

UNIVERSITY OF PIRAEUS



DEPARTMENT OF MARITIME STUDIES

M.SC IN SHIPPING MANAGEMENT

**Quality Shipping: Mechanisms for Safer Shipping
and Cleaner Oceans**

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Masters' Dissertation

Submitted in partial fulfillment of the requirements of University of Piraeus
for the degree of M.Sc. Shipping Management

Piraeus

December 2020

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Abstract

This paper serves as an enquiry into the importance of quality in the shipping industry in combination with the necessary safety and protection of the marine environment. Quality in the field of shipping is not only about the product but also the services, the procedures, the staff and in general with everything involved for the correct execution of the desired results. In order to have profitable results and achieve the goals, each action, system and materials must be possessed by quality. Through a detailed description it becomes clear how important quality is in the field of shipping.

An interesting issue that often comes into conflict with the required quality in shipping is that of safety. In order to achieve the necessary safety, this automatically entails an increase in costs. Safety requires continuous training and information of staff (on board and in companies), modern navigation systems and technology as well as many other important safety issues that are extensively analyzed in this dissertation. Many shipping companies choose to reduce safety in order to respond as well as possible to quality. When safety issues arise then the procedures are more time consuming and costly. However, it has been observed that when safety is neglected, accidents occur. For this reason, rules and laws were created by the International Maritime Organization and many other organizations that oblige shipping companies to comply with and implement specific safety measures. The International Safety Management Code, the Safety Management System and the International Organization for Standardization describe in detail the obligations of each shipping company.

In recent years, emphasis has been placed on environmental protection. Seawater needs immediate treatment as its pollution is high and dangerous for many animals, plants and even humans. Maritime accidents are known to cause enormous ecological disasters, but this does not mean that the passage of ships in the oceans has far-reaching effects on the

marine environment. At this point, great reference is made to the ecological disasters caused by shipping in order to understand the severity of the situation as well as the ways to deal with them. In this regard, relevant legislation has been established that requires shipping companies to take measures to protect the marine ecosystem.

These issues are particularly important for many reasons. Initially, for a shipping company as they determine its competitiveness in the field and its survival. Then, for the safety of personnel and goods and finally for the protection of the marine environment which directly and indirectly affects the whole world.

Keywords: quality, shipping industry, safety, International Maritime Organization, International Safety Management Code, Safety Management System, International Organization for Standardization, environmental protection, maritime accidents.

Περίληψη

Αυτή η διπλωματική εργασία ερευνά τη σημαντικότητα της ποιότητας στην ναυτιλιακή βιομηχανία σε συνδυασμό με την απαραίτητη ασφάλεια και την προστασία του θαλάσσιου περιβάλλοντος. Η ποιότητα στο χώρο της ναυτιλίας δεν αφορά μόνο το προϊόν αλλά και τις υπηρεσίες, τις διαδικασίες, το προσωπικό και γενικά με οτιδήποτε εμπλέκεται για τη σωστή διεξαγωγή των επιθυμητών αποτελεσμάτων. Προκειμένου να υπάρξουν επικερδή αποτελέσματα και επίτευξη των στόχων, θα πρέπει κάθε ενέργεια, σύστημα και υλικά να διακατέχονται από ποιότητα. Μέσα από μία αναλυτική περιγραφή γίνεται σαφές πόση σημαντική είναι η ποιότητα στο χώρο της ναυτιλίας.

Ένα ενδιαφέρον ζήτημα που έρχεται πολλές φορές σε σύγκρουση με τη ζητούμενη ποιότητα στη ναυτιλία είναι αυτό της ασφάλειας. Προκειμένου να επιτευχθεί η απαραίτητη ασφάλεια, αυτό αυτομάτως συνεπάγεται σε αύξηση των κόστων. Η ασφάλεια απαιτεί συνεχή εκπαίδευση και ενημέρωση του προσωπικού (εν πλω και στις εταιρείες), σύγχρονα συστήματα πλοήγησης και τεχνολογίας καθώς και πολλά άλλα σημαντικά θέματα ασφάλειας που αναλύονται εκτενώς στην παρούσα διπλωματική εργασία. Πολλές ναυτιλιακές εταιρείες επιλέγουν να μειώσουν την ασφάλεια προκειμένου να ανταποκριθούν όσο το δυνατόν καλύτερα στην ποιότητα. Όταν τίθενται ζητήματα ασφάλειας τότε οι διαδικασίες είναι πιο χρονοβόρες και πολυέξοδες. Παρατηρήθηκε όμως ότι όταν αμελείται η ασφάλεια, δημιουργούνται ατυχήματα. Γι αυτό το λόγο δημιουργήθηκαν κανόνες και νόμοι από τον Διεθνή Οργανισμό Ναυτιλίας και πολλούς άλλους οργανισμούς οι οποίοι υποχρεώνουν τις ναυτιλιακές εταιρείες να τηρούν και να εφαρμόζουν συγκεκριμένα μέτρα ασφάλειας. Ο Διεθνής Κώδικας Διαχείρισης Ασφάλειας, το Σύστημα Διαχείρισης Ασφάλειας και ο Διεθνής Οργανισμός Τυποποίησης περιγράφουν λεπτομερώς τις υποχρεώσεις κάθε ναυτιλιακής εταιρείας.

Τα τελευταία χρόνια, έχει δοθεί έμφαση στην προστασία του περιβάλλοντος. Τα θαλάσσια ύδατα χρήζουν άμεσης αντιμετώπισης μιας και η ρύπανση τους είναι μεγάλη και επικίνδυνη για πολλά ζώα, φυτά και ακόμη και για τον άνθρωπο. Ως γνωστόν, τα ναυτικά ατυχήματα προκαλούν τεράστιες οικολογικές καταστροφές, αυτό όμως δεν σημαίνει ότι η διέλευση των πλοίων στους ωκεανούς γίνεται χωρίς επιπτώσεις για το θαλάσσιο περιβάλλον. Σε αυτό το σημείο, γίνεται μεγάλη αναφορά στις οικολογικές καταστροφές που προκαλεί η ναυτιλία με σκοπό να γίνει αντιληπτό η σοβαρότητα της κατάστασης όπως και οι τρόποι αντιμετώπισης τους. Και σε αυτό το θέμα έχουν καθιερωθεί σχετικές νομοθεσίες που επιβάλλουν στις ναυτιλιακές εταιρείες να λαμβάνουν μέτρα για την προστασία του θαλάσσιου οικοσυστήματος.

Αυτά τα ζητήματα είναι ιδιαίτερα σημαντικά για πολλούς λόγους. Αρχικά, για μια ναυτιλιακή εταιρεία καθώς καθορίζουν την ανταγωνιστικότητά της στο χώρο αλλά και την επιβίωση της. Ύστερα, για την ασφάλεια του προσωπικού και του εμπορεύματος και τέλος για την προστασία του θαλάσσιου περιβάλλοντος το οποίο επηρεάζει άμεσα και έμμεσα όλον τον κόσμο.

Λέξεις Κλειδιά: ποιότητα, ναυτιλιακή βιομηχανία, ασφάλεια, Διεθνής Οργανισμός Ναυτιλίας, Διεθνής Κώδικας Διαχείρισης Ασφάλειας, Σύστημα Διαχείρισης Ασφάλειας, Διεθνής Οργανισμός Τυποποίησης, προστασία του περιβάλλοντος, ναυτικά ατυχήματα.

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1. INTRODUCTION

The subject of this dissertation is quality in the field of shipping and the mechanisms for safe shipping and clean oceans.

The aim of the dissertation is to clarify the importance of quality at every stage and process of shipping as well as maintaining the safety of staff and property without neglecting the protection of the marine environment.

The purpose of this dissertation is to make clear how important it is to be able to exist a balance between quality, safety and environmental protection.

The main concern that led to the elaboration of this thesis was the issue of major maritime accidents that occur worldwide resulting in the loss of human lives, the pollution of the marine ecosystem and the incalculable economic costs while there is a rapid development of technology that contributes into a safer shipping. This issue conflicts with many theories as to why the causes leading to these results have been extensively investigated. This issue is of immediate interest because despite the efforts of various organizations to solve such problems, they continue to exist.

The methodology followed for this dissertation begins with the analysis of the concept of quality as it is often misunderstood. So once it becomes clear what we mean by quality, the next step was to give a basis to the concept of safety and how important it is for the proper conduct of work. It is analyzed in detail who are responsible for safety and how to implement it as well as the relevant legislation. Finally, special emphasis was given to the protection of the marine environment as it is a direct and major issue nowadays.

Also, it describes who is responsible and what actions should be taken by shipping companies under international law.

What is of interest is that in order to achieve a goal, for example safety, quality must be reduced. In other words, quality, safety and protection are very difficult to coexist without consequences (financial and temporal). For this reason, in this dissertation, the priorities that must be set by the shipping companies are explained as well as solutions that can lead to a compromise of these three parameters.

2. THE MEANING OF QUALITY

To begin with, it is very important to make clear what the term quality means and which are its dimensions. The term quality is used worldwide by many practitioners and academics. The issue that comes out is that there is not an agreed general definition. This happens because this term has many definitions that are defined according to each circumstance.

Some examples about the term “quality”:

“Quality should be aimed at the needs of the customer and future”. (Deming)

“Quality and customer satisfaction are the same thing and quality is a broad concept that goes beyond just product quality to also include the quality of people, processes and every other aspect of the organization”. (Ishikawa)

It is worth mentioning that some quality definitions use the term interested parties instead of stakeholders, such as those quality definitions by the International Organization for Standardization (ISO 9000:2005).

So, according to customer’s expectations and needs quality can vary. Quality refers to people, products, services, processes and environments. An approximate terminology could be that quality is a dynamic state associated with products, services, people, processes and environments that meets or exceeds expectations and helps produce superior value.

Quality cannot be calculated in mathematical terms because mainly is a judgemental process. Human judgement is “ a scaling activity that involves comparison, mental weighing and the consolidation of partial results into conclusions”. (Smith)

Many things around us have plenty characteristics that are similar to an assessment of their quality that come in contrast with any standard that depends on user's needs.

The evaluation of the quality requires the determination of user's needs and demands. It starts with the identification of the entity attributes or in other words with the quality characteristics that are related to the requested needs and demands. After their determination, follows the evaluation of each entity. All these scores together consolidate into a final judgement of quality.

All these steps lead to a process that requires many criteria for decision making. So, all the quality assessments could be done in accordance to analytical procedures.

The use of analytical methods as a criterion has been proven almost unsuccessful. Consequently, the quality cannot be measured precisely by any procedure that is valid. It must be estimated by considering entities and their characteristics which are more directly perceptible.

2.1 TOTAL QUALITY APPROACH, VIEWS AND CHARACTERISTICS

Since we analyzed what is quality, now we will focus on the total quality.

Total quality is about maximizing an organization's competitiveness by the continual improvement of the quality of its people, products, services, processes and environments.

A serious factor for total quality is the decision making and the problem solving. The number of problems can be decreased by making good decisions but on the one hand there cannot exist a workplace without problems.

Traditional and total quality views

- The traditional view states that you cannot have productivity and quality at the same time. The total quality view is that you do not only solve problems but make improvements.
- The traditional view has different definition for quality. It states that quality meets only customer specifications. In contrast, the total quality view states that that quality is about satisfying customer needs and overcoming customer expectations.
- The traditional view states is that quality is checked into the product. The total quality view states that the product and the process are determined by the quality and this can succeed by some effective control techniques.
- The traditional view states that quality is a separate function but total quality's view is that quality should be everyone's concern and responsibility and be absorbed within each organization.
- The traditional view states that the results for poor quality are employees fault. On the other hand, the total quality view states that at 85% of quality problems are management's fault and the other 15% of human error.
- The traditional view states that the relationships with the suppliers are short term and costly. The total quality view states that the relationships with the supplier are long term that supplier relationships are long term and focused on quality.

Characteristics of Total Quality

- ◆ Strategically based: organizations have a clear target.
- ◆ Customer focus: being focused on the customer, not external only but internal as well. (external --> customers and internal --> employees)
- ◆ Obsession with quality: it is never just good.
- ◆ Scientific approach to decision making and problem solving: in total quality organization data are used in order to improve/monitor quality.

- ◆ Long term commitment: as a way to do business.
- ◆ Teamwork: the total quality encourages the human factor and especially teams.
- ◆ Employee involvement and empowerment: giving employees a real voice and authority to make decisions.
- ◆ Continual process improvement: where and when it is needed.
- ◆ Bottom-up education and training: encourage employee for education and training.
- ◆ Freedom through control: provide them the opportunity to apply solutions.
- ◆ Unity of purpose: in order to have effective results, everyone must have the same purpose.

2.2 TOTAL QUALITY PIONEERS

During the years, some people have stood out and become catalysts for their contribution to the total quality. The main pioneers are:

William Edward Deming (1900-1993) has been known for the “Deming Cycle” and the Fourteen Points.

Deming Cycle contains four major components, each of which can be considered as an activity.

1. Plan: the development of a plan for improvement before the problems come out. The creation of a plan for improving the area of responsibility and in particular the processes in that area. In this way, when the problems start existing then they will be capable to be handled within the context of Deming’s Cycle model for continuous improvement.

In order to achieve such a plan there must be followed four steps:

- Identify opportunities for improvement.
 - Document the current process.
 - Create a vision of the improved process.
 - Define the scope of the improvement effort.
2. Do: To carry out the plan. In other words the implementation of the plan for improvement. It is recommended as a first approach, to implement it on a small scale over a specified period of time. In this way, the prototype is tested before moving to full production.
 3. Check: Examination and recording of the results achieved by implementing the plan. The recorded results will be useful for the next component.
 4. Act: the production of the product.

Furthermore, the organization should analyze how the product is absorbed in the market in terms of quality, cost and other criteria.

Deming's Fourteen Points state what an organization must do to effect a positive transition from business as usual to world-class quality.

- 1) Create constancy of purpose for improving products and services.
- 2) Adopt the new philosophy.
- 3) Cease dependence on inspection to achieve quality.
- 4) End the practice of awarding business on price alone; instead, minimize total cost by working with a single supplier.
- 5) Improve constantly and forever every process for planning, production and service.
- 6) Institute training on the job.
- 7) Adopt and institute leadership.
- 8) Eliminate fear.
- 9) Break down barriers between staff areas.

- 10) Eliminate slogans, exhortations and targets for the workforce.
- 11) Eliminate numerical quotas for the workforce and numerical goals for management.
- 12) Remove barriers that rob people of pride of workmanship, and eliminate the annual rating or merit system.
- 13) Institute a vigorous program of education and self improvement for everyone.
- 14) Put everybody in the company to work accomplishing the transformation.

Any organization could follow these principles and that would lead to a more effective implementation of total quality management.

Joseph Moses Juran (1904-2008) has been known for the Three Basic Steps to Progress, the Ten Steps to Quality Improvement, the Pareto Principle and the Juran Trilogy.

✧ Juran's Three Basic Steps to Progress:

1. Achieve structured improvements combined with dedication and a sense of urgency.
2. Establish and extensive training program.
3. Establish commitment and leadership on the part of higher management.

✧ Juran's Ten Steps to Quality Improvement:

1. Build awareness of need and opportunity for improvement.
2. Set goals for improvement.
3. Organize to reach the goals.
4. Provide training.
5. Carry out projects to solve problems.
6. Report progress.
7. Give recognition.
8. Communicate results.

9. Keep score.
 10. Maintain momentum by making annual improvement part of the regular processes.
- ✧ Juran's Pareto Principle: is known as the 80/20 Rule. This principle illustrates that 80% of effects arise from 20% of the causes or 20% of your actions/activities will account for 80% of your results.
- ✧ Juran's Trilogy: is an improvement cycle that is meant to reduce the cost of poor quality by planning quality into the product/service.
1. Quality Planning: it is critical to define who your customer are and find out their needs. After that it must be fined the requirements of the product/service/process/system and develop it. In addition, any plans that might need to be transferred to operators or other key stakeholders should be done during the planning phase. Planning activities should be done with a multidisciplinary team with all key stakeholders represented.
 2. Quality Control: in this phase is determined what is needed to be measured and set a goal for performance. Getting feedback by measuring actual performance and act on the gap between the performance and the goal.
 3. Quality Improvement: there are four different "strategies" to improvement that could be applied during this phase.
 - a) Repair: reactive and fix what is broken.
 - b) Refinement: proactive and in more detail the continually improve of a process that is not broken.
 - c) Renovation: improvement through innovation or technical advancement.
 - d) Reinvention: most demanding approach, to start over with a clean slate.

Philip Bayard Crosby (1926-2001) has been known for his Fourteen Steps to Quality Improvement. They refer to a long-term process improvement and these steps are the responsibility of management.

1. Management committed to quality long term.
2. Cross departmental quality terms.
3. Identify where current and potential problems exist.
4. Assess the cost of quality and explain how to use it as a management tool.
5. Increase quality awareness.
6. Take immediate action to correct problems identified.
7. Establish a zero defect program.
8. Train supervisors.
9. Hold zero defect day for awareness.
10. Encourage individuals and teams to establish improvement goals.
11. Encourage employees to identify obstacles.
12. Recognize employees who participate.
13. Implement quality councils.
14. Repeat everything-quality is a never ending process.

2.3 THE IMPORTANCE OF QUALITY IN SHIPPING

In view of growing competition in the shipping industry, providing high level of customer satisfaction is critical to sustaining businesses (Midoro *et al.*, 2005). In general, a shipping firm can satisfy its customer by offering low cost or differentiated services (Kotler and Armstrong, 2010). One way to differentiate a firm's services from its competitors is by offering high quality services (Dadfar and Brege, 2012, Miles, 2013).

Behind a successful shipping company there is always a successful team of people. Developing an effective training and skills lead to a specific job skills and experience. This can be the basic thought for the creation of progression programs that focus on the quality staff for a long period of time and furthermore for the personal development.

Also, if there is a proper management of the existing staff that will lead to less costs and reduction of wasting time. Sometimes, there may be unnecessary expenses such as campaigns for recruitment.

In shipping companies, quality has mainly to do with stakeholders' requirements but there is also something that they have to cope with and this is safety.

In situations like this, quality and safety come in conflict. A plausible example, is when the customer demands higher speeds for sooner delivery of the cargo. As understandable as this is, it comes into conflict with safety measures since higher speeds can be really risky.

In order to achieve balance between quality and safety, companies need to clarify from the outset what quality levels they offer and where their quality is limited due to safety issues. It must be mentioned, that a quality management has costs and it is not easy for some organizations to deal with it. Since a shipping company can provide a particular level of quality, it will be absorbed by a specific market in which it can compete, until is capable to develop.

3. SAFER SHIPPING

As we mentioned before, quality management is approached by shipping companies with specific ways. First of all, the International Safety Management Code (ISM Code) includes many of “quality” issues mainly referring to improvement and conformity. Each company should set up, implement and maintain a Quality Management System. This is a completed system, a Safety Management System (SMS) and Quality system that contains both requirements (ISM and Quality). When the companies use the Quality Management System it helps them to improve their general performance and their development initiatives. The factor that affects companies’ quality management system is the context of the company and how it the changes. Its purpose is to:

- Understand customers’ requirements and ensure that is capable to meet these requirements.
- Maintain accordingly in order employees to receive the appropriate training regarding quality requirements.
- Keep records that the system complies with the quality requirements.
- Measure performance, analyze results and proceed the proper changer (if it is necessary).
- Continual improvement of the performance and the efficiency of Quality Management System.

Even though there are many difficulties, a quality management system can help all the organizations and especially to the overall performance of them. In addition, the accomplished of the quality requirements leads to the improvement of the quality level as a whole in the organization offering satisfaction to all the stakeholders due to the better results, better services and respecting the environment, the safety measures and the health of the people.

Becoming more specific, we have to mention that there are many safety problems in sea transportation. During the years, many serious accidents happened due to economic reasons and not paradoxically for technical reasons. This has been observed since administrative measures were developed by governments under the IMO (International Maritime Organization) and ILO (International Labor Organization) that focus on safety symptoms while they should be based on economic reasons. An efficient market must balance quality and price. Governments should act, if and where the market fails, integrating economic and safety inputs leading to market self regulation. Such an economic framework requires governments to stop focusing on ship and flag, and instead turn their attention to the operating business environment of the shipping industry. It is the management of the company that determines its safety performance and not the flag state. Nowadays, in shipping everyone escapes from the responsibility for the safety performance except the shipowner who is the only one who pays.

The recognition of shipping as ‘national asset’ has largely disappeared. In its place ‘market mechanisms’ have brought fragmented patterns of ship owning and operating. Persistent overcapacity has led to a poor climate in which to renew an elderly fleet. Yet, because of rising overall trade growth and shipping demand, cyclical markets have brought all kinds of temptations to keep old ships trading at minimum cost (Smith, 1999). In our days, shipowners make sure to agree to the minimum standards and less in self-assessment for the proper operation of the ships.

Only when all players, such as flag states and other, are genuinely interested in the safety of shipping without looking at their own interests, only then will there be an effective global result. This can only be done when the shipping industry has the appropriate self-organizing mechanism. This will only be possible when the shipping industry, has the proper self organization mechanism.

3.1 THE IMO: CREATOR OF THE CODE

In maritime industry, the only international regulatory body about safety issues that exists is the IMO. Its main purpose is to manage and prevent the disaster at the marine environment. More specific, the main cause for the sea pollution are the marine accidents.

IMO's vision is to increase the maritime safety and the quality of the marine environment. This can be done by introducing human element issues in order to improve implementation.

The main idea behind IMO's, was to create an international law. There was the belief that only with international action there could be a safer shipping. Either way, shipping industry is international in its nature, so in order to achieve international effective improvements there must be an agreement and implementation by all maritime countries. There was a big need for a standing maritime organization came out for the first time in the nineteenth century. This goal became reality when the United Nations created at the end of World War II.

According to IMO principles, the human element is a complicated multidimensional matter and takes place in almost every activity. Regulations have been developed in order to emphasize seafarers opinions and respect all those who work at sea. In case of an accident, an effective corrective action should show understanding when the human element is involved. After an investigation and systematic analysis of casualties this is gained. In addition, safeguards role is very important. They must be ready and in place in order to ensure that if happens a human error, it will not cause an accident when these regulations take place. All these regulations must be simple, clear and comprehensive. Crew performance comes out from individual capabilities, management policies, cultural factors, experience, training, job skills, work environment and many other factors. There must be an effective communication through all levels of authority. As far as the human

element is concerned, the focus should be on reducing the likelihood of human errors as much as possible.

IMO's goals aim to have in place a structured approach for the proper consideration of human element issues for use in the development of regulations and guidelines by all committees and sub-committees.

The IMO objectives intend to create a structured approach in order to properly examine the human resources for use in the involvement of regulations and guidelines by all committees and subcommittees.

Furthermore, to provide a comprehensive review of selected IMO existing media from human's view.

In addition, it is very important to be encouraged the communication and the promotion in relation with the principles of the human element in order to be a successful awareness for the environment and especially the marine environment and a maritime safety culture. Also, the encouragement for developing a non-regulatory solutions and the base for human element principles.

The existence of a system that discovers and disseminates the necessary information on the human element. These information can come out from researches, maritime studies and from marine and non-marine incident investigations.

Finally, the training and the education of the seafarers in order to develop their readiness and learning as it concerns the influence of the human element in matters that have to do with ship's safe operations and how to accomplish it correctly.

In other words, the role of IMO is to focus on safety, security and environmental performance and encouraging innovation and efficiency. In order to accomplish this, IMO considers all the factors of the international shipping such as ship's architecture (meaning its design), construction, manning, operation and of course the attention to provide safety of the people and the environment.

IMO has a specific way that develops and acts. Its view about safety and environmental protection, shows not only the organization's posture towards all these considerations but also influences the moulding of the international perception of marine safety.

IMO as is the case with many other corresponding things in this world, so it is in constant and active interplay with immediate and wider environment and is influenced by it.

In the last few years, many changes have been noticed in the synthesis of the maritime industry that lead the IMO to its final shaping and the progress of its culture.

IMO's organizational culture about safety has changed many times. That happened due to the needs of the industry each time. The main goal was to solve all the complex safety matters and to the performance of the targets that the organizations set every time in order to eliminate or minimize the possibility of accidents.

Additionally, IMO's attention has changed many times. On the one hand, it focuses on issues about safety of certain types of ships and on the other hand on human intervention in maritime accidents as well as the adoption of technical regulations in the design of official bodies for the safe management of risk.

Any change that has been observed in the last decade by the IMO concerns mainly safety issues that the organization considered as issues of high priority, trying at the same time to enhance its philosophy instead of changing it completely.

In addition, the organizational culture of the IMO based on the same matters as other business, environmental or political organizations such as a dynamic environment, a crisis and a change in leadership.

In conclusion, we could say that the main goal of the IMO is still unchanged meaning that its culture concerns "safety culture" and the way of succeeded it has taken many forms.

In this way, it can be noticed an evolution to the organizational culture of IMO that is caused by many factors.

Nevertheless, this cultural evolution is related with the strengthening of its organizational culture evolution and not with a whole and based change in its culture and system of shared values.

3.2 PROVISIONS OF THE ISM CODE

The ISM Code is an effective and useful tool for the improvement of the safety culture in maritime industry and as a result to the unstoppable improvement of safety fulfillment.

At the Safety Of Life At Sea (SOLAS) conference of IMO that took place in May 1994, the ISM Code was formally included in Chapter IX of the SOLAS Regulation. The ISM Code was adopted in national law under safety requirement on July 1998.

The IMO was pressured a lot by the society due to the results of loss of life and environmental pollution in reported accidents. That lead the IMO to create the Code as a response to these claims.

Code's main goal is to provide an international standard for the safe management and operation of ships and for pollution prevention.

The ISM Code makes clear to the ship operators which are the basic principles and objectives for a safer shipping and for the protection of the environment. This can be succeeded by an operator who reports the policies for safety and environmental control and also states how these can be done.

When the organizations implement effectively the ISM Code, this not only provides them better results but also this means that they are in compliance with the National and International laws and regulations.

In order for the organizations to be competitive in national and international trade, they have to establish the ISM Code and set common targets for safety implementation, controlling and eliminating the possibility for unexpected liability.

This Code was developed with the purpose to help the shipping organizations by taking more effective actions of preventing accidents and protecting the environment while increasing the economy at the same time.

The ISM Code consists of two parts.

Part A: Implementation

Clause 1: General / Definitions / Objectives / Application / Functional requirements for a safety management system

Clause 2: Safety and Environmental - Protection Policy

Clause 3: Company responsibility and authority

Clause 4: Designate Person (s)

Clause 5: Master's responsibility and authority

Clause 6: Resources and personnel

Clause 7: Shipboard operations

Clause 8: Emergency preparedness

Clause 9: Reports and analysis of Non-Conformities, accidents and hazardous occurrences

Clause 10: Maintenance of ship and equipment

Clause 11: Documentation

Clause 12: Company verification, review and evaluation

Part A of the Code states that it is the companies' duty to establish Safety Management System (SMS).

Part B: Certification and Verification

Clause 13: Certification and periodical verification

Clause 14: Interim Certification

Clause 15: Verification

Clause 16: Forms of certificates

Part B concerns certification and verification: the measures that are available to the administrators (States) for forcing companies act upon their obligation under Part A.

The management is responsible for the development, implementation and maintenance of an effective system of safety management on land and on board the ships which will put into practice the company's policy. The system includes accessible to all:

- Procedures
- Plans
- Directives
- Description of the responsibilities and authority of each individual in connection with the policy on safety and the protection of the marine environment
- The definition of the Designated Person Ashore (DPA)

People are the key for the system's effectiveness and the ship is the working environment for seafarers.

Each company must develop procedures in order to ensure:

1. The safe operation of ship and protection of the environment
2. The familiarization of new personnel
3. The training of the personnel
4. The crucial processes on board ship
5. The response to emergency shipboard situations
6. The reporting of non - conformities, accidents, and hazardous situations and the relevant corrective actions
7. Internal audits and management reviews
8. The maintenance of the vessel
9. The checking of the documents and data relating to the SMS
10. The periodical assessment of the SMS
11. The required verifications

3.2.1 SAFETY MANAGEMENT SYSTEM

The safety management system (SMS) is a well handled system that was improved by the shipping companies in order to secure the safe operation of the ship and the protection of the environment from pollution.

SMS is a result of the International safety management (ISM) Code. It describes extensively all the main procedures, practices and policies that must be implemented by each company in order to ensure the safe operations of ships at the marine world.

As one of the most important parts of the ISM Code, SMS is necessary obligation to the shipping companies and especially to those whose vessels are commercial.

In addition, the safety management system (SMS) focuses on each ship separately and ensures that they follow all the safety rules and regulations as well as all the guidelines, the codes and the standards that the IMO, classification societies and many other related maritime organizations suggest.

There are many basic functional requirements that every policy related with safety must implement. Some of them are:

- Procedure and guidelines to act in an emergency situation
- Safety and environmental protection policy
- Procedure and guidelines for reporting accidents or any other form of non-conformities
- Clear information on level of authority and lines of communication among ship crew members, and between shore and shipboard personnel
- Procedures and guidelines to ensure safe operations of ships and protection of marine environment in compliance with relevant international and flag state legislations
- Procedures for internal audits and management reviews
- Vessel details

A safety management system must contain details about the operation of a vessel on a daily basis. Into them are also the procedures that must be followed when an incident or an emergency takes place, who is responsible, how the training is performing, if all the measures for safety have been taken etc.

In other words, the safety management refers to the responsibility of the owner of the vessel or to the person that the owner hired or to the designated person.

It must be mentioned that only by the people who know the vessel inside-out can an SMS be made and by saying people we mean the master and the crew. They are the most appropriate people for this job.

SMS follows the principles of 'Plan-Do-Check-Act' or PDCA Cycle which is a quality approach toward continuous improvement.

ISM Code connects the ship board operation with the shore base with main goal the unstoppable improvement that is accomplished by the auditing programs.

Without documentation a SMS cannot be effective. This happens because the information that have to do with the ISM Code and its implementation must be kept up and be available to those who need it. Documentation is necessary to people on ship and on shore any time, so they can trace back and investigate any possible action that can be improved or even to detect mistakes that lead to an accident.

It is said that SMS is effective because there is a standard procedure for prevention action.

With the prevention action, it is investigated the cause of problems and the necessary action are taken to the whole system in order to make sure that this cause will never shown up again.

3.2.2 DESIGNATED PERSON ASHORE

The ISM Code defines the Designated Person Ashore(DPA) and explains that his role in the execution of the Safety Management System of a shipping organization is of high importance.

The duty of a DPA is to create a link between people on board and people on shore. He must create the right attitudes, mind-set and behaviour of the employees who work ashore in order to help those who are on the vessel and in general to improve the vessel's operation.

Another duty is to enhance and encourage a positive attitude about the importance of the environmental protection and the safety of the crew.

As we mentioned above, the DPA is an element of this code that is very important for the smooth operation of a shipping company. In more details, this person has to monitor the safe operation of the ship and organize safety audits, report deficiencies and to indicate the corrective actions that must be taken. It is worth emphasizing that the role of the DPA is moot and for this reason the right choice of the DPA is fundamental. The duties that comply with the DPA are plenty, complex and vary and this is why this role is so important especially in legal and insurance matters.

“The DPA is meant to be a key communication link between the ship and shore and is also meant to be an important communication link between the ship and shore, but it is up to the Company to decide how they are to ensure that the DPA provides this link (Anderson, 2005)”.

“The DPA is intended to be ‘an over-seer verifying and checking that the SMS is functioning adequately’(Anderson, 2005)”.

According to the Code, DPA may be the “key point” to improve safety. DPA has access to the highest level of management, monitor the operation of the SMS and ensure it is adequately resourced, and ensure that adequate resources and shore-based support are applied, as required. When it comes to a DPA it means that this person has the appropriate maritime training otherwise it will not be able to deal with its responsibilities. When we say maritime training, we mean that the DPA has to go on board the vessels and perform internal audits according to the ISM. These internal audits do not differ when they take place in a shore-based company. The methods and the techniques that must be followed in order to complete an internal audit are the same. According to the ISM Code in Clause 12, the company must extract internal audits on each ship once a year. This execution is usually driven by the DPA. Each procedure must be correctly documented, verified, reviewed and evaluated (clause 12). In case of any escape it must be documented and reported to the organization immediately. After that, the reason must also be analyzed and the proper actions must be taken in order to be introduced a policy against these deviations. An external audit could request these reports.

“DPA’s formal qualifications do not deal with the ”multicultural” aspect as a DPA have to deal with. Many of these cultures are characterized by a hierarchical system with high power distance (Hofstede, 1991)”.

The DPA has to be careful while he is performing an internal audit because this is very possible to influence the answers he gets. It is too easy to be a misunderstanding. There are hundreds of cases where a major non-conformity is noticed that makes the vessel unable to sail and cannot leave the port before the corrective actions.

3.2.3 RESPONSIBILITIES OF THE MASTER

In order for the application of the ISM Code to be effective, the master is the one who can achieve it, as long as he knows the company's SMS. Here it should be noted that the SMS are different from company to company so if the Master changes company he will have to study the new SMS. Clause 5 of the Ism Code refers to the requirements and expectations of the Master. Also, one of its responsibilities is to verify and control the company's SMS.

The Master's review must be performed at specified intervals and periods within the SMS by each company. Most shipping companies ask the master to submit comments on the SMS once per contract. This means that at least once the Master will send SMS Review report.

A particularly useful tactic would be to ask the Master to provide feedback on the performance of the SMS after its implementation for one and two months from his employment. This tactic can offer the following advantages:

1. Master will have to read, understand and review SMS since first day on board
2. Senior officers' cooperation on SMS issues will be enhance because the Master will request feedback from the head of departments (Chief Officer, Chief Engineer)
3. Company will receive early feedback from Master in order to address items and provide follow up actions.

The ISM Code, we could say that it has the following defect. Many additional documents make the crew's job difficult, resulting in more complicated procedures. Many times, when it comes to providing feedback through SMS control, the company receives a page without suggestions. This is due to the fact that many Masters are afraid of their position within the company and its future encounters and thus decide not to push the situation.

All this, however, does not mean that it is the main motivation of the SMS and consequently of the ISM Code, since this whole situation does not provide possibilities for improvement. Instead of that, the ISM Code seeks to involve all those involved (both on board and on land) for a more effective implementation of the SMS and the ISM Code through the establishment of company policies as mentioned in the SMS.

A Master's SMS Review report should include at least the following items:

- Current status of vessel
- Key personnel on board
- Quick overall Review of SMS
- Master feedback on specific items (as decided by company)
- Master's Open feedback (in order to allow master to express any kind of opinion regarding SMS and Policies implementation)
- Part for suggestions
- An overall evaluation of current status of SMS implementation on board

Furthermore, when the DPA receives the SMS from the Master, then comes to his responsibility, the control and the taking of the necessary measures. Each item should be separate from all the others and can be compared to other items from previous or other Masters.

At this point we must say that every SMS review must be formal (that is, through a formal and authentic conversation between the ship and the company). All items must be recorded and tagged in the evaluation report as well as be available on board by the Master as proof of the effectiveness of the SMS and ISM Code.

3.3 ISO 9001 AND ISO 14001

ISO 9001

The ISO, also called the International Organization for Standardization was founded in 1946.

To begin with, many scholars have analyzed the benefits of the ISO 9001 standard in several performance dimensions (such as operational benefits). The most important benefits are:

- ◆ Market share
- ◆ Exports
- ◆ Sales and sales growth
- ◆ Profitability
- ◆ Improvement in competitive position/competitive advantage
- ◆ Improvement in systematization (improved documentation, work procedures, clarity of work, improvement of responsibilities)
- ◆ Efficiency (productivity, savings in costs, reduction in mistakes and rework, shorter lead time, improved management control)
- ◆ Improved quality in product/service
- ◆ Improved image
- ◆ Improvements in employee results (motivation, satisfaction, teams, communication, knowledge)
- ◆ Improved customer satisfaction
- ◆ Improved relationships with suppliers
- ◆ Improved relationships with authorities and other stakeholders

The impact of ISO 9001 on firm performance is more mixed compared with the impact of quality management, which is more unanimous. Therefore, the clearest benefits are those

influencing the internal performance or operational results, customer results and people results, while the effects on financial results are inconclusive.

ISO 14001

In 1996, at the request of the United Nations Conference on Environmental and Development (UNCED), four years earlier, the ISO introduced ISO 14001, the first of the ISO 14000 family of environmental management systems standards (EMS).

There are six steps that must be followed in order to comply with the ISO 14001 standard:

1. Develop an environmental policy
2. Identify the firm's activities, products and services that interact with the environment
3. Identify legislative/regulatory requirements
4. Identify the firm's priorities and set objectives and targets for reducing its environmental impacts
5. Adjust the firm's organizational structure to meet those objectives, such as assigning responsibility, training, communicating and documenting
6. Check and correct the environmental management system

ISO 14001 has been created to address the needs of companies in various countries and industries. This model consists of three basic principles that lead to its inherent flexibility: pollution prevention, continuous improvement and voluntary participation.

1. The first principle aims to reduce pollution before production even begins.
2. The second principle aims at gradual changes and continuous adjustments to the measurement and control management tools.
3. The third principle is intended to facilitate the purchase of all types of businesses by relieving them of any legal threat.

With all this we conclude that ISO14001 is a standard which is based on process and not performance. For the company operating under the regime ISO14001 indicates that it implements management systems for the effects of pollution and has a pollution

prevention procedure. Proponents of ISO14001 say that developing such a system would improve processes and environmental performance. Skeptics are of the opinion that changes in management systems are possible without the corresponding changes in performance, since the change in performance is necessary to fulfill the social benefits of ISO14001.

For companies that do not want to waste money and time, in order to acquire ISO14001 can apply an internal EMS (Environmental Management System). The disadvantage, however, is that an EMS is not easily recognized by external bodies because there is no audit procedure to certify that the EMS has fulfilled its obligations. For this reason, although not so interest-oriented, ISO14001 is preferable because it is recognized and legal by all bodies.

As we said before, ISO14001 is voluntary and this means that companies are not pressured in the way and rate of reduction of environmental pollution. That is, they can set their own standards on this issue and thus not risk their competitiveness as well as their performance. ISO14001 is based on the company's processes and not on environmental performance. This is so that companies of any size, type and country of origin can take part.

Another and last reason that ISO14001 stands out from other voluntary environmental programs is that as its initial condition for the participants it has the receipt of an initial certification audit. Then, it requires annual re-certification audits to verify that the management systems remain the same under the ISO14001 treaties. At this point it is worth noting that the auditors themselves are approved and certified by their national standardization body. In order to prevent the participants from misconducting against the responsibilities of ISO14001, these control measures and certifications were created.

3.4 MARITIME ACCIDENTS

Accidents are caused by a series of unfortunate coincidences at the wrong time. In this conjuncture of coincidences that lead to accidents is the factor of human error. In the continuation of this thesis we will see how vital human errors are. An accident is mainly caused by naive mistakes whose consequences can be extensive and lasting. Accidents of all kinds happen all the time and some of them have been written in history. Some accidents are common in our time such as car accidents, plane crashes and train derailments, which can happen at any time worldwide. With exactly the same logic accidents happen in the sea area. As in previous accidents, so in the navy, damage is caused and many times losses in human lives. One difference between marine accidents and others is that there are different types of marine accidents since the sea area is the largest on the planet. The seas and especially the oceans are unpredictable and many times the conditions are adverse and the slightest mistake can be fatal. When a maritime accident occurs, the effects are on the people, the shipping companies involved, the marine environment and animals and the ecosystem itself in general.

The main types of marine accidents are listed below:

1. Offshore Oil Rig Accidents

These are heavy machinery and complex processes and even if an error occurs due to a breach or omission of a process or a machine this can be fatal and result in major ecological disasters worldwide.

2. Cruise Vessel Accidents

Cruise ships are known to all and many times our choice for travel. What happens with cruise ships is that in adverse weather conditions (like many beauforts) they suffer serious damage or even overturn. Also, a common cause of accidents is due to the negligence of employees as it has been recorded that 75% of the fires that have occurred are due to it.

3. Commercial Fishing Accidents

We have heard many times, especially in the news, about fatal accidents while fishing. This is mainly due to the difficult weather conditions which can cause serious damage to the fishing boat or even the fishermen, regardless of their experience, to fall into the sea and this can cost them their lives.

4. Accidents on Tugboats

When the vessels are about to enter the docks or need some help then the tugs intervene which help in the movement and guidance of the ships. Although small in size, they are capable enough to offer the necessary security to ships. The most common accidents on tugboats are due to the fact that they have no visibility from vessels due to their size. Also, incorrect handling by the tugboat driver can cause undesirable results.

5. Accidents on Crude Oil Tankers and Cargo Ships

As expected, the majority of tanker accidents are caused by explosions. In fact, the materials that are transported are flammable, which from a single small explosion is enough to repel fatally. From statistics we see that 84-88% of oil tanker accidents are due to crew errors.

6. Grounding of Ships

Ship grounding happens when the bottom of the ship's hull scrapes through the ocean-bed. This accident has a serious impact on ship's hull and even more on the overall sea area where the grounding started and then peaked. And in this case the workers are at risk.

7. Maritime Accident because of Drugs and Alcohol

A global problem that is found in every society is the use of addictive substances. When an employee is addicted, whether to alcohol or drugs, this is likely to lead to a lack of reflexes / concentration, inability to make decisions and inappropriate behaviors. In any work environment and especially in the navy, all this can lead to serious maritime accidents.

8. Crane Accidents

Any work with a crane, whether on land or at sea, is equally dangerous. Crane workers can be seriously injured or even lost their lives due to defective cables or winches.

Another reason may be the mishandling of the crane due to the carelessness or inexperience of the employee.

9. Accidents in Shipyards

Shipyards are the places where ships are built or do other construction work. The work done in the shipyards must be performed by people, so accidents at work such as welding and assembly accidents are inevitable. Another cause is the constant gaseous pollutants that are emitted and inhaled daily by workers.

10. Maritime Accidents on Diving Support Vessels

Diving support vessels are useful for people who want to explore the marine world. But this must be done with certainty. If the crew is not properly trained to supervise and handle the mission properly, then it is very likely that a serious accident will occur.

11. Accidents on Barges

Due to the special construction of the barges, it restricts their movement in the water and thus creates problems in the towing equipment. Many workers due to inexperience or defective use of tow cables cause accidents.

12. Cargo Hauling Accidents

Maritime accidents on cargo ships are mainly caused by people working as cargo carriers. From relevant investigations that have been carried out on the specific accidents, it has been found that the employees overestimate their accidents. As a result, the particular job is less sought after.

Finally, we conclude from the above that one of the most important factors that is the main cause of many and serious accidents are the mistakes of employees. But we can never come up with a definitive documentation without the relevant research. This investigation will then be used so that the plaintiffs can claim the legal debt with absolute precision.

According to the above, we have some suggestions in order to prevent accidents that are related with the mariners:

1. Reporting immediately the risks: Despite efforts to eliminate the risks, insurance reports indicate that maritime accidents still exist.
2. Learning from mistakes: All these accident reports are a good source of information in the shipping industry. People who work in shipping companies can study and learn from these reports and probably avoid future accidents that they never had thought. As they say, we learn from our mistakes and in these from others mistakes as well.
3. Plenty of examples: Information is powerful. For this reason it is very important from where the extraction of information is done by reliable bodies such as P&I Clubs, National Accident Investigation agencies, Chirp Maritime and of course, The Nautical Institute's own Mariners' Alerting and Reporting Scheme (MARS).
4. Human make errors: In case of error, the crew should be on standby. Mistakes can happen at any time. For this reason the crew must be properly trained to deal with the error in the right ways such as utilizing all existing staff, notifying in the master, being an accomplice and maintaining alertness and clarity.
5. Plan in advance: In this case, it has been noticed that very often systems fail. For this reason there must always be a plan B, plan C etc. The risk must be predicted and there must be a procedure for the necessary corrective actions. The most expected dangers like traffic, bad weather conditions and piracy can easily be planned in advance.
6. Beware: Lack of awareness and negligence are the most usual mistakes that lead to accidents.
7. Mooring approaches: Many accidents occur during the mooring of the vessel, such as collisions with the pier or with other vessels. Therefore, at that moment the whole crew should contribute to its safe mooring. This can be done easily, as long as the crew is observant and immediately reports anything dangerous they see, such as a change in wind intensity and direction.
8. Avoidance of diversion: Each employee must stay focus on his tasks while he/she is on duty. In case of that anyone feels stretched then the Master must be informed.

9. Fatigue can be crucial: Fatigue is very common on staff on board the vessel. The conditions are difficult and the human body collapses. This is why the consequences may be as severe as with those of drinking or drugs.
10. No egos: There is no room for selfishness on a ship, so everyone must work as a team and learn from each other. If everyone is helping their colleagues and making sure they stay safe, then this has exactly the same impact on themselves as well. On the vessel, one depends on the other.

Unfortunately, although all accidents are recognized, their elimination is impossible. Even if people have the right information about how to act safely, they will still not be able to do it in many cases. The moment before the accident, the behaviors and psychology of the people cannot be considered correct. In order to avoid these behaviors, some other must be done from the environment from which they come. In more detail, if we want to ensure the attention of the operators, they must be provided with continuous work as well as a knowledge of the results. The training received by the crew must be repeated for certain clarification as well as to be improved in the way they are conducted as well as to be updated. Inside a vessel there are workers of different nationalities. This can lead to some people feeling socially pressured as well as the negative personality of some others. This can be reduced by creating better working conditions as well as by group activities outside of their working hours. When an action is performed, it does not look like errors, until it is too late. As well, accidents at the moment seem inevitable. Now, human produced is an optimistic scenario which can reduce accidents. In order to do this, however, it is not enough to tell the crew to change their behavior when they encounter an accident, because they simply do not realize that they are dealing with an accident until it is too late.

3.5 THE RESPONSIBILITY OF THE CHARTERER

Kinnock was the first to admit that “sometimes, insistence on higher standards can inflict unfair economic disadvantages on poor countries. Furthermore, quality has a price and, as with all other goods and services, this price is determined by demand and supply. Neither shipowners nor regulation alone can force or command this price if quality is not demanded by the users of the shipping service be they manufacturers, traders, freight forwarders or final consumers.”

“A most noteworthy example of charterer diligence, exemplary also of industry self regulation, is provided by the chemical industry through the establishment of the Chemical Distribution Institute” (Stanton, Cooperman).

The CDI is based on the fact that the vessels must be inspected by independent bodies in order to guarantee their authenticity. This means that accredited inspectors are required who will be impartial in their assessment. In addition, it is very important that the information should be kept in electronic form. This offers on the one hand greater security meaning that this information will not be lost and on the other hand access to it will be easy and immediate. The costs are also distributed among CDI members. The institute is not in a position to approve or reject a vessel. This is clearly the responsibility of the individual member companies. In case that a vessel is rejected by the inspections, then the owners of the vessels are immediately informed and the necessary recommendations are made. With this process, many shipowners have significantly increased their standards. The specific program regarding the vessels, reduces the inspections and the controls as well as the pressure they receive in the port, since the total control of the inspections is reduced massively. But above all, a vessel to be considered suitable to sail, must meet the quality standards required and this of course has its cost. Therefore, shipowners must have quality ships and in addition to freight costs, if they want to compete in the market.

As Rapatout argues, “certain conscientious shipowners invest in quality in excess of the level required by regulation, because this is good business that often allows them to rationalize their operations. It would thus be unreasonable to ask charterers to pay a higher price for quality, when the shipowner has invested in this quality for the sake of his own long term interest, particularly in order to anticipate more stringent regulations in the future, to broaden the scope of products he can carry or even to prolong vessel life. When it comes to the second type of ships, i.e. ships that clearly break the law, the responsibility of the charterer who knowingly or negligently employs them cannot be dismissed easily, availability of insurance notwithstanding.”

As Lars Lindfelt, Managing Director of the Swedish Club, once bluntly put it, “behind every substandard ship is a substandard cargo owner, the latter keeps the former in business.”

“Current proposals concerning charterparty wordings and new clauses are thus under discussion (Nunn).”

At this point it is worth mentioning that those cargo shipowners who can intervene in the choice of the vessel and do not do it, the European Commission is going to impose a measure that will oblige them by law and average financial sanctions when a ship is chartered and held for charter major shortcomings.

“In addition, the Commission maintains that insurance companies can and should charge cargo owners extremely high premia in case chartered ships, operated under black-listed flags, are repeatedly detained/banned (Salvarani)”.

Cargo owners could take responsibility for chartering poor quality tonnage, only if they are able to select a ship by effortlessly and efficiently informing the status of other vessels available and ready to be chartered.

As Rapatout again argues, “as long as the names of unseaworthy vessels, manned by incompetent crews, are guarded by the authorities who possess this information or, in the case of liner shipping, when the market organization sets up a smoke screen that makes it impossible to identify the vessels carrying the cargo, or even imposes certain carriers upon the shipper, the ability of the latter to intervene is seriously curtailed. However, some information already exists to facilitate shippers’ choice.”

3.6 PORTS AND PORT SERVICES IN QUALITY SHIPPING

The evolution of the shipping industry also includes the evolution of ports. The ports have always connected the sea with the land. But these days it is much more than that. They are crucial links for the global transport chain. It has been observed all over the world that national hinterlands have begun to disappear. This is because it strengthens the regional port and establishes stricter security policies, in addition to its competitors, and this leads to a reduction in its commercial power. This is especially important for inland ports, which must ensure that the increase in marine cost allows them to retain their advantage of shorter inland connections.

However, some remarkable actions have been taken lately. A notable example is that of the port of Rotterdam. The port of Rotterdam is given the privileged Green Award certification which offers reductions in port charges on all tankers whose crew and equipment comply with the specific quality requirements. As in the port of Rotterdam, the same is true of some ports in Spain and South Africa. So far, more than 30 ships have been certified.

At this point we will become a little more specific. An injustice has been happening to Segregated Ballast Tanks tankers for 15 years. Many ports have taken to correcting this error. The port of Rotterdam, however, is not a good example of the many port facilities and services provided worldwide. Lorenzen's account has many disadvantages. Some of them are: the inability to support new and modern ships due to non-modernized docks, old navigation systems, inadequacy in the new communication systems and accurate

depth locating, non-updated nautical charts (electronic), lack of installations, installations which must always be clean for new merchandise. All this, however, burdens the shipowner with financial impact while he does not have the control to correct them.

In cases where an accident occurs or something goes wrong in terms of piloting, those who are responsible and are immediately reported are the master and the shipowner. On the other hand, the operator is not obliged to run aground in such ports unless there is a profit. When he chooses to run aground in such a port, he automatically calculates the cost of the risk with the possible profit and there is always the hope of coverage by the insurance company.

As it is known, the highest insurance costs are shown in the freight rates and their cases will be seen in the end by the final consumer. As expected, when a port facilitates the proper functioning of trade then it makes sense to have high fares. But what worries many is the high cost in ports which are not efficient.

Furthermore, market forces are able to pressure or even indirectly force governments always with the right guidance, urge the private sector to contribute to the modernization and improvement of ports. As always, in order to make an investment, as far as the port sector is concerned, the available international financial resources must be available at the moment. When governments do not act in this way, they do so out of conviction.

They justify this as follows. The vessel will actually arrive at the port, it goes without saying, so it is like they have a kind of monopoly. They also claim that the port cost is a small amount of the final cost of the goods traded.

So, we come to the part where we talk about the middle ground when it comes to creating more modern and more efficient ports. These priorities are mainly economic and political, for example to create jobs and in general the continuous existence of a public sector and not to be lost by the private sector. Although some tend to want to wipe out the public sector, this is not possible.

Another thing worth noting is that many have censored the navigation process, which is a port service. This is because navigation as a port service is subject to the obligations of

the public sector which includes exclusive rights and restrictive practices. This is not at all effective and the shipowners' objection to the matter is fully understood. For example, when a pilot makes a mistake while navigating, such as a collision, then the shipowners must take full responsibility. Therefore, when a public error occurs, it is charged as private. For this reason, navigation is one of the few economic actions in the world that requires the presence of an expert mainly for the great experience he has on this subject. However, the master is always the one who will be blamed if something goes wrong.

With today's data, through the P&I clubs, the shipowner subsidizes the mistakes of the pilots. In the best scenario, the operator can take the responsibility and be covered by third party liability insurance as is done in other professions, for example doctors.

Reaching the end, it must be emphasized that as far as the contribution of ports to the safety of ships is concerned, the following becomes unjustified. Port charges are linked to tonnage measurement. This is an excellent topic of discussion that is often overlooked.

In order to meet this the shipowners did the following. The design of the vessels is such as to increase the carrying capacity of the cargo but with a given measured capacity. In other words, they have changed the configuration of the vessel (within the set limits of the required tonnage) so that they can carry more goods. This does not mean that it ensures a safe solution for sailors and Masters.

Korteland is of the opinion that in order for there to be a smoother operation of the procedures there must be a higher table and this will help the crew in his work in terms of exhaustion which will be significantly less. In this way, accidents caused by fatigue and physical tiredness will be reduced.

In conclusion, the only sure thing is that there should be a correct alternative economic approach to the way ports are priced. This pricing should be based on the cost ratio especially in infrastructure pricing. This idea is also being considered by the European Commission. Therefore, port charges should be related to and correspond to the services offered by the port to the vessel, such as the sinking, the area of the dock, the maneuvering area as well as the level of services offered in general.

3.7 THE ROLE OF HUMAN FACTOR

As we analyzed in a previous chapter, maritime accidents vary. Those that occur due to natural factors are rare and have a small share of responsibility in relation to the other accidents. When we say natural factors we mean extreme weather phenomena such as unexpected thunderstorms and strong winds, that is, in which there is no human control.

Therefore, the largest percentage of accidents is occupied by accidents in which the human factor is involved. When a human error occurs then it can lead to explosions, fires and collisions which are the most common maritime accidents. In order to increase maritime safety, many studies and researches have been done with the aim of discovering the main causes of these accidents and eliminating them. Statistical results showed that almost 96% of these kind of accidents were due to human error.

As it has been proven, human error, in addition to material damage as well as environmental damage, can be fatal, costing even human lives. Thus, human error can take many forms. There have been many reports stating that these maritime accidents were solely due to human error, without the influence of any other factor. Here it must be emphasized that an accident has its escalation. By this we mean the magnitude of the destruction it causes. For example, a large explosion on the ship may have been the cause of a small fire in the kitchen area. So starting from a small accident we can have big disasters.

Technology has evolved rapidly, especially in recent decades. Technical progress has entered the maritime industry for good. Modern machines such as electronic maps, navigation and information systems, sensors have increased the efficiency of shipping companies while offering greater security. Nevertheless, we see that human error still worries many bodies and organizations. This is because the maritime industry, no matter how much it evolves and advances technologically, will remain a human industry. Automatic machines and advanced software may have come out, but behind them and

usually in a computer or a monitoring room, there is a person who handles and controls them. A mistake of this man from this position will lead to an exponential reaction to the mistakes. It is like a domino. The error will spread quickly and lead to unpleasant results. And think about it, even in cases where nature intervenes and causes accidents, one could say that there is a share of responsibility for human manipulation. If, for example, there was an accident due to extreme weather, this does not mean that it could not have been avoided if the Master was more capable and had made all the right moves to get the vessel out of the storm with safety. Yes, the main cause was the storm, but if there was the absolute correct handling of the Master, then the accident might not have even happened. Therefore, regardless of the vessel, natural phenomena and technology, everything depends on their relationship with the human factor that participates in them.

From the countless studies that have been carried out on this issue, some statistical results have emerged which show that the cause that led man to error was due to fatigue. It has been shown that when a person on board is very tired it leads to lack of concentration, disorientation and inability to make the right decision. Even without any danger, due to fatigue, a big accident like the wrong pulling of a lever can happen.

The first place is occupied by fatigue, insufficient communication follows as a cause of human error. When the crew does not communicate properly with each other then the risk increases rapidly. Many times quick and clear decisions must be made, according to which if it is not properly transferred from one employee to another, then there will be misinformation and consequently wrong results.

Third in the series is the lack of necessary knowledge. To be more specific, high-tech gadgets are now used on vessels in order for the ship's voyage to take place with greater ease and safety. However, this also requires the parallel training of the crew on the specific components. Nothing can be taken for granted or easy to shipping. Even the simplest things should be emphasized to the staff and it should be confirmed that it was understood. For this reason, when a new gadget is used, the corresponding training should be done to the person or persons who are likely to use it. While all of this may not

seem so serious, there have been many maritime accidents by people who did not know how to use the emergency alert system, for example.

Last but not least is the lack of proper training in how to manage risks as well as how to make the right decisions. It has also been observed many times that standards are not met and that there is insufficient knowledge. All this leads to the result that there is a mistake in the procedures, in other words a mistake in the execution of the management. Even in this case,, there is a person behind it who organizes all this.

Good maritime education leads to greater maritime safety because when seafarers are well trained unnecessary accidents are avoided. There are study programmes for seafarers and study programmes for trainers.

Knowledge and skills can be kept up to standard by regularly following training courses. Every seafarer must therefore keep a logbook that contains all relevant information regarding work experience, and completed education programs and training courses.

Classification of human error by Feggetter

We conclude that most causes, even intermediate ones, are due to human actions. In order for these practices to be eliminated or even reduced, we must first find out what people are really doing wrong. Which act, that is, leads them to error. This is exactly what Feggetter did and analyzed in 1982. A common example is tanker smoking. Tankers are known to carry fine materials and cigarettes can cause ignition and therefore explosion which is even impossible to limit. This action could be due to lack of training because it is implied that the smoker did not know or did not understand the consequences of his act. However, it could also be described as a bad habit, especially when it happens regularly and no corrective action is taken until it is too late.

The following are the main reasons for maritime accidents according to Feggetter:

- Human information processing: senses, perception, attention, memory, decision, risk taking and action, monitoring and feedback.
 - Visual illusions
 - False hypothesis
 - Habits
 - Motivation
 - Training
 - Personality
 - Fear

- Social system
 - Social pressure
 - Role
 - Life stress

- Situational system
 - Physical stress: physical condition, state of nutrition, drugs, smoking, alcohol, fatigue, sleep loss
 - Environmental pressure: visibility, glare, temperature, noise
 - Ergonomic aspects: design of controls, design of displays, presentation of material, policy for dealing with emergencies

Since it has become clearer how a human error can be caused, at this point we must say that there will be a great difficulty in the shipping industry worldwide because of human error. More analytically, in the age we live in, rapid innovative changes are taking place in the field of shipping. Although the consequences of accidents are understood by companies, if human error is not limited then the whole shipping space instead of gaining from the upcoming innovations is very likely to have costs and burden it even more in the future.

But in order to reduce accidents by the human factor, the following must be done: first, all the effort is focused on reducing the latent error, then to calculate and reduce the effects due to the psychology of the employees and finally decision-making improvement. In this way, in addition to reducing accidents, on the other hand, the process of innovations and initiatives will be encouraged without fear.

One solution for employee compatibility with innovation is to set up simulations, model and train through web-based simulation. To achieve this, however, the entire shipping community must integrate them into both its systems and its personnel.

Although human error may seem small, its effects can be enormous. Shipping depends on both ships, machinery, ports and human resources. Together they make a smooth and efficient operation. Therefore, human error cannot be ignored. On the contrary, there have been cases where a human error has collapsed entire shipping companies.

As long as the vessels are manned, it is imperative that there is adequate training throughout the crew for the technology used throughout the vessel. Also, emergency drills should be done regularly. And in general the repetition of primary education would not be pointless. With all this, the existence of human error could be significantly avoided. It is also very important that the crew understands the reason for all this training and the impact of the risks involved. However, it is good to do this not only for those on board but also in the whole shipping company. This minimizes the chances of error in the shipping company's space from top to bottom.

4. MECHANISMS FOR SAFER SHIPPING

Systems and Organizations

A future goal for the pursuit of more effective social and technological solutions in the field of shipping is to integrate technical systems into the operator. In this case the difficulty lies with the designer. It is very difficult to choose which functions are relevant and necessary in the technical systems as well as how they must be presented in order to be perceived by the operator. He should take into account the experience of the pilot as well as the training he will receive. Nevertheless, the designer will work based on his own judgment, experience and knowledge, which is different from the operator's view.

In order to facilitate the designer and in general the whole process mentioned above, the operator should have a more active action on issues related to technology. That is, it should determine the information that is necessary to do its job as well as the way in which it should be presented. Through his active action and influence he will be able to clarify who will perform the tasks and who will be assigned to the technical systems. In other words, he is the most competent person to help and guide the designer in the creation of technical systems because he knows exactly what needs and improvements are needed. Thus in combination with technology and the operator, there will be a complete human-centered system, which will perform more efficiently thanks to the help of technology.

In this case, since we have the intervention of the human factor in order to be able to be perceived, the social system of the operator must be understood. It has been observed that although the operator may have excellent training and long experience, they make mistakes and cause accidents. The step to deal with this problem was through instructions and rules to improve the regulation of its actions. Regulations have been created that

indicate that all operators, regardless of experience and knowledge, how they must act in a given situation at a given time.

All this led to the creation of an approach that shows the categorization of errors by operators. All this was done in order to analyze the contribution of the human factor to this issue. The types of errors identified were mainly three. Errors due to the skill of the operator, errors due to insufficient or incorrect knowledge of the operator and errors based on a rule.

However, the disadvantage of this method should also be emphasized. Although it focuses strictly on regulations and the operator for highly regulated activities, on the other hand it does not take into account the other possible causes of accidents. So its efficiency is limited and specific.

We must emphasize that rule systems vary between business sectors. A typical example is air traffic, which is so automated and well-regulated that it leaves little to the carrier to make a decision. As far as the shipping industry is concerned, things are different. This is because the nature of this business is diverse. In this area, the regulations are less, as a result of which more freedom is given to decisions. Therefore, the requirements from someone in the field of shipping are greater than in an airline since there is not so much dependence on his decisions.

A classic method of avoiding the negative effects of the human factor and avoiding accidents is the organization of work. The goal of each company is to seek the participation of many employees in the same job as well as to interact with each other. This theoretically reduces the chances of error since there will always be a second view or observation. But when we refer to a good organization we mean a division of labor which will be efficient. More specifically, the exchange of views between the operators as well as the joint evaluations and disputes will lead to the agreement of a correct result. Also, the experience and knowledge of the operators when combined and cooperated with each other, then these are safer and more correct decisions. This is the reason why

aviation has the first place in such matters. It maintains to a large extent its hierarchy, its authoritarianism and the classic motifs. Nevertheless, it is observed that there is an interest on the part of aviation for teamwork, pilot cooperation as well as Bridge Resource Management modeled for its specifications.

Through this beneficial organization some other human weaknesses appear. For example, through collaboration, communication problems may arise as well as issues related to the division of responsibility and work. If the employees get into a fight or feel that they are being wronged then the results of the organization will not be only positive. So, the dynamics of a team can be really effective and successful but it can also be ineffective. It all depends on how the team will work.

In order to increase the safety of the sea and the marine environment, great efforts are made to reduce the negative effects of human factor extermination through the expansion of the organization. In the past, it was believed that the main causes of accidents were related to the vessel. Nowadays, however, this view has gone a step further and states that the entire organization of the vessel, the shipping company, the relations with other shipping companies and the attitudes to safety issues are included in the issue of the organization. That is, it concerns the entire technological and social system in the field of the shipping industry.

This is exactly the view expressed by the IMO according to the ISM Code, Clause 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 determine the end result."

4.1 ADAPTING PEOPLE TO TECHNOLOGY

As long as research was done to find the weaknesses of the human factor, technology did not remain stagnant. On the contrary, it has evolved and progressed rapidly. It is remarkable how many things have been achieved in recent years in the field of technology. If we could plot it in a diagram we would see an exponential line of technology increase over time. No matter how much technology evolved, some accidents were destined to happen.

Looking at it a little more historically, one point to note was the period of World War II. Despite the support of technology we saw many plane crashes, bombers with targeting systems lost their purpose causing irreparable damage (for example to historical monuments). It was noteworthy that older technology weapon systems outperformed the newer ones. With these facts, many experts were called in to investigate the relationship between man and machine, as common sense had begun to disappear. This made it quite difficult for the experts and it was evident in the fact that it took them almost a decade to come up with the term human factor.

After their research, the experts believed that the elimination of accidents would be possible only if man adapted to the data of technology. This would be done through a proper education, a proper training and the corresponding experience. However, with the data of World War II, all this was overturned since pilots who were properly trained and experienced made mistakes. Thus began the thought that man should have other responsibilities and tasks more suitable for him and other for the technical systems. Seeing how important an issue was created between operator and technology, it turned out to be of high importance and priority since then.

As time went on, man's demands for convenience and safety became greater and greater. The work began to become more demanding and complex and this implies the creation of

more sophisticated technical systems in order to meet these difficulties and requirements. With all the technical systems being introduced on a daily basis in order to facilitate the procedures, human intervention has been significantly reduced, especially in the workplace. Many people think that technical systems are seldom faulty so accidents are rarely caused because of them. For this reason the responsibilities are placed on the human factor which is considered the weakest and most vulnerable. This is because people work with emotion, intuition and psychology which can easily be cloned by factors we have already mentioned.

From the moment it was realized how important the role of the human factor is, efforts are being made until today so that the systems can correct human errors. Because the concern of the experts is great, they have made backup systems for the recognition of anomalies or that something is not performed properly. In other words, they are in a position to assume the position of the pilot if this is necessary. For example, the autopilot or the fire extinguishing systems which, if they detect smoke, are activated by themselves.

All this leads to new research results which show that there are other new human weaknesses. In addition to what we analyzed in a previous chapter, we can add that many times the operator is feeling bored, monotonous and daydreams resulting in an accident. Now, systems and technology in general are assigned more tasks and responsibilities for carrying out tasks than humans. Thus, the employee becomes more of a spectator of the works.

Another use of the systems is obviously for the convenience of the operator. What mediates between an operator and reality is an electronic information system. This information system performs two tasks. The first is to transfer the operator's commands to the technical system it operates. The second is to transmit information related to the state and reactions of the system behind the manipulation through sensors and screens. The advantages are many such as the security they provide to the operator from natural

hazards. If, for example, an outdoor work is required and the operator can do it from a distance then it almost eliminates the danger that would run through him.

To be more detailed, the fact that the electronic support intervenes automatically means that the operator does not have direct physical contact with what he manages since it happens remotely. The operator receives the information through screens, which have been configured by the system designers. This leads to the disadvantage that they have not been selected by the pilot himself who is also the most competent in this case and his point of view should be vital. The information that the operator receives in the end is not always of good quality and many times does not correspond to reality especially in the matter of dimensions. A very illustrative example and specifically for the shipping area is the following: when a vessel reaches the dock, the Master does not have a direct view on all sides of the vessel and its corresponding movements. The accuracy and immediacy with which he places it on the dock is due to the information he receives through cameras and screens. So accidents in ports have been significantly reduced.

Unfortunately, it has been observed that due to the complexity of the systems the operator is often confused or does not understand them. This can create uncertainty and concern for him because he is not able to understand if the system works effectively or if he has to intervene himself in case of system failure.

Reaching today, it is observed that shipping companies and the entire shipping industry in general tend to enhance technology and lose faith in human competence. This, of course, is very likely to lead to a distinction between human factors and technical causes of accidents. When an accident occurs, the operator and the technology are examined separately during the investigation. What is certain is that a good balance has not yet been found between operator and technical systems. However, it is very likely that in the near future there will be a change and a better relationship between them as they will interact more effectively.

4.2 ADAPTING TECHNOLOGY TO PEOPLE

In the previous chapter we explained how and why people need to adapt to technology. In this chapter we will look the other way around. How and why technology should be adapted to humans.

The view that the operator is the cause of many errors should be changed and replaced with the following: the operator is responsible for processing the information he receives as well as for the necessary actions required to be taken at a given time and situation. In other words, it is a human information processing system. To be a quality energy also depends on how good the information he receives are or has access to seek. If its sources of information are incorrect or bad then there will be the corresponding expected result. On the other hand, when there is good and enough information then the energy is much more likely to be effective.

At this point we need to clarify what we mean by the term information. There are two versions. The first is the information that one receives through one's senses. The second is the information that helps reduce uncertainty, that is, it contributes as a positive element in making a decision. The largest information processor is the human brain for it can and does combine both versions of the term information. The way information is received and processed is very complicated. An instant decision that lasts only a few seconds, can be analyzed in many stages that will seem unbelievable how it all happened so quickly.

Receiving information by the senses alone is not enough. An editing and evaluation must be done. When a lot of information is gathered, what can distribute and separate it is the appropriate training and experience. This is because it becomes clear in the brain what information should be sought, as well as how it should be processed and then interpreted.

Through the senses and the technical systems, the operator is given the opportunity to correct, adjust or even improve the actions that are to be taken.

In conclusion, it is very important for the operator to have the best possible information. The more reliable the information the better the result. He must also be able to choose for himself. It would be advisable to train the operators in such a way that they can use their experience. Finally, as is well known, every human being is different and unique. For this reason, a very wise and correct choice of people who will take on critical tasks must be made. In other words, they should be possessed by good perception and reflexes, high ability to handle and make decisions, experience, maturity and respect.

5. CLEANER OCEANS

To begin with, we will first delve into the purity of the oceans, we will mention some of their general characteristics. The oceans are the place where ships move daily for centuries. The ocean coverage rate exceeds 70% of the entire planet. Beyond their vast expanse and the exploitation of man in order to transport goods from one side of the planet to the other, it is also a natural resource of great value. Living organisms and plants are valuable for maintaining the chain in nature. Also, ocean water itself is valuable for the proper functioning and preservation of the natural environment. In other words, the oceans clean the air, determine the weather, provide food for the whole world and the rest of the fauna and finally offer millions of money to many businesses worldwide with the result that a large percentage of the economy depends on them. But beyond the offer of the oceans, we must say that it is also home to many marine animals and plants such as algae and blue whale. Therefore the oceans could be said to be the largest home for many organisms worldwide due to their size.

With the evolution of technology and its reckless use by humans, the environment is burdened daily and uninterruptedly. As far as the effects of marine pollution are concerned, they are huge and severe. It has been observed that water quality is deteriorating, water development has been disrupted, human health has been affected, there has been climate change, animals and organisms are disappearing and much more. But we cannot blame technology for all these effects. The problem that leads to all this is the attitude of man towards some standards that were created for the protection of the marine environment.

First of all, it should be made clear who is affected by these effects. The first to be confronted with the dangers of infection are the flora and fauna of the marine world. For this reason, some scales have been created which concern influences from ocean level to influences concerning species and the genetic level. In more detail we have the following scales:

- ◆ First in climates are species, which provide an acceptable initial classification of biological diversity with specific classification rules for distinguishing between different types. This view has been accepted worldwide.
- ◆ Then come the habitats. They offer suites of species that appear consistently but come from different parts of the taxonomic hierarchy. Also, their ranking can be structured in a hierarchy based on their similarity scores.
- ◆ Then we have the seascape which includes habitat suites and often come from different parts of the hierarchical habitat classification.

Finally, it should be emphasized that this classification differs from scale to scale because different factors intervene and change the requirements.

5.1 SHIPPING ACCIDENTS

The term maritime accident means any accident that contributes to financial loss, loss of life and major ecological disaster. The reasons that can cause a maritime accident are complex and innumerable. The larger the tonnage of a ship, the greater the impact in the event of an accident. This is because as the capacity of a ship grows, so does the cargo, and the crew and the fuel. So in the event of an accident, the goods that will be destroyed or lost will be much more, as will human lives. Therefore, the percentage of risk increases. Another reason for maritime accidents is that vessels, especially large ones, tend to lag behind in flexibility due to their volume and weight.

In general, there are many serious causes for maritime accidents. Some of them are: weather conditions or even more generally natural conditions such as thunderstorms and strong winds, technical failures such as an explosion in the engine room or a complication in the propeller, the route conditions, all the factors related to the ship, the human mistakes that we already have analyzed as well as the factors related to the cargo.

Because maritime accidents vary, so do their consequences for both the shipping company and the marine environment. Depending on the magnitude of the maritime accident, there will be corresponding consequences. Some of the most common maritime accidents are: the collision of the ship on rocks or on the dock of the port or between them, the overturning due to severe weather, the breakdown of the ship due to incorrect division of cargo, the fires and the explosions due to defective machinery systems or human error.

Statistical researches has shown that groundings and fires on the vessel are the most common maritime accidents worldwide.

A landmark event that marked the beginning of environmental protection was the destruction of the Torrey Canyon. The tankers are severely damaged and all the oil is spilled into the sea, then we have oil slicks during which countless fish and birds die. To understand the extent of the ecological disaster they cause, we will cite the following data. Of the 20 largest oil spills in human history, about 2.4 million tons of oil were spilled into the sea.

Despite the achievements of technology and the continuous training of the crew, there will always be risks in shipping. However, significant changes and improvements have been observed worldwide, with the aim of increasing maritime safety and cleaner oceans. Many ship and crew standards have been revised and improved, and shipping management through internationally approved measures has effectively contributed to this goal.

“Shipping is the fundamental as well as dominant means of transport for the world trade as the Earth is almost covered by sea. Nearly 90.000 vessels of various size and more than 250 different types, specialized on cargo or passenger trade or both, serve for humanity”. (O’Neil, 2003)

Shipping is a global mechanism that contributes to the mass delivery of international trade. It contributes significantly to the well-being of humanity, as it is a connecting link for the supply of goods and products. It is the transport of billions of tons of materials, goods, raw materials and products daily through ships from port to port in compliance with the existing specifications and without accidents. Accidents happen but not on a daily basis and some are not so different from other industries.

The truth is that the area in which the vessels are involved is of high risk. This is evidenced by the fact that despite the accuracy of navigation and satellite systems, accidents and losses of human lives at sea still occur. These are some accidents that even the most advanced navigation or communication systems can not prevent.

As expected, the nightmare of every sailor is the realization of a naval accident regardless of type. For example, when an accident occurs on a canal where everything is as narrow as the Suez and Panama canal and the traffic is high then it is very likely that several serious risks will arise. More important, however, is considered when, for example, water enters the vessel. This proves the existence of damages which may be due to weather phenomena. In this case, especially if the ship is far from a port, then it can be fatal. However, there are other accidents where the issue becomes more environmental such as when there is an oil spill.

The Oxford English Dictionary defines an accident as, “anything that happens without foresight and expectation: an unusual event, which proceeds from unknown cause, or is an unusual effect of a known cause.”

Webster’s Third New International Dictionary gives the similar essence - but with slightly more explanation, as “a usually sudden event or change, occurring without intent or volition through carelessness, unawareness, ignorance, or combination of causes and producing an unfortunate result.”

From the above definitions as well as from what we have understood, we conclude that a shipping accident is characterized by any accident that leads to either financial loss or loss of human life or both.

As expected, shipping accidents vary and in many cases are complicated. The economy has been instrumental in creating accidents. In order to transport more cargo for profit and save money and time, larger vessels were created which carry more cargo and therefore require more staff to work. Whenever an accident occurs, the lost property is much more, like the victims. Larger vessels may be profitable due to the transport of more cargo, but this also implies the reduced maneuverability of vessels, which has caused several accidents.

In general, the causes of maritime accidents are many. The main ones are: natural conditions such as weather and rheumatism, technical failures of machines, route conditions, the human factor and generally factors related to the ship and the cargo. In more details:

- By natural conditions we mean weather phenomena such as strong winds, reduced visibility due to fog, rain and snow, strong sea currents, thunderstorms which are sometimes unexpected and the darkness are the factors that affect the crew and the vessel as well.
- By technical failures we mean failures in the vessel's machinery or materials. For example, in an engine or hull fault that may be due to a construction defect, corrosion that has been neglected and not repaired and a defect in the navigation systems on land and not only on those on vessel.
- By route conditions we mean errors that occur during navigation. For example, the inaccuracy of the maps especially when the Master depends solely on them, the diagrams which are uncertain for their reliability, the narrow channels which require sharp and fast treatment which is very difficult due to the small flexibility and the great marine traffic at that moment.

- By ship-related factors, we mean the vessel's weakness such as its size which limits it to flexibility and stability and sinking. Many ports are not able to accept vessels with large drafts.
- By human error we mean inadequacy of knowledge and experience, lack of concentration, incompetence in technical matters, negligence of rules and procedures, negligence in duty, poor communication between the crew, physical and mental fatigue as well as many others that we have already mentioned in previous chapter extensively.
- By cargo-related factors, we mean mainly dangerous and heavy cargo. Dangerous are those that carry chemicals, oil and nuclear substances. For this reason it plays a role how all these have been placed inside the vessel, and where they have been placed meaning in the hold or on the deck. As for the heavy cargo, for instance goods and timber, it matters how much the crew takes care of them because they have to do with the vessel's cargoworthiness.

A shipping accident may not be due to a single cause, but to be a combination of several. Through statistical research, it has been observed that even in the field of shipping, the human factor is the main cause of an accident. Although human error has decreased this has not changed and at a rate of 80% they remain the leading cause. This could be said to be happening because the role of people takes part everywhere.

The second main cause of shipping accidents is the large maritime traffic, especially in areas where crossing is difficult. By difficult we mean that narrow passages (such as some canals) leave very little sea space for vessels to pass so they gather a lot. We have seen cases of collision between them. Also, passing through these passages requires skills from the Master since it is very likely to find the vessel on rocks. Through all this process the Master should not waste time because there will be claims against the shipping company. Therefore, the Master has to handle many situations skillfully at the same time, which is very easy to lead to an accident.

One of the other disadvantages of shipping accidents is that they can happen at any time, anywhere and under any circumstances. That is, they are unpredictable in many ways. Day or night, with good weather or adverse weather conditions, with full visibility or fog, off the sea or in narrow passages, even with all the technical systems working perfectly.

It is obvious that during the day and as long as there is light, the visual estimation of distances can be done much easier and with greater accuracy and confidence. Sometimes the course changes are rather obvious. During the night the whole scene changes. Visibility and estimating distances are very difficult. For this reason, navigating at night requires great care for the following reasons:

- it can confuse the Master from coastal areas with very bright and scattered light
- reduction of the nominal range of visibility of the lights thereby, and,
- sailing lights being hardly visible,
- Unlit navigational hazards affect also the navigational safety.

5.1.1 TYPES OF SHIPPING ACCIDENTS

As expected, shipping accidents also have categories and types. Each type of shipping accident has a different impact on the marine environment. Some examples of common maritime accidents are fire, explosion, collision, contact, capsizing, shipwreck, grounding and dismantling. All of these, of course, are caused by different causes and circumstances.

There are many types of vessels, which differ mainly in size and capacity and then in other characteristics such as vessel's speed. Hundreds of vessels sail all over the world every day to transport goods. But before each vessel starts its journey, the route that the vessel will follow is pre-determined and changes in very few cases. Such a case is an example of the Master judging that he must change course due to dangerous weather phenomena. Therefore, the main goal of the route among others is:

- to keep the shortest distance in order to save money and time
- to avoid navigational hazards, and defective navigational marks and
- to prevent collision(s)

It has been observed that in areas with increased shipping traffic the vessel encounters are many and this can lead to abrupt or sudden maneuvers and consequently to an accident.

The vessels must be in communication with each other in order to avoid possible collisions and to be able to deal successfully with the following actions:

- a. meetings,
 - end-on or nearly end-on as to the other,
 - crossing on either side, or
- b. overtaking the other

The main areas that can cause accidents such as collision, landing or grounding are: where there is heavy shipping traffic such as major ports or port terminals, capes and generally very narrow passages.

One of the most important types of shipping accidents is collision. More specifically, it is the impact of the vessel against vessel by contact. Despite continuous improvements in navigation systems, collision remains a serious threat.

At this point it should be emphasized that when tankers or vessels carrying dangerous goods are involved in the conflict then the impact they have on the environment is enormous.

5.2 WATER POLLUTION

When a shipping accident occurs then the effects on the marine environment are enormous. They affect many factors even if they are not obvious at the time of the accident. For example, the quality of surface water deteriorates, the growth of the aqua (including animals and plants) is disturbed, health and consequently human life are affected and much more other consequences exist. The main reason for water pollution is the observance of the regulations by the people regarding the protection of the marine environment. There are regulations, standards and specifications which unfortunately in many cases are not observed due to economic and political interests.

The causes of the disasters are mainly the following:

- The rupture of chemicals and oils from leaks and functional discharges
- During ballast, foreign marine species as well as fish enter the hulls beyond the sea water, as a result of which the fauna of the place is disturbed. Many fish while being transported to their new environment are unable to adapt to the new waters and survive.
- Many toxic chemicals are used in antifouling paints. But these substances are thrown into the sea.
- Many times and even illegally, a lot of garbage and sewage is thrown from the ship into the sea.
- The vessels emit from their chimneys mainly sulfur dioxide, nitrogen oxides and carbon dioxide, as a result of which the atmosphere is polluted.

- Vessels cause a great deal of noise pollution in the marine environment. As unbelievable as it may sound, the noise disrupts many marine animals such as whales. Also, the fall of the anchor destroys the bottom. Waste-waters have a corresponding impact. Through them we see that natural and other damages are caused.

The largest percentage of the oceans has not yet been explored by humans and due to their large size the expanses from shipping cannot be evenly classified. For this reason, the focus is mainly on the ports and the routes followed by the ships.

Shipping lines have now become routine on many vessels daily. The number of vessels has increased rapidly and shipping companies continue to add vessels to their fleet until today. But as shipping increases, so do the accident rates, especially those leaking.

As the shipping traffic increases, especially in the ports and shipping routes, there is a threat to the ecosystem of the respective area. Areas consisting of rich seabed, wetlands and mudflats are sources of financial income and natural good for each country. And usually such areas are observed near sea areas or ports, as a result of which they are endangered.

5.2.1 MARINE POLLUTION FROM SHIPS

In this chapter we will analyze how vessels cause pollution in the marine environment. The main causes are:

- ◆ Oily-water discharge from ships
- ◆ Tanker accidents
- ◆ Accidental spillage during terminal loading
- ◆ Garbage and other solid waste
- ◆ Ballast - water discharged from ships at ports
- ◆ Marine machinery exhaust
- ◆ Anti-fouling paints
- ◆ Sound pollution

Now we will analyze each cause separately in order to emphasize how serious the effects are on the marine environment. In more details:

- ◆ *Oily-water discharge from ships*: In order for a vessel to operate, it must produce large amounts of energy. This often contributes to leaks of fuel, fat and water in catchments which end up in the marine environment. Although there is an oil-water separator on the vessel, if it is defective or if it is not even on the vessel then the emulsified water and oil that falls into the water causes a great source of pollution. Also, water is contaminated in a similar way when ballast water is pumped from cargo tanks containing oil. These waters contain residues of oil and foreign goods and should be cleaned very well before loading the new crude oil. As we said the hulls contain residues from the previous load. But when it comes time to clean with materials such as detergents, solids and rusty scales they fall into the sea. Therefore, the cleaning of oil tanks leads to marine pollution since the greasy water in combination with the chemicals used for the cleaning all end up in the sea.

Tanker Accidents: Tankers are known to carry oil. Therefore, a common effect of this category is oil spills. Tankers generally carry flammable materials such as gas, oil and other chemicals, so they have a higher risk because a collision or explosion or fire can sink the entire vessel and cause it to human losses. The biggest maritime accidents are related to vessels carrying such materials. Although the environment is polluted daily by many other factors, the damage caused by oil spills is irreversible. Animals and plants cannot survive under these circumstances, with the result that entire sea areas were deserted. For this reason, several moves have been made so that in the event of such a leak the damage can be reduced. Such movements are stricter safety measures on these vessels, corresponding training of personnel and immediate reduction of leakage.

- ◆ *Accidental Spillage during Terminal Loading:* Remaining in the same type of vessels, tankers, we must emphasize that accidents in ports are very common during the loading and unloading of such materials. This is because pumps and valves malfunction, pipe rupture and operational faults lead to leakage which ends up in the sea and in coastal areas. Corresponding leaks may also occur during the refueling of the vessel. The reasons are exactly the same in this case. Also, one should always monitor the oil level in the tank of the vessel when it enters because they could overflow.

- ◆ *Waste water discharged from ships:* Vessels discharge two different effluents. Black Water and Gray Water.
 1. Black Water is mainly sewage from the toilets and medical facilities of the vessel. These effluents are very likely to contain viruses, bacteria, intestinal parasites, harmful nutrients and much more.
 2. Gray Water is mainly water used by the crew to shower, wash clothes and utensils in the kitchen. These waters contain soap, oil, grease, detergents, waste products, bacteria and viruses. As expected both types of water are discharged into the sea

during the voyage and can damage the entire system. For example, fish die, algae blossoms are created and consequently man is affected in the end.

- ◆ *Garbage and Other Solid waste:* In addition to the liquid waste we have already mentioned, we have other solid waste such as garbage. And these end up in the sea. Usually the materials of solid waste are glass, plastic, aluminum, paper and steel. Although seemingly are not so dangerous they can cause enormous damage. Many animals have eaten such waste because they thought that it was food. The bottom of the seas becomes a large garbage dump. And many times we observe beaches and coastal areas full of garbage. All this threatens both the ecosystem and man.
- ◆ *Ballast-water discharged from ships at ports:* Ballasts are used to stabilize ships at sea. This has been happening for many decades, around 150 years. Ballast water is essential for the operation of today's ships as they help in safety and efficient activities. But this has created serious ecological problems such as the transport of fish. As the water enters to the ship in the port of loading, many fish enter and are released again in the port of unloading. In addition to fish, bacteria, germs, eggs, cysts and larvae of various species are also transmitted. These transportable species may or may not survive in the new environment. But if they survive then they will cling to existing organisms thus causing mutations in marine species. Some effects are direct and some indirect. Like the damage to the environment that some can be repaired but others are irreparable.
- ◆ *Marine Machinery Exhaust:* Apart from marine pollution we also have atmospheric pollution. The main emission of ships is sulfur. Sulfur creates acid rain which is harmful to humans, crops, building erosion and other living organisms that come in contact. In its most immediate effect, when inhaled by humans then it creates respiratory problems and increases the chances of heart attack. Irene Blooming, a spokeswoman from the European environmental coalition Seas at Risk, the fuel used in oil tankers and container ships is high in sulfur and cheaper to buy compared to the

fuel used for domestic land use. “A ship lets out around 50 times more sulfur than a lorry per metric ton of cargo carried. These emissions from marine diesel engines contribute to ozone and carbon monoxide non attainment (for example failure to meet air quality standards), as well as adverse health effects associated with ambient concentrations of particulate matter and visibility, haze, acid deposition and eutrophication and nitrification of water . Shipboard incinerators also burn large volumes of garbage, plastics and other waste, producing ash that must be disposed of. Incinerators may release toxic emissions as well. Bunker fuel can also emit volatile organic compound when tanks are vent during loading. ”

- ◆ *Anti-fouling Paints:* Anti-fouling paints are used on ships. When they act, they slowly release poison onto the stagnant seawater that surrounds the ship. This poison because it is soluble is toxic and dangerous to marine life. It has been observed that impacts on marine life but also on the food chain have been caused by this reason mainly in areas with intense shipping activities.

- ◆ *Sound pollution:* As human activities in the field of shipping increase, so does noise pollution. Ships during their voyage make a lot of noise resulting in many marine animals such as whales getting confused, losing their orientation and not being able to communicate with each other. The Convention on the Conservation of Migratory Species constantly emphasizes the effects of noise pollution on marine life and the actions that need to be taken as soon as possible.

5.3 EFFECTS OF MARINE POLLUTION

Since we have mentioned the ways in which the marine environment is polluted, we will now develop the effects that it has on it. Those most at risk are aquaculture facilities, protected areas, fish ponds and cages. These are directly related to humans as they consume fish. If they become infected then they will pass into his body so human health is in danger. Also, protected areas are of the utmost importance because they protect animals and plants that may be endangered. Garbage and chemicals destroy oxygen in the water content making it impossible for many animals such as whales, sharks, dolphins, seals and penguins to survive and even create dead zones. Also, acid rain that falls through runoff in these areas is very harmful and exacerbates the problem.

Garbage dumped into the sea due to human negligence and irresponsibility play a very important role in marine pollution and more. Many animals get confused and consume plastic and other waste, resulting in death. Also, useless nets have caused many deaths of animals which are either confused and considered as food like the sea turtle that confuses the nets with jellyfish, or get entangled in them and can not escape.

From the biological point of view, when many nutrients enter the water bodies, this leads to the increase of chemical nutrients and many times compounds that consist mainly of nitrogen or phosphorus in the water surfaces. All this can cause an increase in primary productivity, for instance overgrowth of plants such as algae and decomposition. Also, other effects are lack of oxygen, reduced water quality and animal population.

However, the effects did not stop at the marine environment. Unfortunately they are also transported to terrestrial animals and this is because many terrestrial animals feed on marine animals, such as some species of birds, bears and many more. These in turn become food for some other animals until we reach man himself. This indirect process makes human life dangerous.

As we have already mentioned, oil is the main cause of pollution in the oceans. Research has estimated that about 3 million tonnes of oil are spilled into the sea each year. At this point, it must be emphasized that oil pollution from the oceans comes mainly from land. Industries and cities dumped their waste in rivers and seas. Adding them up, it turned out that 1/3 of the ocean pollution comes from ships.

Impact of pollution on marine bio-system

In this category we will take for example the spilled oil. This affects both the surface of the water and the underground organisms. Initially, wildlife and its habitats are directly affected. We have all seen in photos many birds and fish being coated with oil, some of them already dead and others trying to save themselves. Oil is toxic and directly affects every organism.

It causes different difficulties in each animal that is covered with oil. For example, birds can not spread their wings and their fur is contaminated with seals. As for the birds because the feathers act as shields to maintain their body temperature, the entry of oil depletes the fat reserves and weakens it.

It is almost impossible to replace these reserves because, in its weakened condition, whenever it flies the bird has to carry as much as 20% extra body-weight in sodden feathers. Also, oil transferred to the surface of its eggs during incubation reduces their hatch ability. Oil pollution also results in disruptions to the cycle of coral reefs, clogging of the gills of fishes thereby resulting in their death and hampering the process of photosynthesis of marine plants leading to their end.

Also, because the oil is mainly on the surface of the water, where the eggs are located during the incubation, it reduces the hatching capacity. As for the coral reefs, which are also hypersensitive, it causes disorders to them, it blocks fish gills causing them to die and finally it hinders the process of photosynthesis of plants.

Impact of pollution on Local industries (often fishing and tourist industry)

Fishing Industry: Another factor that is directly affected by oil spills and we have not mentioned at all so far is the fishing industry. Initially, because the fish are covered with oil or have consumed oil so they are poisonous and inedible. Later, a large percentage of the fish die while it could have been caught. This also has an economic impact because seafood consumption is reduced. This particularly affects the local economies of the coastal areas as they are strictly dependent only on fisheries.

Tourist Industry: Another sector that is negatively affected is tourism. When oil is spilled then all the beaches frequented by tourists are polluted as well as the coastal areas which are also attractions. In other words, the aesthetic beauty of the place is lost because of the oil. There are also many industries that rely on clean seawater for work, so in the event of such an accident they will have to shut down until it is cleaned. As in fishing, the economy is negatively affected.

Impact of Marine Pollution on Public health

Public health is at stake when oil is spilled on a residential area. The concern is when the toxins are transported through the air to the human body resulting in a short period of time causing headaches and nausea and in the long run even cancer. But because oil also contains heavy metals in its composition, they rarely evaporate into the air. On the contrary, when it contains compounds with mercury, nickel and generally materials in high toxic doses such as arsenic then they can seriously damage the human nervous system in small quantities and only.

Furthermore, mercury is considered to be the most likely risk on a regional scale. The World Health Organization recommends that the consumption of mercury-containing foods not exceed 0.3 mg. Mercury by nature is invisible, odorless and is found in fish meat so it is not easy to locate and remove it from the fish. When it comes in contact with the human body then it acts as a neurotoxin and interferes with the nervous system and the human brain causing damage.

As in other cases, pregnant women and young children are the ones who are most exposed to the risk of mercury. The brain, in the early years of children is underdeveloped and absorbs very quickly all the nutrients. From studies and researches that have been done, when mercury even in very small doses penetrates the brain of a small child then it is very likely to cause problems in speech, walking, lack of attention and generally learning difficulties. When babies are exposed to mercury then it has been observed that it causes them mental retardation, deafness, blindness and cerebral palsy. In adults it can cause fertility difficulties, high blood pressure as well as loss of vision and trembling in the extremities. Heart disease has also been reported. In general, we see that regardless of age, mercury causes irreparable and serious damage to the human nervous and cerebral system.

5.4 IMO ABOUT ENVIRONMENTAL PROTECTION

To begin with, we have mentioned the causes and effects of shipping accidents on the marine environment. At this point we must analyze who are the organizations and the people who determine the measures for the protection of the marine environment and how they achieve it.

Monitoring, Control and Preventive Measures of Marine Pollution

More than 80% of world trade is done through shipping. Millions of passengers including tourists on cruises, travel annually to various port destinations. It has been recorded that more than 50,000 vessels carry more than 10 billion tons of cargo annually. These cargoes can be raw materials, fuel and goods. That is why shipping is one of the biggest economic players in the world.

The United Nations agency is primarily responsible for developing and enacting measures to improve the safety of international transport as well as to prevent environmental pollution from ships. Then the International Maritime Organization (IMO)

which contributes to the achievement of the goals related to the United Nations Sustainable Development Goal (SDG) 14: Conserve and sustainability use the oceans, seas and marine resources for sustainable development.

In the last 50 years, the number of ships as well as their size has increased rapidly. This means that there is great mobility in the market. As technology evolves, it helps in more immediate and faster results in the transport process. Many shipping companies have been created around the world which are constantly increasing their fleet by ships. At this point comes the IMO project, which aims to create a unified legal and technical framework to make shipping safer and more efficient. The IMO is made up of 172 Member States, and works with them on a daily basis as well as with other organizations to enforce new cost-effective regulations for the smooth running of shipping worldwide.

The 1948 IMO Convention provided an opportunity to focus on maritime safety and navigation. However, in the 1960s, through a series of unfortunate but serious accidents, the IMO launched a program aimed at protecting the environment and tackling marine pollution. The incidents that changed the IMO guidelines were mainly oil spills, such as the destruction of the Torrey Canyon in the south-west of the United Kingdom in 1967. However, the IMO also dealt with issues of liability and compensation in order to help those in need such as the fisher mans. In 1973, the International Convention for the Prevention of Pollution from Ships, universally known as MARPOL, was adopted.

At this point we will see in more detail what MARPOL was responsible for since its inception. Annex I covers oil tank pollution. Annex II covers pollution from harmful substances which are in liquid form such as chemicals and are transported in bulk into the hold of ships. Annex III covers pollution from harmful substances which are transported in packaged form. Annex IV covers pollution caused by sewage discharges into the sea. Annex V covers pollution caused by discharges into the sea from the ship. In this Annex this ban applies to all ships, while the dumping of plastics has become a worldwide ban.

In more detail and as they are officially written we have:

Annex I - Regulations for the prevention of pollution by Oil: This category includes fat blends, gasoline, spirits and more.

Annex II - Regulations for the control pollution by Noxious liquid substances carried in bulk: This category includes mainly chemicals such as acids, pentanol sodium sulfite, hydrogen peroxide and many more.

Annex III - Prevention of pollution by harmful substances carried in packaged form: This category includes all warning instructions for the issuance of detailed standards for packaging, labeling, incorrect packaging, documentation, storage, quantity restrictions, exemptions and warnings to prevent contamination from these contaminants. substances.

Annex IV - Prevention of pollution by Sewage waste: This is a category that concerns a series of regulations for the disposal of sewage from any type of toilet such as the crew as well as the animals that are transported and much more. Also, the solution to this issue is for the ships to have the appropriate equipment for this work, the installation of appropriate port discharge control systems, the provision of facilities in ports and terminals that are able to receive sewage and finally the conduct research on board ships to ensure that they comply with these requirements.

Annex V - Prevention of pollution by Garbage from ships: This category requires the separation of different types of garbage. More detailed are the plastic bags, the glass, the paper towels, the nets, the wrappers of the devices and much more, the distance from the ground and the way in which they can be discarded are determined. In case that this is not possible then they should be delivered to appropriate facilities on land.

At MARPOL, in 1997, the IMO introduced a new Annex, Annex VI, which dealt with air pollution because ships emit mainly sulfur, nitrogen oxides and other harmful particles.

An important year for the IMO was 2011 when it was recognized as the first international regulatory authority for a transport sector to adopt globally binding energy efficiency requirements. These requirements apply to all ships in global climates without exception. That is, regardless of the marketing standard or the flag state. This was intended to reduce the pollution owed to shipping and therefore the greenhouse effect.

In addition, MARPOL Annex VI contains regulations for other harmful substances and ozone-depleting substances, such as volatile organic compounds, ship incinerators, reception facilities and fuel quality. The aim of these measures is to reduce air pollution which directly affects the health of people living near ports or areas frequented by ships, and indirectly all others in the world.

In addition, Emission Control Areas (ECAs) are included in Annex VI. Sulfur oxide and nitrogen oxide emissions are controlled in these areas. It is set as a strict limit of 0.10% by mass (m/m) for sulfur fuel oil. In order to ensure that these measures are complied with, the IMO has set a global sulfur emission limit, excluding ECA, and that it will be reduced by 0.50% m/m from 3.5% m/m from 1 January 2020. This is a commitment of IMO to a more ecological environment.

The MARPOL Convention is the most important, comprehensive, international treaty today. Because the data is constantly changing, this condition has been modified and updated to keep pace with changes and needs. Its main goal is to prevent air and marine pollution caused by ships, businesses or even accidents. Since the pollution has been substantially reduced thanks to the measures of MARPOL, it continues to have an important and active action even today.

There are some areas which are characterized as Special Areas due to their high ecological priority and maritime traffic. In these areas, MARPOL has greater demands and calls for stricter management of these protected areas. There are 19 Special Areas on the planet such as: the closed and semi-closed seas, such as the Mediterranean, the Baltic, the Black Sea, the Red Sea, and larger oceans, such as the waters of South Africa and

Western Europe. The IMO in conjunction with these Special Areas and global regulations, indicates its absolute commitment to the universal protection of the environment while emphasizing how important it is for every living organism on the planet. Through such actions the IMO proves that it takes seriously the role assigned to it.

Polar waters are a special case. For example, Antarctica has been in the Special Areas since 1992. In this area, the dumping of waste and fatty substances into the sea has been explicitly prohibited. It is noteworthy that from 1 August 2011, in accordance with a new regulation of Annex I of MARPOL, the passage of ships carrying fuel oil was prohibited. In addition to MARPOL, even the IMO since 1 January 2017 has imposed strict measures on the polar waters of both Antarctica and the Arctic.

Particularly Sensitive Sea Areas (PSSAs) are areas under the IMO regime which pay particular attention to, in addition to safety measures, such as the mandatory use of ship routing systems. There are total 14 PSSAs along with two extensions, which include UNESCO World Heritage Marine Sites such as the Great Barrier Reef (Australia), the Galápagos Archipelago (Ecuador), the Papahānaumokuākea Marine National Monument (United States), and the United States. the Wadden Sea (Denmark, Germany, the Netherlands). In combination with Special Areas and PSSAs, the Sustainable Development Goal 14 (SDG 14) objective of increasing coverage of marine protected areas is fully supported. But this requires patience and long-term efforts.

The difference between MARPOL and IMO is mainly based on how they deal with problems and challenges.

MARPOL focuses on accidental accidents and dumping of work on board ships. The IMO, also actively addresses marine pollution from land-based causes but approaches it more indirectly through the London Convention. The London Convention concerns the prevention of marine pollution from the dumping of waste and other harmful substances in accordance with the 1972 and 1996 Protocols. But in this Protocol, there is a list of permitted wastes such as dredging material.

The main goal of the London Convention and the Protocols is to control climate change. This is achieved by regulating the binding and isolation of carbon in submarine geological formations. Also, through regulations and instructions on how proposals for marine geomechanics will be evaluated and tested.

All these procedures for the implementation of the measures in order to be put into operation, in the IMO there is a procedure that is followed every time. It all started with structured forums. Member States then discuss until they agree on the universal measures to be imposed. Safe and sustainable shipping is always the main goal with as few negative effects on the environment as possible.

These procedures are followed by the issue of implementation of the decisions. In order to succeed, IMO also works with other partners such as stakeholders. It thus contributes to the creation of competencies and expertise among its Member States. In this way it reaches the drafting of the standards that will be included in the national shipping legislation. Finally, this implementation will be enforced through this legislation.

In the many years of operation of the IMO, many institutions have shown interest and have offered financially. The most basic are: the European Union, the Global Environment Facility (GEF), the Norwegian Agency for Development Cooperation, the Korea International Cooperation Agency, and many other shipping and maritime organizations such as IPIECA, the global oil and gas industry association for environmental and social issues.

Many regional organizations have contributed to the work of the IMO as well: the Secretariat of the Pacific Regional Environment Programme, the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea, the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden, the Regional Organization for the Protection of the Marine Environment, the Commission

on the Protection of the Black Sea Against Pollution, and the South Asia Co-operative Environment Programme.

In addition to all IMO efforts for global cooperation aimed at protecting the environment and improving safety, it has pioneered other events. The IMO has developed a series of projects based on a global partnership model known as the Glo-X. Glo-X contributes to the immediate acceleration of legal, political and institutional reforms in developing countries with a view to implementing international conventions. In addition, it utilizes private sector partnerships to accelerate research, development and technological innovation with the aim of creating global industrial alliances as well as facilitating the exchange of information.

The GloBallast Partnerships Project (2007-2017), a joint initiative of Global Environment Facility (GEF), the United Nations Development Programme (UNDP) and IMO, has been successful in assisting developing countries in reducing the transfer of potentially harmful aquatic organisms and pathogens in ships ballast water and implementing the IMO Ballast Water Management (BWM) Convention.

The BWM Convention has entered into force in September 2017 and required ships to manage their ballast water to avoid the transfer of harmful aquatic organisms and pathogens, and protect the marine environment, human health, property and resources.

Another global partnerships project is the GEF-UNDP/IMO Global Maritime Energy Efficiency Partnership project (GloMEEP), which is working in 10 lead pilot countries (Argentina, China, Georgia, India, Jamaica, Malaysia, Morocco, Panama, Philippines and South Africa). Its goal is to create global, regional and national partnerships to build capacity to address maritime energy efficiency, in other words, to address greenhouse gas emissions from ships, and for countries to bring this into the mainstream within their own development policies, programs and dialogues.

Another project, funded by the European Union, is the Global Maritime Technology Cooperation Centre (MTCC) Network (GMN), which is establishing a global network of

five MTCCs in Africa, Asia, the Caribbean, Latin America and the Pacific. Its purpose is to help beneficiary countries limit and reduce greenhouse gas emissions from their shipping sectors. The project encourages the uptake of energy efficiency technologies through the dissemination of technical information and know-how.

Through this network of MTCCs, the project enables developing countries in these regions, and in particular, least developed countries and small island developing States, to effectively implement energy efficiency measures in maritime transport through technical assistance and capacitybuilding. Both the GloMEEP and GMN projects will support IMO member States in climate change mitigation, the key aim of SDG 13.

In other oceans-related partnerships, IMO is a partner in, and secretariat for, the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), which advises the United Nations system on scientific components of marine environmental protection. GESAMP evaluates the environmental hazards of harmful substances carried by ships and reviews applications for "active substances" to be used in ballast water management systems, thereby providing inputs into the regulatory process at IMO. GESAMP also provides a systematic overview of new and emerging issues to inform its nine sponsoring United Nations organizations.

Recent key reports by GESAMP on micro plastics in the oceans have contributed to the widening knowledge of the sources and fate of marine litter, specifically micro plastics, in the oceans. IMO is also a co-lead for sea-based sources of marine litter, together with the Food and Agriculture Organization of the United Nations, in the Global Partnership on Marine Litter, which is managed by the United Nations Environment Programme.

In conclusion, we see that the IMO has contributed drastically and effectively to the reduction of pollution in the marine environment and in the atmosphere due to ships. And its work does not stop here as it is committed, together with the cooperation of the Member States and other partners, to develop, maintain and implement all the necessary

global regulations in order to ensure the protection of the environment and the efficiency of shipping.

5.5 SMART PORTS

Nowadays technology has evolved rapidly, especially in recent years. We observe it daily in our lives which is becoming easier and easier. However, technological developments are taking place in the field of shipping. In previous chapters we analyzed how technology contributes to the safe operation of ships and the protection of the environment. However, we also have improvements and developments in the ports, which have completely changed their mentality and the way they operate. In this chapter we will analyze an issue which is very recent and innovative. The Smart Ports which will slowly become widely known.

As the demands of the market increase, therefore the number of ships in order to transport the requested goods also increases. As a result, the global economy is accelerating its pace of shipping. As ships increase in number and size, the respective ports should be able to support such ships with their requirements. The work in the ports should be done faster and with the corresponding safety. The required speed and efficiency requires the use of technology systems that will help ports cope. But this means that it will offer profits, environmental protection and functionality in every requirement and circumstance.

A Smart Port is a port that uses automation and innovative technologies including Artificial Intelligence (AI), big data, Internet of Things (IoT) and block chain to improve its performance.

They can be divided into three infrastructure capabilities:

1. Infrastructure optimally meeting end user needs.

It is essential that each port be able to provide the best capacity for a transport infrastructure network. This covers the ongoing transport, cost, performance, security and risk balancing requirements in order to provide high quality services to end users.

2. Infrastructure meeting environmental and social sustainability needs. The ability to embed transport infrastructure networks in their immediate surroundings, optimally balancing interests from economy, society and environment.

3. Infrastructure achieving added value from digitalization.

The ability to harvest the benefits from digitalization in internal processes of transport infrastructure management as well as in the relation between transport infrastructure management and its end user.

The second infrastructure is the one that concerns the environment.

Infrastructure meeting environmental and social sustainability needs

Innovation Focus Areas

1. Resource efficient manufacturing, construction, operation and deconstruction
2. Advanced strategies and approaches for accommodation of the energy transition in transport infrastructure.
3. Collaborative strategies and approaches to minimize environmental impact
4. Advanced approaches and strategies for the integration of (urban) nodes in the networks - multi-modal, multi-scalar, and multi-objective.

Smart – port Technologies will contribute in:

§ Infrastructure Monitoring

§ Cargo handling operations –Automation / Monitoring /Control

§ Intermodal Traffic § Safety & Security § Energy & the Environment

§ Cargo clearance & Customs

Operations

As we have said there are many types of ships. Therefore, it is logical that each port should be able to accommodate ships carrying containers, tankers, bulk cargo, RoRo ships and refrigerators (Reefers). The main purpose of the ports, regardless of the type of the ship is their loading and unloading as well as the process by which the goods are transported or stored. A Smart Port, in order to achieve this more efficiently, uses technologies along with innovations that increase productivity and minimize costs. The main categories of Smart Ports operations are productivity, automation and intelligent infra-structure.

Environment

As we discussed at length in the previous chapter, ports can be sources of environmental pollution either through maritime transport or land-based activities. The main sources of pollution from the port are: the rupture of waste into the water, pollutant emissions into the atmosphere and noise pollution. These effects pollute the environment and threaten the viability of many living creatures and plants and, in the longer term, of man himself. This is a big challenge for port managers, as they have to stay competitive but reduce their pollutants. Smart Ports place great emphasis on environmental protection. The control and evaluation of the efficiency of the ports is undertaken by the EMS as well as the actions carried out to reduce pollution and waste management.

Waste management

Ships and port activities are serious sources of environmental pollution. The IMO in the MARPOL 73/78 Convention has clarified the types of waste from ships and they are six: oily waste, bulk chemical waste, noxious substances, packaged form, sewage, and garbage. Each of these pollute the environment causing serious consequences. For this reason, plans must have been organized with the aim of properly dealing with the problem, the recycling and generally the reduction of waste rupture.

Water management

The most important cause of pollution from ports is sewage. Many times there are residential or protected areas near the ports, something that makes the problem more immediate and more serious. When waste water is discharged, high organic concentrations are created which lead to the growth of bacteria. All measures and methods applied to reduce waste water must be aimed at reducing marine pollution. Another important problem is the high water consumption of port activities such as the cooling process. This is done either by water companies or by the direct pumping of water by the port companies themselves. The idea of reducing water consumption came from limited water sources and rising costs.

Safety and security

What is worth noting is that ports raise safety issues which can lead to financial loss of ports, their defamation as well as their unreliability. By safety we mean that there are many dangers that threaten a port on a daily basis. For example, the physical dangers, the dangerous activities of the workers as well as the direct attacks by terrorists and their use for arms trafficking. In other words, many kinds of dangers and accidents can be observed in the ports. Smart Ports, however, provide many solutions to safety issues. They use regulations, standards, procedures, regular on-site inspections, staff training, risk assessment and mitigation, monitoring systems for potential safety issues, increased preparedness and improved flexibility. In Smart Ports human activity is limited. Cameras and surveillance systems take place with the result that the employees are not in the field where the dangers await. All controls, monitoring and coordination are done by control rooms in which there are people in charge who operate these systems. A simple example is the following: in ports during the night it is necessary to use lighting so that employees can see very well and do not have an accident. This lighting causes light pollution in the environment but also is a big cost for the port. With Smart Ports because almost everything is automated, the use of light is very limited as it is not so necessary.

Safety management systems

As we mentioned in the second chapter, SMS takes care of carrying out a systematic and organized process in order to mitigate the risks in safety issues. SMS has all the necessary manuals, standards and training procedures. At this point we must say that SMS applies to both ships and ports. ISM Code has the same function. Finally, the IMO requires all international passenger ships, oil tankers, carriers of natural gas and other harmful substances, bulk cargo and ships of 500 tons and over to apply an SMS.

An EMS focuses on the ports in order to ensure the evaluation, the monitoring in order to reduce the environmental pollution from them. According to ISO 14001, the five main stages of an EMS areas follow: commitment and policy, planning, implementation, evaluation, and review (The United States Environmental Protection Agency, 2016). At this point we will mention two well-known examples of EMS implementation are: EU Eco-Management and Audit Scheme (EMAS) and Environmental Review System (PERS). The European Commission in 2017 set up EMAS so that every organization can report, evaluate and improve its performance. EcoPorts has created PERS for each port as an environmental management standard. PERS also incorporates environmental management standards such as ISO14001 along with the specifics of each port.

Smart Ports can meet all the needs required for the proper operation of the shipping. However, the necessary attention has not been paid to the development of ports into Smart Ports. The main reason is financial. To become a Smart Port a port there must be a large financial investment. Automated systems, modern technology, upgrading of facilities as well as the corresponding training of staff require an initial capital. But this will look profitable in the near future and the amortization of money will be done very soon. Smart Ports will not only increase security in port activities but will also significantly enhance environmental protection.

6. CONCLUSIONS

In this thesis, many issues have been extensively addressed that concern many organizations around the world on a daily basis. We started with the term quality because it can be misinterpreted in many ways. Quality, depending on their point of view, everyone has another meaning. That is why a detailed analysis of this term was made as well as how important it is in the field of shipping. Quality is a key factor in the efficiency of shipping. This concept is not just about the quality of a product. Quality is found in every action, activity and process that takes place in the field of shipping. It concerns the quality of the products, the quality of the training of the staff, the quality of the conduct of an emergency procedure and much more. In addition, quality is very important because it depends on how effective the actions will be. This leads to more shareholder profits. But many times in order to achieve quality, safety has been sacrificed. This is a particular issue on which a balance must be struck between these two concepts. It has been observed that the quality is limited due to safety. On the one hand it is bad because the shipping company becomes less competitive and loses money, but on the other hand there must be some limits without endangering both humans and the marine environment.

Next, we delved into the issue of safety. In order to have a balance and control between Quality Management and safety, codes and laws were created that make the landscape clearer. More specifically, SMS, ISM, IMO and many ISO take care to give the necessary attention to the protection of the environment and people, without companies losing their competitiveness. It was also made clear who is responsible for quality assurance and safety. Many competent organizations have been trying for years to find the cause of accidents. Through a series of serious incidents, we have identified that the human factor is one of the leading causes of accidents. Countless researches and new applications have been carried out in order to eliminate the cause of human error. But this is unlikely, even with the best training of employees and the corresponding great experience, there will always be human error. Nevertheless, significant steps have been taken to reduce the rate

of human error. This was done mainly through the integration of technology in people by training them properly so that they can handle new technology systems effectively. However, the opposite happened, meaning that the new technology systems should be accessible to the learner and not demanding and complicated.

Another major issue that concerns the entire planet is the protection of the marine environment. Maritime accidents put a heavy burden on the marine environment, causing indescribable disasters. There are many types of maritime accidents, most notably oil spills. Marine pollution, however, is not only caused by accidents. Sewage discharges from ships and ports contribute significantly to the pollution of the marine world. The effects are not only local but global as they also affect the human health. The IMO is mainly active in protecting the environment as it implements laws and regulations that the involved parts must be complied with worldwide. Through great efforts and collaborations with other agencies, it has managed to reduce marine pollution without restricting the activities of shipping companies and ports. The new measures together with the contribution of technology pay off significantly.

We conclude that the marine environment is a top priority as its protection is urgent. A maritime accident can cause great and irreparable ecological disaster. For this reason, it is very important that all stakeholders comply with the laws and regulations that apply worldwide. The application of technology in combination with the human factor can lead to a safer shipping while maintaining the desired quality and efficiency of processes. All that is needed to be done is to understand the seriousness of the situation, to have a will for improvement and, of course, cooperation at a global level.

7. RECOMMENDATIONS

In previous chapters we made clear how important is the coexistence of quality with safety and the implementation and observance of international laws on maritime protection. Also, it was analyzed what are the causes and effects when the above are not observed. At this point we will suggest some propositions which, if implemented, will contribute greatly to the efficiency of shipping and the protection of the environment.

Technology

As expected, today's maritime accidents have become the main issue related to marine environmental pollution and the financial losses of the companies involved. A maritime accident can be the trigger for radical changes in shipping. The risks as we have analyzed are many and unexpected. Nowadays, all new ships are equipped with modern equipment to reduce the dangers of navigation, loss of human life, pollution of the marine environment and loss of property. Due to the increase in the size of the ships, the use of navigation systems has never been more necessary. These systems that help in accurate navigation appear in two forms:

- **GPS / DGPS or GLONASS:** a receiver placed on board which communicates with a satellite. This satellite sends back the ship's coordinates with great accuracy instantly.
- **LORAN-C:** is a terrestrial radio navigation system.

These systems operate in real time and automatically inform the ship of their location. If this equipment is installed on older ships then the navigation will be carried out with greater safety.

Reduced Speed

An immediate solution to reduce emissions is to reduce the speed of ships. This, in addition to the ecological consciousness it has, offers another advantage to the shipping companies. Because the price of oil has risen significantly, reducing speed helps save fuel and therefore costs. So from an economic point of view, it is better to reduce the speed.

More specific, emissions of mainly carbon dioxide are proportional to fuel consumption. The higher the speed the higher the consumption. For this reason, if the speed of the ships decreases even a little, then the emissions of pollutants will also decrease.

Studies have shown that a ship traveling at high speeds has about the same energy demand as airplanes, while traveling at low speeds is about 10 times more efficient than trucks and 100 times more efficient than airplanes. Therefore, proven this speed reduction saves money and helps the environment.

These two suggestions were the most important and direct ones that can be used. Especially the reduction of speed can be applied on the same day while the integration in the ships of advanced technology systems can be done as soon as the ship reaches a port. Now we will list some other recommendations in general:

Main recommendations:

1. The existence of policies and regulations by the Federal government which will control pollution from ships. In case of violations, it will impose financial sanctions and restrict of the ships that pollute the marine environment.
2. As this is a global action, countries should cooperate with each other on issues other than the enactment of laws. One of them is the exchange of technology and experience information in order to create a research and development program in each country. In this way everyone will be equally effective in combating environmental pollution.

3. The creation of a better level of organization and coordination of the agencies responsible for the protection of the marine environment. If the people in charge work together in a more targeted and organized way, then there will be greater efficiency.
4. Strict observance of IMO laws and regulations, as well as financial sanctions in case of violations.
5. Improving procedures for emergency response, risk assessment and control equipment. Also, the cleaning of the polluted areas should be done more immediately and efficiently with new methods.
6. In order to understand all these efforts as well as the importance of the situation, everyone must be made aware. From the simplest citizen to the shipowners, the crew and the companies. Respect for the marine environment is everyone's responsibility. Therefore, the competent organizations such as the IMO could issue training programs and seminars that will inform the whole world about the effects of marine pollution as well as the actions that anyone can take to help.
7. The crew should regularly perform safety drills so that they are alert, familiar and ready for any situation.

In conclusion, the means for a safer, greener and more efficient shipping are available. It will also improve the quality and safety system worldwide. Therefore, with the right organization of all actors and with a universal action, all the goals can be achieved for a better future.

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