Risk Management in the Maritime Industry: A Theoretical Study of Factors Influencing Safety and Quality in Shipping Operations

by

Alexandros Gorgias

B.Sc., Mechanical Engineering, Technical University of Munich, 1998
M.S., Mechanical Engineering, Technical University of Munich, 2000

Submitted to the Department of Ocean Engineering
in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Ocean Systems Management

at the

Massachusetts Institute of Technology

February 2002

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Signature of Author

Department of Ocean Engineering
December 15, 2001

Certified by

Henry S. Marcus
Professor of Marine Systems
Thesis Supervisor

Accepted by

Henrik Schmidt
Professor of Ocean Engineering
Chairman, Department Committee on Graduate Students
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Abstract

The maritime industry is currently experiencing changes related to safety and quality of operations. The International Safety Management Code is a regulatory instrument that focuses on management and organizational issues in the maritime industry and requires the shipping companies to improve their operations. The goal of this thesis is to provide a theoretical framework for how shipping companies should manage operational risks and seek continuous improvement in their performance. First, all the potential risks facing a shipping company are identified. Then, the key issues affecting risk management in shipping are investigated with an eye to the latest trends in the industry. Finally, a new approach to managing risks is suggested.

Thesis Supervisor: Henry S. Marcus
Title: Professor of Marine Systems
Acknowledgements

First of all I would to express my gratitude to my advisor Prof. Henry Marcus. His guidance, support, and easygoing character not only contributed to this thesis, but also inspired my personal and professional development. I would like to thank my parents and my brother for their continuous support and enthusiasm throughout my education.

I would also like to thank:

Capt. Jon Calder for his help and support throughout this thesis.

My friend and colleague Anthony, who was always there for me when I needed help.

Prof. Gutowski for trusting me with a teaching assistant position.

Prof. Sarma for including me in the very exciting Auto-ID project.
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Glossary of Terms

- **Hazard**: a source of potential harm, or a situation with a potential for causing harm, in terms of human injury; damage to health, property, the environment, and other things of value; or some combination of these.

- **Risk**: the chance of injury or loss as defined as a measure of the probability and severity of an adverse effect to health, property, the environment, or other things of value.
1 Introduction

In today's world, a number of major maritime accidents have increased the public's awareness of the dangers involved in transporting goods at sea. As a result, the maritime industry has come under substantial pressure to reduce the risks of such accidents.

Maritime accidents are classified as low probability/high consequence events. That is, the probability of a major maritime accident is considered relatively low; however, the consequences are in some cases extremely high, resulting in significant overall risk. In order to survive, shipping companies need to eliminate or control such risks. As Benjamin Franklin said, "an ounce of prevention is worth a pound of cure."

The attitude of the maritime industry has been primarily reactive. The focus has been to minimize the consequences of major accidents. Shipping companies have been dealing with risk primarily through marine insurance. With this approach, only as much information is gathered as is necessary, in order to settle the insurance claim.

To meet the new demands to prevent accidents, a different approach is needed. The general theories of accident and loss prevention are based upon the premise that there is a need to continuously improve the system by gathering and evaluating objective data, with which to assess levels of risk. There is also a need to address human and organizational factors affecting the safety of shipping operations. The International Safety Management (ISM) Code is a
regulatory instrument focusing on these issues in the maritime industry. In order to meet the requirements of the ISM Code, shipping companies must identify all risks and develop preventive or corrective measures for those risks.

1.1 Thesis Objectives

The goal of this thesis is to provide a theoretical framework for how shipping companies should manage operational risks and seek continuous improvement in their performance. First, all the potential risks facing a shipping company are identified. However, due to length limitations, this work focuses mainly on operational risks. The key issues affecting risk management in shipping are investigated with an eye to the latest trends in the industry. In particular, human and organizational factors are analyzed. Some strategies to manage them are then proposed. Shipping companies need to integrate risk management principles into their safety management system, in order to improve quality of operations.
1.2 Outline

Following this introduction, Chapter 2 introduces and describes the concept of risk-based decision making. Chapter 3 focuses on the different kinds of risk faced by a shipping operator. It further presents the ISM Code and discusses some of the implications for the shipping industry. Chapter 4 discusses the key issues affecting the safety of shipping operations. First, it analyzes the factors affecting human error and then it proposes several strategies to reduce it.

The conclusions of the analysis are presented in Chapter 5, accompanied by some suggestions for further research.
2 Risk-Based Decision Making

Although the concept of risk-based decision making has been accepted and applied in various ways for many years, there appears to be no common understanding of what it means. This chapter seeks to provide a common understanding of what risk-based decision making is and what its most important features are.

Participants in the maritime industry (as in any industry) are frequently faced with difficult decisions. Risk-based decision making processes have been the subject of a great deal of interest recently, because of their ability to encode and incorporate the uncertainties inherent in today's highly complex and variable environment. Risk-based decision making provides a process to ensure that decisions reached are optimally consistent with the goals and stated values of the organization.

To use risk-based decision methods, there is a need to analyze the term "risk". Risk can be characterized in terms of probability (the likelihood of a hazard occurring), consequence (the monetary and non-monetary "costs" of a hazard) and sensitivity to countermeasures (susceptibility to risk management measures), as shown in Figure 2-1 [5].
Risk characteristics can be rated either qualitatively (e.g. low, medium, high) or quantitatively (numerical values), depending on the available data.

Risk-based decision making has five major components, as shown in Figure 2-2.

Figure 2-2: Risk-based decision making process

This is an iterative, never-ending process. The first is the identification of a set of goals for the organization. The involvement of stakeholders in identifying goals and problem areas is critical. With increased stakeholder involvement come many benefits, such as better understanding and acceptance of the goals.
Although the goal selection step is very important, it will not be analyzed further here.

### 2.1 Risk Assessment

Assessing risks is necessary, in order to identify their relative importance and to obtain information about their extent and nature. Risk Assessment is the process of identifying potential hazards in the system, and ranking them in terms of risk characteristics, as defined previously. The ranking of risk characteristics can be done on a qualitative and/or a quantitative basis, depending on the time and data available. The majority of hazards are identified by using simple qualitative techniques. The most severe hazards are further analyzed with quantitative techniques, if data is available.

Risk assessment should cover a greater scope than is customary in the marine field – e.g., not just look for oil in the water. The scope of risk assessment can include health effects, facility damage, human aspects, organizational components, and other attributes. Risk assessment in the maritime field lacks a set of common principles and methods because of its unique nature. There is a need for validated tools that can point out what we really need and why. The challenge is lack of data, particularly lack of good human factors data. Current assessments rely heavily on experienced mariners.

Successful risk assessment provides an enhanced basis for risk management. The latter is discussed in the next section.
2.2 Risk Management

Risk management is the process of evaluating alternative risk minimization/mitigation actions, selecting from among them, and implementing them in an integrated fashion to optimize risk reduction efforts. Risk management uses the risk characteristics (probability, consequence, sensitivity) developed during the risk assessment phase, in order to control risk. For example, if a risk is ranked high due to a high probability of occurrence, then countermeasures must be developed to prevent the hazard from occurring. If a risk is ranked high due to large consequences, then measures must be developed to minimize the potential effects. Sensitivity is used as an indicator of the potential effectiveness of risk management. Countermeasures are applied to a hazard until the sensitivity decreases to a point, where further risk management is not an attractive option. Therefore, sensitivity is an important factor in decision making.

Risk management can be performed with various tools and methods. One common tool for developing risk management actions is the error causal chain. The causal chain, shown in Figure 2-3, is a graphical representation of how mishaps are generated.
While the diagram shows the emergence of a mishap from left to right, risk management and analysis follow the reverse path. Examples of possible countermeasures against the development of the disaster are shown before each stage. It can be seen that the sooner in the causal chain that countermeasures are enacted (e.g., prevent error causes vs. minimize accident impacts), the more effective and efficient they will be.

It is important to recognize that for every serious accident there are a lot of warnings that have not been heeded. It has been scientifically found that for every serious accident there are 30 warnings in the form of minor accidents and 300 in the form of near-misses. Similarly, these reflect 3000 unsafe acts and conditions [14]. These warnings should be taken seriously, since each of them could have led to a serious accident if the conditions had been slightly different. It
is therefore necessary to incorporate those warnings into any risk management analysis to help prevent recurrence.

2.3 Impact Assessment and Risk Communication

Given today's climate of rapid change and rough competition, organizations must continually seek to improve. In order to provide input for future goal selection and risk assessment, an assessment of the effect of the countermeasures used must be conducted. In this stage, data collection and process analysis take place in order to identify and rank the changes in risk resulting from risk management activities. This is done to ensure that the decisions made remain optimal, given the changes to the system that inevitably take place.

Risk communication is an interactive process of exchanging information and opinions among the stakeholders. Communication between stakeholders and experts can be difficult for a number of reasons. Stakeholders and experts often have different levels of knowledge related to specific issues. Things that are not well understood by all parties often result in misunderstandings. The decision process should be open and transparent to build trust between decision-makers and other stakeholders. If there is trust among all stakeholders, the decisions stand a better chance of being accepted.
3 Managing Risk in Shipping Companies

The shipping industry is highly competitive with over-tonnaging in most sectors. Operational and capital costs are generally increasing, but revenues remain flat. It has therefore been a market where charterers have selected the lowest bidder for transportation services, which has resulted in lower quality standards and fewer funds available for maintenance and crew training.

Most shipping companies are getting more complex, affected by regulation, international economics, and technological development. High intelligence and sound judgment will be required of management [26]. Like all disciplines, safe practices have to be learned and improved. Once a company loses its commitment to safety standards, it reduces its ability to contain risk. This important lesson is re-learned every time there is a marine disaster, but by that time it is too late [30]. On the other hand, in a competitive market where other companies are innovating, restructuring and seeking competitive advantage through quality, customer relations, economies of scale and financing deals, it is not possible to stay still for long and commercial risks have to be taken.

This chapter intends to analyze risk management issues from an operator's perspective. The first section focuses on the different kinds of risk faced by a shipping company. The second section presents the ISM Code and discusses some of the legal and practical implications. Finally, the third section is concerned with risk management of design activities in the context of shipping.
3.1 Types of Risk

In today’s maritime world, shipowners are faced with multiple types of risk on an ongoing basis. In this section those risks are divided into three distinct categories: financial risk, operational risk, and environmental risk. The fact is that environmental risk can be seen as a consequence of operational risk; however, it will be analyzed separately due to the importance of safety and environmental protection as issues today.

3.1.1 Financial Risk

Merchant ships are a large capital investment. In a world where the volume of trade is constantly changing, someone has to decide when to order new ships and when to scrap old ones. Managing financial risk can be a very difficult process in a business where there is great uncertainty about the future.

Shipping companies are exposed to a world economy, which itself is extremely volatile and uncertain. All industries face this variability to some extent, but the shipping market alone has internal cyclical dynamics. Each shipping cycle is controlled by the supply and demand equilibrium. On the one hand, the world economy, political events, the average haul, and transport costs affect demand; while fleet productivity, shipbuilding production, and tonnage retirement affect supply. The way that these variables equilibrate themselves is through the freight rate market. When ships are in short supply, freight rates increase and shipowners order new ships. When these ships are delivered, freight rates depress, leading to increased lay up and scrapping, causing the supply of
vessels to decrease and freight rates to increase once again. However, this process is not instantaneous. The time lag between the placement of the order and the delivery, is usually between 18 and 24 months.

The supply of vessels is determined by the interplay between four shipping markets: the newbuilding market, the freight market, the S&P market, and the demolition market. During a market downturn, the newbuilding market collapses and the demolition market flourishes. At the point in the cycle when the freight rate market is at its peak, the newbuilding market is most active, while the demolition market declines. All ships are operational and running at full speed. Under such conditions, the mismatch in supply and demand can only be settled in the long run, when the newly built vessels are delivered. The S&P market is usually active during both times, energized by speculators who play their game of seeking fast profit. The demand of vessels depends chiefly on events and conditions external to shipping itself, as noted above. Most of the imbalance between supply and demand is settled in the realm of the supply of vessels, as discussed.

Financial risk involves the chance that the shipping company will not be able to meet its interest payments, debt obligations, or pay out dividends to its owners. Downturns in market cycles, poor financial planning, and excessive expenditures are often causes of this condition for shipping companies. Effective management of the financial risks that shipowners encounter can be achieved through the use of several instruments. Forward Freight Agreements provide a means for limiting or increasing exposure to risk in historically volatile
markets. Derivative contracts also allow for hedging against certain financial risks such as interest-rate risk, currency risk, and fuel price volatility.

3.1.2 Operational Risk

Operational risk arises from the performance of the ship and the shipping company’s adherence to safety and maintenance standards. Each shipboard operation can be associated with a certain risk. For example, the way the ship is maintained can influence the probability of any equipment or mechanical failure.

3.1.2.1 Human Element

The human element has a substantial impact on the reliability of shipboard and shore operations. Based on statistics, the major cause of accidents is human error. The United Kingdom P&I Club performed an analysis of claims filed in 1993 in which it was discovered that human error was the primary cause of 66% of those accidents [29]. Figure 3-1 shows the distribution of causes.
Due to the large number of accidents caused by human error, success in reducing operational risk in shipping depends primarily on measures to improve human performance [18].

As Figure 3-1 shows, a significant portion (44%) of the major accidents is resulted from crew on board (including officers) errors. In many commercial maritime environments, mariners traditionally endure harsh working conditions, extreme temperatures, long work hours, frequent separation from family, and fatigue. Crew members, working under these conditions, experience frequent lapses of attention that ultimately set the stage for the occurrence of errors in job performance. As a result, these factors have a direct impact on productivity and
safety. It is, therefore necessary, that the company's management as well as the masters have a clear understanding of work-related risk factors that compromise performance. These factors must be controlled in order to maintain performance within safety limits. Human and organizational factors affecting shipping operations will be further analyzed in Chapter 4.1.

3.1.2.2 Passage Planning

Section 7 of the ISM Code requires the preparation of plans and instructions for key shipboard operations concerning the safety of the ship and the prevention of pollution. While preparing the passage plan, the navigating officer must ensure that the charts and publications to be used are fully up-to-date. There is still an unacceptably high incidence of reports of ships with out-of-date nautical charts and publications. In 1993, the UK P&I Club's ship inspectors carried out 555 ship inspections [25]. In 43% of these it was necessary for the inspector to record comments on service and maintenance issues: 48% of these comments related to charts (19%) and nautical information (29%).

The voyage planning process is an area where the disciplines of risk management can be applied to good advantage. The hazards related to the voyage need to be identified and their potential risk assessed. There are a number of factors which may be relevant, and these need to be prioritized. Safe navigation has an obvious priority, but how does this relate, for the voyage in question, to the need for a fast passage, or the need to find favorable currents and conserve bunkers? Options which the master may have to balance include
whether weather routing will avoid inclement weather, but take the vessel into areas of high traffic density, with little or no net benefit. Or, if deck maintenance is required, a longer and more equatorial route may be justified. Many of these conflicting options can have monetary values allocated to them (such as the cost of bunkers, the vessel's day rate, or the cost of shore as opposed to ship's maintenance), so that a real cost-benefit analysis can and should be undertaken.

3.1.2.3 Cargo Operations

There are several risks related to cargo operations. For example, there is a legal risk inherent in signing the bill of lading as a receipt for the cargo loaded. In addressing the bill of lading as a receipt, the master will need to check the weight and quantity of the cargo, condition and quality of the cargo, date of bill of lading, additional clauses, and letters of indemnity. In case of a dispute about the quantity of the cargo, the burden of proof is on the carrier to prove that the said quantity of cargo was not loaded, unless the bill of lading contains the statement “weight and quantity unknown.” In that case, the burden of proof is shifted onto the shipper to prove that the stated quantity was, in fact, shipped.

The company's risk manager should not focus only on the cargo operation itself, but should also consider matters such as the weather forecast and its possible impact on cargo operations, times of high and low water, and any draught restrictions, etc. During the loading process, one of the most important risk control measures is to have active and observant officers continually out and about on deck and monitoring the vessel's stability and stress condition.
3.1.2.4 Charter Parties and Other Documents

Responsibility for risk control measures for commercial aspects lies mainly with the chartering department, which must ensure that the correct clauses are contained within the contracts of carriage. The most important documents governing the commercial and legal relationships between the parties are charter parties and bills of lading. In addition, there are documents such as cargo manifests, invoices, and Customs declarations, etc., which are required by various authorities. Figure 3-2 shows the relationship between the various parties contractually linked in the movement of goods by sea and indicates where the crucial linkages lie.
Managing Risk in Shipping Companies

One highly important risk control measure, which needs to be instituted at the earliest possible stages of contractual negotiation, is to ensure that as many as possible of the terms that protect the shipowner's interests in one contract, are incorporated into the others. Therefore, it is essential for the carrier, that the bill of lading contains reference to the charter-party, in order to be able to rely on the protection (e.g., of the Hague or Hague-Visby Rules) contained in the charter-party.
3.1.3 Environmental Risk

Environmental risk is the most sensitive issue as far as public opinion is concerned. The shipping companies have not conducted themselves with the required sensitivity toward this issue in the past. Large-scale disasters such as *the Amoco Cadiz* in 1978, and, more recently, *the Exxon Valdez*, have drastically changed the situation. Public opinion was quickly mobilized following such accidents, which led to new legislation such as the OPA-90 (Oil Pollution Act) and a change of attitude within the companies. Large oil companies, in particular, are taking a very responsible and conservative approach to reducing environmental risk.

Environmental concerns must be consistently incorporated into the risk-based decision making process from the beginning. The National MTS (Marine Transportation System) Conference recommended that the use of risk assessment be broadened in its application by addressing a multitude of potential environmental concerns, such as those presented in Figure 3-3 regarding port operations.
The ISM Code clearly states that a company should develop an environmental protection policy. The company must ensure that the policy is implemented and maintained throughout all levels of the organization and that it receives the same attention as all other policies.
3.2 The ISM Code

The International Maritime Organization (IMO) Resolution A741(18) was adopted on November 4, 1993, as the "International Management Code for the Safe Operations of Ships and for Pollution Prevention." This resolution puts responsibility on a shipping company's management for the way they operate their ships.

The use of certificates, such as classification society certificates or certificates issued by the flag state, has been a common requirement in the shipping industry. The International Safety Management (ISM) Code, which was first implemented in 1998, is a safety management system that is quite different and maybe new to some in the shipping industry. It does not just require some written documents; it is a system of processes and procedures. Each shipping company needs to develop and implement a Safety Management System (SMS) that includes:

- detailed information about the company's operation, structure, and management practices;
- detailed information about the roles and responsibilities of individuals within the company;
- detailed reports of all accidents, hazardous occurrences, and other non-conformities being sent to the Designated Person (DP);
- details of feedback from the Designated Person to the vessels regarding corrective action;
confirmation reports that the corrective action had worked.

Paragraph 1.2 of the ISM Code states the objectives (Appendix I). These objectives provide clear guidance to shipping companies for the development of a safety management system. In broad terms they are equally applicable to the development of a risk management system (Paragraph 1.2.2.2). Many shipping companies, especially the large ship management companies, were already familiar with the philosophy of formal management systems.

3.2.1 Legal Implications

There are legal implications associated with the ISM Code. As a natural part of the proper creation and implementation of a functioning SMS, a considerable amount of documentary evidence is produced. Much of this evidence may highlight things that have gone wrong, or may relate to actual accidents or incidents that have happened. It may draw attention to the fact that certain rules and regulations have been breached. In the hands of a prosecutor or claimant, such documentary evidence could prove totally devastating for the shipowner’s defense.

There is a serious risk of misuse of such documents by claimants. However, in a company in which the SMS is working properly, there will be corrective action reports and reports confirming that the corrective action has achieved its desired result. But still, the question arises: should prosecutors and claimants be legally deprived of access to these reports in order to encourage shipowners to pursue a
policy of open reporting without fear of being penalized for every incident? There is a public policy conflict.

On the one hand, it would be against public policy to discourage shipowners to do all they can to work towards safer ships and cleaner seas. But on the other hand, it would also be against public policy to deny genuine claimants and prosecutors the right to seek justice [10]. The shipowners appear to be in a "no-win" situation. If they do not produce reports and documents, they run the risk of not being allowed to trade any more, since they are not compliant with the Code. However, it has been suggested that a court should look favorably on a company which, though an accident has occurred, can demonstrate that the SMS is properly implemented and working as anticipated by the ISM Code. That would mean that the company has demonstrated that it has exercised the necessary due diligence to mitigate its liability. This suggestion requires a shift in thinking on the part of the judges and arbitrators; they will play a crucial role in the fate of the ISM Code.

Another important issue is whether the shipowner can limit his financial liability in certain situations. Under the 1976 London Convention, there is a limitation on shipowner liability. However, a shipowner liable shall not be entitled to limit his liability, if it is proved that the loss resulted from his personally acting recklessly and with knowledge that such loss would probably result. Under the ISM Code, the DP needs to have direct access to the highest levels of management, but that does not mean that all incidents will be reported. Consequently, the shipowner's knowledge is not necessarily the same as that of the DP, which makes it difficult
for the claimant to prove that the shipowner had knowledge of a certain incident. Even if the claimant proves such knowledge, that would not establish the intent or recklessness with knowledge of the probable result.

There is also the case where the company implementing the ISM Code is not the owner, but a ship manager. Even if the claimant proves his case against the manager, the shipowner can probably still limit his liability. Can it be right, that a shipowner can protect himself by putting his ships out to management and deliberately isolating himself from knowledge of how the manager is operating the ship?

In the case of a cargo claim, the cargo owner will try to prove that either the vessel was unseaworthy in some way, or the carrier has failed to care for the cargo while it was in the carrier’s possession. If the vessel doesn’t have an adequate SMS, this can impact negatively the owner’s liability. The claimant has greater means at his disposal for requesting documentary evidence to establish whether or not the owner is in breach.

Several questions are exposed within the code that have no clear answers. The role of the Designated Person and the potential self-incriminating use of documents and reports generated within a good SMS as evidence against the shipowners have to be clarified. Recent reports show that many operators are reluctant to fully commit to implementation of the code. It remains to be determined whether the ISM Code has really improved safety at sea or quality in the operations of ships. However, a new study carried out by The Swedish Club confirms that shipowners implementing the ISM Code can expect to achieve a
reduction in hull claims of 30% or better, together with a similar improvement in the incidence of P&I claims [7].

3.2.2 Effect on Company's Risk Management Policy

For every serious accident there are 30 warnings in the form of minor accidents and 300 in the form of near-misses, and non-conformities, as discussed in section 2.2. The ISM Code as a mandatory instrument requires that shipping companies operate a safety system whereby non-conformities should be reported and acted upon to avoid recurrence. It is expected that occurrences of non-conformities should show a decline in the long term, but it should also be normal in the short term to notice increases of occurrences, in situations where near accidents/misses have not been reported as a matter of traditional principles.

Relating all the preceding issues to the subject of risk management, several questions arise:

1) How much importance do shipping companies place on different kinds of risk?
2) Will they produce a safety management system just to be ISM Code compliant or will they go a step further, to fully embrace a safety culture and really perform risk management practices?
3) Will shipping companies continue to handle risk basically through marine insurance?

The answers to those questions are not straightforward. Even though the types of risk described in chapter 3.1 might seem to be independent of each other, the
Managing Risk in Shipping Companies

reality is that they are influenced by and related to each other. It is obvious that the operational and environmental risks have a direct impact on the financial exposure of the company. However, the environmental risk has become first priority (even more important than financial risk) for many companies, especially the tanker operators. Because oil spills, if they occur, are extremely hazardous to the environment, these companies are obviously exposed to a higher environmental risk.

In order for a company to meet the requirements of the ISM Code, it must develop policies related to the safe operation of ships and ensure that personnel at all levels of the organization understand and accept the purpose and relevance of these policies. The company's organizational culture influences every aspect of its operations. Organizational culture refers to the personnel's shared perception of the organization, and it includes the traditions, values, customs, and practices found in the organization. Part of the organizational culture is the safety culture, which refers to the characteristics of the work environment that influences the personnel's perception of the importance the company places on safety. The importance of an organizational safety culture is the underlying concept of the ISM Code. The Code states that the company is required to develop a management system that ensures that safety and pollution prevention are central in the way it operates [12]. The ISM Code has succeeded in making shipping operations more transparent for the whole industry, but it depends on each individual operator how open the structure of the company's safety policy is. A company can continuously improve the system by gathering
and evaluating objective data by which to assess levels of risk. It can further improve the system by addressing human and organizational factors affecting safety and shipping operations, as will be described in section 4.1.

Referring to the third question, any risk management program must ensure that a serious loss or claim will not affect the viability of the business. For this reason, the starting point of any risk management policy is the purchase of insurance. What insurance does is identify certain risks which will be transferred onto the insurer in accordance with the terms of a contract of insurance and in return for an agreed price, which is called the insurance premium.

Insurance companies have established methods for determining where the client (a shipping company) stands with regard to safety and quality of operations. They evaluate the client before they commit themselves, especially to long-term agreements. Evaluations include areas such as:

- the company's overall organization
- technical maintenance – procedures and methods
- accident, incident, non conformity reporting
- crewing selection and training
- insurance and claims handling

Shipping companies and insurance companies have common financial incentives. Safe and high-quality operations result in fewer and less expensive claims on the insurers. Insurers can then make higher profits and shipping companies benefit over the long term from lower insurance premiums. This
consideration should give an extra motivation to shipping companies to achieve quality in operations.

However, an insurance policy will not eliminate the risk. Some of the losses will be covered under various insurance policies and others will not, because the possible scenarios are endless. A good risk management program should attempt to minimize risk by eliminating or reducing the company's exposure to hazards that are not covered by insurance policies.
3.3 Managing Risk Through Design

It is widely recognized that shipping operations are affected by design decisions. A design idea that is good in itself, but leads to a system that requires great care by the crew in its operation, can lead to hazards. High-quality designs are much more expensive to construct and would thus increase the ship's production cost. Participants in the design phase (shipping companies, shipyards) need to make optimal decisions in order to meet commercial interests as well as safety requirements. Insufficient consideration to the safety aspect in the design phase can lead to difficulties in operating the ship efficiently and safely. The following presents some important issues that need to be considered:

- The cost of the project
- The safety of the project
- Maintenance
- Performance
- Methods of construction
- Operability

Risk management practices can prove useful in seeking to overcome such problems, but these require examination of the various types of hazards and their impact on the ship's life cycle.
4 Key Issues in Achieving Quality in Shipping Operations

This chapter reviews a new risk management philosophy for shipping companies. First, human and organizational factors affecting safety and quality of shipping operations will be identified. Several strategies to minimize human error will be discussed, and a new approach for operational risk management is suggested.

4.1 Human and Organizational Issues

The human element and the organization have a substantial impact on the reliability and performance of shipping operations. As mentioned earlier (in section 3.1.2.1), human and organizational errors cause the majority of maritime accidents. The shipping industry has not addressed the human element in the past. It has focused instead on technological improvements and punitive measures aimed at the operators. With the implementation of the ISM Code this focus is changing. It's important to recognize that while human and organizational errors are inevitable, their occurrence can be reduced and their effects mitigated by improving operations, organization, crew training, procedures, and maintenance.

High reliability organizations from other industries (aerospace, nuclear, chemical) have been shown to be able to develop high reliability systems (human + equipment) that operate relatively error-free over long periods of time and, in many cases, in very hazardous environments [24]. High reliability organizations
go beyond Total Quality Management and International Standards Organization certifications in their quest for safety. They have extensive process auditing procedures to help spot safety problems and they have reward systems that encourage risk-mitigating behaviors. They have high quality standards and maintain their high risk awareness. Shipping companies can adopt similar strategies to increase safety.

4.1.1 Factors Influencing Human Error

Accidents resulting from human error can be differentiated into those caused by design, construction, and operations. Focusing on operations, there are five components that contribute to human error, as shown in Figure 4-1. Human errors usually involve a complex interaction of these factors.

![Figure 4-1: Factors and interfaces that can lead to human error](image)

Figure 4-1: Factors and interfaces that can lead to human error [17]
There are numerous ways to classify individual errors. In 1976 the Panel on Human Error in Merchant Marine Safety defined 13 types of individual errors [19]. A study of unanticipated compromises of acceptable quality involving marine structures resulted in a list of individual error factors [2]. Both studies are summarized in Figure 4-2.

![Figure 4-2: Individual error factors and errors](image)

Personnel need to have a minimum level of expertise with a framework of appropriate procedures that are developed, evaluated, implemented, and enforced by the organization. Technological development has increased hardware and equipment reliability, but the individual still needs to have a clear understanding of the inner workings of the system, in case of a crisis [17].
The influence of the organization (e.g., shipping company) on the reliability of marine systems is the most pervasive of the human-failure-related accidents [2]. Pressures to reduce costs and maintain schedules may jeopardize the safety of operations. Wrong decisions that lead to accidents can be related to the communication flow-path among the crew. It is the organization that establishes and controls this communication flow-path. The crew needs to function as a team and share information, in order to perform safely.

The environment also contributes to human error:

1. External factors (darkness, extreme temperature, storms, other natural phenomena);
2. Internal factors (lighting, temperature, noise levels, and vibrations).

Environmental effects can create psychological and physiological human responses that increase the potential for human error [1].

While these principles might be considered by many to be common sense, it is only too clear that they have often been overlooked. One example of a major accident, that was influenced by a failure to address human issues is the Herald of Free Enterprise [13]:

“The company had not issued clear standing orders..., it had not defined responsibilities clearly..., it had even failed to support the Masters in disciplinary matters aboard ship. On many occasions the ships’ Masters had raised various concerns... most notably, the need for indicator lights on the bridge to show the position of the clam doors..., these concerns fell on deaf ears onshore”.
Human error can be classified into two categories: active and latent failures. Active failures are those errors that have a direct and immediate impact upon the system and are recognized immediately. Latent failures are not immediately noticeable; they become apparent, when being combined with other factors [22].

4.1.2 Strategies to Minimize Human Error

While the importance of human failure has been known, little has been done to effectively address it. The human element is directly integrated into quality and safety in design, construction, operational maintenance, and operations [17]. Shipping companies need to perform risk management practices, in order to achieve a certain standard of quality.

4.1.2.1 Organizational Culture

As mentioned earlier, the influence of the organization on the reliability of marine systems is the most pervasive of the human failure related accidents. The organizational culture refers to the shared perception of the organization, and it involves the traditions, values, and goals by which the organization may be characterized. The culture of the organization influences to a large extent the manner in which the personnel act, carry out tasks, and socialize. For example, the goals set by an organization may induce otherwise rational people to make irrational decisions. The organization needs to establish a safety culture and an
environment of safety consciousness. Four characteristics defining the adequacy of the safety culture are the following [32]:

1. Knowledge acquired by personnel regarding safety
2. Attitude of personnel toward safe operations
3. Choice of performance goals
4. Establishment of lines of responsibilities and communication

The organization must ensure that its policies are not ambiguous and personnel must believe that the policies will be consistently enforced; any behavior that leads to a hazard (alcohol, drug abuse, or refusal to follow safety procedures) cannot be tolerated. Every employee must adopt a safety behavior, look out for the safety of others and bring constructive ideas for safety improvement to management.

4.1.2.2 Task Analysis

Task analysis is a global term for a variety of specific techniques, which collect information about tasks, organize it, and use it to make various judgments. The primary purpose of task analysis is to compare the demands of the system with the capabilities of the human operator, and, if necessary, to change those demands to reduce the potential for error and improve human performance. It is a process of data collection, representation, and analysis [16]. A task analysis should be carried out, before any attempt to assess potential human errors. The task analysis identifies what the crew member should be
doing, how he should be doing it, when he should act, and what other factors might influence his performance. It is the basis of any human error assessment.

4.1.2.3 The ISM-SMAS Process

The ISM-SMAS (Safety Management Assessment System based on the International Safety Management Code) is a qualitative assessment process that provides a framework and the opportunity to focus on the human and organizational factors that have a major influence on the safety of marine operations. It was initially developed by the Marine Technology and Management Group at the University of California at Berkeley for the marine industry [4]. There are three phases of the ISM-SMAS process, as shown in Figure 4-3.

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Pre-Assessment Phase
- Vessel Selection
- Assessor Selection & Training

Phase 1 (shoreside)
- Initial Data
- Coarse Qualitative Evaluation
- Select Levels of Concern

Phase 2 (onboard ship)
- Detailed Qualitative Evaluation
- Develop scenarios
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Prior to the formal phases of the assessment, there is a pre-assessment phase, where the assessment team selection and training takes place. The team is composed of qualified and trained members of the company, who are guided by an “outside” consultant. It is critical that those selected have adequate experience of the operation and the proper motivation, and the assessment team includes members of the ship’s operating crew.

The first phase includes review of certificates, SMS documents, and environmental policy. Interviews with shoreside management take place, and a broad overview of the company’s system is provided. The second phase is the most important, because it contains a detailed qualitative evaluation of the vessel and the crew, based on the previous assessments. The final phase takes place ashore and is primarily a documentation phase.

The SMAS model encompasses the factors that influence the safety of marine operations (Figure 4-1). It uses attributes based on the ISM Code, the STCW (Standards of Training, Certification, and Watchkeeping) guidelines, the U.S. Coast Guard’s Prevention through People program, and quality standards. The
assessment team assigns numeric values to each attribute, based on a seven-point scale. An uncertainty measure of the evaluation score is incorporated in the ISM-SMAS protocol, in order to adequately address the uncertainty of assessing human factors. This gives an assessment of the condition of the company’s SMS.

The ISM-SMAS process is a practical process that can produce meaningful and useful results. It also provides a link to a quantitative probability based instrument named SYRAS (System Risk Assessment Software) for possible quantitative analysis. It can be used by shipping companies as part of their risk management system; research is under way to demonstrate this task.

4.1.2.4 Crew Endurance

Crew endurance refers to the ability to maintain performance within safety limits while enduring job related physiological and psychological challenges. Crew Endurance Management (CEM) practices contain field-tested methods used to deal with fatigue and stress related factors. The U.S. Coast Guard performed a study that lists some crew endurance risk factors [31]:

- Insufficient daily sleep duration (less than 7-8 hours of uninterrupted sleep)
- Poor sleep quality (awakenings during the night due to work related disruptions or noisy environment)
- Changing work/rest schedules (rotations from day to night work-hours one or more times per week)
Key Issues in Achieving Quality in Shipping Operations

- Long work-hours (exceeding 8-12 hours per day)
- Sustained work-hours with no breaks (optimal to break 15 min per hour)
- Poor diet (frequent fried foods, high fat and sugar content, frequent caffeine consumption)
- High workload (high physical and/or mental effort requirements)
- High stress
- Harsh operating environment (noise, vibration, temperature)
- Motion Sickness

These endurance risk factors are often observed in shipping operations, but their impact on crew performance remains unnoticed until crew members experience severe deterioration of alertness and energy. Management support and coordinated planning is required to control those crew endurance risk factors. Management must actively encourage, and lead crew members to the consistent practice of endurance strategies. A four-step process is required to develop a crew endurance management system [31]:

1. Review crew endurance management information
2. Identify endurance risk factors
3. Identify elements affecting endurance during shipping operations
4. Analyze relationships between elements; determine modifications

Management has to review the company's current work practices to properly document duty hours, workload, etc. Crew members have to be provided with information on how to perform crew endurance practices. The implementation of
Key Issues in Achieving Quality in Shipping Operations

CEM practices can enable shipping companies to enhance their efforts towards maintaining high levels of crew endurance and safety.

4.1.2.5 Emergency Management

Real-time management of emergencies is another approach to achieving safety of shipping operations that needs to be further recognized and developed [3]. As previously described in section 2.2, it is generally acknowledged that for every accident there are from 30 to 300 near-misses. This is an indication that operators are very often responsible for rescuing systems. In other words, when systems move into risky states, people more frequently return them to safe states than misdirect them into states that result in accidents [22].

Two of the most important aspects of an emergency are initial surprise and the rate at which the danger to the system increases [21]. When the rate of increase in danger is rapid, there is little time for exploration, experimentation, and optimal decision making. This creates significant stress for those who are responsible for emergency management.

Shipping companies should develop emergency management teams that have the necessary awareness, skills, and knowledge. Auditing, training, and re-training are needed to maintain skills and readiness. Emergency management teams need to be organized in sub-teams that are assigned management of different aspects of any evolving emergency. One way to organize the team is through the “divide and conquer” strategy [23]. Teams are organized into three components:
1. Strategic command

2. Tactical command

3. Task performance (operating teams)

The strategic command is responsible for strategic planning, information flow, and situation awareness. Tactical command ascertains resources, chooses operational procedures, and serves as a central communications link. The operating teams provide techniques, observations, and feedback (see also Appendix II). Selection and training of personnel are critically important in building effective emergency management teams. Technical comprehension, perceptiveness, sociability, self-control, and stress tolerance are some of the selection criteria [9].

4.1.2.6 Process Variation Method

The process variation method is a quantitative method that focuses on the behavior of a process. The tool has been used by the U.S. Coast Guard to improve their inspection efforts [8]. It uses control charts to measure marine safety process performance. The control chart is a graphical tool that tests the process against the average and standard deviation of their theoretical distribution, and flags points that are “out of control.” Control chart theory establishes three standard deviations as the limit beyond which a point is “out of control” and represents an unnatural cause. Beyond these limits, expected random occurrences based on the underlying process have stopped, indicating
that the process is broken. Research would begin at these out of control points to determine the reasons behind the failure.

Figure 4-4: Process chart from USCG project [8]

In looking at a control chart a process is considered out of control when a data point falls outside the natural process control limits. Also a process is considered to be in trouble when five or more data points fall above or below the limits. Figure 4-4 shows an example of the X-Chart (top) and the R-Chart (bottom). The X-Chart depicts a time-series view of the variation of individual values as it relates to the upper and lower control limits that bound its natural process. The R-Chart (bottom) depicts the variation in the range between consecutive values.
shown in the X-Chart as it relates to its upper control limit. All points that fall outside the bounds of the limits are considered out of control and should be investigated.

Shipping companies could use this method for their risk evaluation, turning raw data into management information. The difficulty is the lack of processes that lend themselves to this sort of analysis. In other words, in order to carry out process charting, there must be a process with definable limits and able to be described so that it can be measured over a period of time. Over time, however, a company could develop and maintain the task descriptions and data sets that this would require.

### 4.2 Incorporating Risk Management Principles into a Company’s Safety Management System

The response of the maritime industry towards maritime accidents has been primarily reactive. This approach has been based on analysis of the accident. An attempt is made to understand the causes of the accident, and then to put measures in place to prevent future accidents. However, the reactive approach has some limitations.

Most accident investigations attempt to “fix blame” and do not involve properly trained investigators or protocols that can help to identify the key factors and sequences involved in the accident. All parties involved in past accident investigations (underwriters, shipowners, cargo-owners, flag state), have shown unwillingness to reveal details of what occurred, or provide other information,
which has severely hampered the analytical processes. The reasons for these poor responses are the legal difficulties involved with the release of information, particularly where such information might reveal negligence by or liability of the parties concerned. Furthermore, the usual reaction to accidents has been to attempt to put in place hardware and equipment that will be likely to prevent the next accident. Such attempts have not proven to be effective, especially with human-error-related accidents.

Shipping companies can put themselves in a proactive position by identifying hazards and introducing preventive and/or mitigating steps. This approach attempts to analyze the system before it fails so as to identify how it might fail in the future. There is a need to integrate risk management and risk assessments into daily work activities, regardless of complexity or size, and to strive for continuous improvement. The safety and protection of personnel, vessels, cargoes, and the environment must be the preeminent core value of the company. This means that whenever there is an issue where safety conflicts with commercial or other interests, thorough assessment of the risks must be performed. If the risks cannot be managed to an acceptable level, then the operation should not be undertaken. Safety should not be viewed as a cost but as a competitive advantage.

The following measures are suggested:

- Management commitment and leadership; Management must set the goals, provide sufficient resources, and make the necessary decisions to achieve safety.
Key Issues in Achieving Quality in Shipping Operations

- Development of positive economic and psychological incentives to achieve safety; Personnel must also believe in the company's safety culture and adopt it as a personal characteristic.
- Development of effective internal and external checking / verification / auditing measures and procedures;
- Development of measures to encourage early perceptions and responses to emerging risks;
- Development of crew endurance management (CEM) and emergency management systems.

If an operating incident or near-miss occurs, then management and personnel must want to know the real story. The true causes must be identified and data must be gathered. Lessons learned from those incidents become a key input to the company's continuous improvement process.

4.2.1 Use of Data

The use of data is essential in performing risk management in shipping operations. A risk management process performs two types of analysis: qualitative, or quantitative (or both).

Quantitative analysis is only as good as the quality of data used, whereas a qualitative process relies heavily on the knowledge and experience of the assessors. Very sophisticated quantitative analyses seem to have value in addressing some types of uncertainty, especially for systems in which the
interactions of people with the systems are minimal. In the case of shipping
operations, the human element plays a significant role in the safety of the
system. Unfortunately, existing databases do not serve as a reliable source of
the data required to perform a quantitative analysis. Furthermore, most data on
the reliability of humans in performing tasks is very limited. Qualitative processes,
in the hands of qualified and properly motivated personnel (internal and external),
can be of great value.
5 Conclusion

In order for shipping companies to manage the multiple risks inherent in marine transportation, risk management is required for the continuous improvement in the safety of shipping operations. However, there is a lack of any useful risk analysis in the marine transportation business. The ISM Code requires the development of a continuous improvement process, but leaves any sort of detailed quantitative analysis as a voluntary task. Progressively managed companies realize that if you don't measure it, you can't manage it. Inspecting safety of marine operations is a very difficult task, but the industry is attempting to foster a safety culture. Shipping companies have to take responsibility for their operations and not rely on inspection and regulation only as they have done in the past.

After all, the question arises: does an extensive risk management program really pay off? The truth is that there is no financial market premium for safety. Safety has become more like a prerequisite in order to get business. Most customers consider not only the freight rate but the quality of operations in evaluating the bids for their business. The increased costs due to safety can be compensated over the long term. Improved operations lead to lower medical expenses and fewer claims (legal costs). The number of satisfied customers steadily increases, which provides long-term growth prospects.

There is also a need to address human and organizational factors affecting the safety of shipping operations. Several tools have been presented that focus on
these issues. There is no single tool that can completely solve all problems. In many cases the correct combination of several tools will be required to produce some useful results. An area for further research could be a more practical study including case studies and further development of these tools, using actual operating data. The future of a safety culture in the maritime industry will depend on the ability of the operators to develop and use these tools in shipping operations as well as on their commitment to continuously improve safety performance.
References


Appendix I

INTERNATIONAL SAFETY MANAGEMENT CODE
(ISM CODE)

INTERNATIONAL MANAGEMENT CODE FOR THE SAFE OPERATION OF
SHIPS AND FOR POLLUTION PREVENTION

Preamble

(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 ship Master 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 organisation 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 shipowners 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 wide-spread
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.

1 GENERAL

1.1 Definitions
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 Organisation.

1.1.2 *Company* means the owner of the ship or any other organisation or person such as the manager, or the bareboat charterer, who has assumed the responsibility for operation of the ship from the shipowner 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.

1.2 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 on board 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 organisation, administrations, classification societies and maritime industry organisations 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 (SMS), 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 organisation both, ship-based and shore-based.

3 COMPANY RESPONSIBILITIES AND AUTHORITY

3.1 If the entity 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 entry 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 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.

5 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 SMS and reporting its deficiencies to the shore-based management.
5.2 The company should ensure that the SMS operating on board the ship contains a clear statement emphasising the Master's authority. The company should establish in the SMS 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.

6 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 SMS; 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 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 SMS 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 SMS 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 SMS 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 SMS.

7 DEVELOPMENT OF PLANS FOR SHIPBOARD OPERATIONS

The company should establish procedures for the preparation of plans and instructions 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.
8 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 programs for drills and exercises to prepare for emergency actions.

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

9 REPORTS AND ANALYSIS OF NON-CONFORMITIES, ACCIDENTS AND HAZARDOUS OCCURRENCES

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

9.2 The company should establish procedures for the implementation of corrective action.
10 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 SMS to identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The SMS should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of standby 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.
11 DOCUMENTATION

11.1 The company should establish and maintain procedures to control all documents and data which are relevant to the SMS.

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 SMS 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.

12 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 SMS.

12.2 The company should periodically evaluate the efficiency of and, when needed review the SMS 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.

13 CERTIFICATION, VERIFICATION AND CONTROL

13.1 The ship should be operated by a company which is issued a document of compliance relevant to that ship.

13.2 A document of compliance should be issued for every company complying with the requirements of the ISM Code by the Administration, by an organization recognized by the Administration or by the Government of the country, acting on behalf of the Administration in which the company has chosen to conduct its business. This document should be accepted as evidence that the company is capable of complying with the requirements of the Code.
13.3 A copy of such a document should be placed on board in order that the Master, if so asked, may produce it for the verification of the Administration or organizations recognized by it.

13.4 A certificate, called a Safety Management Certificate, should be issued to a ship by the Administration or organization recognized by the Administration. The Administration should, when issuing the certificate, verify that the company and its shipboard management operate in accordance with approved SMS.

13.5 The Administration or an organization recognized by the Administration should periodically verify the proper functioning of the ship’s SMS as approved.

Resolution A.741(18)

Adopted on 4 November, 1993

THE ASSEMBLY

RECALLING Article 15(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations and guidelines concerning maritime safety and the prevention and control of marine pollution from ships,
RECALLING ALSO resolution A.680(17), by which it invited Member Governments to encourage those responsible for the management and operation of ships to take appropriate steps to develop, implement and assess safety and pollution-prevention management in accordance with the IMO Guidelines on Management for the Safe Operation of Ships and for Pollution Prevention,

RECALLING ALSO resolution A.596(15), by which it requested the Maritime Safety Committee to develop, as a matter of urgency, guidelines, whenever relevant, concerning shipboard and shore-based management, and its decision to include in the work program of the Maritime Safety Committee and the Marine Environment Protection Committee an item on shipboard and shore-based management for the safe operation of ships and for the prevention of marine pollution, respectively,

RECALLING FURTHER resolution A.441(XI), by which it invited every State to take the necessary steps to ensure that the owner of a ship which flies the flag of that State provides such State with the current information necessary to enable it to identify and contact the person contracted or otherwise entrusted by the owner to discharge his responsibilities for that ship in regard to matters relating to maritime safety and the protection of the marine environment,

RECALLING FURTHER resolution A.443(XI), by which it invited Governments to take the necessary steps to safeguard the ship Master in the proper discharge of his responsibilities in regard to maritime safety and the protection of the marine environment,
RECOGNISING 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,

RECOGNISING ALSO that the most important means of preventing maritime casualties and pollution of the sea from ships is to design, construct, equip and maintain ships and to operate them with properly trained crews in compliance with international conventions and standards relating to maritime safety and pollution prevention,

NOTING that the Maritime Safety Committee is developing requirements for adoption by Contracting Governments to the International Convention for the Safety of Life at Sea (SOLAS), 1974, which will make compliance with the Code referred to in operative paragraph 1 mandatory,

CONSIDERING that the early implementation of that Code would greatly assist in improving safety at sea and protection of the marine environment,

NOTING FURTHER that the Maritime Safety Committee and the Marine Environment Protection Committee have reviewed resolution A.680(17) and the Guidelines annexed thereto in developing the Code,

HAVING CONSIDERED the recommendations made by the Maritime Safety Committee at its sixty-second session and by the Maritime Environment Protection Committee at its thirty-fourth session,

ADOPTS the International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code), set out in the annex to the present resolution,
STRONGLY URGES Governments to implement the ISM Code on a national basis, giving priority to passenger ships, tankers, gas carriers, bulk carriers and mobile offshore units which are flying their flags, as soon as possible but not later than 1 June, 1998, pending development of the mandatory applications of the Code,

REQUESTS Governments to inform the Maritime Safety Committee and the Marine Environment Protection Committee of the action they have taken in implementing the ISM Code,

REQUESTS the Maritime Safety Committee and the Marine Environment Protection Committee to develop guidelines for the implementation of the ISM Code,

REQUESTS ALSO the Maritime Safety Committee and the Marine Environment Protection Committee to keep the Code and its associated guidelines under review and to amend them as necessary,

REVOKES resolution A.680(17).
Appendix II

Divide and conquer strategy and organization [30]