DPA and the company, without giving explicit instructions. The 12 elements are: General which includes definitions, objectives and application of the ISM Code; Safety and environmental protection policy; Company responsibility and authority; Designated person ashore; Master's responsibility and authority; Resources and personnel; Development of plans for shipboard operations; Emergency preparedness; Reports and analysis of non-conformities, accidents and hazardous occurrences; Maintenance of the ship and equipment; Documentation; Company verification, review and evaluation.

ISM Code Part B pertains to certification and verification of compliance with the code. Part B elements are:
Certification and periodical verification; Interim certification; and Verification (The ISM certification process, initiated at the request of a company, consists of the following stages: Initial verification, after which interim and, eventually, full certification will be issued; annual verification of the company DOC; Intermediate verification of the Safety Management Certificate (SMC) between the second and third anniversary of the issue; Renewal verification for both on the fifth anniversary of the issue; Additional verification whenever further surveillance is deemed necessary by flag or port state inspections

For a properly functioning ISM safety management system, preparations for an ISM audit should be minimal. Preparations should be limited to ensuring that the correct documents, certificates, procedures, records and reports are on hand and can be accessed during the briefing interview with the auditor. These include:
PM records; Hours of rest; Officer and crew certificates; Record of non-conformities and master's review; Crew training and drill record; Checklist folders for procedures; Crew familiarisation records; Bridge and navigation records; Up-to-date bridge

Before conducting the audit/inspection the following questions should be answered.

Has the company provided:

- Procedures for safe practices in ship operation and a safe working environment; an assessment of all identified risks to its ships, personnel and the environment and establish appropriate safeguards? Yes No
- A means for continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies related both to safety and environmental protection? Yes No
- A verification system for ensuring compliance with mandatory rules and regulations? Yes No
- A checklist that applicable instruments/codes, guidelines and standards recommended by the Organization, Administrations, classification societies and maritime industry organizations are taken into account? Yes No
- A safety and environmental protection policy? Yes No
- Instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant international and flag State legislation? Yes No
- Defined levels of authority and lines of communication between, and amongst, shore and shipboard personnel? Yes No
- Procedures for reporting accidents and non-conformities with the provisions of this Code? Yes No
- Procedures to prepare for and respond to emergency situations? Yes No
- Procedures for internal audits and management reviews? Yes No
- Handover procedures Yes No

Has the company provided the:

- List of ship's crew members? Yes No
- Details of the Designate Person(s)? Yes No
- Details of minimum level manning/Safe Manning Document for the vessel? Yes No
- List of all STCW certificates and medical fitness for each crew member including the Designated Person(s)? Yes No
- Appraisal records of officers and ratings Document of Compliance (DOC) as per SOLAS Annex 1, MSC 1462, MEPC Circ. 817 ad Fal Circ. 177? Yes No
- Safety Management Certificate (SMC)? Yes No
- Is the SMC an Interim Certificate? Yes No

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p/ps, corrections and publications; Drill and training records; Procedures in place for principal operations; and Procedures being followed.

The ship's master would implement the environmental protection policy by ensuring that he has an overview of the tenets of MARPOL annexes 1 to 6 and verify that these are being followed. He should check that all associated documents and certificates are being correctly observed. The ship's master should also motivate the crew to meet the following requirements: Anti-fouling certificate is in place and good order; Ballast water management plan is in place and being demonstrably observed; Garbage management plan is in place and is being met; SEEMP is in place and being incorporated; ODME equipment is functioning and being correctly recorded in the ORB; Fuel SOX change-over records are complete.

- Is there an International Security Certificate? Yes No
- Document / Letter copy to Flag delegating responsibility of ship management (where relevant), and do the details of ship management corelate with the details in the DOC and CSR? Addition requirements due to the type of ship or cargo? Yes No
- A record of all its corrective actions? Yes No
- A record of all preventive actions? Yes No

Depending on the ship type are the following certificates available:

- International Noxious Liquid Substances (NLS) Certificate and IOPP (International Oil Pollution Prevention) Certificate? Yes No
- International Air Pollution ~~and~~ Prevention (IAPP) Certificate? Yes No
- Evidence for the requirements of MARPOL Dangerous Goods and Annex IV ~~4~~ Reg 5 MEPC Circ. 408? Yes No
- Energy Efficiency Certificate(s)? Yes No
- Passenger Ship Safety Certificate? Yes No
- Special Trade Passenger Ship (STP/SSTP)? Yes No
- Single Hull Tankers >15 years old Certificate of Compliance Yes No

With regard to maintenance requirements:

- Is there evidence of an effective maintenance system? Yes No
- Has the ship carried out 5 yearly CAS (Condition Assessment Scheme) Yes No
- Carried out an Enhanced Survey Program (CAP) Yes No
- Has all the maintenance Documents to date? Yes No

2. IMO ISM Code: During Audit Process

Is there evidence of:

- The Master having overriding authority for the safety of the crew,
- Ship and the environment Yes No
- Are details of company organization chart, lines of communications,
- and job descriptions available? Yes No
- Are Clear and simple set of instructions available to crew including
- officers e.g., Master's standing orders, night orders, Master's
- circulars, etc.? Yes No
- SMS familiarization of the crew including officers Yes No
- Motivation to follow SMS along with evidence with the aim of
- promoting motivation by organizing safety debates, lectures,
- competitions, presentation of safety awards etc.? Yes No
- Review of previous audit reports, non-conformities
- Accidents/incidents or hazardous occurrences? Yes No
- Regular review of SMS and suggestions for changes to shore

- management? Yes No

Additional questions:

Has there been recent changes in ownership, flag State and classification society?
Is updated CSR available? Yes No

If yes, is company fully aware of implications associated with ISM Code and corresponding SMS requirements? Yes No

Could you also verify the following during the audit/inspection:

. Are auditors' report(s) on non-conformities, accidents and hazardous occurrences followed-up? Yes No

. Are non-conformities clearly linked to ISM Code requirements and the SMS? Yes No

. Are relevant Conventions, Regulations, Codes, Standards and Industry Guidance available on the ship, or can be accessed digitally? Yes No

. Does the ship's SMS have a maintenance routine, which includes the testing of stand by equipment and critical equipment/systems, and are records available? Yes No

. Are records of risk assessments and appropriate safeguards available? Yes No

. Are procedures/records of how the company deals with request for resources available? Yes No.

. Is relevant documentation regarding the SMS in a working language understood By crewmembers? Yes No

. Are program and records for drills and exercises to prepare for emergency actions available? Yes No

. Are introduction/familiarization procedures for crewmembers carried out in accordance with documented procedures? Yes No

. Are crewmembers able to communicate effectively in the execution of their duties related to SMS? Yes No

. Is there evidence of repetitive observations or non-conformities from previous ISM Code audits? Yes No

. And have these been considered at safety committee meetings and SMS review? Yes No

. Does the company keep the Safety Management documentation on board? Yes No

. Is there evidence that the master has carried out the review of the SMS? Yes No

. Can senior officers identify the "designated person" responsible for the operation of the ship and the means to contact that person? Yes No

. Have the procedures for establishing contact with shore management in an emergency been tested? Yes No

. Are emergency plans/procedure available on board, along with evidence of

shore-based company emergency response and contract with ERS?
Yes No

. Are records of inspections, condition and maintenance reports available? Yes No

. Are records to tests, sample analysis, calibration records, outcomes of routine checks, completed checklists, etc., available?"
Yes No

. Are records available related to amendments, upkeeping, retrieval, storage and destruction of documents. Yes No

. Does the company consider that the incident and accident assessors including investigation agencies should standardize their reporting system and focus on human performance?
Yes No

Do you apply any of the KPIs listed below when assessing/monitoring the ISM Code implementation?
(The list of KPIs below is not exhaustive and other relevant KPIs may also be considered).

- The number of non-conformities identified during ISM audits. Yes No
- The number of accidents and incidents involving ships registered with the Administration implementing the ISM Code. Yes No
- The number of accidents and incidents attributable to human error. Yes No
- The percentage of ships holding valid SMS certificates. Yes No
- The number of inspections carried out by the Administration. Yes No
- The number of deficiencies identified during SMS verification. Yes No
- The number of accidents and incidents involving ships with valid SMS certificates. Yes No

Chapter 4: Risk Based Approach to Maritime Safety

1. Introduction

The International Safety Management (ISM) Code establishes a mandatory requirement for every company to actively engage in risk management as a core function of its Safety Management System (SMS). The Code's objectives explicitly state that a company's safety management should provide for safe practices in ship operation, a safe working environment, and "assess all identified risks to its ships, personnel and the environment and establish appropriate safeguards." This is not an optional activity but a foundational pillar of modern maritime safety.

However, meeting this requirement presents a major challenge for many companies, particularly smaller ones. The Code also requires companies to "continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies," which demands significant resources for planning, training, and application that are not always available.

This chapter investigates the application of a risk-based approach in the shipping industry. It assesses the effectiveness and usefulness of the methods companies use to conduct the risk assessments required by the ISM Code, exploring the frameworks, cultural elements, and human factors that determine success.

2. Foundational Principles and Principles

Before applying a risk-based approach, it's crucial to understand the core concepts and the legal framework that governs it.

Key Definitions

A **hazard** is a source of potential injury, harm or damage. It may come from many sources, e.g. situations, the environment or a human element.

Risk has two elements:

- The **likelihood** that harm or damage may occur.
- The potential **severity** of the harm or damage.

Duties of Shipowners and Seafarers

The legal framework places a clear duty on shipowners and employers to protect the health and safety of seafarers. According to Merchant Shipping and Fishing Vessels Regulations (S.I. 1997/2962, Reg. 5), the duties of shipowners are based on several key principles:

- the avoidance of risks, which among other things includes the combating of risks at source and the replacement of dangerous practices, substances or equipment by non-dangerous or less dangerous practices, substances or equipment;
- the evaluation of unavoidable risks and the taking of action to reduce them;

- the adoption of work patterns and procedures that take account of the capacity of the individual, especially in respect of the design of the workplace and the choice of work equipment, with a view in particular to alleviating monotonous work and to reducing any consequent adverse effect on workers' health and safety;
- the adaptation of procedures to take account of new technology and other changes in working practices, equipment, the working environment and any other factors that may affect health and safety;
- the adoption of a coherent approach to management of the vessel or undertaking, taking account of health and safety at every level of the organization;
- giving collective protective measures priority over individual protective measures; and
- the provision of appropriate and relevant information and instruction for workers.

This responsibility is shared with seafarers, who are required to:

- take reasonable care for their own health and safety and that of others on board who may be affected by their acts or omissions;
- cooperate with anyone else carrying out health and safety duties, including compliance with control measures identified during the employer's or Company's risk assessment;
- report any identified serious hazards or deficiencies immediately to the appropriate officer or other responsible person; and
- make proper use of plant and machinery, and treat any hazard to health or safety (such as a dangerous substance) with due caution

Recommended Standards and Guidelines

To assist in the process of identifying risks, companies can refer to several international standards and industry guidelines, including:

- MCA – Code of Safe Working Practices for Merchant Seafarers, 2015 edition, Amendment 3, October 2018;
- ISO 31000:2018 – Risk management -- Principles and guidelines;
- IEC 31010:2009 – Risk management – Risk assessment techniques.
- IACS Rec.127 - A Guide to Risk Assessment in Ship Operations

3. The Risk Assessment Process in Practice

The risk assessment process identifies hazards present in a work undertaking, analyses the level of risk, considers those in danger and evaluates whether hazards are adequately controlled, taking into account any measures already in place.

Effective risk assessments:

- correctly and accurately identify all hazards;
- identify who may be harmed and how;
- determine the likelihood of harm arising;
- quantify the severity of the harm;

- identify and disregard inconsequential risks;
- record the significant findings;
- provide the basis for implementing or improving control measures; and
- provide a basis for regular review and updating.

Potential language difficulties should be taken into account. Temporary staff or those new to the ship or the Company who are not fully familiar with the safety management system or other operational details should be considered where relevant. Other seafarers who should be given special consideration include young persons and pregnant seafarers (MGN 1838(M) and MGN 522(M+F)).

Any assessment must address risks to the occupational health and safety of seafarers as well as to property and environment. Advice on assessment in relation to using personal protective equipment, manual-handling operations and using work equipment is given in Chapters 8, 10 and 18. In addition, specific areas of work involving significant risk, and recommended measures to address that risk, are covered in more detail in later chapters of the Code.

The assessment of risks must be 'suitable and sufficient' but the process need not be overcomplicated. This means that the amount of effort that is put into an assessment should depend on the level of risks identified and whether those risks are already controlled by satisfactory precautions or procedures to ensure that they are as low as reasonably practicable.

The assessment is not expected to cover risks that are not reasonably foreseeable.

There are no fixed rules about how risk assessment should be undertaken. The assessment will depend on the type of ship, the nature of the operation, and the type and extent of the hazards and risks. The intention is that the process should be simple, but meaningful. The relevant legislation regarding risk assessments should be referred to when deciding on what methodology will be employed. There is a requirement that seafarers must be informed of any significant findings of the assessment and measures for their protection, and of any subsequent revisions made. It is a requirement to retain copies on board each vessel and that there is a process for regular revisions to be carried out. In particular, the risk assessment must be reviewed and updated as necessary, to ensure that it reflects any significant changes of equipment or procedure or the particular circumstances at the time, e.g., the weather or level of expertise of those carrying out the task.

Risk assessment should be seen as a continuous process. In practice, the risks in the workplace should be assessed before work begins on any task for which no valid risk assessment exists.

A very effective approach that is employed by some companies is to use a four-level process, as outlined below.

Risk assessment level 1

The ISM Code requires that the safety management objectives of the Company should, amongst other things, assess the risks associated with all identified hazards in respect of its ships, personnel and the environment, and establish appropriate safeguards.

These risk assessments, sometimes known as generic risk assessments, should therefore be carried out at a high level in the Company with appropriately knowledgeable and experienced personnel, and the results used to ensure that appropriate safeguards and control measures are contained within the Company's safety management system in the form of policies, procedures and work instructions.

Risk assessment level 2: task based

In addition to the general requirements under the ISM Code, the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 require that a suitable and sufficient assessment shall be made of the risks to the occupational health and safety of seafarers arising in the normal course of their activities or duties.

There are vessel- and task-specific risk assessments that must be carried out on board each vessel. Whilst it is clear that the Company can assess the generic risk of, for example, working at height, working with electricity, movement about ship, etc., it is not possible for them to conduct a risk assessment for changing a navigation light bulb up the main mast on a given vessel on a given day because they would not be able to take into account all the factors that were applicable at that time on that vessel. For this reason, it is essential that any generic risk assessments are used in context, and not seen as being suitable for specific tasks. For this, task-based risk assessments should be carried out on board each vessel by those involved in the work.

Two distinct types of task-based risk assessments may be used. First, a range of vessel-specific generic task-based risk assessments that can be used for all routine and low-risk tasks can be developed. These should be periodically reviewed, but frequency would very much depend on the particular circumstances on the vessel and the level of risk.

The second type of task-based risk assessments would be used for specific high-risk jobs that are not routine, such as working aloft or enclosed space entry. These should relate to the specific persons who will be involved in the work and valid only for the duration of that job.

In both cases, the assessments should be carried out by a competent person or persons who understand the work being assessed. It is also preferable that seafarers who will be involved in the work should also be involved in the assessment process.

Risk assessment level 3: toolbox talk

A toolbox talk is another form of risk assessment carried out in support of a task-based risk assessment. Its prime purpose is to talk through the procedures of the job in hand and the findings of the task-based risk assessment with the seafarers involved.

When carrying out a toolbox talk, it is important to actively involve those carrying out the work and others who may be at risk, i.e., seafarers, sub-contractors and others on board ship who may be affected by the work. Full and active participation should be encouraged and any questions or concerns discussed and taken into consideration. Once finished, confirm that all fully understand their role in the task and the precautions in place ('closed-loop communication'). This should then be recorded along with details of any relevant risk

assessment referred to. A toolbox talk should be conducted prior to any work being carried out that involves more than one person and where there is significant risk to persons or assets.

Risk assessment stage 4: personal assessment of risk

This is an informal assessment of day-to-day risks carried out as you are going about your work and life in general. It is a technique used to ensure that we perform even the most mundane of tasks without getting hurt. It is used to maintain awareness of our environment at all times and aid in the identification and control of immediate hazards as we go about our work. Use of personal assessment of risk should be developed and encouraged.

This is about taking a few minutes to step back, look at the job to be done, consider what could go wrong and how it may occur, and what steps you can personally take to avoid any incident occurring. As the work is proceeding, you should also monitor the worksite for any change in conditions that might alter the hazards and controls in place. If there is any concern, stop the work, re-assess the controls and, if necessary, re-plan and re-assess the task. This approach may also be called a 'dynamic risk assessment'. If the person does not believe that the dynamic risk assessment is sufficient move back to stage 2. Every task carried out on board the vessel should be subject to risk assessment. This does not mean that a risk assessment needs to be written every time a simple task is carried out, but the existing risk assessment must be referred to as part of a toolbox talk (stage 3) before the task can commence to ensure that the hazards and controls are fully understood, still relevant and appropriate. Once the task commences, it is important to monitor the work site for any changes in conditions that might alter the hazards and controls in place. If there is any concern, stop work authority should be used. In all cases, on completion of the task, it is important to record or feedback any lessons learned and make improvements for next time including, where appropriate, reviewing and updating existing risk assessments. Everyone should be encouraged to contribute. It is recommended that a proactive hazard-reporting system with empowerment and expectation for immediate corrective action is also in place and that information on hazards and risks is shared as widely as possible.

4. Application of Risk Assessment Across the SMS

Risk assessment is not a standalone task but a continuous process that is integrated into various key areas of the Safety Management System.

1. Identifying Key Shipboard Operations

The company must establish procedures and instructions for "key shipboard operations". Risk assessment is the tool used to identify these operations. The company should consider activities that could create hazardous situations if they are not properly controlled by plans and instructions. The procedures developed for these key operations must include measures to manage the identified risks. Furthermore, the company is expected to have identified and documented the specific risks associated with a particular type of vessel and its trade.

2. Identifying Critical Equipment and Systems

A crucial application of risk assessment is in maintenance. The Company must identify equipment and technical systems where a sudden operational failure might result in a hazardous situation. A risk assessment should be carried out specifically to identify this critical equipment.

Once identified, the SMS must provide specific measures aimed at promoting the reliability of such systems. These measures should include the regular testing of stand-by arrangements and equipment that are not in continuous use. Techniques such as **FMECA (Failure Mode, Effect and Criticality Analysis)** can be successfully applied for this purpose.

3. Emergency Preparedness

Risk assessment directly informs emergency planning. The Code requires the Company to "identify potential emergency shipboard situations, and establish procedures to respond to them". This list of potential emergencies is the output of a risk assessment process. The company must identify all possible situations where contingency planning would be required, relative to the ship's type, equipment, and trade. Common identified scenarios include:

- Collision
- Grounding / stranding
- Fire / explosion
- Flooding
- Structural failure / heavy weather damage

5. Industry Application: Findings from Case Studies and Surveys

In a case study prepared for this chapter, Company NK has provided its response on whether the risk-based approach used by the company in conducting assessments as required by the ISM Code is effective and useful.

The Company has a risk-based approach to ensures that safety measures are proportionate to the level of risk, making it a more efficient and effective way to manage safety. Company also aware risk assessments are not static; they require ongoing monitoring and adjustment. This approach encourages a culture of continuous improvement, as companies must regularly review and update their assessments to adapt to changing circumstances and emerging risks. There is a safety-first culture within company. When employees understand the risks associated with their tasks and are involved in the risk assessment process, they are more likely to take safety seriously and adhere to safety protocols.

Company has a clear and wide procedures for Risk assessments;

- The Risk Assessment Process: Step by Step Approach,
- Risk Evaluation,
- Risk Control,
- Reviewing Risk Assessments,
- When to carry out a Risk Assessment;

List of work that requires risk assessment, which by no means is exhaustive:

- Any Hot Work outside of the designated Hot Work location on board
- For any work that is planned in an enclosed space or Pump room beyond the scope of the respective entry permit
- The malfunctioning of (or any work which requires disabling of) critical systems, such as steering, inert gas, alarm systems, fire-fighting or lifesaving appliances, etc.
- Working on live electrical circuits
- Working on any system that is subject to LOTO.
- Undertaking major maintenance / repair / renewal jobs
- Movement, removal or replacement of heavy items such as cylinder heads, pistons, liners, large pumps or motors, pipelines, etc.
- Diving (or internal work) on underwater shipside connections (e.g. pipelines & valves).
- Critical areas of navigation, including shallow water, Sensitive Areas and difficult night passages.
- Loading unusual cargoes (may be detrimental to health or the ship).
- For STS Operations, SBM and CBM mooring, Tandem mooring to an FSO/FPSO (Spread moored or Turret moored) – the risk assessment should take into account the approach, mooring operations, hose connection and disconnection, cargo operations and unmooring operations. In addition, factors such as the control of tugs and tugs lines, ready availability of engines, weather factors, including the availability of proper weather forecasts, squalls and other local weather phenomena, should be among those taken into consideration.
- When calling at Ports / Terminals / Berths, where mooring arrangements may require special considerations.
- Inadequate berthing / mooring / terminal facilities.
- Discovery of cracks, cargo ingress into non-cargo spaces, etc.
- When receiving or transferring bunkers in any tank (FO/DO/MGO) above 90% by volume.
- Rescue and Salvage operations.
- When carrying out ship-helicopter operations
- At any other time or operation considered appropriate by Shipboard Management.
- When directed by Shore Management

The Company has Risk assessments library which includes around 125 generic risk assessments created to assist onboard crew to make a better risk management.

A survey of shipping companies shows a high adoption rate of a risk-based approach, with 91% affirming its use and 95% of those finding it "Highly" or "Moderately effective." However, findings also reveal significant gaps.

- **Bullying and Harassment:** A significant portion of respondents (62%) do not currently include the risk of bullying and harassment in their risk assessments, a potential area for improvement.

- **Training Needs:** Companies identified training in Collision Regulations, ERM and BRM integration, and Crew-Pilot interactions as particularly helpful for the effective implementation of the ISM Code.
- **Improving SMS Compliance:** The most valued methods for improving SMS compliance were company and ship-specific familiarisation (58%), followed by increased monitoring through audits (46%), streamlining the SMS (45%), involving all employees (44%), and integrating ISM with job responsibilities (36%).

6. The Human Element: Cultivating a Culture of Safety

If seafarers are fully informed and aware of the risks to their health, safety and welfare, they are much more likely to ensure they avoid the risks and remain safe. This knowledge is attained through risk assessment and in other ways throughout our lives including training in theory and practical application, information, observation, instructions, supervision and personal experience. We can improve the quality and usefulness of the information available by effective knowledge management. Application of the knowledge in the workplace is influenced by our values, beliefs, attitudes and behaviors and by the views of others. This is facilitated by ensuring a safe working culture.

Extensive research has identified certain elements that contribute greatly to maintaining a safe working culture. These can be described as:

- clearly defined expectations;
- good communications;
- clear leadership;
- good planning;
- risk awareness;
- accountability;
- good safety culture; and
- effective knowledge management.

These elements should be both put in place at a Company level within the safety management system and implemented on board the vessel by the master and crew. It is important that the entire workforce, from the most junior crew members through to the senior managers ashore, are involved in the development of these elements for them to be fully successful. Many of them are already present within management systems but often some are missing, which can create weaknesses in the management system.

A good approach is to conduct a gap analysis to identify those elements that are missing or weak, and amend the systems accordingly. The more developed and comprehensive the systems are, the more effective they can be.

On accountability

Maintaining a safe living and working environment on a vessel is a shared responsibility of all on board and ashore. All personnel have a role to play and they can adversely affect others on board by their acts and/or omissions. For these reasons, it is important that:

- there are well-defined rules and guidelines, which are clearly understood;
- responsibilities are clearly defined for all on board and ashore;
- consequences of unacceptable (safety) behavior are made clear; and
- there is a fair, transparent and consistent response to unacceptable safety behavior, commonly referred to as a 'just culture'.

On accountability, it is necessary to highlight the current separation of responsibility from authority.

The first two Points have been covered under 'Clearly defined expectations' and 'Good communications' above.

On just culture

A just culture policy is an important part of a positive health and safety culture. It clearly sets out the expectations for adherence to procedures in the workplace and provides a context for enforcing them. It recognizes behaviors that exceed Company expectations as well as those that fall below expectation, but are not always the fault of the seafarer.

A just culture places responsibilities on management to provide support, training and resources such that seafarers will have the necessary competence to undertake their tasks to the required standard.

The just culture policy provides a process (with appropriate support) for managing behaviors that fall below expectations in a transparent and fair manner. A just culture seeks to improve the organizational culture and the performance of the organization by modifying behavior, encouraging seafarers to take greater personal responsibility for their actions and rewarding behavior exceeding expectations. It also recognizes that firm action may be needed in circumstances where, despite management having carried out their responsibilities, inappropriate behaviors are still evident.

The just culture decision tree is a guide for ensuring consistent management for those who exceed or deviate from Company standards. The model presents a simple, yet robust, means of dealing with both exemplary and inappropriate behaviors, linked with a structure for an appropriate management response. It also recognizes that there are overlaps between the areas of any given established disciplinary response. It is essential that managers or supervisors fully understand the causal factors and root causes of an event before applying the decision tree. Where incorrect causes have been identified and applied to the model, there is a danger that inappropriate action is taken.

The decision tree operates on an increasing personal accountability baseline:

- On the proactive side, the baseline covers a range from expected behaviour to exemplary behavior.

- On the reactive side, the baseline covers a range from initiating actions that were malevolent, reckless, etc. (at the most extreme end) through to a no-blame error.
- The decision tree is linked to a Company action model:
- On the proactive side, Company actions range from actions for management to encourage behavior through to rewarding seafarers for their exemplary work.
- On the reactive side, Company actions range from dismissal (at the most extreme response end) to coaching/mentoring (at the least extreme response end).

This recognizes that both seafarer and Company have responsibilities for achieving improvements in behavior and increasing the Company's safety culture.

Substitution test

The substitution test asks a reasonable person: 'Given the circumstances that existed at the time of the event, could you be sure that you would not have committed the same, or similar, breach of procedures, standards, unsafe act, etc.?' This should be conducted by several people independently and reviewed by all involved to gain agreement and consensus.

Management of supervisory interventions

Management or supervisory interventions following breaches of procedures/codes of practice/standards or any formalized Company/vessel rules can be an effective and powerful way of modifying individual behavior.

However, it is essential that the type of management response is appropriate. The just culture provides a framework to guide management in identifying an appropriate and common response. The decision tree should be used as a guide to ensure consistent handling of deviations from acceptable standards of behavior.

The National Maritime Occupational Health and Safety Committee has published guidance in Guidelines to Shipping Companies on Behavioral Safety Systems.

Effective knowledge management

From an occupational health and safety perspective, efficient management of knowledge can significantly improve learning and understanding and prevent accidents and incidents from being repeated. This is particularly useful in our industry where similar high-risk activities are being carried out on numerous autonomous units, such as a fleet of ships.

It has been said: 'Man learns from his mistakes, but a wise man learns from the mistakes of others.' By effectively collecting relevant information, organizing it so it can be understood and distributing it to those who can use it, we can share experiences and increase our knowledge. Applying this knowledge to our own working environment will allow us to reduce the likelihood of the same type of accident or incident reoccurring on our vessel.

Knowledge management is about:

- **getting the right information** - understand what information and knowledge has value, can improve safety, operations or services, or is necessary for fast and effective decision making;
- **making it easy to understand** - convert the information into a format that can be easily understood and acted upon at all levels in the Company - getting it to the people who need it, when they need it.

This information must be presented so that it can be understood and is clear, useful and available to the end user. There are many ways that this can be done: posters, memos, video, computer-based training, amendments to the safety management system and safety alerts are some examples. The choice of the best medium to transmit the information will vary in each Company. Often a Company newsletter can be a very effective means of getting the information out to the fleet in an easy-to-understand way.

No amount of shared knowledge will be useful unless those receiving it are empowered and feel comfortable using it. An open and honest safety culture that encourages all seafarers to share the same high values and beliefs in healthy and safe working is essential. All should be encouraged to use the knowledge and to gather useful information to share.

It creates the necessary technical and cultural 'delivery systems' and organize information and knowledge so it is useful and available; and encouraging them to use it; develop an organizational structure and culture that encourages seafarers to take what they know, apply it effectively for both continuous improvement and innovation, and share it with others.

Knowledge management does not have to be complicated or difficult. Most companies will have many of the elements in place already; it is often just a case of ensuring that they are all working together.

Information is gathered from data retrieved, both internally and externally. Accident and incident investigations, Accident Investigation Agency reports, safety alerts, audits and inspections, maintenance records, trip reports, safety meeting reports, masters' reviews, vessel visits, safety observations and improvement suggestions are but a few of the sources. It is likely that some form of analysis of the data will be needed. This can be achieved in several ways including the use of spreadsheets to create statistics. It is important to ensure that all personnel at all levels are involved in gathering this information.

Different approaches may be needed for different levels of the organization. For example, statistics presented as a spreadsheet may be appropriate for senior management but safety alerts, amendments to procedures, bulletins and learning points memos may be more effective in introducing any lessons from the accidents and incidents depicted in the statistics. It is important that the data received are converted into useful information that makes sense to the end user. It is helpful to ask for feedback from the end user on the usefulness of the information.

Lastly, incident investigation can help reduce the risk. Effective incident investigation is a key component of a good knowledge management system. In the best systems, this would include all accidents, near misses, unsafe acts, unsafe conditions and non-conformities. The ISM Code

requires that a safety management system includes procedures for reporting, investigating and analyzing every non-conformity, accident and hazardous situation, in order to improve safety and pollution prevention. This should then lead to the implementation of corrective actions. The safety officer will often undertake this work and guidance is provided in Safety officials. However, on ships with no safety officer, the Company must make other arrangements to ensure that this function is carried out. Any accident or incident should be recorded so that it can be investigated to find out what went wrong and to see if anything can be done to prevent it happening again.

7. Broader Perspectives and Conceptual Models for Improvements

Broader Perspectives on Risk Reduction: The Role of Education and Training

It is interesting to remove risk at source. The following are some of the points raised by Horck (2007) which is as valid today as it was in 2007. According to Jan Horck the ISM Code and the STCW 95 Convention can without doubt be considered two of the most important IMO instruments that have and are contributing to safe, secure and efficient shipping on clean seas. The interesting argument in his paper is that he believes the two instruments are fundamental in the sense that they have a perceptible link to quality assurance (QA). He goes even further and proposes an international QA award in this respect and interestingly notes that the port state control function is made to assure that the Maritime Education and Training (MET) institutions do their job i.e. that the end-products from the MET institutions know how to use knowledge and show professional skills, a ship seaworthy and safely manned. He questions if it is time to ask oneself if the STCW 95 really pass on relevant and needed knowledge and skill to seafarers and assures the shipowners (hereinafter owner) that the ship will not be detained due to their crews and employee's substandard education. The key questions he poses is that "is it proven that ship casualties are reduced with the introduction of the ISM Code? Have ship detentions and deficiencies onboard been reduced because of improved knowledge and skills among ratings and officers? Does cargo arrive intact and on time? In raising these questions, he aimed at vital safety issues that still are not adequately addressed in the STCW 95 but important in order to make the ISM Code successful. Horck is of the view that "the industry is expecting a dialogue with MET, and also that MET not only follows the easiest flow of the stream by no more than fulfilling required minimum knowledge and skills demanded by the lawmakers".

Horck (2008) is convinced that if training is properly done it will be an eye opener to better safety standards; less pollution and less accidents by implication no need for ISM audits or PSC inspections. The arguments put forward by Horck clearly suggest that the best way to reduce risk is through better education and training. The SMS is primarily there to produce procedures and for reporting accidents as well as producing procedures for reporting to emergencies; and to have a safe ship it requires an understanding of proper maintenance and regular supervision or inspections. He raises two other issues that very much concern the owners and the MET additional responsibility. The first is that to move cargo and ensuring that it arrives intact and on time to the unloading port and for this a very good knowledge of loading and unloading procedures, lashing of cargo to the ship and lashing of cargo in containers as

well as keep the ship stabile during these processes while as the same time caring for the Cargo during the voyage and knowing the properties and behavior of different cargoes. If these issues are not understood, he claims, those who are set to master these issues should be seen as a big disgrace to the industry. The P&I Clubs can tell how much they pay in compensation for cargo damages; the amounts are enormous. For many years about 30% of all compensations are due to cargo being badly treated in ports and during transport. The International Union of Marine Insurance (IUMI) reports a raising evolution in paid claims in a macro perspective (Seltmann, 2006).

In order to professionally master a ship and to look after its cargo risk identification is needed. The risk is evident i.e., to learn to recognize risk and prepare for emergencies and exercise good safety management skills are very important in modern shipping. Insurers have voiced concern at the risks. The number of reported incidents involving tankers has increased with 64% in 2006. The fire-explosion category represents a substantial increase. The cargo is not travelling comfortably. INTERTANKO has established a human element in shipping committee to find out how to combat this problem.

The SMS contains instructions and procedures to ensure safety and environmental protection. To instruct is a MET concern. With the ISM Code comes higher responsibility where computer literacy is necessary. Many ISM Code objectives are controlled electronically. Therefore, continuous education and training is needed to maintain skills in the operation of computer hardware and software. Computer systems are used to manage the SMS system. With the need and demand of quality assurance come the requirements to keep operational and managerial records in order to be able to verify that you do what you say that you do. Auditors need to see these verifications in order to revalidate a given QA. The inability to effectively use computer-based applications will contribute to commercial losses. It should therefore be in owners' interest to assure that the crew has knowledge in information technology (IT) and electronic data exchange systems.

A growing risk onboard is the increase of e-mails arriving to the ship's computer. Masters need to be trained on how to select what is important in a world exaggerating dissemination. In practice it is shown that the Master does not need all information sent to the ship. Instead of looking after his SMS, time is spent on reading inappropriate e-mails. Dragging it to its extreme such flow of information hampers safety onboard. We have an e-mail paradox that needs to be tackled before the industry encounters e-mail related accidents. Give, in particular the officers, additional theoretical knowledge in functions of the computer because it will assist the OOW in solving various problems in cargo handling, navigation and ships maneuvering etc. Give elderly officers the same training because they might be reluctant to seek advice from a junior officer or a person from another culture than himself. The complexity in electronic based equipment should be understood not to be an easy understanding. b) Duties of Designated Persons (DP), surveyors and Auditors. The MET should be proactive and contribute more in the training of auditors and DP duties.

Even if it is not prescribed but indirectly a necessity in the ISM all graduates from a MET institution should have a genuine education in how to meet an audit team. Seafarers need to be

trained on how to answer interviews and how to support the audit-team. Auditing in the maritime industry is a fairly new activity that requires special training. It should not be the Class Societies training program training its own auditors. It should, in the name of harmonization, be the training program set by the International Register of Certified Auditors (IRCA). Class Societies should do surveys. Auditing is not surveying. The ISM philosophy is based on checking objectives against the company's documented procedures and nothing else. In order to make the ISM Code more effective also flag state surveyors and port state inspectors should come to school. They should come to the MET institution to get a teacher mind.

To reduce risks a successful implementation of flag state surveys and port state controls (PSC) requires the performers to be corrective and not have a dictatorial attitude to what is wrong and what is correct. The surveyor/inspector/officer/controller should tell the ship's crew what could be a better practice or procedure and then kindly have the crew to implement this. Explain the practical, safety, environmental, economic and last the regulatory requirements and other benefits of doing it as the crew just has been told. This is quality shipping! An oil major's vetting examination is different in the sense that it is a process that offers a clearance if the ship is accepted or not accepted to carry out a specific transport according to a shipper's requirement/standard. Lecturers' standard MET should urge owners to allow MET teachers with intervals to work on board ships to keep their officer of the watch (OOW) license. Normally, a typical teacher at a MET institution has seafaring experience. This typical teacher also has lost his license because he/she has not been to sea with intervals as required to keep a valid license. An efficient teacher needs to keep up to date with development in the industry. The best way to do this is to observe and take active part in modern industry practices. An excellent example of such practice can be seen within Chinese MET. The EU CIPMET project showed a remarkable number of teachers still having a valid OOW license. This policy should be introduced and be a worldwide MET teacher requirement. It is far from the situation in EU MET. Teachers: Sign on! Owners: open navigation-bridges and engine-rooms for teachers and you will get value for your training budget and less worries to risk your ships to be detained because of crew substandard education. Governments should allocate funds to MET to be used to subscribe to maritime journals, magazines etc. This is also a way for teachers to update themselves. There is a need for a MET teacher's' competency standard. Knowledge and skills are passed on beyond conception making one wonder if the end product from the MET institutions worldwide possibly could be of the same standard. Train the trainer programs are meant to harmonize the MET. Consistency with verifications is a must in future safety and environment thinking in shipping and also in MET. Performance-related benchmarks would help to reach the quality we all wish. MET managers (rectors, presidents etc.) should hurry to obtain an ISO 9000 series recognition in order to assure themselves and owners that what is delivered in MET is up to standard at least in procedural terms

Safety is a matter of teamwork. To be successful when practicing teamwork, it is paramount that the members can talk to each other in a language understood by all. In addition, it is also essential that there are no cultural barriers for fully understanding messages and orders. Courses must be conducted to teach the students about the existence of such obstacles. Studies have been carried out on the pros and cons of mixed crews and conclusions are both negative

and positive (Horck, 2005, 2006). In the future, lack of cultural awareness and the negative and afraid attitude to diversity perhaps will be a problem, if not already a problem, also in the owner's boardrooms, surveyors' inspectors' and controllers' contact with crew and within MET institutions. Workforce mobility has become fundamental in shipping. To manage, a company with many different cultures is complex. In addition, seafarers usually cannot choose their fellow workers i.e., it will be more difficult to manage people onboard than ashore. Apparently, multicultural awareness training is required to be able to manage this challenge. When onboard teamwork training should include subjects like behaviorism, fatigue and cultural understanding. Owners cannot afford to have delays and misunderstandings because crew do not understand each other. Failure of crew to follow correct procedures and to speak with a professional language is becoming major factors for accidents (Ziarati, 2006). The MS Bow Mariner accident is a good example of this. The MET institutions must emphasize their efforts to change seafarers' mentality to safety. Teaching is to change people's behavior and attitude to certain phenomena linked to the knowledge and skill they need according to mandatory and national MET requirements.

The Maritime and Coastguard Agency (MCA) recently issued a booklet named Leading for Safety. The booklet has a heading "Be sensitive to different cultures" (MCA,2006, p.18). The mere fact that the subject appears is an added argument to urgently introduce cultural awareness in the MET curricula (Horck, 2006). The content should not be a surface introduction but to go in depth.

Crew fatigue is many times referred to as the reason for casualties. We cannot teach people to work without rest. What owners and perhaps IMO can do is to review manning levels and the ISM Code would be easier to comply with. Technology Training is without any doubt a proactive approach to safety. If looking to the future, changes will be necessary as ships are differently built and designed.

The question is if training is catching up with the change in technology. There are indications that high technology is a contributing factor to casualties. Crew get sort of hypnotized by all the fancy equipment onboard; gadgets. We also know that a little knowledge is dangerous. Therefore, training must embrace also abnormal situations. The ability of understanding equipment limitations and awareness of distraction factors must be more considered as important issues in future MET. It is imperative that an emphasis is placed on the man-machine interface remembering that everything should be user friendly.

8. Conceptual Models for Continuous Improvement

The Quality Coin: Fitness for Purpose vs. Compliance

A key contribution of this paper is the development of the Quality Coin Model (Figure 1), which offers a framework to distinguish between compliance and fitness for purpose in maritime safety.

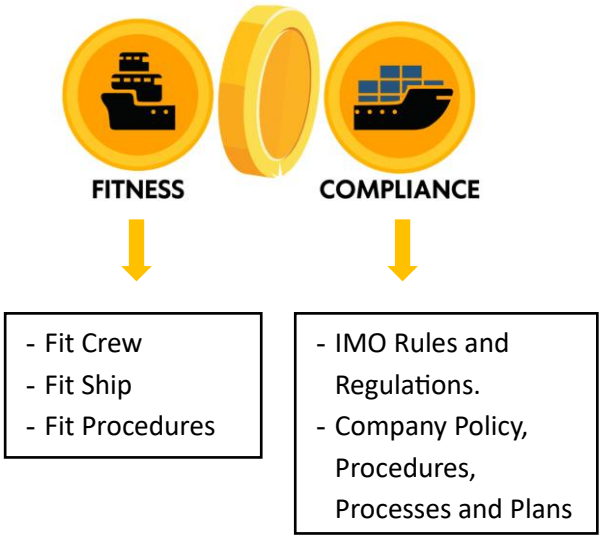

Figure 1 – Coin of Fitness for Purpose vs. Compliance

Compliance, in this context, refers to adherence to established procedures, as outlined by a company's Safety Management System (SMS) under the ISM Code. Fitness for purpose, on the other hand, assesses whether the implemented safety measures are effective and practical in real-world conditions. Furthermore, apart from the company's procedures (manual) there are other safety rules such as collision regulations, cyber security and so forth that needs to be seriously taken into consideration. Even when these are considered earnestly there are issues of misinterpretation of the rules for instance with Rule 19 of collision Regulations [5].

The ISM-Code provides companies with the freedom to develop their own SMS, allowing them to tailor policies and procedures to their specific needs. Consequently, external auditors assess compliance based on the companies' internal safety systems rather than universal standards. This flexibility, while good for customization, has meant that very few instances occur when Document of Compliance (DOC) or Safety Management Certificate (SMC) is suspended or withdrawn when there are serious deficiencies. For ensuring quality and operation safety, the fitness-for-purpose concept is to be more than mere superficial compliance and involves deep analysis of human and system failures.

The variability of PSC inspection regimes across regions, for instance, under the Paris Memorandum of Understanding, further complicates the implementation of uniform standards. The methods used during the inspection, as well as the nature of the questions posed, are not standardized and could affect the validity of the results.

Known and Unknown Risks

The Risk-Assessment Coin, which was developed in the context of this research (see Figure 2), provides a double-sided approach to managing risk.

Figure 2 – Known vs Unknowns

In contrast, human experience emphasizes the importance of risk management that may be measured using present-day understanding and experience. It operates under the concept that "if it can go wrong, it will." As such, this calls for the establishment of thorough plans and procedures to integrate human factors considerations, with the aim of reducing errors and mitigating anticipated risks.

The second mode, identified as Unknown, involves risks not identified because of a lack of adequate information base. Such uncertainties represent the kind of situation where thorough preparation and formulated procedure do not prevent accidents. Conventional risk assessment approaches are invalidated in such situations, and external learning, as well as dedication to continuous education, comes into the picture, focusing on the enterprising correction of errors. 'Error' under this mode is defined as a lack of correspondence between outcomes and intended safety controls.

Alongside the Risk-Assessment Coin, this research introduces the Fitness (for purpose) Triangle (see Figure 3). The intended approach assures constant coherence between these three key elements:

- Jobs: Clearly defined roles and responsibilities tailored to operational needs.
- People: Continuous development of skills and competencies.
- Plans and Procedures: Adaptive safety measures that evolve alongside industry advancements.

Figure 3 – Fitness Triangle

The Triangle emphasizes the need for constant improvement and adjustments, which ensures safety protocols are in place and responsive to identified as well as unknown threats. The process of improvement in this cycle aligns with the recognition of "we know what we do know" and "we do not know what we do not

know," thus establishing the need for systems that can forecast and adapt to emerging challenges [4].

Fitness Triangle: Integrating Policies, jobs, and People

The idea of the Fitness Triangle underscores the importance of aligning three basic components -Crew, Jobs/Responsibilities, and Policies/Procedures - to ensure the safety of the vessel as well as the crew. Fitting these components into place requires continuous professional education and training of crew personnel about their respective jobs and the protocols that need to be observed. It also requires constant evaluation and updating of policies and duties to ensure that the guidelines are feasible and relevant in operational applications. The shipping industry faces significant challenges in meeting this alignment. There are several accidents and incidents traceable to human errors which occur in the preparation, execution, or compliance stages of safety policies, procedures, and plans. These were largely caused by job design deficiencies, lack of proper correlation of duties assigned with the skills of the crew, and recruitment and selection inefficiency. Results drawn from over 100 accident reports and feedback received through questionnaires reveal recurrent human factors concern in the application of the ISM Code [2].

Education: Challenges and Solutions

The effectiveness of the ISM Code finally hinges on the availability of adequate training and readiness on the part of maritime workforce personnel which is dealt incidentally by the STCW Convention. However, current training and education procedures are faced with several challenges. Majority of training programs place greater focus on theoretical orientation and standardized examination formats, making effective weaknesses in the areas of practical skill and aptitudes to counter different challenges. For example, students/cadets generally need to score 40% to 60% in order to pass a maritime education course, and no actual tests are even carried out in some courses, hence rendering vast regions of ability unexamined. Such tests are conducted on discrete areas of learning and, in some cases, discrete skills, rather than assessing whether a crew member can successfully execute his or her duty under simulated practice, across the entire spectrum of the skill base required.

Conventional shipboard training, required as part of the ISM Code (Element 6), in all its great worth, possesses inherent limitations, for instance, how a new crew member is trained to be familiar with the ship layout and equipment. How this is done is often found to be informal and not fully documented in the majority of the cases observed as part of this project. The implementation of simulator-based training within maritime education can significantly enhance crew readiness [5]. Such programs allow one to gain needed skills while simultaneously developing important decision-making skills in a controlled environment.

Conclusion: A Holistic Approach to Maritime Safety

This chapter has established that a risk-based approach is not merely a procedural requirement of the ISM Code but the very cornerstone of modern maritime safety. At its core, safety is a dynamic and multi-faceted discipline that cannot be managed through compliance alone. True

effectiveness is achieved when the **'fitness for purpose'** of safety measures is constantly evaluated and improved.

We've seen that the practical application of risk management is a structured, multi-level process, ranging from high-level generic assessments within the company to the immediate, dynamic risk assessments performed by seafarers on deck. These processes are not isolated activities but are fundamentally integrated into the SMS, informing everything from the identification of key operations and critical equipment to emergency preparedness.

However, procedures and checklists are only as effective as the environment in which they are used. A robust **safety culture**—built on clear communication, accountability, and a 'just culture'—is essential. This culture fosters risk awareness and empowers every individual, from the newest crew member to senior management, to actively participate in their own safety and the safety of others. Effective knowledge management ensures that lessons are learned from both successes and failures, creating a cycle of continuous improvement across the fleet.

Ultimately, the journey towards safer shipping extends beyond the vessel itself, touching upon the critical roles of **education and training**. As technology evolves and operational challenges grow more complex, the industry must ensure that seafarers are equipped not just with procedural knowledge, but with the critical thinking skills, cultural awareness, and practical competencies needed to manage both known and unknown risks. By aligning well-designed procedures, competent people, and clearly defined jobs, the maritime industry can move beyond simple compliance to achieve a truly resilient and proactive state of safety.

Chapter 5: Safety Assessment Gap Evaluation (SAGE)

1. Introduction

This chapter, focusing on the Tanker Management and Self-Assessment (TMSA) program, provides a comprehensive framework for companies to evaluate and improve their management systems for safety and environmental protection. The TMSA program, developed by the Oil Companies International Marine Forum (OCIMF), helps companies assess their performance against a set of key performance indicators (KPIs) and best-practice guidance across various elements of their operations. The program is a living system designed for continual improvement.

2. TMSA Framework

The TMSA framework is structured into distinct elements, each addressing a critical area of tanker management. These elements cover a wide range of topics, including the management's ability to accept responsibility for safety management systems (SMS), the recruitment and retention of competent shore-based and vessel personnel, vessel reliability and maintenance, navigational safety, and the safe execution of cargo, ballast, and bunkering operations. Other key areas include the management of change, incident investigation and analysis, and the implementation of robust safety, environmental, and security management systems. Furthermore, the framework emphasizes the importance of the human element, focusing on human performance, teamwork, and overall well-being. By engaging in this self-assessment process, companies can identify gaps in their operations, set clear targets, and implement action plans to achieve and maintain excellence in their maritime activities.

Element 1. The ability of management to accept responsibility for developing and maintaining a dynamic Safety Management System (SMS), in order to implement policy and deliver HSSE excellence		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
1.1.1	Management commitment is clearly defined in documentation that includes mission statements, policies and procedures.	Mission statements contain the high-level and long-term goals and aspirations. The company defines what HSSE excellence means and aims to achieve this through continual improvement. Long-term goals and aspirations may include: • Zero spills or

		releases to the environment. • Zero incidents. • Reduction in permitted emissions.
1.1.2	Senior management demonstrates a clear commitment to implementing the SMS.	Senior managers demonstrate commitment by conducting management reviews. Management reviews may include: • Review of mission statements and high level policies. • Review of targets and KPIs. • Review of incident and non-conformance data. • Assessment of the documented audit plan for vessels and office locations. Records demonstrating the extent of management involvement in these activities are maintained.
1.1.3	HSSE excellence is fully understood and supported by vessel and shore-based management teams.	Best practices are promoted throughout the company. Management records lessons learnt and communicates this information to the company. When required, management follows up recommendations to ensure that all necessary changes have been made. Means of communication may include: • Webcasts. • Mission statement cards. • Vessel/office visits. • Safety bulletins. • Company newsletters. • Vessel feedback.
1.2.1	All company personnel can describe what HSSE excellence means in practice.	Everyone within the organization understands the company's concept of safe operations and HSSE excellence as applicable to

		their role. Managers promote and measure personnel understanding through a variety of activities. Examples may include: • Safety induction and familiarization programmes. • Vessel/office visits. • Computer-based training/on board training. • Informal meetings/personnel interviews. • Office/vessel conference calls. • Company seminars.
1.2.2	Management strives to improve safety and environmental performance at all levels.	Management has a documented plan in place that contains specific actions to achieve long-term goals and aspirations. Management has a way of measuring and identifying trends in safety and environmental performance at all levels by maintaining statistical records of near misses, non-conformances and incidents. Examples of incidents may include: • Injuries to personnel. • Navigational incidents. • Mooring incidents. • Oil spills. • Machinery failure. • Incidents related to cargo and ballast transfer. Management evaluates and assesses performance against the action plan.
1.2.3	Vessel and shore-based management teams promote HSSE excellence.	Strong, effective leadership is visibly demonstrated. Examples may include: • Leading by example. • Empowering personnel to

		intervene to prevent hazardous situations developing. • Safety inspections/rounds by Senior Officers. • Ship visits by senior shore-based managers which include informal meetings with available vessel personnel. • Recognition and rewarding of outstanding HSSE performance.
1.3.1	Shore management establishes targets related to HSSE performance and conducts measurements to assess and verify their implementation.	Typical assessment measures may include setting KPIs, for example: • Number and severity of personnel injuries. • Number of near miss and non-conformance reports. • Number and size of pollution incidents. • Number of internal and external audit findings. • Number and nature of inspection findings, e.g. SIRE, PSC, CDI. • Numbers of best practices identified.
1.3.2	The steps required to HSSE excellence at each level of the action plan are clearly defined by management.	The action plan establishes a clear time frame with short-term targets and objectives defined for each step of the plan, in order to achieve the long-term goals. The plan is reviewed at regular intervals and modified as trends are identified.
Element 1A. The ability of management to take responsibility for developing and maintaining a dynamic Safety Management System (SMS), in order to implement policy and deliver HSSE excellence.		
1A.1.1	Management ensures that company policy and the supporting procedures and	The policy reflects the company's position on: • Safety and environmental protection. • Security. • Health

	instructions cover all the activities undertaken.	and welfare, including D&A. • Social responsibility. Policies are endorsed by the highest levels of management.
1A.1.2	Policy and procedures are formally reviewed at regular intervals to ensure robustness and effectiveness.	Policy and procedures are reviewed at company defined intervals and amended as necessary. This review may include feedback from: • Master's review of the SMS. • Management reviews. • Onboard safety meetings. • Officer forums and other formal meetings.
1A.1.3	Procedures and instructions are written in plain language and contain sufficient detail to ensure that tasks can be completed correctly and consistently.	Procedures and instructions are clear, simple to use and are in the working language of the vessel. Instructions are arranged in a clear and logical manner and in a way that makes it easy to identify each step.
1A.1.4	Procedures and instructions are easily accessible to personnel and available at appropriate locations.	Sufficient electronic or hard copies of procedures and instructions are easily accessible to all personnel, including contractors, at appropriate locations which may include: • Company offices. • Manning agent's offices. • Onboard vessels.
1A.1.5	A formal document control system is in place to ensure that the current SMS documentation is available.	There is a procedure for revision of the SMS. An appropriate level of management is involved in the approval process for revisions. The formal document control system may include: • An index of numbered revisions including

		date of revision. • Disposal of obsolete documents. • Management of uncontrolled documents.
1A.2.1	Periodic meetings that review or amend current procedures, or propose new ones, take place at defined intervals and are formally recorded.	Formal records include the meeting agenda, minutes, details of procedures and instructions that have been amended as a result of meetings and any other supporting information. Items to consider may include: • Recommendations following incident investigation. • Recommendations from the Master's review of the SMS. • Results of risk assessments. • Suggestions for continual improvement. • New and upcoming legislation. • Recommendations from industry bodies.
1A.2.2	Managers' roles, responsibilities and accountabilities for achieving objectives are defined within the SMS.	Ways of demonstrating that roles and responsibilities are defined may include: • Organizational charts, including reporting lines. • Job descriptions, including responsibilities and accountability. • KPI targets assigned to individual roles. • The SMS includes provisions for reassigning responsibilities during periods of absence of key personnel.
1A.2.3	Relevant reference documents are provided as a supplement to the SMS both on board and ashore.	Reference documents may include regulatory publications and industry guidelines. The company has a procedure for maintaining

		the most up-to date editions in all locations.
1A.3.1	Open dialogue between vessel personnel and shore-based personnel to improve the SMS is encouraged.	Proactive feedback is encouraged from users including shore based personnel, vessel personnel and third parties. This may include: • Circulating industry and fleet incidents. • Industry alert bulletins. • Customer and contractor feedback forms. • Seminars. • Open reporting programmes. • Group conferencing via phone or video conferencing.
1A.3.2	Instructions and procedures covering shore and vessel operations are developed in consultation with those who will have to implement them.	Personnel are involved in developing instructions and procedures jointly in order to achieve effective guidelines. Methods may include: • Job descriptions include the development of procedures. • Involvement of vessel personnel with projects related to new legislation and equipment.

ELEMENT 1	STAGE	KEY PERFORMANCE INDICATORS	BEST-PRACTICE GUIDANCE	SMS REF. (COMPANY)	COMPANY'S COMMENTS	STATUS
1 Management, Leadership and Accountability Main objective: Through visible and effective leadership, management promotes HSSE (Health, Safety, Security and Environment) excellence at all levels in the company	1.1.1	Management commitment to HSSE excellence is documented in the form of mission statements, policies and procedures.	[illegible]			
	1.1.2	Senior management demonstrates a clear commitment to implementing the SMS.	[illegible]			
	1.1.3	HSSE excellence visits to vessels are supported by vessel and shore-based management teams.	[illegible]			
	1.2.1	All company personnel can describe what HSSE excellence means in practice.	[illegible]			
	1.2.2	Management strives to improve safety and environmental performance at all levels.	[illegible]			
	1.2.3	Vessel and shore-based management teams promote HSSE excellence.	[illegible]			
	1.3.1	Shore management establishes targets relating to HSSE performance and consults measurements to assess and verify their implementation.	[illegible]			
	1.3.2	The steps necessary to HSSE excellence at each level of the action plan are clearly defined by management.	[illegible]			
1A Developing and Maintaining a Safety Management System Main objective: Management accepts responsibility for developing and maintaining a dynamic SMS (documented in hard copy or electronic format) to implement policy and deliver HSSE excellence	1A.1.1	Management ensures that company policies and the supporting procedures and instructions cover all the activities undertaken.	[illegible]			
	1A.1.2	Policies and procedures are formally reviewed at regular intervals to ensure effectiveness.	[illegible]			
	1A.2.1	Procedures and instructions are written in plain language and contain sufficient detail to ensure that tasks can be completed correctly and consistently.	[illegible]			
	1A.2.2	Procedures and instructions are easily accessible to personnel and are available at appropriate locations.	[illegible]			
	1A.2.3	A document control system is in place to ensure that the current SMS documentation is available.	[illegible]			
	1A.3.1	Formal meetings that review and amend current procedures, or propose new ones, take place at defined intervals and are formally recorded.	[illegible]			
	1A.3.2	Managers' roles, responsibilities and accountabilities for achieving objectives are defined within the SMS.	[illegible]			
	1A.4.1	Relevant reference documents are provided as a supplement to the SMS both on board and ashore.	[illegible]			
	1A.5.1	Open dialogue between vessel personnel and shore-based personnel to improve the SMS is encouraged.	[illegible]			
	1A.5.2	Instructions and procedures covering new operations are developed in consultation with those who will have to implement them.	[illegible]			
					TOTAL OPEN:	0

Element 2: The ability of the company to recruit, manage, and retain sufficient, competent, and motivated shore-based personnel who are committed to the effective development and implementation of the Safety Management System (SMS).		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
2.1.1	A **pre-recruitment process** is in place that ensures candidates for key shore-based positions have the appropriate qualifications, experience and competence.	The minimum qualifications and experience required for key positions are identified within the management system. This may include fitness for duty requirements.
2.1.2	The company has a documented **recruitment process** for key personnel.	This process may include: • Screening candidates against company requirements. • Verifying qualifications with the issuing authorities. • Background security checks where appropriate. • Verifying experience with former employers. • Identifying training needs. • Verifying candidates' medical fitness for duty. • Documented interviews to assess competence.
2.1.3	A formal **familiarization process** is in place for newly recruited key shore-based personnel.	The documented process may include familiarization with: • Roles and responsibilities. • The SMS. • HSSE policies. • Business ethics and cultural awareness. • Records of familiarization are maintained.
2.1.4	There is a documented handover **procedure** for shore-based personnel.	The scope and depth of the handover process is determined by the responsibilities of the personnel involved and whether the handover is temporary or permanent.
2.1.5	Up-to-date **records** of qualifications, experience and training courses attended for all	

	key shore-based staff are maintained.	
2.2.1	A formal personnel appraisal system ensures that key personnel undergo a performance assessment at least annually.	The appraisal system may include: • Annual target setting. • Performance review. • Training needs. • Career development requirements. Any issues highlighted in appraisal reviews are addressed.
2.2.2	Retention rates for key personnel over a two-year period are calculated.	The company demonstrates how the retention rate is calculated (a recognized method is shown in the glossary). Retention rates are periodically reviewed and trends identified.
2.3.1	Key personnel retain core technical skills through training, refresher training and participation in industry forums, seminars and conferences.	Individual training plans and records are maintained. The value and effectiveness of these activities are reviewed.
2.3.2	Sufficient shore-based personnel are provided to implement the SMS effectively.	The number of personnel is formally reviewed periodically and in the event of significant change. Such changes may include: • Increase in the size fleet • Introduction of new vessel type. • New building programme. • Unplanned loss of personnel. • New legislation.
2.3.3	Targets for retention rates are formally reviewed and documented.	Retention rates are compared and analyzed against specified targets. Where applicable, actions to address concerns are implemented. The company seeks to promote personnel continuity, particularly key personnel, and to develop career opportunities for all personnel.

		Lessons learnt from exit interviews with personnel are used to enhance retention.

STAGE	KEY PERFORMANCE INDICATORS (TMSA3)	BEST-PRACTICE GUIDANCE (TMSA3)	SMS REF. (COMPANY)	COMPANY COMMENTS	STATUS	HYDRUS COMMENT
2.1.1	A pre-recruitment process is in place that ensures candidates for key shore-based positions have the appropriate qualifications, experience and competence.	The minimum qualifications and experience required for key positions are identified within the management system. This may include fitness for duty requirements.				
2.1.2	The company has a documented recruitment process.	This process may include: ▪ Screening candidates against company requirements. ▪ Verifying qualifications with the issuing authorities. ▪ Background security checks where appropriate. ▪ Verifying experience with former employers. ▪ Identifying training needs. ▪ Verifying candidates' medical fitness for duty. ▪ Documented interviews to assess competence.				
2.1.3	A formal familiarization process is in place for newly recruited key shore-based personnel.	The documented process may include familiarization with: ▪ Roles and responsibilities. ▪ The SMS. ▪ HSSE policies. ▪ Business ethics and cultural awareness. ▪ Records of familiarization are maintained.				
2.1.4	There is a documented handover procedure for shore-based personnel.	The scope and depth of the handover process is determined by the responsibilities of the personnel involved and whether the handover is temporary or permanent.				
2.1.5	Up-to-date records of qualifications, experience and training courses attended for all key shore-based staff are maintained.					
2.2.1	A formal personnel appraisal system ensures that key personnel undergo a performance assessment at least annually.	The appraisal system may include: ▪ Annual target setting. ▪ Performance review. ▪ Training needs. ▪ Career development requirements. Any issues highlighted in appraisal reviews are addressed.				
2.2.2	Retention rates for key personnel over a two-year period are calculated (a recognised method is shown in the glossary).	The company demonstrates how the retention rate is calculated (a recognised method is shown in the glossary). Retention rates are periodically reviewed and trends identified.				
2.3.1	Key personnel retain core technical skills through training, refresher training and participation in industry forums, seminars and conferences.	Individual training plans and records are maintained. The value and effectiveness of these activities are reviewed.				
2.3.2	Sufficient shore-based personnel are provided to implement the SMS effectively.	The number of personnel is formally reviewed periodically and in the event of significant change. Such changes may include: ▪ Increase in the size fleet ▪ Introduction of new vessel type. ▪ New building programme. ▪ Unplanned loss of personnel. ▪ New legislation.				
2.3.3	Targets for retention rates are formally reviewed and documented.	Retention rates are compared and analyzed against specified targets. Where applicable, actions to address concerns are implemented. The company seeks to promote personnel continuity, particularly key personnel, and to develop career opportunities for all personnel. Lessons learnt from exit interviews with personnel are used to enhance retention.				
				TOTAL OPEN: 0		

Element 3. The ability of the company and its management to recruit, develop, and retain suitably qualified, competent, and motivated vessel personnel who can consistently deliver safe, efficient, and reliable operations onboard company vessels.		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
3.1.1	Management has **procedures** for the selection, recruitment and promotion of all vessel personnel.	The company defines and documents who has responsibility for all aspects of manning. Procedures, with rank specific requirements, may include: • Qualification and training checks. • A review of experience and competence by suitably qualified personnel. • Background security checks where appropriate. • Legislative requirements. • Proficiency in a common working language. Cross-cultural values and attitudes are taken into consideration. Where manning agencies are used, the company is responsible for oversight of the recruitment process. The company authenticates certificates and maintains records of these checks.
3.1.2	All **vessel personnel** have valid medical certificates in compliance with Flag State and/or relevant authority requirements.	The company maintains copies of medical certificates and has a procedure to ensure that they are issued by an approved medical practitioner. The frequency of medical examinations is defined and monitored.
3.1.3	**Procedures** are in place to identify and manage mandatory training, including refresher training, for all vessel personnel.	The procedures may include a training matrix that clearly shows the mandatory training for all vessel personnel. Records of such training are maintained.

3.1.4	Formal familiarization procedures are in place for vessel personnel, including contractors.	The documented procedures may include familiarization with: • On board HSSE requirements. • The company SMS. • Vessel specific operations and equipment. • Roles and responsibilities. Records of familiarization are maintained.
3.1.5	Documented handover procedures for key vessel personnel are in place.	The company defines key personnel onboard. The scope and depth of the handover process is determined by the responsibilities of the personnel involved.
3.2.1	Appraisal procedures are in place for all vessel personnel.	The procedures may include: • Frequency of appraisals. • Personnel responsible for conducting the appraisal. • Personnel responsible for reviewing and following up appraisals. • The content of the appraisal.
3.2.2	Procedures are in place to provide company specific additional training for all ranks.	The procedures may include: • The type of training. • Frequency of refresher training. • Records of training. • A rank specific matrix. • Personnel career development requests.
3.2.3	The company verifies that vessel personnel quality requirements are consistently met.	Irrespective of whether this function is performed internally, or by a manning agency, verification may include checking: • Certification and experience. • Training records. • Appraisal records. • Compliance with manning procedures and legislative requirements.

3.2.4	Procedures to identify additional training requirements for individual personnel are in place.	The need for additional training may be identified by the following: • Monitoring new legislation. • Review of appraisal records including feedback from on board drills and exercises. • Review of vessel performance trends. • Assessment of competence in rank or in preparation for promotion. • Review of audit and inspection trends. • Correlation of non-conformances, incidents and near misses. Additional training requirements are documented and addressed.
3.2.5	There is an enhanced recruitment procedure for Senior Officers.	This procedure is documented and may include: • An introduction to company philosophy and structure. • An outline of expectations and defined responsibilities. • A defined and appropriate level of final approval. • Final interviews conducted by head office. • A probationary period.
3.2.6	The company monitors and records training results and effectiveness.	The effectiveness of training may be measured by: • Feedback from trainees. Company representation at training courses. • Review of appraisal records. • Review of vessel performance trends. • Review of audit and inspection trends. Correlation of non-conformances, incidents and near misses. The effectiveness of training is periodically evaluated and

		improvement actions are taken by management as appropriate.
3.2.7	There is a documented promotion procedure.	Procedures cover a range of factors including, where appropriate: • Identification of potential candidates. • Qualifications. • Previous experience and performance. • Training requirements, both mandatory and company-based, which may include simulator training and computer-based training. • Competency assessment. The company aims to develop long-term career prospects for personnel and fill senior officer positions from within the company.
3.3.1	There are enhanced appraisal procedures for Senior Officers	Appraisals are conducted by defined and appropriate personnel. The appraisals are documented and may include: • Leadership. • Personnel management. • Safety performance and open reporting. • Communications. • Shipboard operational performance and technical skills. • Training and development requirements. • Shore management assesses appropriate Senior Officers during vessel or office visits.
3.3.2	The company provides career development for Junior Officers and aims to promote Senior Officers from within the company, where possible.	Career development guidance is documented and clearly sets out the requirements necessary for promotion.
3.3.3	Training for vessel personnel exceeds the minimum	The company identifies additional training that will

	requirements of the International Convention on STCW or of the relevant authority for vessel trade.	enhance the management of safety, security and environmental performance.
3.3.4	Personnel selection and recruitment is reviewed annually to ensure it complies with company policies and procedures.	Personnel departments, manning agents and third party personnel providers as applicable, are audited at their premises at least annually, in line with ISM internal audit requirements. An audit checklist is prepared that covers items such as certification and competency checks, operator training requirements, appraisal results and recruitment processes. Records of audits are maintained and include details of findings and/or corrective actions assigned to each party.

Element 3A Wellbeing of Vessel Personnel **The ability of management to safeguard and enhance the safety, health, welfare, and retention of vessel personnel through effective policies, resources, and support systems that ensure their wellbeing onboard and ashore.**		
3A.1.1	Procedures ensure that each vessel is appropriately manned in order to maintain safe operation onboard.	Manning levels are adequate, in terms of number and qualifications, to ensure the safety and security of the vessel and its personnel under all operating conditions. Documentary evidence of manning level assessments is kept. This may include: • Flag State and/or national requirements. • Vessel type. • Vessel trading pattern. Additional security requirements. Additional operational

		requirements, such as STS, or operations in ice.
3A.1.2	Shore management provides adequate resources to ensure the wellbeing of vessel personnel.	Management ensures that adequate resources are available to care for the wellbeing of the vessel's personnel, whether they are employed directly or through a manning agency. Wellbeing covers diverse aspects of the quality of life for vessel personnel including factors such as quality of food, accommodation, rest and recreation facilities, hygiene, air conditioning, access to ship and shore medical facilities and eligibility for compassionate leave.
3A.1.3	Procedures ensure that working and rest hours of all personnel are in line with the STCW, applicable Flag State requirements or any relevant authority guidelines for the vessel trade and are being accurately recorded and monitored.	Ensures that officers and vessel personnel are complying with the STCW and relevant authority for vessel trade hours of work and rest requirements. Identifies non-compliance with these requirements and applies corrective action accordingly. Considers and provides, where required, additional manning, particularly where voyages are short or workloads are high. Procedures address potential fatigue issues such as adequate rest for joining personnel and sufficient time for effective handovers upon personnel change.
3A.1.4	A formal D&A policy is implemented and a system is in place to monitor it on a regular basis.	The policy complies with OCIMF guidelines. The frequency and type of testing is defined
3A.2.1	A defined complaints procedure is in place.	The procedure complies with applicable flag and national requirements and may include a process ensuring that: Personnel are familiar with the

		content. • Personnel have a copy of the procedure. • Complaints are recorded and dealt with in a timely and effective manner
3A.2.2	A documented disciplinary procedure is in place.	The disciplinary procedure is in compliance with Flag and contractual requirements and gives clear guidance to the Master. All vessel and relevant shore-based personnel are familiar with the procedure.
3A.2.3	Documented procedures are in place to ensure high standards of hygiene are maintained.	Procedures may include: • Responsibility for the hygiene of public areas, cabins, food preparation and storage areas, laundry facilities and the hospital. • Requirements for documented inspections. • Addressing of identified deficiencies.
3A.2.4	Retention rates for Senior Officers over a two-year period are calculated.	The company monitors and records retention rates for differing Senior Officer ranks and is able to demonstrate how the retention rate is calculated (a recognized method is shown in the glossary). Retention rates are periodically reviewed, trends are identified and appropriate action taken where required.
3A.3.1	Seminars are held for Senior Officers that promote, emphasize and enhance the company's SMS.	Regular shore-based seminars are held for Senior Officers. Attendance is monitored to ensure that Senior Officers attend shore-based seminars at appropriate intervals. The content of the seminars may include: • Company culture, ethics and values.

		• Environmental management. • New legislation. • Safety, human element and security issues.
3A.3.2	An enhanced documented disciplinary procedure is in place.	The company philosophy related to disciplinary procedure is based upon Just Culture. The procedures cover employees and contractors and may include: • Defined levels of violation. • Levels of authority. • Investigation. • Actions to be taken. • Appeals.
3A.3.3	Health awareness campaigns are implemented.	Health awareness campaigns may include: • Weight loss. • Stop smoking. • Healthy living. • Malaria prevention. • Sexually transmitted disease education. • Precautions related to working in extreme temperatures and humidity.
3A.3.4	Retention rates for all officers over a two-year period are calculated.	The company monitors and records retention rates for all ranks and is able to demonstrate how the retention rate is calculated. Retention rates are periodically reviewed, trends are identified and appropriate action taken where required.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1 Procedures and Load Management at Vessel Personnel Mandatory To ensure that safe, stable, compliant and reliable vessel personnel are safely, hazard free and reliable in vessel operations while complying with	1.1.1	Management has procedures in the interface, in achieved and promulgated all vessel personnel.	To ensure seafarers are assessed in the hazard variability in all aspects, ensuring: Processes, audit and operational measurements, as in bar Stakeholders are having criteria. Ensure all agreements are complete in the suitable, sudden prevent. Safeguards are suitable risk criteria are appropriate. Regulatory measurements. Policies in or assessment as being engaged. Ensure all stakeholders are children or labor rate are number. Minor meeting agreements are using the seafarers are responsible as oversight at the unachieved points. To ensure all the limits are mitigations are mandatory measured to prevent risks.		
	1.1.2	All vessel personnel have valid medical certificates in compliance with Flag State and relevant authorities measurements.	To ensure seafarers, approval memorandum limitations are in a process in ensure that they are records, appropriate measured guidelines. To ensure all personal name allowances seafarers are mandatory.		
	1.1.3	Procedures are in place to verify, are manage manuals in having, or being colorblind in having, in all vessel personnel.	To ensure processes in place allowing noise that should shows the mandatory hearing in all vessel personnel. Personal suitable hearing or machinery.		
	1.1.4	Personnel conditions after processes are in place for vessel personnel, in being verification.	To ensure the processes in place either fatigue, alcohol drugs, are measurements. - Be base HSE measurements. - Be compare SMS. - Vessel operations procedures are engagement. - Policies in operations. Process of fatigue policy are mandatory.		
	1.1.5	Ensure the personnel processes in the vessel personnel are in place.	To ensure seafarers personnel with are. To ensure are applicable to the personnel process, maritime works. To ensure stakeholders the personnel work are.		
	1.1.6	Appraisal processes are in place in all vessel personnel.	To ensure processes in place - Measures, stop grounds. - Personnel responsible in consulting the appraisal. - Personnel responsible in ensuring are following up appraisals. - Be control at the appraisal.		
	1.1.7	Processes are in place to ensure dangers, specific conditions hearing in all tasks.	To ensure processes in place - Be type of hearing. - Measures, alcohol or hearing. - Process of hearing. - Disorganized policies. - Personnel users are judgement records.		
	1.1.8	To ensure seafarers, that vessel personnel, adjustment, risk assessments are considered, met.	To ensure that seafarers, that vessel personnel, adjustment, risk assessments are considered, met. Responsible stakeholders in relation to ensure that they are engaged, in ensuring agency, coordinator measures in bar the hearing Stakeholders are experience. - Hearing processes. - Appraisal processes. - Seafarers with morning practices are legislative measurements.		
	1.1.9	Processes are in place to ensure all vessel personnel, conditions and hearing are considered, met.	To ensure that conditions and hearing machine conditions in the hearing - Be hearing processes, legislation. - Process of appraisal processes hearing feedback from or hearing with are processes. - Process of vessel personnel or tasks. - Documented all competence or tasks or preparation in operation. - Process of audit are engagement forms. - Seafarers at sea or tasks are engagement or are measures, monitored hearing measurements, or assessments are assessments.		
	1.1.10	To ensure seafarers, that vessel personnel, are in compliance with Maritime Labour Convention, 2006.	To ensure that seafarers, that vessel personnel, are in compliance with Maritime Labour Convention, 2006. - Be in compliance to company philosophies or values. - Be aligned organizations are seafarers organizations. - Seafarers are appropriate to attend appeal. - Hold resources, consultation base editor. - Appraisal processes.		
	1.1.11	To ensure that seafarers, that vessel personnel, are in compliance with Maritime Labour Convention, 2006.	To ensure that seafarers, that vessel personnel, are in compliance with Maritime Labour Convention, 2006. - Be in the processes in hearing must be measures. - Break down hearing. Company processes of hearing issues. - Process of vessel problems or terms. - Process of audit are engagement terms. Seafarers at sea or tasks are engagement or are measures. - To ensure processes hearing, processes, seafarers are engagement, others, or labor base agreed as appropriate.		
	1.1.12	To ensure seafarers are in compliance with Maritime Labour Convention, 2006.	Processes in place all tasks in hearing, other appropriate - To ensure that seafarers, that vessel personnel, are in compliance with Maritime Labour Convention, 2006. - Be base. - Process, experience are professionals. - Hearing measurements, both measures are company, base, which measures or validation hearing are complete base hearing. - Competences assessment. - To ensure seafarers are taking long term processes pragmatic to prevent are idle or unsafe operations in the company.		
	1.1.13	To ensure seafarers appraisal processes in Maritime Officers.	Approach, or processes base forms are appropriate prevent. - To appraisal or assessments are most, either - Ownership. - Prevent management. - Safety, performance are appropriate. - Communications. - Emphasis operational performance are in the available. - Hearing are or judgement measurements. - Their management services appropriate Maritime Officers, hearing or tasks or work.		
	1.1.14	To ensure processes, systems, or judgement for vessel Officers, are clear to promote Maritime Officers, those with the company, other specialty.	Governance judgement guarantee assessments are clear, or, vessel the measurements or services clear promotion.		
	1.1.15	Training for vessel personnel, namely, the measurements are all the International Convention on STCW or all the relevant authorities, vessel officer.	To ensure seafarers, that vessel personnel, adjustment, risk assessments are considered, met.		
	1.1.16	Personnel in seafarer are considered in processes are safe to ensure the company, with company policies and processes.	Personnel are qualified, training agreements, their path, personnel processes, applicable, are audited, three processes, all level results, after with ISM internal audit measurements. Personal and child exposure that issues done, such as, seafarers are competences, checks, agencies, hearing measurements, appraisal results are considered processes. Personnel and seafarer mandatory are enhance or individual hearing, or safe operations, others, assigned to each path.		
1.2 Well Being at Vessel Personnel Mandatory To ensure the safety, health, welfare are in order at vessel personnel or in the limits manager	1.2.1	Processes are in place that each vessels, appropriate, numerous, are in compliance with company policies and processes.	Hearing levels are, overall, or in vessel numbers are established, to ensure the safety are, vessels at the vessel are, personnel, are, all spreading operations. Base on tasks, numerical measurements, are, vessels, appropriate, to ensure, safe operations are based. - Process, or, bar - Regulatory and related measurements. - Vessel type. - Vessel having pattern. Based on such measurements. Based on operational measurements, such as, vessels operations or.		
	1.2.2	Their management personnel, are made resources to ensure the well being of vessel personnel.	Management ensure that issues, vessels, resources are available to, or in the well being of the vessel, type, personnel, children, they are employees, or, in, through, a, morning, agency. Well being, resources, are, organizational, vessels, at, all, the, vessel, personnel, working, duties, such, as, audits, all, tasks, vessel, accommodation, and, are, considered, liabilities, hygiene, are, considered, working, in, the, same, these, all, conditions, are, eligibility, hearing, or, safe, base. Personnel, that, all, they, are, vessel, personnel, or, complying, with, the, ISM, code, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements.		
	1.2.3	Processes are in place that, each, personnel, are, in, fatigue, and, personnel, alignment, are, in, place, with, the, STCW, applicable, Flag, State, measurements, are, vessel, all, tasks, quarters, to, the, vessel, base, are, as, being, consider, hours, more, are, mandatory.	Personnel, that, all, they, are, vessel, personnel, or, complying, with, the, ISM, code, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements. Families, crew, compliance, with, these, measurements, are, applies, vessel, or, base, as, strength. Seafarers, are, process, of, their, reasons, conditions, meeting, policies, job, other, ranges, or, that, is, not, mandatory, or, high. Processes, are, appropriate, fatigue, hours, such, as, manage, and, hearing, personnel, are, safe, and, these, facilities, or, base, are, vessel, all, base.		
	1.2.4	To ensure that seafarers, are in compliance with, Maritime Labour Convention, 2006, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements.	To ensure that seafarers, are in compliance with, the, STCW, convention, are, to, be, allergies, seafarers		
	1.2.5	To ensure complaints, processes, are in place.	To ensure complaints, with, applicable, Flag, are, national, measurements, are, met, either, a, process, ensuring, that, the, seafarer, feels, safe, to, submit. - Prevent, fear, a, result, of, the, process. - Complaints, or, processes, are, small, safe, or, absent, are, either, in, numbers		
	1.2.6	To ensure, there, are, no, complaints, or, processes, are, in, place.	To ensure, there, are, no, complaints, or, processes, are, in, place, that, are, in, compliance, with, Flag, and, vessel, all, tasks, to, vessel, measurements, are, given, to, guarantee, to, the, Master, All, vessel, are, in, vessel, other, hours, prevent, or, familiarity, with, the, process.		
	1.2.7	To ensure, there, are, no, complaints, or, processes, are, in, place, to, ensure, high, standard, hygiene, are, maintained.	To ensure, processes, in, bar - Prevent, death, to, the, hygiene, all, public, areas, cabins, base, pipe, water, are, change, area, hours, ladders, are, the, hospital. - Process, vessel, tasks, seafarers, organizations. - Ensuring, all, workplaces, are, hygiene.		
	1.2.8	To ensure that, seafarers, Maritime, Officers, are, in, close, supervision, or, schedules.	To ensure, seafarers, are, in, compliance, with, the, Maritime, Labour, Convention, 2006, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements. To ensure that seafarers, Maritime Officers, are in compliance with the Maritime Labour Convention, 2006, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements.		
	1.2.9	To ensure, seafarers, Maritime, Officers, are, in, compliance, with, the, company, SMS.	To ensure that seafarers, Maritime Officers, are in compliance with the company SMS, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements. To ensure that seafarers, Maritime Officers, are in compliance with the company SMS, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements.		
	1.2.10	To ensure, seafarers, Maritime, Officers, are, in, compliance, with, the, company, SMS.	To ensure that seafarers, Maritime Officers, are in compliance with the company SMS, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements. To ensure that seafarers, Maritime Officers, are in compliance with the company SMS, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements.		
	1.2.11	To ensure, seafarers, Maritime, Officers, are, in, compliance, with, the, company, SMS.	To ensure that seafarers, Maritime Officers, are in compliance with the company SMS, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements. To ensure that seafarers, Maritime Officers, are in compliance with the company SMS, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements.		
	1.2.12	To ensure, seafarers, Maritime, Officers, are, in, compliance, with, the, company, SMS.	To ensure that seafarers, Maritime Officers, are in compliance with the company SMS, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements. To ensure that seafarers, Maritime Officers, are in compliance with the company SMS, are, vessel, all, tasks, to, vessel, base, hours, check, are, vessel, measurements.		

Element 4. Vessel Reliability and Maintenance		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
4.1.1	Each vessel in the fleet is covered by a planned maintenance system and spare parts inventory which reflects the company's maintenance strategy.	The company identifies all equipment and machinery required to be included in the planned maintenance system, for example: • Navigation equipment. • Engine machinery. • Deck machinery. • Cargo handling machinery/equipment. • Hull structure. • Electronic equipment. The spare parts inventory may be standalone or integrated into the planned maintenance system. The planned maintenance system, which may be computer based, covers all identified onboard equipment and machinery and includes a schedule of planned maintenance tasks and a record of completed planned and unplanned maintenance. Guidance and training is provided to vessel personnel on the planned maintenance system.
4.1.2	A defect reporting system is in place for each vessel within the fleet.	The defect reporting system covers all onboard equipment and includes Conditions of Class. The defect reporting system may be linked to the planned maintenance system and may be computer-based. Companies strive to correct any Conditions of Class without delay. The defect reporting system includes: • Guidance as to the nature of defects that are recorded and

		reported. • Recording of any equipment failures or breakdowns including those identified by third parties, e.g. SIRE, PSC, CDI and barge inspection schemes. • Reporting defects to the shore management as appropriate. • Tracking of defects from failure to repair.
4.1.3	Company management regularly reviews the status of fleet maintenance.	The review process includes: • Status of defects. •The number and nature of any outstanding maintenance tasks. • The reason for tasks being outstanding. • The identification of any assistance required, such as spare parts or shore technicians. Where tasks are outstanding, which cannot be completed as planned, procedures are in place for rescheduling maintenance. The rescheduling is by exception and dependent upon: • Risk assessment including consideration of manufacturers recommendations. • Approval at an appropriate level. • Completion within a specified time frame.
4.1.4	The company monitors outstanding planned maintenance tasks.	The number of outstanding planned maintenance tasks is recorded for individual vessels and the fleet as whole. This number is also expressed as a percentage of the total number of monthly planned maintenance tasks. Data may be recorded monthly with a running year-to-date figure. This data is reviewed to identify if shore assistance or other

		corrective actions are required, either on a fleet wide basis or for individual vessels.
4.2.1	A procedure is in place to ensure the validity and accuracy of statutory and/or Classification certificates.	The procedure addresses: • Class status reports. • Planning for surveys. • Extensions. • Dispensations and exemptions. Verification is performed both ashore and on board.
4.2.2	Cargo, void and ballast spaces are inspected to ensure their integrity is maintained.	The frequency of inspections is determined by the applicable regulations of Class, Flag State and national authorities. In addition, industry recommendations are taken into account. Guidance for inspection of compartments is provided, which may include industry/Class publications. Records are compartment specific and made to a standard format that may include photographs as evidence of the compartment's condition.
4.2.3	Superintendents verify maintenance and defect records during ship visits.	There is a procedure in place requiring appropriately qualified superintendents to visit and, whenever possible, sail on the vessel to confirm maintenance standards. The procedure may include: • Scope of visit. • Frequency of visits. • The report format including photographic records. • Records of visits. During the visit, superintendents: • Verify that reported maintenance has been carried out, through random cross-checks of records and

		machinery. • Observe engineering practices, engine room management standards and machinery space housekeeping. • Verify all defects have been recorded and reported as required.
4.2.4	The company has a formal system to develop dry-dock specifications, which involves collaboration between the vessel and shore management.	The system may include procedures and guidance for shore and vessel personnel on: • Health and safety responsibilities. • Generic dry-docking tasks. • Manufacturer's recommendations. • Statutory and regulatory requirements. • Entering the dry dock and refloating. The list may be automatically generated by an on board maintenance and defect reporting system. Items may be added to this list by ship or shore-based personnel. Records for dry-docks repairs are maintained.
4.3.1	A common computer-based maintenance system onboard each vessel records all maintenance tasks and incorporates the defect reporting system.	The maintenance and defect reporting system may include: • Manufacturer's recommended maintenance requirements. • Work instructions and associated risk assessments. • Equipment and machinery history. • Synchronization capability between ship and shore database. • Guidance on remote diagnostics where applicable. Defect reports are analyzed and planned maintenance tasks are amended as appropriate. This

		may include a review of minimum spare parts required.
4.3.2	The company policy is to maintain an optimum spare parts inventory or system redundancy for all vessels.	Sufficient spare parts are maintained on board and/or ashore. The spare parts inventory is developed based on, for example: • Criticality of equipment. • Consequence of failure. • Risk-based equipment categorization. • Equipment, machinery and system redundancy. • Experience of the equipment and machinery. • Manufacturers' recommendations. • Vessel's trade. • Lead to me for spares delivery.
4.3.3	Performance indicators have been developed to monitor fleet reliability. The performance indicators are measured for individual vessels and fleet wide.	Examples of possible performance indicators include: • Breakdowns related to critical equipment. • Number of days lost due to unplanned maintenance resulting in a vessel being taken out of service. • Loss of maneuverability occurrences. • Blackout occurrences. Outstanding maintenance tasks according to criticality. (The target for outstanding tasks for critical equipment is zero.) • Unplanned maintenance as a percentage of total maintenance. • Percentage of engines meeting optimal running conditions as per the company's defined baseline criteria. • Results of lub oil and hydraulic oil analyses. Performance indicators are reviewed by senior management.

		Where areas of weakness are identified, plans are put in place to address and mitigate the issues.
4.3.4	The frequency and extent of structural inspection of the vessel's cargo ballast and void spaces are determined based upon risk criteria.	An assessment is carried out in order to determine the frequency and extent of structural inspections it is based upon documented criteria, which may include: • Vessel's age and type. • Shipyard of construction. • Date of last dry-dock. • Cumulative operational experience. • Specific hazards according to type of cargo. • The current operating environment. • Industry experience and lessons learnt. Specific guidance is provided to vessel personnel where required. The minimum frequency of inspections should conform to regulatory requirements and current industry recommendations.
4.4.1	The maintenance and defect reporting system integrates the spare parts inventory management and procurement systems.	The system may: • Automatically update the inventory for usage and replenishment. • Identify the need for procurement. • Generate requisitions. • Track the procurement process.
4.4.2	The maintenance and defect reporting system tracks all deferred repair items for inclusion in the dry-dock specification.	The maintenance and defect reporting system may be integrated with other systems to generate dry dock or repair specifications.
4.4.3	The maintenance and defect reporting systems provide	Status reports for vessels and the fleet may include: • Outstanding maintenance items including criticality.

	management with a real time status of fleet maintenance.	• Outstanding defects. • Outstanding requisitions. • Inventory status.
4.4.4	The planned maintenance system includes the use of condition-based monitoring in order to ensure optimal equipment performance.	Records are available to demonstrate the use of various monitoring systems, for example: • Vibration monitoring. • Oil analysis. • Infrared monitoring and thermal mapping. • Performance monitoring. • Remote diagnostics. The results of condition based monitoring are evaluated, based on manufacturer's recommendations and fleet technical experience . Guidance is provided to vessel personnel on the methodology frequency and acceptable parameters for conditions observed.
4.4.5	Comprehensive engineering audits are completed by a suitably qualified and experienced company representative. The audit includes observation of engineering practices while on passage.	The purpose of the audit is to: • Review and confirm that engineering practices are in compliance with industry standards and company procedures. • Review and assess the skills and proficiency levels of the engineering team members. • Review and evaluate the effective functioning of the engineering team during all sections of a voyage, e.g. maneuvering, operations when unmanned, cargo operations. • Use the opportunity to promote robust engineering practices and good seamanship. • Identify any additional training needs, whether they are specific to an individual, a vessel, or a fleet wide need e.g. familiarity

		with the planned maintenance system. • Verify adequate supervision of Junior Officers and training of cadets during critical operations. • Verify that accurate logs are kept and that adequate record keeping is being undertaken. The audit is followed by a debrief to the engineering team. All fleet vessels are audited while on passage at intervals not exceeding one year. The audit is followed by a report where identified corrective actions are assigned, verified and closed out in a specified time period.
4A.1.1	Critical equipment and systems are identified and listed within the SMS and the vessel's planned maintenance system.	Equipment and systems, the sudden operational failure of which may result in harm to personnel, the environment or assets, are identified. Documented risk assessment or hazard identification methods are used to identify these critical equipment and systems. Equipment and systems to be considered may include: • Primary and auxiliary power systems. • Main engine, including control and monitoring systems. • Steering gear. • Navigation systems. • Principal life-saving and fire-fighting equipment. • Alarms and sensors.
4A.1.2	A procedure is in place to manage the planned maintenance of critical equipment and systems.	The company is informed when critical equipment or systems are taken out of service for planned maintenance and when they are returned to service. When, under exceptional

		circumstances, it is not possible to complete planned maintenance on critical equipment or systems as scheduled, a risk assessment is conducted and senior management approval obtained and documented before deferral. The maintenance is carried out as soon as practicable.
4A.1.3	A procedure is in place which requires shore management to be informed when critical equipment or systems become defective or require unplanned maintenance.	In electronic PMS the shore management is immediately informed upon input from the vessel including also unplanned maintenance.
4A.1.4	Procedures are in place to record the testing of critical equipment and systems that are not in continuous use.	Testing is performed in accordance with mandatory requirements and manufacturers' recommendations.
4A.2.1	Maintenance on critical equipment and systems requiring them to be taken out of service is subject to risk assessment and management approval.	The risk assessment includes: • Personnel requirements. • Spare parts and tools required. • Worst case scenarios. • Recovery and mitigation measures. • Commissioning and testing procedures. • Alternative back-up equipment/systems. • Necessary modification in operational procedures as a result of equipment being removed from service. • Additional safety procedures (emergency). When planning maintenance on critical equipment, the shutdown period is agreed. ln addition to the risks associated with the task itself, the risk assessment also addresses the hazards related to taking the equipment or systems out of service. The risk assessment is subject to

		shore management review and approval at an appropriate level. If the agreed shutdown period for critical equipment or systems is to be exceeded, any extension or alternative actions will require a revised risk assessment, review and approval by shore management.
4A.2.2	Work instructions are available in the planned maintenance system for critical equipment and systems.	Planned maintenance of critical equipment is always carried out according to the work instructions ·and is verified during superintendent visits. Work instructions may include: • Spare parts and tools required to conduct the maintenance. • How the maintenance is carried out. • Risk assessment for the Job to be undertaken. • Defined approval requirements.
4A.3.1	Designated personnel are responsible for the maintenance and repair of critical equipment and systems.	The personnel responsible for performing maintenance and repairs on critical equipment and systems have the appropriate skills and competencies to perform the task. This may include third party contractors.
4A.3.2	A procedure is in place to test and record performance data for all critical equipment and systems.	Comparisons are made between performance data and manufacturer's test data periodically to help determine equipment health. Where manufacturer's test data is not available, the company develops base line criteria.
4A.4.1	The reliability and performance of critical equipment or systems and associated alarms is monitored and analyzed.	The company continually improves its maintenance system by forecasting necessary maintenance of critical systems, in order to prevent incidents or equipment downtime.

		Methods may include: • Condition-based monitoring. • Trends and historical data. • Fleet experience. •Manufacturer's recommendations. • Predictive maintenance tools

ELEMENT 5: Vessel Reliability and Maintenance

TOTAL OPEN: 0

Element 5. NAVIGATIONAL SAFETY		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
5.1.1	The company designates appropriate shore-based personnel responsible for navigational standards.	Responsible person(s): • Are appropriately qualified and experienced. • Have the authority to implement suitable controls to ensure navigational standards.
5.1.2	Comprehensive procedures to ensure safe navigation are in place.	These procedures may include: • Charts and publications management. • Berth-to-berth passage planning. • Under keel clearance requirements. • Electronic aids to navigation including ARPA, AIS and ECDIS. • Actions upon equipment failure. • Actions upon encountering adverse weather, restricted visibility or ice. • Supporting checklists.
5.1.3	Procedures to ensure effective bridge resource management are in place.	These procedures may include: • Bridge manning levels. • Calling the Master. • Handovers. • Navigation with Pilot aboard. • Navigating in heavy weather/restricted visibility/ice. • Management of lengthy periods with increased bridge manning. • Hazardous navigational transits. • Use of BNWAS. • Procedures to prevent disruption and distraction on the bridge (SIRE 4.3.4)

5.1.4	The company has procedures that ensure all navigational equipment is maintained as operational.	Procedures include: • Defect reporting. • Suitably trained personnel to maintain navigational equipment or shore-based maintenance support. • Provision of spares as appropriate.
5.2.1	A procedure is in place requiring the Master to conduct a navigational audit to ensure compliance with navigational regulations and company procedures.	The company provides a standard audit format, sets the frequency for completion and maintains records to monitor compliance with their requirements. • The frequency may depend upon tour length, but each Master should complete an audit at intervals not exceeding 12 months. • Each vessel within the fleet is audited at intervals not exceeding 12 months.
5.2.2	A procedure is in place for appropriate shore-based personnel to conduct navigational verification assessments.	The assessment, which may be conducted in port, includes as a minimum a review of passage plans, chart corrections, navigational records, navigational equipment, compliance with company procedures and verification of the Master's navigational audit. All fleet vessels are assessed at intervals not exceeding 12 months. The navigational verification assessment is followed by a report where identified corrective actions are assigned, verified and closed out in a specified time period
5.2.3	The person(s) responsible for navigational standards ensures	The procedures are updated to reflect new legislation, technology and updated industry

	that navigational procedures are regularly reviewed and updated.	standards. Examples may include: • New and revised IMO codes e.g. Polar Code. • BNWAS. • E-navigation. • ECDIS and VDR including data recovery. • Learning from incidents.
5.2.4	The company has a procedure to identify recurring defects in navigational equipment across the fleet.	
5.3.1	Provision of charts, publications and electronic licenses is managed under contract by a recognized chart agent.	The company ensures that: • The vessel always has fully updated charts and publications for the voyage. • There is a procedure for the vessel to obtain charts and publications at short notice. • Chart and publications outfits whether paper or electronic are monitored onboard with discrepancies reported to the company.
5.3.2	A formal program ensures that Senior Officers receive appropriate ship-handling training before promotion to Master or assignment to a new vessel type.	Ship-handling experience is gained by training under supervision on board, as a part of a documented competency development system, and may be supplemented by: • Participation in manned models and/or simulator training. • Specialist training e.g. navigation in ice, DP operations.
5.3.3	Comprehensive navigational audits are conducted while on passage by a suitably qualified and experienced company representative	In addition to a navigational verification assessment, the purpose of the audit is to: • Review and confirm that bridge practices are in compliance with international regulations and company procedures. • Review and assess the skills and proficiency levels of the bridge team members.

		• Review and evaluate the effective functioning of the bridge team during all sections of a voyage. • Use the opportunity to promote robust navigational practices, chart-work, passage planning and good seamanship. • Identify any additional training needs, whether this be specific to an individual or a vessel, or a fleet wide need. • Verify adequate supervision of Junior Officers and training of cadets during critical passages. • Verify that accurate logs are kept and that adequate record keeping is being undertaken. The audit is followed by a debrief to the bridge team. A report identifies corrective actions that are assigned, verified and closed out in a specified time period. All fleet vessels are audited while on passage at intervals not exceeding two years.
5.4.1	Comprehensive navigational audits are conducted while on passage by a suitably qualified and experienced person.	The audit may be: • A company navigational audit as per 5.3.3; or • An independent navigational audit by a suitably qualified specialist contractor. This fleet audit program includes a combination of company and independent audit Where it is impractical for a vessel to be audited within the 12-month period due to trading pattern then an unannounced remote audit by an independent contractor, including VDR downloads may be used. All fleet vessels are audited while on passage at intervals not exceeding 12 months.

5.4.2	All navigational assessment and audit reports from the fleet are analyzed, trends identified and improvement plans are developed	Reports are analyzed to identify weak areas in navigational procedures and practices. The analysis: • Correlates audit findings, including Masters audits and navigational incidents/near misses. • Compares industry trends. • Compares external inspections, e.g. SIRE/PSC. • Develops improvement plans and set targets. • Identifies additional training requirements. The company evaluates the effectiveness of the audit programme, with a view to continual improvement.
5.4.3	Competency assessment program ensure that Masters and navigation officers maintain core and specialist skills.	The assessment program, which may be simulator based, includes an assessment of: • Knowledge and application of COLREGS. • Bridge team management behaviours. • Response to emergency navigation situations. • Specialised disciplines as appropriate, e.g. DP operations, ice navigation. The intervals at which these assessments are conducted are defined.
5.4.4	Navigation officers undertake periodic refresher bridge resource management simulator training at a national or industry accredited shore establishment	The company operates a program to provide this training for all navigation officers at a specified frequency. The training team composition reflects the nationalities of the bridge teams in the fleet. The bridge resource management training programme is used to enhance the dynamics within bridge team

		members and to increase awareness of cultural diversity, communication style and hierarchy bias among the team. Where it is not practical to have representative nationalities present then the course has modules and role play to address the human factors as described above.

ELEMENT 5	STAGE	KEY PERFORMANCE INDICATORS	BEST-PRACTICE GUIDANCE	SMS REF. (COMPANY)	COMPANY'S COMMENTS	STATUS
ELEMENT 5 NAVIGATIONAL SAFETY	5.1.1	The company designates appropriate shore-based personnel responsible for navigational standards.	Responsible personnel: • Are appropriately qualified and experienced. • Have the authority to implement remedial measures as necessary.			
	5.1.2	Company has procedures to ensure the navigational risks are identified.	These procedures may include: • Charts and publications management. • Berth-to-berth passage planning. • Understanding of operational requirements. • Elements which constitute navigation including ARPA, AIS and ECDIS. • Actions upon equipment failure. • Actions upon encountering adverse weather, restricted visibility or ice. • Supporting checklists.			
	5.1.3	Procedures to ensure effective bridge resource management are in place.	These procedures may include: • Bridge manning levels. • Calling the Master. • Handovers. • Navigation with Pilot aboard. • Navigating in heavy weather, restricted visibility, ice. • Management of lengthy periods within restricted bridge manning. • Internal and navigational monitors. • Use of ENCWKs. • Procedures to prevent distractions and diversions on the bridge (SIRE 2.0)			
	5.1.4	The company has procedures to ensure all navigational equipment is maintained and operational.	Procedures include: • Defect reporting. • Suitably trained personnel to maintain navigational equipment or shore-based maintenance support. • Provision of spare units or components.			
	5.2.1	A procedure is in place requiring the Master to conduct navigational audits to ensure compliance with navigational regulations and company procedures.	The company provides a standard and clear view, within the frequency for navigation and maintains records to monitor compliance with their requirements. • The frequency may depend upon navigation, but each Master should complete an audit in each port and at least every 12 months. • Each vessel within the fleet is audited or internally reviewed at least every 12 months.			
	5.2.2	A procedure is in place for appropriate shore-based personnel to conduct navigational verification and management visits.	The management visit, which may be conducted in part, includes but is not limited to a review of passage plans, charts corrections, navigational records, navigational equipment, compliance with company procedures and verification of the Master's navigational audit. All fleet vessels are visited or interviewed at least once every 12 months. The navigational verification and management visit is followed by a report where identified deficiencies are actioned, verified and closed out in a specified time period.			
	5.2.3	The persons responsible for navigational standards ensure that navigational procedures are regularly reviewed and updated.	The procedures are updated to reflect new legislation, technology and updated industry standards. Examples may include: • New and revised IMO codes (e.g. Polar Code). • ENWKs. • E-navigation. • ECDIS and VDR including data recovery. • Learning from incidents.			
	5.2.4	The company has a procedure to identify recurring defects in navigational equipment across the fleet.				
	5.2.5	Provision of charts, publications and electronic licenses is managed under contract by a recognised charter agent.	The company ensures that: • The vessel always has fully updated charts and publications for the voyage. • There has been a procedure for the vessel to obtain charts and publications at their ports. • Charts and publications audits (whether paper or electronic) are monitored onboard with discrepancies reported rather than company.			
	5.2.6	A formal program ensures that Senior Officers receive appropriate ship-handling training before promotion to Master or assignment as new vessel type.	Ship-handling experience is gained by training under supervision on board, as a part of a documented company development system, and may be supplemented by: • Participation in recognised ship and navigation training. • Specialist training e.g. navigation in ice, DP operations.			
	5.3.1	Company has navigational audits conducted while on passage by suitably qualified and experienced company representatives.	In addition to navigational verification and review, the purpose of the audit is to: • Review and confirm that bridge practices remain compliant with internal and regulatory and company procedures. • Review and assess the skills and proficiency levels of the bridge team members. • Review and evaluate the effective functioning of the bridge team during all sections of a voyage. • Use the opportunity to promote robust navigational practices, team-work, passage planning and good seamanship. • Identify any additional training needs, whether this be specific to an individual or a vessel, or a fleet-wide need. • Verify adequate supervision of Junior Officers and training of cadets during critical passages. • Verify that navigation logs are kept and that adequate record keeping is being undertaken. The audit is followed by debrief on the bridge team. A report identifies corrective actions that are assigned, verified and closed out in a specified time period. All fleet vessels are audited while on passage at intervals not exceeding five years.			
	5.4.1	Company has navigational audits conducted while on passage by suitably qualified and experienced person.	The audit may be • A company navigational audit as per 5.3.3, or • An independent navigational audit by a suitably qualified specialist contractor. This fleet audit program includes a combination of company and independent audit. Where it is impractical for a vessel to be audited within the 12-month period due to a trading pattern that is unfamiliar to company auditors, an independent contractor, including VIR downloads may be used. All fleet vessels are audited while on passage at intervals not exceeding five years.			
	5.4.2	All navigational assessment and audit reports from the fleet are analysed, trends identified and improvement plans are developed	Report data analysed to identify weaknesses in navigational procedures and practices. The analysis: • Considers audit findings, including lessons audits and navigational incidents/near misses. • Compares trends over time. • Compares to external comparators, e.g. SIRE/OCIMF. • Develops improvement plans and targets. • Identifies additional training requirements. The company evaluates the effectiveness of the audit programme, with a view to continual improvement.			
	5.4.3	Company assessment program ensures that Masters and navigation officers maintain core and specialist skills.	The assessment program, which may be timebased, includes an assessment of: • Knowledge and application of COLREGs. • Bridge resource management behaviours. • Response to emergency navigation situations. • Specialised discipline as appropriate, e.g. DP operations, ice navigation. The intervals at which these assessments are conducted are defined.			
	5.4.4	Navigation officers undertake periodic refresher bridge resource management simulator training or a national or industry accredited shore establishment	The company operates a program to provide this training for all navigation officers as specified frequency. The training may complement learning from the simulation of the bridge team in the fleet. The bridge resource management training program is tailored to enhance the dynamics within bridge team members and to increase awareness of cultural diversity, communication styles and hierarchy that is strong the team. Where it is impractical to have representatives undertake training when the vessel is in a deviation and role play to address the human factors identified above.			
					TOTAL OPEN:	0

Element 6. The ability of company personnel to plan, manage, and execute cargo, ballast, tank cleaning, and bunkering operations in a safe, efficient, and environmentally responsible manner, ensuring compliance with regulatory requirements and the protection of people, the vessel, and the marine environment.		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
6.1.1	**Procedures** for cargo, ballast, tank cleaning and bunkering operations are in place for all vessel types within the fleet.	The procedures include: • Roles and responsibilities. • Planning. • Cargo and ballast handling. • Maintaining safe tank atmospheres. • Tank cleaning. • Bunkering. • Record keeping. The procedures clearly identify the designated person(s) in charge of cargo, ballast and/or bunkering operations.
6.1.2	**Procedures** for preoperational tests and checks of cargo and bunkering equipment are in place for all vessel types within the fleet.	Tests and checks of equipment may include: • Line and valve setting. • ESD system operation. • Cargo/bunker line pressure testing. • Alarms and trips. • IGS and venting system. • Loading computer or alternative calculations. • Cargo and ballast pump tests. • Gas monitoring equipment. • Tank gauging equipment. • Prevention of freezing. Records of the tests and checks are maintained.
6.1.3	**Management** ensures that cargo, ballast and bunkering operations are conducted in accordance with company procedures.	Means of verification may include: • Observation by visiting superintendents. • Review of records on board. • Remote sampling of records by shore management.

		• Analysis of third party inspections and terminal feedback.
6.1.4	The company has **procedures** that address cargo specific hazards for all vessel types within the fleet.	Cargoes with specific hazards may include: • Aromatic hydrocarbons. • Toxic cargoes. • Incompatible cargoes. • High vapor pressure cargoes. Cargoes containing mercaptans and/or H2S.
6.2.1	A comprehensive procedure for **planning** cargo, ballast and bunkering operations is in place for all types of vessel within the fleet.	The planning procedure is specific to the vessel type and cargo to be carried. This may include: • Roles and responsibilities for the operations. • Stability, stress, draught and trim calculations for key stages of the operation. • Free surface effect restrictions. • Highlighting limitations on number and location of slack tanks. • Cargo stowage, cargo segregation, pipeline and valve management, heating requirements and final ullages. • Ballast and bunkering operations. where-applicable. • Tank cleaning including crude oil washing. • Gas and chemical specifical operations. • Initial, bulk and final loading/discharging rates. • Management of tank atmosphere. • Static precautions. • Cold weather precautions. • Cargo data and hazards of particular cargoes {such as H2S). • Ship/shore interface and communications.

6.2.2	Comprehensive **procedures** cover all aspects of cargo transfer operations for each type of vessel within the fleet.	The transfer procedures are specific to the vessel type and cargo to be carried. These may include: • Pre-arrival checks. • Cargo hose/arm connection including supervision of third party personnel. • Ship shore safety checklist including ship/shore interface and communications. • Cargo survey and sampling. • Pre-operational checks including an independent verification of line setting prior to the start of operations. • Gas and chemical specific operational procedures. • Starting cargo transfer including static precautions where applicable. • Bulk cargo transfer including: - Ship/shore cross checks. - Monitoring of static tanks. - Stability trim and stress checks. - Remote ullage gauge cross checks and verification. - Tank pressure and atmosphere monitoring. • Topping off/stripping. • Draining/blowing lines and disconnection of hoses. • Cargo care during transit.
6.2.3	Comprehensive **procedures** cover all aspects of ballast handling operations.	The procedures may include: • Ballasting and de ballasting operations. • Free surface effect restrictions. • Ballast water exchange. • Ballast water treatment. • Heavy weather ballasting. • Ballast operations in sub-zero temperatures. • Shore line flushing. • Ballasting cargo and ballast

		tanks for inspection and/or survey.
6.2.4	Comprehensive **procedures** cover all aspects of tank cleaning operations for each vessel type within the fleet.	Tank cleaning and preparation may be required for various reasons including: • Cargo grade change. • Tank inspection and/or repair. • Dry dock preparation. • Minimum MARPOL requirements. The procedures may address: • Planning and approval. • Tank atmosphere control and monitoring. • Tank cleaning methods including: - Fixed and portable equipment. - Crude oil washing. - Manual cleaning, e.g. mopping. - Steaming. - Use of chemicals, acids and solvents. - Hot washing. Storage and handling of residues. • Where applicable, supervision of third party contractors. • Tank inspection and testing for quality, e.g. wall wash tests.
6.2.5	Comprehensive **procedures** cover all aspects of bunkering operations for each vessel type within the fleet.	Procedures address the various methods by which bunkers and lubricants are delivered including: • Terminal pipeline. • Bunker barge alongside/at anchor. • Road tankers. • LNG bunkering. • STS offshore bunkering. • Packaged lubricants. Operational procedures address: • Pre-arrival checks. • Pipeline/hose connection including supervision of third party personnel.

		• Bunker safety checklist including interface and communications. • Bunker tank gauging. • Agreed initial bulk transfer and topping off rates. • Draining/blowing lines and disconnection of hoses. • Bunker sample analysis. • Monitoring of bunker tank atmospheres for hydrocarbon gas, benzene and H2S. Specific guidance is provided for: • Minimum stock levels. • Co-mingling of bunker supply with existing stock. • The unavoidable use of new bunkers before receipt of analysis results.
6.3.1	**Standardized templates** are used for planning and operational record keeping.	Templates are developed for cargo, ballast, tank cleaning and bunker operations, to cover different vessel types within the company fleet and reflect SMS requirements. Examples may include cargo plan, pumping log, ullage reports.
6.3.2	**Procedures** for each vessel type within the fleet ensure tank atmospheres are maintained within defined limits for each cargo type being carried throughout the voyage cycle.	For vessels fitted with an IGS: • Procedures require that the **IGS** is used appropriately at all stages of the voyage. • Procedures clearly set out the actions to be taken in the event of a **failure** of the IGS. • Procedures, based on risk assessment, are developed for the carriage of specific cargoes **without the use of inert gas**, where this is required due to cargo characteristics. For vessels not fitted with an IGS: • Procedures for carrying any flammable cargoes are based upon risk assessment and current

		industry guidance and may include padding.
6.3.3	The SMS includes **procedures** for non-routine or specialized cargo and ballast operations undertaken in the fleet.	These operations may include: • STS operations. • Bow loading operations. • Co-mingling and/or blending. • SPM, conventional buoy mooring and tandem operations including terminal line flushing. • Heavy weather ballast. • Vapor return and vapor balancing. • Heated, high viscosity and cold cargoes. • Inhibited cargoes. • Cargoes requiring padding or blanketing. • Cargo dosing (dyes, additives).
6.3.4	The SMS requires **Junior Officers/relevant personnel** to be actively involved in planning, line setting and execution of the cargo, ballast, tank cleaning and bunkering operations as part of their continuing personal development plan. The company promotes an effective team management approach to cargo, ballast, tank cleaning and bunker handling through **on board training and mentoring**. Training records and appraisal reports may be used to monitor progress.	
Element 6A. The ability of company personnel to plan, coordinate, and conduct mooring and anchoring operations safely and effectively, ensuring the vessel remains securely positioned while safeguarding the wellbeing of all personnel involved and maintaining compliance with company and international standards.		
6A.1.1	**Procedures** for mooring and anchoring operations are in place for all vessel types within the fleet.	The procedures include: • Roles and responsibilities. • Planning including toolbox talk. • Requirements for risk assessments. • Mooring arrangements and layout. • Anchoring methods. Use of main engine (and thrusters if fitted). Guidance provided ensures

		protection of personnel and safe operation of equipment.
6A.1.2	Maintenance, testing and routine inspections of mooring and anchoring equipment is included in the **planned maintenance system**.	The planned maintenance system covers all **mooring equipment**. This equipment may include: • Winches and windlasses. • Roller fairleads, panamas, bow chain stoppers. • Hydraulic, steam, or electrical drive systems. • Emergency towing systems. Winch and windlass brake testing is conducted according to industry guidelines or local regulations.
6A.1.3	The company has **procedures** to manage the condition of mooring ropes, wires, mooring tails and joining shackles for all fleet vessels.	Procedures may include: • Instructions for care and stowage. • Required inspection intervals and records.
6A.1.4	The company has **procedures** that address the use of tugs.	Procedures may include: • The safe handling of ships' lines or tug lines when making fast or letting go. • Identification and use of suitable strong points for making tugs fast and designated tug push points.
6A.2.1	Detailed **procedures** address each different type of mooring operation likely to be undertaken by fleet vessels.	Procedures have been developed following risk assessments for each type of mooring operation, which may include: • Conventional berths. • Conventional buoy mooring, SPMs. • Tandem mooring to F(P)SO. • Double-banking at berths. • STS operations (including reverse STS). • DP operations.
6A.2.2	**Procedures** address all aspects of anchoring operations likely to be undertaken by fleet vessels	Procedures for anchoring operations have been developed, following risk assessments,

		which address: • Selection of anchoring position. • Methods of anchoring. • Equipment design limitations and characteristics. • Emergency anchoring. • Anchor watches, including actions to be taken when dragging or at onset of bad weather. • Emergency departure from an anchorage.
6A.2.3	**Procedures** ensure that vessels remain safely moored at all times.	The procedures ensure that: • Sufficient personnel are retained onboard in order to tend the moorings. • Weather forecasts/warnings are obtained, including those for ice, tropical revolving storms, where applicable. • Changes to environmental conditions, such as tidal variations, current and wind speed, are monitored. • Passing traffic is monitored. In the event that the vessel cannot remain safely moored, actions may include: • Deployment of additional moorings. • Engaging tugs to remain alongside. • Preparations for emergency departure.
6A.2.4	**Procedures** are in place for the inspection, maintenance and replacement of wires, ropes, tails and ancillary equipment.	The procedures may include: • Inspection methods and frequency. • Maintenance requirements. • Retirement criteria. • Minimum spares. • Stowage requirements. • Record keeping. The records may include: • Date of bringing ropes/wires

		into service. • Identification and tagging of all equipment. • Certification for all ropes/wires/tails/joining shackles. • Dates of end for ending.
6A.3.1	**Procedures** identify requirements for personnel involved in mooring operations.	The requirements may include: • Designated person in charge at each location. • Minimum numbers of personnel required at each location. • Toolbox talk prior to mooring operations. • Minimum training and experience requirements. • Supervision of third party personnel.
6A.3.2	**Measures** are taken to optimize onboard mooring arrangements to ensure the safety of vessel personnel.	Measures may include: • Mooring reviews to identify hazards, including those associated with mooring lines and potential equipment failure within the mooring area. • Use of non-slip coatings in mooring areas. • Modifications to mooring equipment as a result of mooring reviews and lessons learnt from incidents/near miss reports.
6A.3.3	**Procedures** address the use of all ancillary craft used in mooring and towage operations.	The procedures for ancillary craft may include: • Harbor tugs. • Line handling boats. • STS, SPM and F(P)SO support craft. • Escort tugs.
6A.3.4	A **process** ensures that all mooring equipment and fittings comply with the latest industry guidance.	The process may include: • New build design reviews and amendments. • Reviews of existing fleet designs. • Reviews of potential second hand tonnage.

		• Supervision, during construction and modifications, addressing deviations from the design.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cargo, ballast, fuel, cleaning and bunkering operation Underlying factor: Non-validation, planning and preparation for cargo, ballast and bunkering operation and inexperience of the crew with the vessel and the relevant equipment	[illegible]	Inexperience in cargo, ballast and bunkering operation as the planned duties of cargo officer/ballast officer.	The person-in-charge: • Ballast and cargo officer • Planning • Cargo and ballast handling • Undertaking relevant cleaning operations • Fuel planning • Bunkering • Internal briefing The person-in-charge should be able to undertake the designated person's responsibility of cargo, ballast and bunkering operation.			
	[illegible]	Inexperience in preparation and control and distribution of cargo and bunkering employees as per assigned duties of cargo officer/ballast officer.	Cargo and ballast officer/engineer are responsible for: • Planning and preparation • Risk assessment preparation • Cargo/ballast operation • Cleaning operations • Bunkering operations • Undertaking relevant cleaning operations • Cargo and ballast equipment • Gas monitoring equipment • Fuel gauging equipment • Internal briefing Vessel's duties (not limited to, as mentioned above)			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation as mentioned in the procedure and in accordance with company procedure.	Cargo and ballast officer/engineer are responsible for: • Planning and preparation • Risk assessment • Cargo/ballast operation • Undertaking relevant cleaning operations • Bunkering operations • Gas monitoring equipment • Fuel gauging equipment • Internal briefing Vessel's duties (not limited to, as mentioned above)			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation as mentioned in the procedure and in accordance with company procedure.	Cargo officer and ballast officer are responsible for: • Planning and preparation • Risk assessment • Cargo/ballast operation • Undertaking relevant cleaning operations • Bunkering operations • Gas monitoring equipment • Fuel gauging equipment • Internal briefing Vessel's duties (not limited to, as mentioned above)			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation as mentioned in the procedure and in accordance with company procedure.	The person-in-charge: • Ballasting and deballasting operation • Vessel securities selection • Ballast water exchange • Ballast water treatment • Ballast operation in ECA zone as per company procedure • Internal briefing • Ballasting engineer/officer and other relevant duties as per company procedure			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation as mentioned in the procedure and in accordance with company procedure.	Fuel changing and preparation before and after bunkering operation as mentioned in the procedure and in accordance with company procedure. • Cargo/ballast change • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection The person-in-charge: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation The vessel crew/engineers: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection • Ballasting and deballasting operation • Ballast water exchange • Ballast water treatment • Ballast operation in ECA zone as per company procedure • Internal briefing • Ballasting engineer/officer and other relevant duties as per company procedure • Engineer checking work			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation due to another vessel within the lines	The person-in-charge: • Bunkering and deballasting operation • Vessel securities selection • Ballast water exchange • Ballast water treatment • Ballast operation in ECA zone as per company procedure • Internal briefing • Ballasting engineer/officer and other relevant duties as per company procedure • Engineer checking work			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation due to another vessel within the lines	Fuel changing and preparation before and after bunkering operation as mentioned in the procedure and in accordance with company procedure. • Cargo/ballast change • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection • Ship/shore interconnection, bunkering, cargo and ballast operation The person-in-charge: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation The vessel crew/engineers: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection • Ballasting and deballasting operation • Ballast water exchange • Ballast water treatment • Ballast operation in ECA zone as per company procedure • Internal briefing • Ballasting engineer/officer and other relevant duties as per company procedure • Engineer checking work			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation due to another vessel within the lines	The person-in-charge: • Ballasting and deballasting operation • Vessel securities selection • Ballast water exchange • Ballast water treatment • Ballast operation in ECA zone as per company procedure • Internal briefing • Ballasting engineer/officer and other relevant duties as per company procedure • Engineer checking work			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation due to another vessel within the lines	Fuel changing and preparation before and after bunkering operation as mentioned in the procedure and in accordance with company procedure. • Cargo/ballast change • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection • Ship/shore interconnection, bunkering, cargo and ballast operation The person-in-charge: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation The vessel crew/engineers: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection • Ballasting and deballasting operation • Ballast water exchange • Ballast water treatment • Ballast operation in ECA zone as per company procedure • Internal briefing • Ballasting engineer/officer and other relevant duties as per company procedure • Engineer checking work			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation due to another vessel within the lines	Fuel changing and preparation before and after bunkering operation as mentioned in the procedure and in accordance with company procedure. • Cargo/ballast change • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection • Ship/shore interconnection, bunkering, cargo and ballast operation The person-in-charge: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation The vessel crew/engineers: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection • Ballasting and deballasting operation • Ballast water exchange • Ballast water treatment • Ballast operation in ECA zone as per company procedure • Internal briefing • Ballasting engineer/officer and other relevant duties as per company procedure • Engineer checking work			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation due to another vessel within the lines	The person-in-charge: • Ballasting and deballasting operation • Vessel securities selection • Ballast water exchange • Ballast water treatment • Ballast operation in ECA zone as per company procedure • Internal briefing • Ballasting engineer/officer and other relevant duties as per company procedure • Engineer checking work			
	[illegible]	Inexperience in the preparation and control of cargo and bunkering operation due to another vessel within the lines	Fuel changing and preparation before and after bunkering operation as mentioned in the procedure and in accordance with company procedure. • Cargo/ballast change • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection • Ship/shore interconnection, bunkering, cargo and ballast operation The person-in-charge: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation The vessel crew/engineers: • Bunkering preparation • Fuel sampling before and after bunkering • Fuel changing and preparation • Vessel draft preparation • Vessel securities selection • Ballasting and deballasting operation

Element 7. The ability of company management and personnel to evaluate, control, and implement changes to operations, procedures, equipment, or personnel in a structured manner that ensures all potential risks are identified, assessed, and mitigated before the change is executed.		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
7.1.1	There is a documented **procedure** for management of change.	The procedure addresses both permanent and temporary changes onboard and ashore. These may include: • Installation of new equipment and modification of existing equipment. • Temporary isolation and reactivation of alarms for maintenance purposes. • Changes and/or upgrades to software. • Implementation of new legislation. • Changes in trading area. • Organizational changes. • Revisions to procedures. • Taking new tonnage under management.
7.1.2	A **procedure** is in place to ensure that the impact of any proposed change is assessed.	The assessment may include the following factors: • Justification for change. • Potential consequences including safety, personnel and environmental implications. • Risk reduction measures. • Any additional resources required.
7.1.3	The **management of change** procedure clearly defines the levels of authority required for the approval of any changes.	The procedure ensures that any proposed change is approved at an appropriate level and not by the person directly involved in the change.
7.1.4	**Procedures** identify emerging requirements.	Such requirements may be legislative or industry recommended best practice, permanent or temporary, and

		cover: • Safety. • Environmental and energy management. • Security. • Health. • Operational, including navigation, engineering, maintenance, cargo and mooring. The company has identified sources that will provide this information.
7.2.1	The **management of change** process ensures all proposed temporary and permanent changes to onboard procedures and equipment are subject to risk assessment.	The risk assessment is conducted as a part of the planning of the proposed change. The risk assessment identifies and addresses the full range of hazards and consequences of the proposed change.
7.2.2	**Management of change** identifies all personnel that may be affected by the change and ensures that they understand the extent and likely impact of any planned change.	The management of change procedures ensure personnel involved in the proposal, development, implementation, verification and monitoring stages of the change, are kept fully informed of the process to date.
7.2.3	**Management of change** procedures ensure that training needs arising from any proposed changes are identified and documented.	The procedures identify relevant training and familiarization requirements and personnel affected by the change are trained within a defined period.
7.2.4	**Management of change** identifies all documentation and records that may be affected by the change.	Permanent changes, and the review process that led to their approval, are documented. This mechanism links with and ties into, the document control system, so that important controlled documentation remains up-to-date. Examples may include: • Certification. • Manuals. • Plans and drawings.

		• Operational procedures. • Records checklists and forms. • Planned maintenance including spare parts inventories
7.2.5	Regular reviews are conducted of **management of change** plans being implemented. Any changes not carried out within the proposed timescale are reviewed, revalidated and approved.	The plans are sufficiently documented to facilitate the review and ensure that: • Progress is monitored against time. • Objectives are being met and risks managed. • Any deviations are identified and addressed. • Any identified improvements to the plan are recorded. • Temporary changes do not exceed the initial authorization for scope or time without review and re-approval by the appropriate level of management.
7.3.1	A management of change **procedure** is applied when the company acquires additional vessels.	The procedures apply to both new builds and existing tonnage and may include the following: • Supervision of new builds. • Pre-purchase inspection and survey of existing vessels, including priority maintenance requirements. • Involvement of appropriate personnel in the decision making process. • Identifying manning requirements both onboard and ashore. • Familiarization and training requirements both on board and ashore including a period of sailing or standby for key vessel personnel prior to delivery. • Transfer of operational history for existing tonnage e.g. planned maintenance history, vessel modifications history and vessels plan!?. • Where applicable, a period of

		downtime, between delivery and entering service is considered.
7.3.2	There is a periodic review of the outcome of all changes to ensure objectives have been met.	The company reviews the changes implemented to verify that they have-achieved their objectives. Where objectives have not been met a procedure ensures that appropriate action is taken and any issues resolved. The review period is defined and fully documented. The findings may be included in the periodic management reviews.
7.3.3	A software management procedure covers all shipboard and shore systems.	The procedure may include: • Assigned responsibilities for software management including cyber security. • Records of all software installed including version numbers. • A method to ensure that the appropriate/latest version is installed. • Compatibility checks to ensure integration with existing systems. • Instructions for installation of updates. • Instructions for back-up where applicable. • Performance tests following software upgrades. • Training requirements.
7.4.1	For major changes to the shore organization, management of change procedures ensure that manning, competency and experience levels are maintained so that there is no deterioration in supervision and the management of key processes.	Such major changes might include: • Significant increase or decrease in fleet size. • Introduction of a new vessel type to the fleet. • Merger and/or acquisition. • Restructuring.

7.4.2	The company actively seeks out improvements for new build design specifications	Design improvements are considered in future new-build specifications and existing vessels are upgraded proactively as required. Improvements may include: • Ergonomics including the bridge and control rooms. • Enhanced environmental performance. • Energy efficiency. • Operational safety and efficiency. • New and improved technology. • Mooring equipment design and layout. • Enhanced security features. • Personnel accommodation and recreational facilities. Design improvements may be based upon feedback from vessels, discussions with equipment manufacturers, industry best practices and participation in pilot programs.

ELEMENT 7	STAGE	KEY PERFORMANCE INDICATORS (FMGAS)	BIES PRACTICE GUIDANCE	SIMS REF: (COMPANY)	COMPANY'S COMMENTS	STATUS
7 Management of Change (MOC) Main objective To establish procedures for evaluating and managing changes to operations, procedures, equipment etc to ensure that all risks are identified and mitigated prior to implementing a change	7.1.1	There is a documented procedure for management	The procedure addresses both permanent and temporary changes onboard and ashore These may include • Installation of new equipment and modification of existing equipment. • Temporary isolations and inactivation of alarms for maintenance purposes • Changes and/or upgrades to software • Implementation of new regulations • Changes in technology area • Organizational changes. • Revisions to procedures • Failure analysis or any other management			
	7.1.2	A procedure is in place to ensure that the impact of any proposed change is assessed	The assessment may include the following factors • Justification of a change • Potential consequences including safety, personnel and/or environmental implications • Limitations on users • Any additional resources required			
	7.1.3	The management of change procedure defines the levels of authority required for the approval of any changes	The procedure ensures that any proposed changes is approved at an appropriate level and not by the person directly involved in the change			
	7.1.4	Procedures identify emerging requirements	Such improvements may be legislative or industry recommended best practice, permanent or temporary, and others •Safety • Environmental and energy management. •Security • Health •Operational, including navigation, engineering, marine sensor, cargo and mooring The company has identified sources that will provide this information			
	7.2.1	The management of change procedure ensures all proposed for temporary and permanent changes to be based on risk and engineering analysis subject to risk assessment.	The risk assessment is conducted as a part of the planning of the proposed change The risk assessment identifies and addresses the full range of hazards and consequences of the proposed change			
	7.2.2	Management of change identifies all personnel that may be affected by the change and ensures that they are advised of the extent and likely impact of any planned change	The management of change procedure ensure personnel involved in the proposal, development, implementation, verification and monitoring stages of the change, are kept fully informed of the process to date			
	7.2.3	Management of change procedure ensure that, training needs association any proposed changes are identified and documented	The procedure identifies relevant training and familiarization requirements and personnel affected by the change are trained within a defined period			
	7.2.4	Management of change identifies all documentation and records that may be affected by the change	Permanent changes, and the review process that led to it form approval, are documented This includes risk assessments, the Document control system, so that important control documentation remains up-to-date Examples may include • Certificates • Manuals • Plans and drawings •Operational procedures • Records checklists and forms • Planned maintenance requirements and system			
	7.2.5	Regular reviews are conducted of management of change plans being implemented Any changes not actioned (not within the proposed timescale are reviewed), invalidated and approved	The plans are sufficiently discussed to familiarize the crew and ensure that • Progress is monitored against time •Objectives are being met and risk managed • Any deviations are identified and addressed • Any identified improvements to the plan are recorded • For temporary changes Do not record the actual deviations for inspection review test, review and review period by the appropriate level of management.			
	7.5.1	A management of change procedure is applied where the company acquires additional vessels	The procedure apply to both new builds and existing tonnage and may include the following •Acquisition of new builds. • Pre-purchase inspection and survey of existing vessels, including priority master vessel requirements • Involvement of appropriate personnel at key decision making points • Identifying training requirements for both internal and active • Familiarization and training requirements for shore based and active including period of cadetship or Andby for key vessel personnel pre-to-Delivery • Transfer of operational data/software including passage planned maintenance history, vessel modifications history and records plan ID • Where applicable, a period of downtime, between old river ny and new tonnage ownership is considered			
	7.5.2	There is a periodic review of the outcome of all changes to ensure objectives have been met	The company reviews the changes implemented to verify that they have achieved there objectives Where objectives have not been met, procedure ensures that appropriate actions are taken and any issues resolved The review period is defined and fully documented The findings may be included in later periodic management reviews			
	7.5.3	A software management procedure covers all shipboard and shore systems	The procedure may include • Assigned responsibilities for software management including cyber security • Records of all software installed including version numbers • A method to ensure that the appropriate updates/versions are installed •Compatibility checks to ensure integration with existing systems • Instructions for installations of updates • Instructions for backup where applicable • Performance tests following software upgrades • Training requirements.			
	7.4.1	For major changes to the shore organization, management of change procedures ensure that training, competency and experience levels are maintained so that there is no deterioration in performance and the management of any associated	Such major changes might include • Significant increase or decrease in fleet size • Introduction of a new vessel type to the fleet • Mergers and/or acquisitions • Restructuring			
	7.4.2	The company actively seeks out improvements for new build design specifications	Design improvements are considered in future new-builds specifications and existing vessels are upgraded periodically as required. Improvements may include • Improvements including better budget and control rooms • Increased environmental performance • Energy efficiency •Operational safety and efficiency • New and improved technology • Ergonomic improvements, design and layout • Increased security features • Personnel accommodations and recreational facilities Design improvements may be based upon feedback from vessels, discussions with equipment manufacturers, industry forums and participation in pilot programs			
					TOTAL OPEN: 0	

Element 8. Incident Reporting, Investigation and Analysis		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
8.1.1	Procedures ensure prompt reporting and investigation of incidents and significant near misses.	Procedures may include: • Clear definitions of reportable incidents and significant near misses. • Person/department responsible for investigation. • Description of the investigation process.
8.1.2	The reporting and investigation procedures ensure that all mandatory notifications are carried out within the required time frame.	Examples of mandatory reports include notifications to: • Company DPA/CSO. • Flag State. • Coastal Authorities and/or Port State. • Classification Society. • Qualified Individual, if applicable.
8.1.3	Procedures ensure the fleet is rapidly notified of urgent information related to incidents and near misses	Where an incident has occurred and the company has identified immediate issues of concern to other fleet vessels, then procedures to ensure that immediate investigative and preventative actions are addressed onboard. The company verifies that the actions have been completed on each vessel
8.1.4	Procedures ensure that incidents are investigated and analyzed. Corrective and preventative actions are identified and implemented.	The investigation and analysis is sufficiently detailed to accurately establish the root causes of the incident with the objective of improving safety and pollution prevention. Actions are identified to prevent reoccurrence
8.1.5	Procedures ensure that the appointed incident investigation team are appropriately trained and	The investigating team may comprise shore-based personnel, vessel personnel and/or third party contractors.

	qualified to conduct the investigation and analysis.	Incident investigation and analysis training may include: • An industry recognized training program. • Appropriate in-house training by an accredited trainer. • Appropriate computer-based training.
8.2.1	The incident-investigation procedure ensures that the root causes and factors contributing to an incident or significant near miss are accurately identified.	Procedures include a systematic methodology or tool to determine root causes. The investigation procedures may consider the use of all available information such as: • D&A testing. • Review of work and rest hours. • Witness statements. • Photographic evidence/CCTV. • VDR and/or ECDIS data. • Evidence from vessel traffic services. • Review of relevant records and forms.
8.2.2	The composition of the investigation team is established according to the severity and type of the incident.	The company has access to sufficient resources which may include vessel personnel who can conduct and/or assist with an investigation. The persons conducting an investigation are not connected with the incident. In order to maintain independence, appropriately qualified external contractors may be employed.
8.2.3	External training in incident investigation and analysis is given to at least one member of the shore-based management teams.	Industry recognized training providers are used to facilitate specific courses in incident investigation and analysis. Knowledge from the training courses may then be used to train other shore and vessel personnel

8.2.4	The safety culture encourages reporting of all near misses and incidents.	The reporting system is simple and user friendly in order to motivate and encourage fuII participation from all vessel personnel. Near miss and incident reports promulgated to the fleet are reviewed at shipboard safety meetings.
8.2.5	Lessons learnt from incidents are used to prevent any recurrence.	There is a process to analyze the identified root causes and to draw conclusions from incident investigations. The lessons learnt are effectively applied throughout the company to avoid repeat incidents.
8.3.1	Lessons learnt from incidents and near misses and safety performance statistics are promulgated across the fleet periodically.	Lessons learnt from incidents and near misses are included in safety bulletins or circular letters to all vessels and during company seminars. Analysis from this data is used to drive improvements in HSSE performance.
8.3.2	Analysis of company incidents and significant near misses is conducted at periodic intervals.	The analysis can be used to: • Identify trends and common issues. • Measure the effectiveness of preventative measures. • Establish action plans to drive improvements to company's HSSE performance.
8.3.3	Incidents and subsequent investigations are reported to oil major vetting departments.	Data may also be shared using the OCIMF incident data repository within SIRE.
8.3.4	Procedures ensure that incident investigation and analysis refresher training takes place after an appropriate period.	The appropriate period is defined by the company. The training is documented and recorded.
8.4.1	Incident analysis data is shared with industry groups.	Industry groups who can be contacted include Classification Societies, professional institutes, industry associations and equipment manufacturers.

		The shared data may be used for benchmarking purposes. Results of benchmarking may be used to drive safety performance.
8.4.2	Procedures ensure that, where possible, all trained personnel are given the opportunity to participate in incident investigation and analysis.	Trained personnel are given opportunities to participate in investigations and practice the relevant skills, before being expected to lead an investigation.

ELEMENT 8	STAGE	KEY PERFORMANCE INDICATORS	BEST-PRACTICE GUIDANCE	SMS REF. (COMPANY)	COMPANY'S COMMENTS	STATUS
ELEMENT 8: Incident Reporting, Investigation and Analysis	8.1.1	Procedures ensure prompt reporting and investigation of incidents and significant near misses.	Procedures may include: • Clear definitions of reportable incidents and significant near misses. • Person/department responsible for investigation. • Description of the investigation process.			
	8.1.2	The reporting and investigation procedures ensure that all mandatory notifications are carried out within the required time frame.	Examples of mandatory reports include notifications to: • Company DPA/CSO. • Flag State. • Coastal Authorities and/or Port State. • Classification Society. • Qualified Individual, if applicable.			
	8.1.3	Procedures ensure the fleet is rapidly notified of urgent information related to incidents and near misses	Where an incident has occurred and the company has identified immediate issues of concern to other fleet vessels, the procedures to ensure that immediate investigative and preventative actions are addressed onboard. The company verifies that the actions have been completed on each vessel			
	8.1.4	Procedures ensure that incidents are investigated and analyzed. Corrective and preventative actions are identified and implemented.	The investigation and analysis is sufficiently detailed to accurately establish the root causes of the incident with the objective of improving safety and pollution prevention. Actions are identified to prevent reoccurrence			
	8.1.5	Procedures ensure that the appointed incident investigation team are appropriately trained and qualified to conduct the investigation and analysis.	The investigating team may comprise shore-based personnel, vessel personnel and/or third party contractors. Incident investigation and analysis training may include: • An industry recognized training program. • Appropriate in-house training by an accredited trainer. • Appropriate computer-based training.			
	8.2.1	The incident-investigation procedure ensures that the root causes and factors contributing to an incident or significant near miss are accurately identified.	Procedures include a systematic methodology or tool to determine root causes. The investigation procedures may consider the use of all available information such as: • DBA testing. • Review of work and rest hours. • Witness statements. • Photographic evidence /CCTV. • VDR and/or ECDIS data. • Evidence from vessel traffic services. • Review of relevant records and forms.			
	8.2.2	The composition of the investigation team is established according to the severity and type of the incident.	The company has access to sufficient resources which may include vessel personnel who can conduct and/or assist with an investigation. The persons conducting an investigation are not connected with the incident. In order to maintain independence, appropriately qualified external contractors may be employed.			
	8.2.3	External training in incident investigation and analysis is given to at least one member of the shore-based management teams.	Industry recognized training providers are used to facilitate specific courses in incident investigation and analysis. Knowledge from the training courses may then be used to train other shore and vessel personnel			
	8.2.4	The safety culture encourages reporting of all near misses and incidents.	The reporting system is simple and user friendly in order to motivate and encourage full participation from all vessel personnel. Near miss and incident reports promulgated to the fleet are reviewed at shipboard safety meetings.			
	8.2.5	Lessons learnt from incidents are used to prevent any recurrence.	There is a process to analyze the identified root causes and to draw conclusions from incident investigations. The lessons learnt are effectively applied throughout the company to avoid repeat incidents.			
	8.3.1	Lessons learnt from incidents and near misses and safety performance statistics are promulgated across the fleet periodically.	Lessons learnt from incidents and near misses are included in safety bulletins or circular letters to all vessels and during company seminars. Analysis from this data is used to drive improvements in HSSE performance.			
	8.3.2	Analysis of company incidents and significant near misses is conducted at periodic intervals.	The analysis can be used to: •Identify trends and common issues. •Measure the effectiveness of preventative measures. •Establish action plans to drive improvements to company's HSSE performance.			
	8.3.3	Incidents and subsequent investigations are reported to oil major vetting departments.	Data may also be shared using the OCIMF incident data repository within SIRE.			
	8.3.4	Procedures ensure that incident investigation and analysis refresher training takes place after an appropriate period.	The appropriate period is defined by the company. The training is documented and recorded.			
	8.4.1	Incident analysis data is shared with industry groups.	Industry groups who can be contacted include Classification Societies, professional institutes, industry associations and equipment manufacturers. The shared data may be used for benchmarking purposes. Results of the benchmarking may be used to drive safety performance.			
	8.4.2	Procedures ensure that, where possible, all trained personnel are given the opportunity to participate in incident investigation and analysis.	Trained personnel are given opportunities to participate in investigations and practice the relevant skills, before being expected to lead an investigation.			
					TOTAL OPEN: 0	

Element 9. Safety Management		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
9.1.1	Safety standards are monitored across the fleet during shore-based management visits to vessels.	Procedures ensure that all onboard inspections include a safety element. Following vessel visits, a report is completed that includes recommendations for any safety improvements to be made.
9.1.2	During vessel visits, every opportunity is taken to promote a strong safety culture across the fleet.	Meetings with the vessel personnel on safety related matters are conducted during shore management visits to vessels. Any feedback obtained during the visit is used to improve the company's safety procedures.
9.1.3	Procedures include a documented risk assessment system.	The risk assessments identify hazards and assess risk levels arising from work activities onboard the vessel and include identification of risks to health and hygiene.
9.1.4	A documented permit to work system is in place.	The permit to work is used to control the risks associated with hazardous tasks, such as enclosed space entry and hot work. The system requires company management approval for higher risk activities, such as hot work in identified hazardous areas.
9.2.1	Risk assessments for routine tasks are used to develop safe working procedures.	The risk assessment identifies all hazards associated with a task and any personnel at risk. All risk mitigation measures to address identified hazards are incorporated into the safe working procedures. Reference sources from industry

		organizations, the Code of Safe Working Practices for Merchant Seafarers and IMO guidelines are referred to when compiling a risk assessment. Such risk assessments are reviewed and updated, procedures are amended as required and records are maintained.
9.2.2	The risk assessment process includes provision for assessing new, non-routine and unplanned tasks.	Where no safe working procedure exists, a risk assessment is carried out, reviewed and approved at an appropriate level defined by the company. The risk assessment process results in alternative methods of work being considered and documented where the residual risk has been determined to be unacceptable.
9.2.3	Risk assessments for new, non-routine and unplanned tasks are available to all relevant personnel.	Such risk assessments are assessed by shore-based personnel to ensure that they are fit for purpose. All relevant personnel are familiarized with the content of the risk assessments. Records may be maintained onboard or ashore at relevant locations.
9.2.4	Procedures ensure that all identified mitigation measures are completed prior to commencing work.	Procedures may include: • Use of the permit to work system for both planned and unplanned tasks. • Use of the risk assessment form to confirm implementation. Final approval for commencement of work is subject to implementation of mitigation measures.

9.2.5	Procedures manage the safety of contractors on board.	These procedures may: • Define and identify on board contractors, e.g. riding squads, service technicians, repair teams. • Establish clear responsibilities between contractors and the vessel for work management including personnel in charge. • Ensure that safety inductions are conducted with contractors prior to commencing work. Establish work management processes e.g. permit to work systems. • Ensure compliance with company HSSE policies including PPE, D&A, hours of work/rest and smoking regulations.
9.3.1	A formal process is in place for shore management to review all risk assessments periodically.	The review process ensures that all risk assessments remain relevant by considering, for example: • That the effect of new legislation and/or equipment is incorporated into the risk assessment. • That changes in manning level(s) are taken into account. • Non-routine tasks are considered (which may become standard tasks following review). Where applicable, company procedures are amended.
9.3.2	Proprietary safety tools are used to encourage hazard identification and to improve safety awareness throughout the organization	Such tools may include: Unsafe Act Awareness programs. • **Behavior-based safety system.***** • Concentrated safety awareness campaigns. Campaigns encourage a strong safety culture within the company e.g. near miss

		reporting programs may be introduced as they help to reduce operational risks.
9.3.3	The company selects and maintains a list of approved contractors.	There are detailed procedures for the selection of contractors which may include: • Defining selection criteria for contractors such as: - Industry recognized quality management systems. - Minimum training requirements. - Equipment manufacturers' accreditation. - HSSE performance. - Contractors corporate social responsibility policy. • Identifying, assessing and selecting suitable contractors. • Maintaining a list of approved contractors. In addition, the company has procedures to manage the appointment of contractors who are not on the approved list where necessary.
Element 9A. Safety Management		
9A.1.1	Procedures require that safety inspections are conducted at scheduled intervals by a designated Safety Officer.	Safety inspections of the vessel: • Identify hazards and potential hazards to health, safety and the environment. • Include all accessible areas of the vessel. • Are recorded and reviewed at the monthly onboard safety meetings. Procedures provide guidance on the frequency and format of the inspections. The designated Safety Officer is suitably experienced and trained.
9A.1.2	The company safety culture encourages all personnel to	Procedures require that any identified hazards are addressed. Where hazards are identified that

	identify, report and where applicable address hazards.	cannot be rectified by vessel personnel, then the company management are informed in order for remedial action to be taken.
9A.1.3	On board safety meetings are held at least monthly. In addition, extraordinary meetings are held as soon as practicable after any serious incident on board or within the fleet.	Meetings are attended by all available personnel and minutes recorded. Safety meetings are an open forum which encourages vessel personnel to actively participate. The meeting is used to: • Raise safety awareness. • Voice safety concerns and identify remedial actions. • Promulgate lessons learnt. The company reviews and responds to monthly and extraordinary safety meeting minutes from the vessel.
9A.1.4	Procedures require daily work planning meetings to take place	Work planning: • Agrees the scope of work to be undertaken. • Identifies any operational or departmental conflict. • Identifies personnel requirements. • Identifies tools and equipment required. • Establishes appropriate PPE requirements. • Ensures compliance with work and rest hours.
9A.2.1	Intervention to prevent unsafe acts and unsafe conditions occurring are actively encouraged.	Safety intervention techniques used may include: • Unsafe Act Awareness and intervention. • Stop work authority. • Tool box talks. • Safety observations. Progress is reviewed at the monthly safety meetings.

9A.2.2	Appropriate training in hazard identification and risk assessment is provided to vessel personnel.	Various levels of training are provided based upon individual roles and responsibilities
9A.3.1	Procedures encourage the reporting of safety best practices.	Personnel are actively encouraged to submit safety related ideas by methods such as personnel competitions or individual recognition. Safety best practices received are reviewed and circulated to the fleet. Where appropriate the best practices are incorporated into revised procedures.
9A.3.2	Procedures measure and compare the strength of the safety culture across the fleet to identify areas for improvement and to provide motivation to vessel personnel.	Procedures measure: • Near miss reports. • Behavior-based safety system observations. • Incident free days. • Best practices identified. • Hazards identified. • Unsafe acts identified. • Safety suggestions. Results are circulated to the fleet.
9A.3.3	Management identifies opportunities to strengthen their safety culture through interaction with fleet personnel.	Examples of methods of interaction might include presentations via: • Safety themed seminars. • Telephone conferences. • Webinars. • Safety magazines. • Intranet. • The company produced videos.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Safety Management	[illegible]	[illegible]	[illegible]				

TOTAL OPEN: 0

Element 10. The ability of company management to develop and implement an environmental and energy management plan that identifies sources of emissions, optimizes energy efficiency, reduces environmental impact, and sets measurable targets for continual improvement in environmental performance.		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
10.1.1	An environmental protection policy and management plan is in place.	The policy, which is signed by senior management, includes a commitment to minimizing the environmental impact of operations. The policy is conspicuously posted onboard vessels and in company offices ashore. All company personnel including third party contractors are aware and familiar with the policy. The environmental management plan may include: • Energy management and efficiency. • Waste management. • Responsibilities of personnel ashore and onboard. • Record keeping. • Training and familiarization.
10.1.2	All sources of marine and atmospheric emissions attributable to company and vessel activities have been **systematically identified**.	These sources could include: • Funnel emissions (CO2, NOx, SOx, particulate matter). • Greenhouse gases. • Garbage. • VOC. • Cargo residues. • Oil emissions (stern tube lube oil, bilge, sludge). • Effluent discharges (IGS discharge, grey water). • Ballast water. • Sewage. • Antifouling paints. • Noise, including underwater disturbance.

10.1.3	**Procedures** minimize marine and atmospheric emissions and ensure that they are always within permitted levels.	Procedures may include: • Methods of minimizing emissions. • Identification of applicable regulations. • Environmentally responsible disposal methods. • Emissions monitoring. • Fuel analysis. • VOC management.
10.2.1	The **environmental management plan** includes energy efficiency and fuel management.	Energy management may include monitoring and reporting requirements for the following: • Daily fuel consumption including main engine, boilers, IGS and auxiliaries. • Vessel's speed and distance travelled. • Vessel's condition (laden or ballast). • Vessel's trim. • Weather, sea state and wind direction. Data is recorded on a voyage by voyage basis, for individual vessels and on an overall fleet basis. Time spent alongside and at anchor is included.
10.2.2	The **environmental management plan** addresses efficient use of energy and includes actions to improve environmental performance.	Actions may include: • Establishing baseline criteria and targets to be achieved. • Operational measures to improve environmental performance such as engine room waste management, garbage management, slop management, VOC management. Regular performance reviews include the calculation of specific fuel consumption trends, monitoring of hull condition and propeller fouling, the performance of main engines, boilers, IGS and

		auxiliaries and the generation of waste.
10.2.3	The company seeks to optimize vessel energy efficiency.	Measures may include: • Optimization of vessel trim. • Speed optimization where practical. • Weather routing. • Optimizing onboard power management such as the use of generators and boilers. • Propeller polishing/cleaning. • Hull cleaning. • Most efficient method of ballast water exchange/treatment.
10.2.4	The **environmental management plan** includes procedures for fuel management in order to ensure regulatory compliance, energy efficiency and reduced emissions.	Procedures to ensure quality control of fuel may include: • Identification of required fuel specifications according to the vessel's trading pattern. • Fuel purchasing. • Fuel sampling and analysis. • Management of off spec fuel. Onboard fuel management procedures may include: • Requirements prior to entering and leaving Emission Control Areas. • Onboard fuel segregation and minimum stock levels. Consideration is given to issues that include fuel compatibility in order to minimize sludge production and keep the plant in optimum operational condition.
10.3.1	The **potential environmental impact** of all company and vessel activities is subjected to evaluation.	The evaluation may include: • Measurement and recording of all emissions. • Acceptable impact levels. • Procedures and mitigating measures to minimize the environmental impact. • Impact upon marine life.
10.3.2	Specific emissions reduction targets are set in the	Targets may be set for: • Funnel emissions (CO2, NOx,

	environmental management plan.	SOx, particulate matter). • Greenhouse gases. • Garbage . • VOC. • Oil emissions (stern tube lube oil, bilge, sludge, etc.). • Effluent discharges (IGS discharge, grey water, etc.). • Ballast water. • Sewage. • Antifouling paints. • Noise, including underwater disturbance.
10.3.3	A long-term environmental plan is maintained.	The plan may include: • Long-term objectives. • Short-term targets set to achieve the long-term objectives. • Periodic review of the plan.
10.3.4	Environmentally sound ship recycling practices are employed/adhered to.	
10.3.5	Environmental performance improvements are incorporated during the **new build process**.	This may include: • Hull form optimization. • Energy saving devices, e.g. LEDs, variable frequency drives on heavy power consumers. • Pollution saving arrangements. • Clean fuel technology. • Waste reduction equipment.

ELEMENT / ID	STAGE	KEY PERFORMANCE INDICATORS (TMSAS)	BEST PRACTICE GUIDANCE (TMSAS)	SMS REF. (COMPANY)	COMPANY'S COMMENTS	STATUS	HYDRUS COMMENT
10 Environmental and Energy Management Main objective To establish an environmental management plan that identifies sources of marine pollution, including accidental spills, energy efficiency and reduced emissions, and which targets for continual improvement in environmental performance.	10.1.1	An environmental protection policy and management plan is in place.	The policy, which is signed by senior management, includes commitments to minimising the environmental impact of operations. The policy is communicated onboard vessels and in company offices. The environmental management plan may include: • Energy management and efficiency. • Waste management. • Responsibilities of personnel ashore and onboard. • Record keeping. • Training and familiarisation.				
	10.1.2	All sources of marine and atmospheric emissions attributable to company and vessel activities have been systematically identified.	These sources could include: • Fuel emissions: CO2; NOx, SOx, particulates, fumes. • Greenhouse gases. • Garbage. • VOC. • Cargo residues. • Oily emissions from tube oil, bilge, sludge. • Exhaust discharges: IGS, boilers, engine, gas vents. • Ballast water. • Sewage. • Anti-fouling paints. • Noise, including underwater discharges.				
	10.1.3	Procedures in place to minimise and atmospheric emissions and ensure that they are always within permitted levels.	Procedures may include: • Methods of minimising emissions. • Identification of applicable regulations. • Environmentally non-permitted disposal methods. • Environment monitoring. • Fuel analysis. • VOC management.				
	10.2.1	The environmental management plan includes energy efficiency and fuel management.	Energy management may include monitoring and reporting requirements on the following: • Daily fuel consumption including main engine, boilers, IGS and auxiliaries. • Vessel's speed and distance travelled. • Vessel's condition (clean or dirty) inc. • Vessel's trim. • Weather, sea state and wind direction. Data is recorded on a voyage by voyage basis, for individual vessels and on an overall fleet basis. The personal engaged and training undertaken.				
	10.2.2	The environmental management plan addresses efficient use of energy and includes actions to improve environmental performance.	Actions may include: • Establishing baselines/marks and targets to be achieved. • Operational procedures to improve environmental performance such as engine room management, garbage management, slop management, VOC management. Regular performance reviews including the calculation of specific fuel consumption trends, monitoring of hull conditions and propeller fouling, the performance of main engines, boilers, IGS and auxiliaries and the generation of waste.				
	10.2.3	The company takes actions to minimise vessel energy efficiency.	Measures may include: • Optimisation of vessel trim. • Speed optimisation when practical. • Weather routing. • Optimising onboard power management such as the use of generators and boilers. • Propeller polishing/cleaning. • Hull cleaning. • More efficient methods of ballast water exchange/treatment.				
	10.2.4	The environmental management plan includes procedures for fuel management in order to ensure regulatory compliance, energy efficiency and reduced emissions.	Procedures to ensure quality control of fuel may include: • Identification of required fuel specifications according to vessel's trading pattern. • Fuel purifying. • Fuel sampling and analysis. • Management of "spec fuel". Onboard fuel management procedures may include: • Requirements prior to entering and leaving Emission Control Areas. • Onboard fuel segregation and minimising sludge. Considerations given to ensure that the fuel consumption is in order to minimise sludge production and keep the plant in optimum operational condition.				
	10.3.1	The potential environmental impact of all company and vessel activities is subject to evaluation.	The evaluation may include: • Measurement and recording of all emissions. • Acceptable limits/levels. • Procedures and mitigating measures to minimise the environmental impact. • Impact upon marine life.				
	10.3.2	Specific emissions reduction ranges are set in the environmental management plan.	Targets may be set for: • Fuel emissions: CO2; NOx, SOx, particulates, fumes. • Greenhouse gases. • Garbage. • VOC. • Oily emissions from tube oil, bilge, sludge, etc. • Exhaust discharges: IGS, boilers, engine, gas vents, etc. • Ballast water. • Sewage. • Anti-fouling paints. • Noise, including underwater discharges.				
	10.3.3	A long-term environmental plan is maintained.	The plan may include: • Long-term objectives. • Short-term targets to reach/work towards long-term objectives. • Periodic review of the plan.				
	10.3.4	Environmentally sound ship recycling practices are employed where able.					
	10.3.5	Environmental performance improvements are incorporated during the new build process.	This may include: • Hull form optimisation. • Energy saving devices, e.g. FDDs, variable frequency driven on heavy power consumers. • Waste saving arrangement. • Clean fuel technology. • Waste reduction equipment.				
					TOTAL OPEN: 0		

Element 11. The ability of company management and personnel to establish, maintain, and regularly test an emergency response system that ensures continual readiness to respond effectively to incidents and manage them in a safe, coordinated, and controlled manner.		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
11.1.1	Detailed vessel emergency response plans include initial notification procedures and cover all credible emergency scenarios.	Vessel emergency response plans are reviewed at least annually, to reflect changes in legislation, contact details, vessel equipment and changes in company procedures. They are additionally reviewed following any incident or drill where the emergency response plans have been used.
11.1.2	A detailed shore-based emergency response plan covers all credible emergency scenarios.	The shore plan includes effective notification procedures and communication links for rapidly alerting the emergency response team and ensures there is 24-hour cover that takes account of holidays and work-related travel arrangements. Exercises provide a comprehensive test of all communication systems and mobilization, including exercises being conducted outside normal office hours.
11.1.3	The **shore-based emergency response plan** has clearly defined roles, responsibilities and record keeping procedures.	The plan sets out the actions to be taken for each of the defined roles. Individuals are identified to fill each role with alternates for key positions including the person with overall authority. Personnel are trained in their designated emergency response roles.

11.2.1	The company provides suitable emergency response facilities.	This may include a dedicated room with facilities such as: • Dedicated phone lines and additional connection points. • Sufficient power outlets for equipment including mobile phones and fax. • Sufficient computer work stations/docking stations with network access and dedicated email. • Electronic or paper charts. • A whiteboard, markers and/or flip charts. • Satellite or cable television. • Back-up power supply. • Breakout rooms. Incident room facilities are regularly reviewed to take account of new technology.
11.2.2	The scope and frequency of drills and exercises is determined by the number and type of vessels within the fleet and their trading pattern(s).	An exercise schedule is used to ensure that exercises are conducted within the given time frame. Incident scenarios for exercises have varied content and duration and fully test the contingency plans, including security elements. Comprehensive vessel/shore exercises are carried out at least annually these may be supplemented by table top exercises which test specific areas of the emergency response plan.
11.2.3	The plan includes **procedures and resources** to interact with the media.	The interaction with media may include: • Responding to media enquiries. • Press releases. • Monitoring of news broadcasts. • Monitoring and responding to social media. • TV and radio interviews. Company personnel receive media training appropriate to

		their role. External consultants may be used to support the company.
11.2.4	Lessons learnt from exercises and actual incidents are incorporated into the emergency response plans.	Following an exercise or incident, the company: • Records lessons learnt. • Identifies areas for improvements. • Ensures that corrective actions are implemented, including any identified training requirements. • Ensures that exercises are discussed at the management reviews. • Circulates lessons learnt among fleet and shore-based personnel.
11.3.1	Records are kept of participants who have been involved in emergency drills and exercises.	All personnel assigned a role take part in an exercise at regular intervals. Designated alternates for key roles are included in the planned exercises and drills. External resources and vessel personnel may be invited to actively participate in planned exercises and drills.
11.3.2	Arrangements are in place to use external resources in an emergency.	Contact details are readily available for: • Salvage and towage contractors. • Emergency response services. • Flag States and local authorities. • Charterers and cargo owners. • Hull and machinery insurers and P&I. • Media consultants. • Legal resources. • Manning agents where appropriate. • Logistic resources, including travel and procurement.
11.3.3	**Drills and exercises** test the effectiveness of arrangements to call on external consultants and resources.	External resources are mobilized at least annually. Communications links to external resources are checked regularly during the exercises.

11.3.4	Business continuity, in the event of potential disruption to the main place of business, has been addressed.	The company documents how they would maintain shore-based operations in order to ensure safe management of the fleet.
11.3.5	**Procedures** address recovery following an incident.	Procedures may include: • An assessment of the ability of the ship and personnel to safely proceed on voyage. • The need to preserve evidence, such as CCTV records and VDR information. • Engagement with external agencies as appropriate, e.g. Flag, Class, P&I, Coast Guard, law enforcement.

ELEMENT 11	STAGE	KEY PERFORMANCE INDICATORS (mSAS)	BEST-PRACTICE GUIDANCE (mSAS)	SMS REF. (COMPANY)	COMPANY'S COMMENTS	STATUS	HYDRUS Comment
11 Emergency Preparedness and Contingency Planning Main objective: To establish an emergency response system and regularly test it to ensure an adequate ability to effectively respond to and manage incidents	11 11	Detailed vessel emergency response plans including actual notification procedures and coverall credible emergency scenarios	Vessel emergency response plans are reviewed at least annually, to reflect changes in legislation, contact details, vessel equipment and changes in company procedures They are additionally reviewed following any incident, and all vessel emergency response plans have been used				
	11 12	A detailed ship-based emergency response plan covers all credible emergency scenarios	The ship's plan includes effective notification procedures and communication links for rapidly alerting the emergency response team and reviews 'at sea' 24-hour cover that takes account of holidays and work-related curfews in assigned ports Exercises provide a comprehensive test of all communication systems and limitations, including exercises being conducted outside normal office hours				
	11 13	The shore-based emergency response plan has clearly defined roles, responsibilities and escalation procedures	The plan sets out the actions to be taken for activation of the defined roles Individuals are identified to fill each role with alternates for key positions, including the person with overall authority Personnel are trained in their designated emergency response roles				
	11 21	The company provides suitable emergency response facilities	This may include dedicated rooms with facilities such as: • Dedicated phone lines and additional connection points • Sufficient power outlets or requirements including mobile phones and IT kit • Sufficient computer workstations/desktop stations with network access and dedicated email • Hardcopy charts • A water board, markers and grifo charts • Satellite or cable television • Back-up power supply • Secluded rooms Incident room facilities are regularly reviewed to take				
	11 22	The scope and frequency of drills and exercises is determined by the number and type of vessels within the fleet and their trading patterns	An exercise calendar is used to ensure that exercises are conducted within the given timeframe Incident scenarios for exercises have varied content and evolutions and fully test the contingency plans, including any identified learning requirements Completed exercises (ship-to-shore exercises are carried out at least annually) have may be supplemented by table top exercises which test specific areas of the emergency response plan				
	11 23	The plan includes procedures and resources to interact with media	The plan states who media enquiries may include: • Responding to media enquiries • Press releases • Monitoring of news broadcasts • Monitoring and responding to social media • TV and radio interviews Company personnel interview media using appropriate for their role External consultants may be used to support the company				
	11 24	Lessons learnt from exercises and actual incidents are incorporated into the emergency response plans	Following an exercise or incident, the company: • Records lessons learnt • Identifies areas for improvements • Ensures that corrective actions are implemented, including any identified training requirements • Ensures that exercises are discussed at the management reviews • Circulates lessons learnt across the fleet and shore-based personnel				
	11 31	Records are kept of participants who have been involved in emergency drills and exercises	All personnel assigned a role in the plan participate in exercises at regular intervals Designated alternates for key roles are included in the plan and exercises and drills External resources and vessel personnel may be involved to actively participate in plan drill exercises and drills				
	11 32	Arrangements are in place to use external resources in an emergency	Contact details are readily available for: • Salvage and towage contractors • Emergency response services • Flag States and local authorities • Charterers and cargo owners • Hull and machinery insurers and P&I • Medical consultants • Legal advisers • Manning agents where appropriate • Logistic resources, including travel and procurement				
	11 33	Drills and exercises test the effectiveness of arrangements to call on external consultants and resources	External resources are mobilised at least annually Communication tests to external resources are carried out regularly during exercises				
	11 34	Business continuity, recovery of potential disruptions to the normal place of business, has been addressed	The company documents how they would maintain ship-based operations in order to continue safe management of the fleet				
	11 35	Procedures address recovery following an incident	Procedures may include: • An assessment of the ability of the ship and personnel to safely proceed on voyage • Filing of ship's preservation, such as, CCTV records and VDR information • Engagement with external agencies as appropriate, e.g. Flag State, P&I, Coast Guard, Lawyers comment				
					TOTAL OPEN: 0		

Element 12. The ability of company management to implement effective inspection and audit programmes that monitor vessel condition and SMS compliance, analyse results to drive continual improvement, and maintain the SMS as a living system integrated at the core of business operations.		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
12.1.1	A company specific format is used for conducting and reporting vessel inspections.	The standard format is used as a basis for all vessel inspections. The inspection format covers all areas of the vessel and its equipment. The format is controlled through the company document control system.
12.1.2	An inspection plan covers all vessels in the fleet, with at least two inspections of each vessel a year.	The inspection is conducted by suitably experienced superintendent(s) and may be carried out in conjunction with other inspections/audits. Following each inspection a report is made and is reviewed/ signed off by shore management. The inspection process provides company management with a comprehensive overview of the condition of the fleet at specified intervals. Records are kept of the inspections and reviews.
12.2.1	The inspection format is of a standard that is at least equivalent to the vessel inspection reports issued by industry bodies such as OCIMF, COi or EBIS.	The format is reviewed against industry formats and in addition incorporates: • Company specific items. • Areas identified from lessons learnt. • Company and industry best practice. • Where applicable, vessel type specific items.
12.2.2	A system records any deficiencies identified by the inspections and tracks them through to close out.	The outcome of inspections is recorded and deficiencies tracked

		to ensure close out within a specified time frame. Regular checks are made on the status of open items. A summary of the status is provided to senior management on a quarterly basis.
12.3.1	To improve vessel standards, the company analyses its inspection results and makes comparisons within the fleet.	Identified best practices are shared with the fleet. Where comparisons identify weaknesses or anomalies corrective action is taken. The analysis supports a cycle of continual improvement.
12.3.2	In order to improve the inspection process, analysis of inspection results is compared with data from third party inspections	The company compares its own inspection results with the results of inspections conducted by third parties. The comparison is comprehensive and identifies any specific areas of weakness. Where there are consistent anomalies, the The vessel inspection process is reviewed and improved. These comparisons are used to monitor/improve fleet inspection standards.
12.3.3	The inspection process identifies weaknesses in personnel familiarity with equipment and operations	Where the review of the inspection report indicates that the root causes of deficiencies are attributable to a lack of familiarity, this is addressed.
12A.1.1	The company has documented audit procedures and standard audit formats.	The formats are designed, as required, for ISM, the ISPS Code, ISO Standards and any company internal audits.
12A.1.2	Company auditors are appropriately trained and qualified.	Auditors have received formal audit training. The company maintains training

		records of individual auditors and a record of audits conducted by them.
12A.1.3	An audit plan covers all vessels and company offices.	The plan provides for audit(s) of the entire company organization and fleet at specified intervals.
12A.2.1	Audit results are reported to management within a specified time frame.	The audit procedure sets an internal performance standard for the time taken from completing the audit to producing and distributing the report.
12A.2.2	Audits are performed in line with the audit plan.	Any deviations to the audit plan are justified and approved by senior management. Management reviews the number of audits performed against the number of audits planned on a regular basis, (at least quarterly). Where necessary, managers assign additional resources to keep up-to-date with the plan.
12A.3.1	All audit non-conformities are closed out within the prescribed time frame.	All non-conformities are tracked through to completion and records demonstrate effective close out of required corrective actions. An audit status report, including open non-conformities is reported to senior management on a quarterly basis. A procedure addresses, by exception, non-conformities that cannot be closed out within the original time frame.

ELEMENT 12	STAGE	KEY PERFORMANCE INDICATORS	BEST-PRACTICE GUIDANCE	SMS REF. (COMPANY)	COMPANY'S COMMENTS	STATUS
Measurement, Analysis and Improvement Main objective To establish effective inspection and audit programmes that measure compliance with the SMS and monitor the condition of vessels. Analysis of the results drives continual improvement. To be fully effective, the SMS is maintained as a living document at the core of the business	12.1.1	A company specific format is used for conducting and reporting vessel inspections.	The standard format is used as a basis for all vessel inspections. The inspection format covers all areas of the vessel and its equipment. The format is controlled through the company document control system.			
	12.1.2	An inspection plan covers all vessels in the fleet, with at least two inspections of each vessel a year.	The inspection is conducted by suitably experienced superintendent(s) and may be carried out in conjunction with other inspections/audits. Following each inspection a report is made and is reviewed/ signed off by shore management. The inspection process provides company management with a comprehensive overview of the condition of the fleet at specified intervals. Records are kept of the inspections and reviews.			
	12.2.1	The inspection format is of a standard that is at least equivalent to the vessel inspection reports issued by industry bodies such as OCIMF, CDI or EBIS.	The format is reviewed against industry formats and in addition incorporates: ▪ Company specific items. ▪ Areas identified from lessons learnt. ▪ Company and industry best practice. ▪ Where applicable, vessel types specific items.			
	12.2.2	A system records any deficiencies identified by the inspections and tracks them through to close out.	The outcome of inspections is recorded and deficiencies tracked to ensure close out within a specified time frame. Regular checks are made on the status of open items. A summary of the status is provided to senior management on a quarterly basis.			
	12.3.1	To improve vessel standards, the company analyses its inspection results and makes comparisons within the fleet.	Identified best practices are shared with the fleet. Where comparisons identify weaknesses or anomalies corrective action is taken. The analysis supports a cycle of continual improvement.			
	12.3.2	In order to improve the inspection process, analysis of inspection results is compared with data from third party inspections	The company compares its own inspection results with the results of inspections conducted by third parties. The comparison is comprehensive and identifies any specific areas of weakness. Where there are consistent anomalies, the vessel inspection process is reviewed and improved. These comparisons are used to monitor/improve fleet inspection standards.			
	12.3.3	The inspection process identifies weaknesses in personnel familiarity with equipment and operations	Where the review of the inspection report indicates that the root causes of deficiencies are attributable to a lack of familiarity, this is addressed.			
	12A.1.1	The company has documented audit procedures and standard audit formats.	The formats are designed, as required, for ISM, the ISPS Code, ISO Standards and any company internal audits.			
	12A.1.2	Company auditors are appropriately trained and qualified.	Auditors have received formal audit training. The company maintains training records of individual auditors and a record of audits conducted by them.			
	12A.1.3	An audit plan covers all vessels and company offices.	The plan provides for audit(s) of the entire company organization and fleet at specified intervals.			
	12A.2.1	Audit results are reported to management within a specified time frame.	The audit procedure sets an internal performance standard for the time taken from completing the audit to producing and distributing the report.			
	12A.2.2	Audits are performed in line with the audit plan.	Any deviations to the audit plan are justified and approved by senior management. Management reviews the number of audits performed against the number of audits planned on a regular basis, (at least quarterly). Where necessary, managers assign additional resources to keep up-to-date with the plan.			
	12A.3.1	All audit non-conformities are closed out within the prescribed time frame.	All non-conformities are tracked through to completion and records demonstrate effective close out of required corrective actions. An audit status report, including open non-conformities is reported to senior management on a quarterly basis. A procedure addresses, by exception, non-conformities that cannot be closed out within the original time frame.			
					TOTAL OPEN: 0	

Element 13. SECURITY		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
13.1.1	Documented security plans are in place.	The plans cover all aspects of activities including: • Shore-based locations. •Vessels. • Personnel. The personnel responsible for security related matters are identified.
13.1.2	The company has documented procedures in place to identify security threats applicable to vessels trading areas and shore-based locations.	Security threats may include: • Petty theft. • Vandalism. • Stowaways. • Cargo theft. • Cyber threat. • Inadequate port security. • Trafficking of people, arms or drugs. • Smuggling. • Piracy. • Sabotage and arson. • Terrorism and its subsequent effects. The identified threats are reviewed as required by changes in circumstance.
13.1.3	Measures have been developed to mitigate and respond to all identified threats to vessels and shore based locations.	Mitigating measures may include: • Access control. • Physical security measures. • Drills and training. • Security patrols. • Searches. Contingency plans are in place to respond to any potential breaches of security.
13.1.4	Procedures are in place to obtain, manage and review current security related information.	Security information is obtained by the company from appropriate sources that may include:

		• International and national agencies. • Regional Maritime Security reporting centers. • Flag State. • Industry bodies. • Local agents. • Military sources. • Specialist consultants. The responsible person(s) reviews the information and issues relevant guidance to shore-based locations, personnel and vessels as appropriate.
13.1.5	Procedures include the reporting of potential security threats and actual security incidents.	The reporting procedures may include: • Internal ship reporting. • Vessel to the company. • Vessel to external authorities. • Company to external authorities.
13.2.1	Formal risk assessments of company activities are undertaken to identify and mitigate potential security threats.	The risk assessments are regularly reviewed, updated and company procedures amended as necessary. Ship specific security risk assessments are reviewed prior to entry into areas identified as having an increased risk. Where the risk assessment determines it necessary, ship specific hardening measures are developed, documented and implemented. Consideration is given to the provision of appropriate ship protection materials/equipment, which may then be recorded in a vessel specific ship protection measures/ hardening plan.
13.2.2	The personnel responsible for security receive training appropriate to their role and the company's activities.	Training reflects the scope of the company's activities and, where required, meets minimum international or national legislative requirements.

		Consideration is given to the need to train an alternate for key security roles. A security briefing is provided to all personnel as part of their familiarization process.
13.2.3	Policy and procedures include cyber security and provide appropriate guidance and mitigation measures	Risks to IT systems may include: • Deliberate and unauthorized breaches. • Unintentional or accidental breaches. • Inadequate system integrity, such as firewalls and/or virus protection. Systems with direct or indirect communication links, which may be vulnerable to external threat or inappropriate use, are identified. These may include navigation, engineering, control and communication systems. In developing procedures, the company may refer to relevant current industry guidance.
13.2.4	The company actively promotes cyber security awareness.	Effective means are used to encourage responsible behavior by shore-based personnel, vessel personnel and third parties. Such behavior may include: • Locking of unattended work stations. • Safeguarding of passwords. • No use of authorised software. • Responsible use of social media. • Control/prevention of misuse of portable storage and memory sticks.
13.3.1	A travel policy is in place to minimize security threats to personnel.	The policy is based on risk assessment and includes vessel personnel, shore-based personnel and contractors travelling on company business. As appropriate, restrictions and

		guidance is in place for travel identified as being an elevated risk. The travel policy is regularly reviewed to take account of changes to security threats.
13.3.2	Security procedures are updated taking into account current guidance.	Industry guidance may include: • Best Management Practices for Protection against Somalia Based Piracy. • Drug Trafficking and Drug Abuse (ICS). • Maritime Security- Guidance on the ISPS Code (ICS). • Security planning charts. • Guidelines on cyber security from industry and Class. • Large Scale Rescue Operations at Sea (ICS). • Regional Guide to Counter Piracy and Armed Robbery Against • Ships in Asia (ReCAAP-ISC). Company vessels are provided with the latest editions of relevant security related publications.
13.3.3	The security policy and related procedures are included in the internal audit program.	The audit assesses compliance with all aspects of company security procedures, including personal awareness and behavior.

ELEMENT 13	STAGE	KEY PERFORMANCE INDICATORS	BEST-PRACTICE GUIDANCE	SMS REF. (COMPANY)	COMPANY'S COMMENTS	STATUS
SECURITY	13.1.1	Documented security plans are in place.	The plans cover all aspects of activities including: • Shore-based locations. • Vessels. • Personnel. The personnel responsible for security related matters are identified.			
	13.1.2	The company has documented procedures in place to identify security threats applicable to vessels trading areas and shore-based locations.	Security threats may include: • Petty theft. • Vandalism. • Stowaways. • Cargo theft. • Cyber threat. • Inadequate port security. • Trafficking of people, arms or drugs. • Smuggling. • Piracy. • Sabotage and arson. • Terrorism and its subsequent effects. The identified threats are reviewed as required by changes in circumstance.			
	13.1.3	Measures have been developed to mitigate and respond to all identified threats to vessels and shore based locations.	Mitigating measures may include: • Access control. • Physical security measures. • Drills and training. • Security patrols. • Searches. Contingency plans are in place to respond to any potential breaches of security.			
	13.1.4	Procedures are in place to obtain, manage and review current security related information.	Security information is obtained by the company from appropriate sources that may include: • International and national agencies. • Regional Maritime Security reporting centers. • Flag State. • Industry bodies. • Local agents. • Military sources. • Specialist consultants. The responsible person(s) reviews the information and issues relevant guidance to shore-based locations, personnel and vessels as appropriate.			
	13.1.5	Procedures include the reporting of potential security threats and actual security incidents.	The reporting procedures may include: • Internal ship reporting. • Vessel to the company. • Vessel to external authorities. • Company to external authorities.			
	13.2.1	Formal risk assessments of company activities are undertaken to identify and mitigate potential security threats.	The risk assessments are regularly reviewed, updated and company procedures amended as necessary. Ship specific security risk assessments are reviewed prior to entry into areas identified as having an increased risk. Where the risk assessment determines it necessary, ship specific hardening measures are developed, documented and implemented. Consideration is given to the provision of appropriate ship protection marker risk/equipment, which may then be recorded in a vessel's specific ship protection measures/ hardening plan.			
	13.2.2	The personnel responsible for security receive training appropriate to their role and the company's activities.	Training reflects the scope of the company's activities and, where required, meets minimum international or national legislative requirements. Consideration is given to the need to train an alternate for key security roles. A security briefing is provided to all personnel as part of their familiarization process.			
	13.2.3	Policy and procedures include cyber security and provide appropriate guidance and mitigation measures	Risks to IT systems may include: • Deliberate and unauthorized breaches. • Unintentional or accidental breaches. • Inadequate system integrity, such as firewalls and/or virus protection. Systems with direct or indirect communication links, which may be vulnerable to external threat or inappropriate use, are identified. These may include navigation, engineering, control and communication systems. In developing procedures, the company may refer to relevant current industry guidance.			
	13.2.4	The company actively promotes cyber security awareness.	Effective means are used to encourage responsible behavior by shore-based personnel, vessel personnel and third parties. Such behavior may include: • Locking of unattended workstations. • Safeguarding of passwords. • No use of unauthorised software. • Responsible use of social media. • Control/prevention of misuse of portables storage and memory sticks.			
	13.3.1	A travel policy is in place to minimize security threats to personnel.	The policy is based on risk assessment and includes vessel personnel, shore-based personnel and contractors travelling on company business. As appropriate, restrictions and guidance is in place for travel identified as being an elevated risk. The travel policy is regularly reviewed to take account of changes to security threats.			
	13.3.2	Security procedures are updated taking into account current guidance.	Industry guidance may include: • Best Management Practices for Protection against Somalia Based Piracy. • Drug Trafficking and Drug Abuse (ICS). • Maritime Security- Guidance on the ISPS Code (ICS). • Security planning charts. • Guidelines on cyber security from industry and Class. • Large Scale Rescue Operations at Sea (ICS). • Regional Guide to Counter Piracy and Armed Robbery Against • Ships in Asia (ReCAAP-ISC). Company vessels are provided with the latest editions of relevant security related publications.			
	13.3.3	The security policy and related procedures are included in the internal audit program.	The audit assesses compliance with all aspects of company security procedures, including personal awareness and behavior.			
					TOTAL OPEN: 0	

Element 14. The ability of company management to ensure that all personnel, ashore and onboard, possess the knowledge, skills, and commitment required to perform at the highest standards, thereby promoting safe, secure, efficient operations and protecting the environment.		
STAGE	**KEY PERFORMANCE INDICATORS**	**BEST-PRACTICE GUIDANCE**
14.1.1	The SMS defines an inter-departmental group responsible for Human Element matters	This group should include representatives of the relevant corporate functions: operations, safety, ship and technology design/acquisition, recruitment, manning, and training. Ideally as well as managers, the group should include appropriate subject matter experts (SMEs) such as specialists in ergonomics, human factors, and organizational psychology. SMEs could be company employees or consultants brought in to help with specific issues. Importantly input should be sought from front-line personnel in the form of concerns, current problems, and suggested improvements. For convenience this group is referred to here as the Human Element Steering Group (HESG), although companies may choose their own name. The SMS should identify the members of the HESG and list their individual and collective responsibilities. At a minimum, the HESG should meet every six months, with additional meetings to examine significant issues as they arise.
14.1.2	The SMS contains a clear statement of the values that the company requires to be reflected	Common values in the tanker industry may include: • Safety as a priority • Protection of the environment

	in the behaviour of employees and contractors.	• Respect for laws and regulations • Service to customers/clients • Taking care of each other • Proactive action to identify and address potential problems before they arise • Continuous learning and improvement • Teamwork as a value, including the freedom for staff at all levels to speak out on safety concerns • Honesty, respect and equal treatment for all nationalities, ethnic backgrounds, religion, gender, sexual orientation, age, seniority, profession • Freedom from bullying • Fair treatment in disciplinary cases and incident investigations • Ethical business practices • Fair rewards • Care for physical and mental health • Opportunities for professional development • Freedom to exercise professional discretion where appropriate This list is not exhaustive.
14.1.3	The SMS specifies the company will develop and maintain a Human Performance Development Plan	A key responsibility of the HESG is to produce, oversee and maintain a Human Performance Development Plan. This plan should specify how the company is going to address the five pillars of successful human performance (see Introduction to Chapter 14): • Leading and shaping the culture you want • Well executed tasks and procedures • Well designed equipment and controls

		• Skills to respond to emerging situations • Learning before and after things go wrong The SMS should state at what intervals the plan will be reviewed and updated. To begin with, the plan may be fairly general, but over time it should define a detailed programme of actions designed to promote higher standards of human performance, including responsibilities, timescales, resources required, and criteria of success. A fuller account of the five pillars is included in the International Safety Guide for Oil Tankers and Terminals (ISGOTT), 6th edition.
14.1.4	The SMS defines channels of communication between crews on ships and senior management	The SMS should define what information should routinely pass between senior management and crews, how this information should be communicated, and how often. There should also be designated channels for communicating about non-routine events, requests, safety concerns, etc. as well as positive reports on what is working well and suggestions for improvements in working practices. As well as regular communications and reports, there is likely to be a need for special visits (e.g. ship visits by top managers), meetings (e.g. officer forums/conferences), newsletters, surveys and briefings to keep “ship and board room” working smoothly and productively together. A major theme in company

		communications should be how to succeed, not how to avoid failure: what successful performance looks like, what obstacles to success there are, and how these obstacles can be removed.
14.2.1	The company provides training for all personnel in safety critical roles to enable them to respond effectively in challenging situations compliant with "The 2010 Manila amendments to the STCW Convention and Code" and also meets any further company specific requirements.	The STCW 2010 Manila Amendments introduced a range of new requirements for seafarers. The sections of the STCW 2010 Manila Amendments relevant to this chapter are: • Reg. A-II/1 for Bridge Resource Management • Reg. A-III/1 for Engine-room Resource Management • Reg. A-II/2 and A-III/2 for Use Leadership and Managerial Skills • Reg. A-II/1, A-III/1 and A-III/6 for Application of Leadership and Teamworking Skills The STCW 2010 Manila Amendments should be regarded as specifying the minimum requirements. It is recommended that the original Amendments are reviewed to identify additional requirements that should be covered. It is also recommended that the coverage and quality of any training provided to personnel is assessed for coverage and quality.
14.2.2	The company provides personnel on ships with methods, tools and training to assess human performance in safety critical roles.	Assessments should follow a standard procedure specifying: • what tasks should be assessed • under what conditions the assessments should be made • when the assessment should be made • how often the assessment

		should be made • who should make the assessment • the records that should be taken The heart of any assessment should be the walk-through/talk-through of any task with the people that do the job to identify potential problems and opportunities for improved safety.
14.2.3	A procedure is in place requiring the designated onshore managers and Masters to conduct regular reviews of standards of performance of safety-critical crew tasks	The company provides a standard review format based on the Five Pillars, sets the frequency for the conduct of reviews, and maintains records to monitor compliance. Corporate oversight of these reviews should be a responsibility of the HESG (see 14.1.1) Guidance is given for the managers onshore and Masters on the delegation to senior staff of responsibility for reviews. The focus of these reviews are the decisions and actions of individuals and teams carrying out safety-critical tasks. See also the OCIMF-Intertanko Competency Assessment and Verification system with particular attention to: • Navigation • Mooring • Cargo operations • Engineering Where necessary, reviews include assessment of the following factors affecting human performance against defined company and/or industry standards: • Fatigue, stress, boredom and mental health issues

		• Working/living conditions • Design/availability of equipment and tools • Level of professional knowledge and skills • Knowledge of rules, regulations, procedures • Workload and distractions • Shift patterns • Motivation and clarity of goals • Leadership, supervision and support • Teamwork • Relationships with colleagues • Impact of professional standards and requirements, national culture and communication It will not normally be practical to cover all these topics in one review. The master and senior officers should agree the scope of each review, ensuring that all topics are covered over time.
14.2.4	The Master is required to take action to improve any areas of sub-standard performance with support from the company where necessary	If an assessment reveals aspects of human performance where improvement is possible and local action is feasible, the Master together with the shipboard team should initiate action at the earliest opportunity. The assessment records should include what the improvement action was intended to achieve, what action was taken and when. It should also be noted when results of the action are to be reviewed, and whether they have been successful. Where a human performance improvement is identified that exceeds what can be addressed on ship, the Master should notify the company of the problem and their recommended action.

14.3.1	Comprehensive independent human performance audits are conducted while on passage by a suitably qualified and experienced person.	Human Performance Reviews by ship personnel are complemented with audits by an independent auditor or auditing team that includes staff qualified in applied or organizational psychology, and/or a safety professional with experience in the practice and drivers of behavioural safety and resilience. A representative sample of fleet vessels are independently audited for human performance while on passage at least every 2 years.
14.3.2	The company operates an Error Management System (EMS).	It is important to keep in mind that the purpose of the EMS is not to assign blame, but to support the company in its striving for and delivering operational excellence. The EMS exists to inform the strategic plan for improving effectiveness and safety. It should support the building of stronger performance and proactively eliminating critical failures. The SMS defines the following elements of the EMS: • EMS aims, methods and responsibilities, including its relationship to the company incident reporting system (see Element 8) • Training of crews and investigators in their respective roles in the EMS • Relevant policies, rules and procedures • Details of errors to be formally reported • The use of confidential reporting

		• The conditions when a formal investigation is required • The investigation process • Disciplinary measures and rights of appeal • The communication of investigation findings and recommendations • The collation and analysis of all error data for company learning The company makes resources available to regularly analyze and report adverse event and near miss data at: • Team and department level at least every six months • Ship level at least twice per calendar year • Company level at least once per year There are procedures in place to follow up on recommendations to ensure they have been acted upon and to assess how successful they have been.
14.3.3	The company provides all personnel engaged in safety-critical activities to facilitate advanced training in decision making under pressure, and teamwork	To take on a particular role in tanker operations a person must demonstrate they have certain levels of competence. At the beginning the person will typically have achieved the minimum standards. To move beyond the minimum requires practical work experience and focused training. This can be characterized as a progression from competent to proficient to expert. At Level 1 a company provides support to all personnel engaged in safety-critical activities to raise their competences to higher levels of proficiency and

		eventually expertise. Each individual should have a plan for continuing professional development (CPD) which is reviewed and revised annually in consultation with their superior/manager. The company should support individuals and teams by providing appropriate in-work opportunities for wider and deeper learning experiences, supplemented with formal training courses. In the area of safety, a key need is for individuals at all levels to develop their abilities to continue to make good decisions even in the most stressful of situations. Evidence from accident investigations reveals that poor, late or non-existent decisions are common contributors to the cause or mis-management of accidents. Poor decisions are often associated with poor teamwork. Level 2 requires seafarers to have training in Bridge Resource Management, Engine-room Resource Management and Human Element Leadership and Management as appropriate. Training courses in these areas typically provide valuable but basic introductions to decision making, stress management and teamwork. However, the ability to make decisions when facing serious threats and limited time to act demands high quality information, experience in

		knowing what to do and the ability to control emotions. At Level 3 individuals and teams should have regular opportunities to rehearse a wide range of safety-critical scenarios and conditions. These could include: • Drills in the workplace • Table-top exercises • Sessions in bridge and/or engine room simulators
14.3.4	The company should regularly review levels of motivation in staff engaged in safety-critical work.	All human performance at work depends on motivation. Without motivation, performance will fall short of the safe, reliable standards required on a tanker. Staff turnover is likely to be high, reducing overall levels of competence. To monitor motivation levels, a regular review across the workforce should be undertaken at least every two years. Possible sources of data for a review can be: • Staff surveys • Routine performance appraisals • Observations from Master and senior staff • Feedback from human performance audits (see 14.3.1) • Reports via the EMS (see 14.3.2) Where the review identifies motivational issues, the company should seek to make improvements. These can involve fundamental and wide-ranging changes in how the company operates. Changes might be needed in policies and

		practices including: • Recruitment, manning and contracts • Job design and crew structures • Rewards and career progression • Management style • Disciplinary measures • Communication and consultation about company plans and directions • Employee support programmes • Accommodation and food • Social and leisure arrangements

STAGE	KEY PERFORMANCE INDICATORS	BEST-PRACTICE GUIDANCE	SMS REF. (COMPANY)	COMPANY'S COMMENTS	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]				
				TOTAL OPEN:	0	

Conclusion

The Tanker Management and Self-Assessment (TMSA) program is a fundamental tool for driving **operational excellence** and **continuous improvement** in the maritime industry. By systematically assessing performance against a comprehensive set of KPIs and best practices, companies can proactively identify and address weaknesses in their management systems and onboard operations. This self-assessment process is not merely a compliance exercise but a strategic approach to enhancing safety, protecting the environment, and ensuring the well-being of all personnel. The detailed guidance provided within the TMSA framework, from personnel management and navigational safety to incident investigation and security, forms a roadmap for organizations committed to maintaining the highest standards. Ultimately, the TMSA framework enables a robust culture of safety and accountability, ensuring that companies are well-prepared to navigate the complexities and challenges of modern maritime operations.

Acknowledgement

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Chapter 6: VR Application

1. Introduction

Building on the analytical foundation of the preceding chapter, this section explores how real maritime accident data is transformed into immersive training scenarios under the OPTIMSM training programme. By recreating hazardous situations in a safe, virtual environment, the programme enables seafarers to practise critical safety procedures, improve hazard recognition, and internalise lessons from real-world incidents.

As a part of the preparation of the OPTIMISM training programme, over 1000 accidents have been analysed, then some 100 accidents have been picked from this pool. Out of these 100 accidents the four most impactful incidents involving enclosed spaces onboard ships were picked and analysed to prepare several case studies.

Case Study 1

The incident took place on board a cargo vessel during routine preparations for loading at the next port. The Chief Officer (C/O), tasked with ensuring that the ship's empty tanks were clean and ready, inspected one of the tanks and found traces of dampness and residue. Determined to have the tank ready in time, he decided to remove the remaining material with the assistance of the bosun and two ordinary seamen (OS), referred to here as OS A and OS B.

The decision to enter the tank was made quickly. No gas freeing was carried out. No checks were performed to assess oxygen levels or detect the presence of hazardous gases. The crew carried neither a portable gas detector nor the required personal protective equipment (PPE). It was a breach of the most fundamental safety protocols for working in enclosed spaces—a high-risk environment known for oxygen depletion and toxic gas accumulation.

As the work began, OS A started feeling drowsy and light-headed, early warning signs of oxygen deficiency. Looking around, he saw OS B lying motionless on the floor at the bottom of the tank. Alarmed, he left the tank to alert the bosun, who in turn reported the situation to the C/O. In the course of the rescue attempt, the C/O himself was exposed to the same hazardous atmosphere. OS B eventually regained consciousness after receiving assistance, but tragically, the C/O did not survive.

The investigation revealed a chain of failures that allowed this fatal accident to occur. First and foremost was non-compliance with enclosed space entry procedures. The C/O and crew bypassed critical safety measures such as atmosphere testing, ventilation, and the use of PPE. The ship's Safety Management System (SMS) contained policies and procedures for enclosed space entry, yet these were either inadequately enforced or ignored entirely.

The culture on board appeared to prioritise operational efficiency over safety. There was insufficient supervision to challenge unsafe decisions, and the team composition lacked a designated safety watch or competent person to assess the hazards. Knowledge gaps and inadequate training were also evident—particularly regarding the dangers of oxygen depletion and the correct use of gas detection equipment.

This accident was entirely preventable. If the SMS had been strictly followed, gas levels would have been checked before entry, ventilation would have been carried out, and PPE—including breathing apparatus—would have been worn. Crew training should have reinforced the fact that even experienced officers are not immune to the dangers of enclosed spaces. Shipping companies must take proactive steps to provide regular, scenario-based training, carry out unannounced safety drills, and maintain rigorous internal audits to ensure compliance.

Case Study 2

The incident occurred in the engine room of a bulk carrier during a routine voyage. The vessel had experienced recurring problems with the main engine's fuel injector pumps. On this day, the Chief Engineer (C/E) instructed two engine crew members—Motorman A and Motorman B—to carry out maintenance while the engine was running at low load. It was a task they had performed before, but the approach taken on this occasion would prove catastrophic.

The maintenance involved replacing a fuel injector pump on the port side of the engine. Standard safety protocols required that the fuel supply be isolated, pressure released, and the area adequately ventilated before work commenced. However, pressed for time and aiming to avoid delays to the ship's schedule, the crew bypassed these steps.

As the motormen loosened the securing nuts, fuel under high pressure sprayed into the surrounding hot engine components. Within seconds, atomised fuel vapour ignited on contact with the engine's heated surfaces, triggering a violent explosion. Flames erupted instantly, filling the confined engine room space with thick black smoke and intense heat.

Motorman B, positioned closest to the blast, sustained severe burns to his face and hands. Motorman A was thrown backwards by the force of the explosion, suffering injuries to his legs and back. The C/E, who was in the control room at the time, immediately initiated the engine room fire response plan. Fire suppression systems were activated, and the crew managed to bring the fire under control within minutes. However, both injured crew members required urgent evacuation to shore for medical treatment.

The investigation identified multiple safety violations and lapses in judgement. The most critical was the decision to perform high-risk maintenance on a running engine without isolating the fuel system. The lack of adherence to lock-out/tag-out (LOTO) procedures created a dangerous environment in which pressurised fuel lines were exposed to ignition sources.

Compounding this were deficiencies in risk assessment. No formal assessment had been documented, and no toolbox talk was held to identify hazards and agree on a safe method of work. It was evident that a culture of expediency had taken root—where operational continuity was valued above strict compliance with safety protocols.

This explosion was entirely avoidable. Following standard procedures—isolating the fuel supply, depressurising the system, wearing fire-resistant PPE, and ensuring adequate ventilation—would have removed the ignition risk entirely. Training on the dangers of hot work and fuel system maintenance in operational conditions should be reinforced for all engineering staff, regardless of experience level.

Case Study 3

The International Safety Management (ISM) Code, established by the International Maritime Organization (IMO), sets a structured framework to ensure the safe operation of ships and the prevention of marine pollution. Under the Code, ship operators must maintain a Safety Management System (SMS) that includes procedures for the safe entry into enclosed spaces, which are widely recognised as one of the most dangerous environments on board. In this case, the accident occurred on a vessel carrying logs, where the cargo hold presented a hazardous enclosed space. The Code of Safe Working Practices for Merchant Seafarers requires all unattended dangerous spaces to be locked or otherwise secured against entry, and for any access points to be clearly marked as dangerous spaces. The hatch in question was marked only with "Restricted Area Authorized" – a designation that did not meet the Code's requirement for explicit "Dangerous Space" signage, nor was it secured to prevent entry.

Two stevedores, while engaged in operations on board, approached and entered the cargo hold without authorization from ship officers. The ship management failed to prevent this by ensuring both the physical security of the hatch and the clarity of its hazard markings. With no physical barriers in place and an ambiguous warning sign, the stevedores proceeded inside, unaware or unmindful of the enclosed space risks. The cargo hold, containing logs, was oxygen-deficient and presented an immediate threat to life. Tragically, both stevedores succumbed shortly after entry, with emergency response efforts unable to save them. The sequence revealed both procedural breakdowns and inadequate hazard communication.

The investigation concluded that the accident was the result of two primary failures. Firstly, ship management acted recklessly in not fully complying with the Code of Safe Working Practices, failing to lock or secure the cargo hold access hatch and not marking it with the mandatory "Dangerous Space" warning. Secondly, the two stevedores made a critical procedural error by disregarding shipboard enclosed space entry protocols, entering without authorization or a permit-to-work. The inadequate signage – "Restricted Area Authorized" instead of the required "Dangerous Space" designation – compounded the risk, as it did not clearly communicate the life-threatening hazard inside. These errors collectively created an environment where the fatal entry could occur without intervention.

This tragedy could have been entirely avoided had the shipboard enclosed space entry procedures been followed and enforced. Securing the access hatch, in compliance with the Code, would have physically prevented unauthorized entry. Additionally, correct hazard markings would have provided a clear warning, reinforcing the need for adherence to the permit-to-work system. Proper crew training, frequent safety drills, and vigilant enforcement of SMS procedures would have ensured that both ship crew and visiting workers understood and respected the dangers of enclosed spaces. With these measures in place, the likelihood of recurrence is negligible.

Case Study 4

The International Safety Management (ISM) Code, adopted by the International Maritime Organization (IMO), provides a structured framework to ensure safe ship operation and protect

personnel and the environment. It requires shipping companies to implement and maintain effective safety management systems, including procedures for safe entry into enclosed spaces. In this case, a bulk carrier was carrying soya beans—a fumigated cargo that can emit toxic gases such as phosphine. Despite the presence of a gas-free certificate, the vessel's enclosed space entry procedures and risk assessments were incomplete or inadequately applied, particularly concerning the detection of phosphine gas, which was not monitored by the onboard gas detection equipment.

While the bulk carrier was at anchor, an ordinary seafarer entered the cargo hold containing soya beans and collapsed due to exposure to lethal phosphine gas levels. Upon hearing the alarm, the chief officer entered the hold to assist but also collapsed. Both individuals were subsequently rescued by a team wearing breathing apparatus and transferred to shore-based medical care. The chief officer recovered fully, but the ordinary seafarer succumbed to the toxic exposure. The investigation revealed that procedures for enclosed space entry were not followed, and essential risk assessments and proper gas detection were missing prior to entry.

The primary root cause was procedural error and unsafe assumptions. Although the cargo holds were identified as enclosed spaces, the mandatory enclosed space entry procedures were not followed. The crew assumed the holds were safe because the vessel possessed a gas-free certificate, leading to the omission of phosphine gas detection. The vessel's multi-gas meter lacked sensors for phosphine, a critical oversight given the fumigated nature of the cargo. Furthermore, key risk assessment forms (S-18 and SM-15-01/02) were not completed as part of the risk management process. These failures in risk assessment, hazard identification, and monitoring created conditions that led to the fatal exposure.

This accident was preventable. Strict adherence to enclosed space procedures, including comprehensive risk assessments and verification of the presence of hazardous gases, would have mitigated the risk. Specifically, carrying and using appropriate gas detection equipment with phosphine sensors prior to entry is essential for fumigated cargoes. The gas-free certificate should be reassessed to reflect the specific hazards associated with fumigated cargoes. Company policies on mandatory use of breathing apparatus when entering holds where pesticides have been applied were subsequently implemented. Enhanced training on enclosed space risks and safety culture for all personnel before joining vessels is critical to prevent recurrence. Additionally, improved oversight of risk assessments through ISM audits by Flag State authorities and Recognized Organizations will further reduce such incidents.

The patterns of procedural neglect, inadequate risk assessments, and poor safety culture identified in the preceding case studies serve as the direct blueprint for VR Emergency @ Sea which is utilised in this chapter. The hard-learned lessons are transformed into a fully functional and immersive VR training application. The ultimate goal is to deliver a high-fidelity tool that enhances the preparedness of maritime professionals for emergencies in high-risk environments, such as enclosed spaces, engine rooms, and cargo holds, ultimately contributing to improved safety in maritime operations.

2. Module Overview: A Targeted Training Experience

The application is composed of several core modules, each meticulously designed to deconstruct the failures identified in the case studies and rebuild crew competency through interactive, experiential learning. The effectiveness of this approach lies in its ability to move beyond passive knowledge transfer and immerse trainees in the very situations where fatal mistakes were made, allowing them to learn from simulated failure without real-world consequences. This section will now explore the deeper pedagogical framework of each module and its potential to foster a lasting culture of safety.

PPE Training & Practice Modules: Rebuilding Procedural Foundations

These interconnected modules are the direct antidote to the procedural chaos and equipment-related failures that led to the tragedies in Case Studies 1, 3, and 4. They systematically address the non-compliance, knowledge gaps, and complacency that defined those incidents by grounding safety knowledge in its practical context. Figure 1 shows a screenshot from PPE training module.

- Direct Link to Case Studies: The core of these modules is built from the chain of failures in the case studies. The failure to test the atmosphere in Case Study 1 and the use of incorrect gas detection equipment in Case Study 4 are addressed by the mandatory and interactive “Calibrate Gas Detector” step. The complete disregard for permits-to-work and checklists is countered by the innovative wrist menu checklist, which digitises and enforces the procedural discipline that was critically absent. The fact that the crew in Case Study 1 entered with no PPE at all is tackled by forcing the trainee to physically identify, pick up, and don each piece of required equipment.
- Effectiveness through Situated Learning: The power of these modules extends beyond simple kinaesthetic learning; they are an application of Situated Learning theory, which posits that knowledge is most effectively learned and retained when it is embedded in the context of its real-world application. By forcing the trainee to perform these tasks not in a classroom but at the virtual entrance to a cargo hold, the training ensures that the knowledge of *what* to do is inseparable from the knowledge of *where* and *why* to do it.

The wrist menu (see figure 1) acts as a "cognitive scaffold," a tool that supports the trainee's performance initially but can be relied on less as they internalise the steps. This process rebuilds the procedural discipline mandated by the ship's Safety Management System (SMS) from the individual level up. The immediate, data-driven feedback from the summary report after the practice module is critical. It depersonalises error, framing it not as a personal failure but as a simple, correctable deviation from a standard procedure, making the lesson easier to accept and integrate.

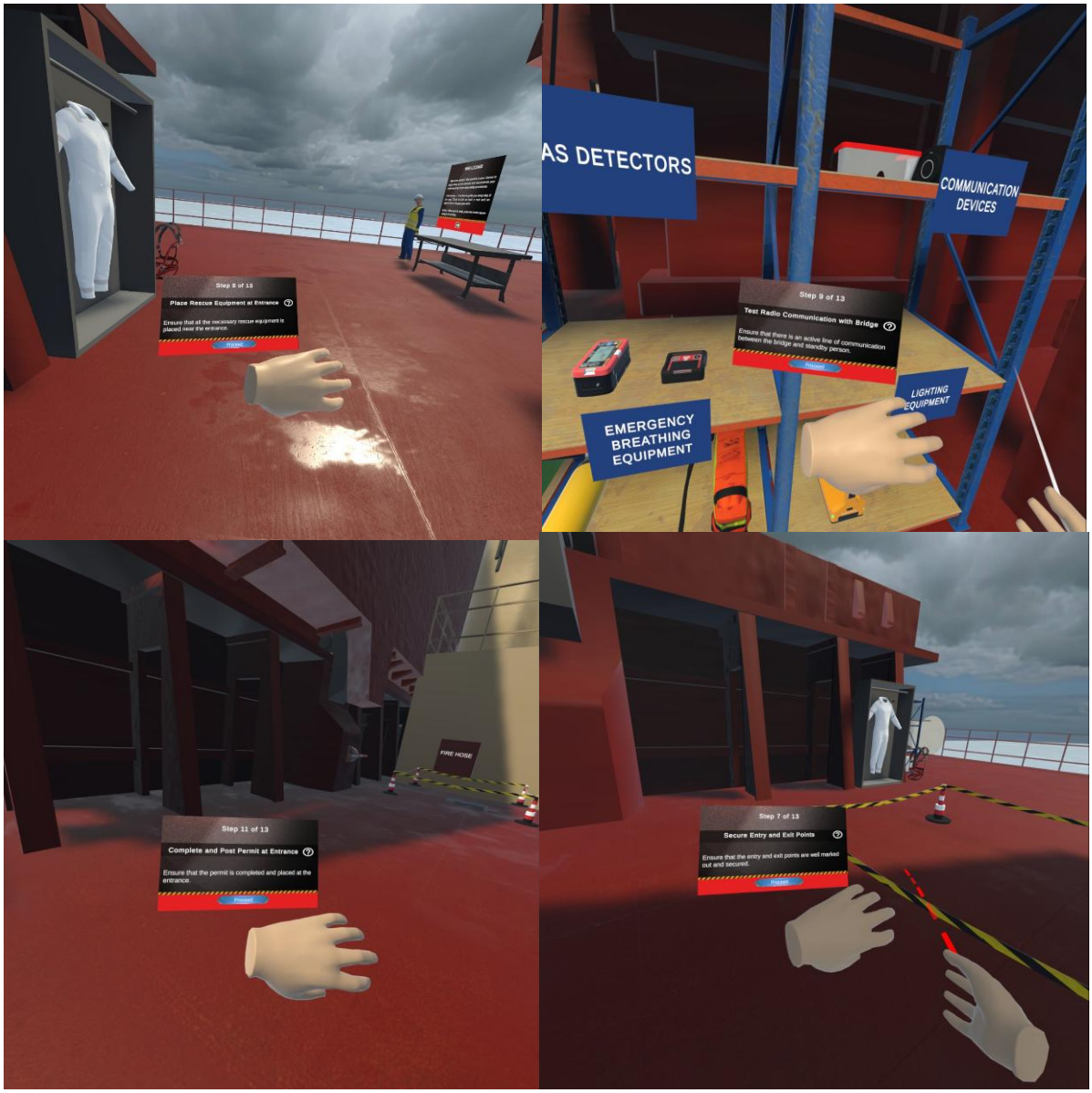

Figure 1:Screenshots from the wrist menu

Enclosed Space Emergency Module: Mastering Decisions Under Duress

This module is a direct simulation of the escalating crisis in Case Study 1, but with a critical difference: the trainee is placed in the role of the potential rescuer, not the victim. This shift in perspective is designed to build the psychological resilience and procedural adherence needed to prevent a bad situation from becoming a fatal one. Figure 2 shows a screenshot from a scene in the enclosed space emergency module.

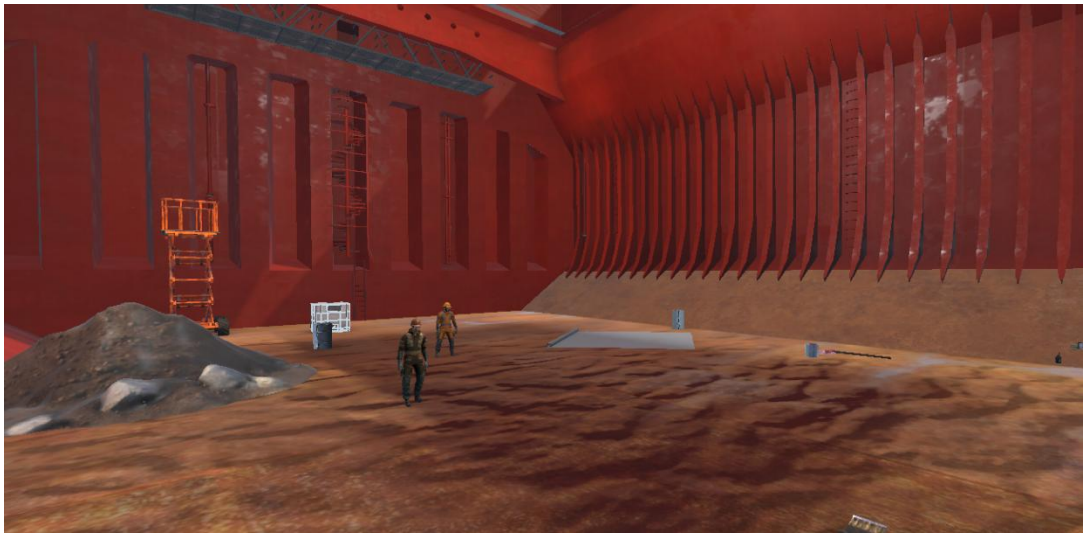

Figure 2: Empty cargo hold as the location of the emergency training experience

- Direct Link to Case Studies: This scenario recreates the precise moment of failure from Case Study 1—a crew member collapsing from oxygen deficiency. It directly confronts the trainee with the consequences of the initial procedural failures they learned about in the previous modules. The need for constant communication with the chief officer via radio and the reliance on the personal gas monitor are reinforced as critical lifelines, directly addressing the communication breakdown and lack of monitoring in the real-world incident.
- Effectiveness through Experiential Learning Cycles: This module's effectiveness is best understood through Kolb's Experiential Learning Cycle. The trainee is rapidly pushed through all four stages:
    1. Concrete Experience: The colleague collapses, and the timer starts. This is a visceral, emotionally charged event.
    2. Reflective Observation: If the trainee fails, the "FAILED" screen forces them to stop and reflect on what went wrong. The debriefing session serves as a more structured form of this reflection, analysing the sequence of events.
    3. Abstract Conceptualization: From this reflection, the trainee forms a new understanding of the principles involved—e.g., "I see now that alerting the bridge *before* approaching the victim is the critical first step."
    4. Active Experimentation: The trainee then re-attempts the scenario, applying their new understanding to change their actions and achieve a successful outcome.

By compressing this entire learning cycle into a few minutes, the VR simulation creates an incredibly potent and memorable learning experience. It trains the user to manage the amygdala hijack the state of panic where rational thought is impaired by repeatedly and safely exposing them to its triggers. This is not just safety training; it is cognitive-emotional conditioning for high-stakes decision-making.

Fire Fighting Training Module: Developing Automaticity and Judgment

Designed as a direct response to the engine room explosion in Case Study 2, this module focuses on building practical, hands-on skills for a hazard that requires instantaneous and correct decision-making. Figure 3 shows a screenshot from a scene in the fire fighting module.

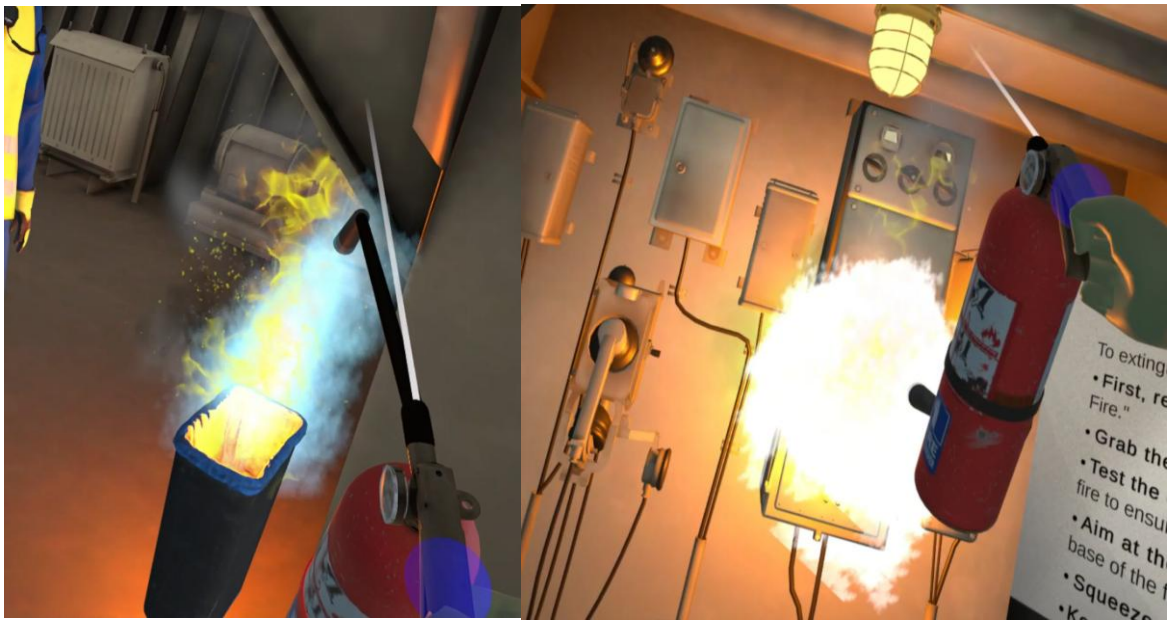

Figure 3: Water & CO2 fire extinguishers in action

- Direct Link to Case Studies: The module directly addresses the catastrophic outcome of working on a pressurised fuel system in Case Study 2 by creating scenarios for Class B (flammable liquid) fires. It moves beyond the specifics of that incident to address the broader competency of fire response. The core failure in Case Study 2 was a breakdown in risk assessment and procedure; this module builds the foundational knowledge of fire types and extinguisher use that is a prerequisite for any fire-related risk assessment. The presence of different fire classes (A, B, and C) forces the trainee to think critically about the hazard, rather than just reacting.
- Effectiveness through Procedural Memory: The key objective here is to develop automaticity—the ability to perform complex tasks with little to no conscious thought. In a fire, there is no time to consult a manual. Repeated practice across different fire scenarios builds procedural memory (or muscle memory), which is far more reliable under stress than declarative memory (simply knowing a fact).

When a trainee has virtually extinguished a dozen electrical fires, the action of grabbing a CO2 extinguisher becomes an automatic, conditioned response, not a slow, deliberate choice. Crucially, the module also trains the "negative" skill: judgment. By reinforcing the rule to evacuate from large fires, it helps build the cognitive framework needed to override the heroic instinct to fight an unwinnable battle. This directly counters the culture of expediency seen in Case Study 2, replacing reckless action with trained, intelligent response.

3. Long-Term Impact: Reshaping Organizational Safety Culture

The ultimate goal of the OPTIMISM programme is not just to train individuals but to catalyse a fleet-wide shift in safety culture. The VR application is a tool for this organizational change.

- Data-Driven Safety Management: Anonymized performance data from all training sessions can be aggregated into a central dashboard for a company's Designated Person Ashore (DPA). If, for example, this data reveals that 60% of crew members initially fail the phosphine gas detection step (from Case Study 4), it signals a systemic knowledge gap, not just an individual one. This allows management to move from reactive, post-incident investigation to proactive safety assurance, implementing targeted campaigns, bulletins, or hands-on drills *before* the next accident occurs.
- Systematically Countering Complacency: The VR training directly attacks the "culture of expediency" that was a root cause in nearly all the case studies. In the virtual world, there are no rewards for taking shortcuts; they are hard-coded to lead to failure. Procedural compliance is consistently reinforced as the only pathway to success. By allowing crew members to repeatedly experience this direct, unambiguous relationship between actions and consequences in a powerful and memorable way, the training systematically rewrites the dangerous mental models that value speed over safety. It provides a shared experience and a common language for safety that can help transform a company's SMS from a document on a shelf into a living, breathing part of daily operations.
- Manual to use the VR Applications

Recognizing that users will have diverse levels of experience with virtual reality (VR), the application begins with a dedicated orientation designed to serve as a manual for its use. This initial experience is set within a spacious ship's office, an environment crafted in consultation with subject matter experts to be both realistic and comfortable. The expansive layout provides a safe and unconstrained area for new users to practice controls without pressure.

Upon entering the virtual environment, users are guided through a structured orientation procedure. The training methodology combines auditory narration from a virtual officer with corresponding visual text prompts displayed on-screen. A custom script synchronizes these audio and visual elements, ensuring the instructions are clear, cohesive, and easy to follow.

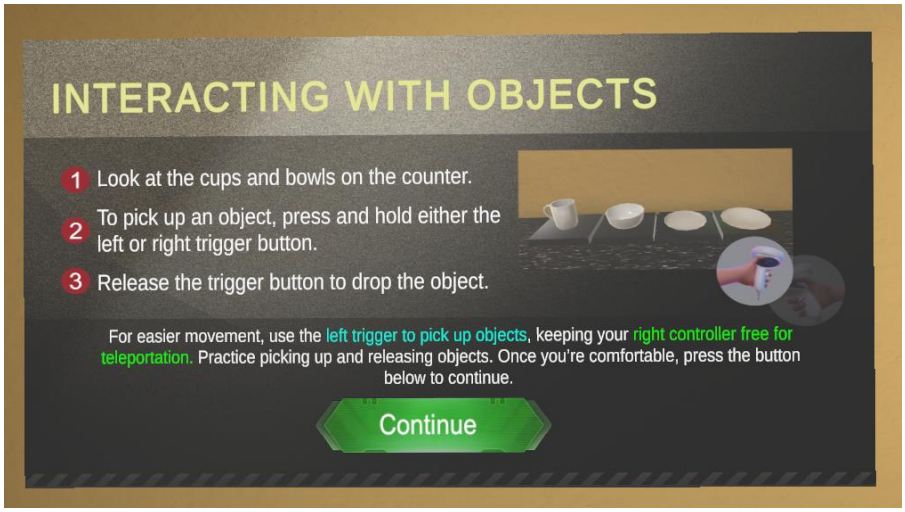

Figure 4: Instruction for interacting with objects

Figure 4 shows screenshot from user manual in the application. The orientation provides step-by-step instructions on fundamental VR interactions. Users are explicitly taught how to use the controller for two primary functions:

- Navigation: Learning to move around the virtual space.
- Interaction: Learning how to use the controller to select and press on-screen buttons.

This foundational training ensures every user is equipped with the core skills needed for all subsequent training modules. The orientation concludes with the presentation of the **Main** Menu, which displays a complete overview of all available training modules. From this screen, users are prompted to select a module to officially begin their training experience.

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