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Konstantinos Stathoulopoulos

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LIST OF ABBREVIATIONS

AFS – Anti-fouling System Convention

AIS – Automatic Identification System

BIQ - Barges Inspection Questionnaire

BIRP – Burge Inspection Report Program

BPQ - Barge Particulars Questionnaire

BWM – Ballast Water Management

CBT - Computer Based Training

DNV – Det Norske Veritas

DPA - Deputy Person Ashore

DWT - Deadweight

EEDI – Energy Efficiency Ship Index

EF – Excess Factor

FIC – Focused Inspection Campaign

GPG – General Policy Group

HCD - Human Centred Design

HSSE – Health, Safety, Security & Environment

IAPP – International Air Pollution Prevention

IHM – Inventory of Hazardous Materials

ILO – International Labor Organization

ILO 147 - the Merchant Shipping Convention

IMDG - International Maritime Dangerous Goods

IMO – International Maritime Organization

ISM – International Safety Management

ISO – International Organization for Standardization

KPI – Key Performance Indicator

KRI - Key Result Indicators

MARPOL – International Convention for the Prevention of Pollution from Ships

MLC – Maritime Labour Convention

OCIMF – Oil Companies International Marine Forum

OHSAS – Occupational Health and Safety Assessment Series

PI – Performance Indicators

PIF - Performance Influencing Factors

PRS – Polish Register of Shipping

QMS – Quality Management System

RI – Result Indicators

SEEMP – Ship Energy Efficiency Design Index

SIRE – Ship Inspection Report Program

SMS – Safety Management System

SOLAS – International Convention for the Safety of Life at Sea

STCW - International Convention on Standards of Training, Certification and Watchkeeping for Seafarers

STCW - Standards of Training, Certification and Watchkeeping

SWA – Stop Work Authority

TMSA – Tanker Management Self - Assessment

VIQ - Vessel Inspection Questionnaire

VPQ – Questionnaire regarding Vessels Particulars

ABSTRACT

Maritime transport holds the largest and the most important share of world transport with a percentage of up to 90%. The main purpose of this dissertation is to analyze the external inspections which carried out in ships and ensure the safety of the vessel, the crew, the ports and the environmental protection and sustainability. The main categories of inspections are: the TMSA, the Vetting Inspections, the Flag Inspections, the Green Award Inspections, the Port State Control and the Classification Society. Their combination or even each one individually has significant effects on the economy and the company's overall appearance. An important reference is the historical development of inspections and how they began to be implemented. Additionally, every kind of external inspection displays the required procedure to be followed and several elements. It is important to highlight that the TMSA and Vetting inspections correlate with the tanker ships and oil companies. On the other hand, the Port State Control and the Classification Society concerns all kind of merchant ships. It is known that the international literature lacks studies of the external inspections, but the researchers acknowledge is rich of studies that examine this kind of issue and explain the implementation in the shipping industry.

Key Words: Safety Management Systems, Performance Measurement, Continual Improvement, Port State Control

ΠΕΡΙΛΗΨΗ

Οι θαλάσσιες μεταφορές κατέχουν το μεγαλύτερο και το σημαντικότερο μερίδιο των παγκόσμιων μεταφορών με ποσοστό έως και 90%. Κύριος σκοπός της παρούσας εργασίας είναι η ανάλυση των εξωτερικών επιθεωρήσεων που πραγματοποιούνται στα πλοία και η διασφάλιση του σκάφους, του πληρώματος , των λιμανιών και της περιβαλλοντικής προστασίας και βιωσιμότητας. Οι βασικές κατηγορίες επιθεωρήσεων είναι το TMSA, το Vetting, οι Επιθεωρήσεις του Κράτους Σημαίας, τα Green Awards, ο Κρατικός Έλεγχος του Λιμένα (PSC) και ο Νηογνώμονας. Ο συνδυασμός τους ή και το καθένα ξεχωριστά έχει σημαντικές επιπτώσεις στην οικονομία και τη συνολική εμφάνιση της εταιρείας. Σημαντική αναφορά αποτελεί η ιστορική εξέλιξη των επιθεωρήσεων και το πώς ξεκίνησαν να υλοποιούνται. Επιπλέον, κάθε είδους εξωτερική επιθεώρηση παρουσιάζει την απαιτούμενη διαδικασία που πρέπει να ακολουθηθεί και διάφορα άλλα στοιχεία. Είναι σημαντικό να τονιστεί ότι οι επιθεωρήσεις TMSA και Vetting συσχετίζονται με τα δεξαμενόπλοια και τις εταιρείες πετρελαίου. Από την άλλη, ο κρατικός έλεγχος λιμένα και ο Νηογνώμονας αφορούν κάθε είδους εμπορικά πλοία. Είναι γνωστό ότι η διεθνής βιβλιογραφία στερείται μελετών για τις εξωτερικές επιθεωρήσεις , αλλά υπάρχουν αρκετές μελέτες που εξετάζουν αυτού του είδους τα ζητήματα και εξηγούν την εφαρμογή στη ναυτιλιακή βιομηχανία.

Λέξεις-Κλειδιά: Συστήματα Διαχείρισης Ασφαλείας, Μέτρηση Απόδοσης, Συνεχής Βελτίωση, Έλεγχος Λιμένα

INTRODUCTION

During the past decades a continuous development has been observed in the shipping industry. Especially, the last fifty years the maritime transportation demand has been skyrocketed. This sharp rise brings hopeful prospects and eventually positive results globally. This rapid growth favored the economies of many countries to develop and to be competitive in the shipping industry, providing better services. But this huge flourishing entails a lot of threats and risks for the shipping industry like oil spills, environmental pollution, work accidents or collisions, and many more. After some serious accidents, the people of shipping turned their attention to maritime safety and started to investigate how they could improve the process of shipping transportation, to protect seafarers' health and especially the environment. All this research resulted in the creation of TMSA, Vetting inspection, Port State Control inspections and the Classification societies.

The need for more effective estimation of risk has contributed to the establishment of TMSA. TMSA estimates the level of risk according to KPIs and includes four levels of estimation. It is consisted of 13 elements, which cover a range of risky issues that are met in Shipping Industry (from the management of human capital to environmental issues, for example). The outcome of TMSA should be analyzed by each shipping company, and according to the analysis, measures related with Performance Measurement and Management must be taken. Detection and prevention methods should also be implemented in order to identify the human errors, which are the primary cause of accidents and risk increase in Shipping Industry.

In maritime shipping industry a growing number of independent organizations, international governmental organizations and companies are taking initiatives to eliminate oil spills incidents. Today international legislation has become stricter for the tanker industry. IMO of UN enforced the MARPOL which entered into force in 1983 and includes regulations regarding the construction and operation. Besides this, international community trying to support the elimination of oil spill pollution and the enforcement of huge fines by the government courts introduced several inspection initiatives such as Vetting.

Firstly, the ISO standards are analyzed at the same time with significant for the shipping safety conventions (STCW Convention, ILO Convention etc.). In addition, the safety management systems are defined, which are considered as the basis for the establishment of TMSA. After the analysis of these fundament principles, TMSA elements are referred and analyzed. Comparisons of all the TMSA editions are analyzed too. Having considered the significance of TMSA, the requirements for the successful implementation are analyzed with an emphasis to Performance Measurement and Management. Finally, in the last section of this chapter a survey is conducted to draw conclusions regarding the TMSA, how it works in Shipping Industry and examples of KPIs calculations used in TMSA are presented.

1.1 THE ISM CODE

The main aim of the ISM Code is to promote the implementation of the standards and procedures that are required for the operation of the shipping companies and ensuring that the safety of the human life in the sea, the environment protection and the safe daily operation both of the vessels and the office ashore. Under this context, the shipping company must provide a safe working environment for all the personnel and estimate the possible hazards resulting from the daily operations. Furthermore, under ISM Code the improvement of the personnel's skills and their development must be ensured with the appropriate procedures. The ISM code has been developed, as many studies have highlighted the role of the human factor and its impact to the risks provoked. It is noticed that most of the accidents are provoked by the human factor. For this reason, a system of rules, standards and procedures has been recorded. For example, the vessels are subject to frequent changes in the legislation and the vessels' technology. If the technology changes promote more the automation and reduction of the number of the seafarers, then the impact to the safety and the effectiveness must be estimated. It is possible that the reduction in the vessel's personnel may have negative impact to safety and daily operation. The ISM Code is based more on: prevention, estimation of the possible causes to the safety problems, acknowledgement of personnel's roles and vessel's characteristics that are related with the procedures that must be implemented. The ISM code covers the organisation and the measures that must be recommended by the shipping company to reduce the hazards and the safety level to increase. It is consisted of two sections: the first section describes the implementation and is consisted of 12 detailed elements for the implementation of the policies and the second section is referred to the types of the required certificates and the verification.

1.2 OCIMF & SIRE

(OCIMF) is an association of oil companies, which are specified in the shipment of oil and gas. Companies that are related with oil exploitation, production and shipment may be members of this association. The organization publishes different editions with recommendations of measures to be taken, advices and ways for the effective implementation of SMS. SIRE was firstly launched on 1993 and has been

determined as a tanker risk management tool, which was used by several counterparties, to enhance the shipping safety. SIRE system is a large database including information regarding operations of tankers and barges. Especially, OCIMF has focused on the effective implementation of the procedures according to the safety policies and standards. SIRE system is consisted of: Vessel Inspection Questionnaire (VIQ), Barges Inspection Questionnaire (BIQ), Uniform SIRE Inspection Report, Vessels Particulars Questionnaire (VPQ), Barge Particulars Questionnaire (BPQ), and these features, which have been established to convert the SIRE program to a more user-friendly edition for the operators and the companies. It is increasingly used by the oil industry in order to ensure that the vessels operate under the safety rules and policies imposed by the legislation and the organization.

1.3 ISO STANDARDS

ISO standards, such as ISO 9001 or OHSAS 18001, have greatly influenced the way in which human capital is managed in shipping. In particular, the IMO in its regulations includes specific provisions and tools which are related exclusively to human capital and its security. These conditions and regulations have a huge impact as well as positive effects on the security and management of human capital.

1.4 THE STCW CONVENTION AND THE HUMAN FACTOR

In 1978 the IMO introduced the STCW Convention to ensure minimum safety standards for seafarers. Since the establishment of this convention and after, there have been continuous upgrades, most recently the upgrade of the convention in 2012, while the most important upgrade took place in 1995 when stricter criteria for crew training were established. In particular, this amendment was intended to introduce uniform training, assessment and certification of seafarers' knowledge, while it also aimed to introduce special provisions that would prove that each seafarer has all the necessary knowledge and skills in matters concerning the handling of equipment on board, but also how to respond to emergencies. The establishment of this contract was quite important, as it was the first step in establishing the necessary safety standards for seafarers. At the same time, the IMO in 1997 adopted the human factor in management and safety standards, an element that affects maritime safety, and is also related to the activities of seafarers and

workers on land. The human factor is the element that will greatly contribute to the successful improvement of safety and management standards and the implementation of IMO regulations and conventions, through the ongoing training of those directly involved, as it is a fact that the majority of accidents at sea due to human mishandling.

1.5 ILO CONVENTION

A new convention was concluded in 2006 by the ILO, an international organization that aims to reduce social imbalances, protect workers, and improve working conditions. This contract established minimum age limits for seafarers to work, significantly improved working conditions through the obligatory conclusion of an employment contract, the observance of specific working hours, provided medical coverage to seafarers and social security. In addition, the living conditions of the workers on board have improved considerably.

1.6 ISO 9001 & OHSAS 18001

The ISO 9001 management standard analyzes the requirements that a shipping company must meet in order to develop an efficient quality control system, which ensures customer satisfaction, complying with the conditions imposed by the framework. In addition, the company should have established procedures, in which the crew and employees are involved, in order to deal with special situations concerning both the environment and safety. The OHSAS 18001 management model was developed in 2007 with the aim of creating a widespread and accepted health and safety management system, thus helping to reduce risks in the work environment. This standard will soon be replaced by ISO 45001. Specifically, OHSAS aims to reduce the risk in the workplace, informing employees of the potential risks they face during work, while providing protection against an accident at work. Some of the main features are: the assessment of workplace safety measures, the predetermined procedures to be followed during ship repairs, and the instructions for work under specific procedures and control. The introduction of OHSAS came to cover the shortcomings that had been observed in terms of compliance with the provisions of the institutional framework, the implementation of safe operating procedures, the evaluation of safety policies by conducting risk assessments and the safety training of seafarers.

1.7 ISO 14001 & ISO 50001

ISO 14001 has its main objective to specify the requirements that are requested for an environmental management system, and therefore the organization can monitor more effectively the environmental performance. ISO 14001 has a significant contribution to the implementation of environmental management systems in the shipping industry. Shipping companies need to establish a life-cycle perspective when environmental aspects are taken into consideration. The EMS has similar procedures and has similar importance as the Safety Management System to ISM. The EMS should refer in detail on how the company's management will commit the company toward the environment. If the organization wishes to complete its aims and be compliant with environmental legislation, management's meetings must be held to estimate the situation, management should set targets- KPIs, related to environmental discharges, and frequent visits to the vessels by the management to ensure that their operation are compliant with the environmental policies. All of these policies followed by companies to measure the environmental performance, are analysed further in TMSA elements. ISO 14001 procedures are related with: complying with rules, regulations, guidelines and special practices, promoting and enhancing the personnel's feeling and confidence to participate to environmental actions.

ISO 50001 was introduced by ISO in June 2011 mostly for the shipping companies. It is modelled based on Quality Management System (QMS), trying to improve the energy management system and the energy performance. Improvement of environmental performance is not a requirement of ISO 50001. The requirements that are essential for the effective implementation of ISO 50001 are: the Management responsibility, the suitable energy policy, an effective energy action plan, correct implementations and operations, the conduction of performance audits and the management review.

2.1 SAFETY MANAGEMENT SYSTEMS

Each shipping company must introduce and implement a safety management system, which ensures that each shipping company is consisted with the rules and procedures, implemented in the shipping sector, and the operational requirements of these systems must have a relation with: policies for the safety and environment

protection, directions and procedures ensuring that there is a safe operation of the vessels according to the national legislation and flag state's legislation, satisfied roles – responsibilities assigned to the personnel, procedures for the reference of accidents between ashore and onshore personnel, procedures for readiness preparation in case of special and emergency situations and the procedures of internal – external audit. The daily risks and situations of emergency that are faced daily in the shipping sector have contributed to the need of establishment of legislation and measures that will contrive to the risk management and hedging of the risk. One of these measures that have neem used and recommended are the safety management systems. In addition, the safety management systems are required to encourage the improvement of the safety standards in the shipping sector and use effective safety management systems to hedge the risk. SMS include all the essential procedures to ensure the safety in each action takes place in the sea. All the merchant vessels must comply with the requirements of SMS. A SMS provides details and information about the vessel's daily operations, the responsibilities of the crew in case of emergency, and how the training of crew is conducted. Typically, a SMS is divided into the below sections (Raunek, 2021):

- "General
- Safety and environmental policy
- Designated person
- Resources and personnel
- Master's responsibilities and authority
- Company's responsibility and authority
- Operational procedures
- Emergency procedures
- Reporting of accidents
- Maintenance and records
- Documentation
- Review and evaluation"

Especially, a SMS follows a standard procedure which is the below:

Figure 1: SMS Standard Procedure (Raunek, 2021)

- Step 1 – Plan

A new statement is required in SMS as a policy regarding the organization's approach.

- Step 2 – Do

A SMS should specify the organizational structure. In particular, the organisation must record the specific risks that will be faced in the future.

- Step 3 – Check

Procedures should be implemented for monitoring safety performance. Furthermore, this step is required for evaluating healthy and environmental performance. This stage is not limited only in this category but also could provide new actions and procedures in case of emergency (for example an accident).

- Step 4 – Act

This step includes review and the action according to the information that has been collected.

An effective SMS is required to achieve HSSE excellence. Operational Excellence is the Health, Safety, Security and Environment (HSSE) industry, is an element attempting to ensure sustainable improvement of KPIs.

The satisfied development and implementation of the SMS will drive to the issue of new certificates: Document of Compliance & Safety Management Certificate,

which last for 5 years and will be subject to continuous estimation. It must also be referred that the SMS includes procedures and directions which must be up to date and are accessible by all the personnel. DPA is responsible for whatever has a relation with SMS, for example for the checking and verification of the appropriate implementation of the SMS. For this reason, DPA must have strong relationships with the upper management, ensuring with this way the provision of the requested support for the implementation of the SMS. The implementation of the SMS is based on many elements such as: personnel, the vessels and the equipment, and the procedures.

2.2 FACTORS FOR THE DEVELOPMENT OF SMS

The design and implementation of SMS is highly significant for the implementation of ISM Code. The factors that can contribute to the effective implementation of a SMS are the below:

- The commitment of the management for the changes and improvements that may contribute to the development of safety culture in the company
- Appropriate education and training must be provided to the personnel for the development of new skills
- Effective interaction and communication between the vessel and the office
- Establishment of new culture which will contribute to the adoption of new improvement standards
- Continuous control over issues that may occur due to cultural differences between the members of the teams
- Support provision and enhancement of relationships between the crew and office employees, given that the element of interpersonal confidence has a positive impact to the implementation of safety culture

3. SAFETY CULTURE IN SHIPPING INDUSTRY

In ISM Code there is not a clear reference for the definition of the safety culture. However, the development and the promotion of the safety culture is highly significant for the successful implementation of the SMS. The design and implementation of the SMS without a safety culture will create problems in the

consistency of the procedures. Moreover, the deficit of safety culture encourages the complacency and contributes to the misinterpretation of the rules and procedures. The safety culture is described as the common values and ideas which interact with the structure of a company, auditing the SMS procedures so as to create new behaviour standards for all the personnel. The safety culture is a part of the company's culture, which means that the prominent company's culture has an impact to the company's growth. A significant prerequisite for the promotion of the safety culture is the development of informed culture, which demands that the personnel have the appropriate knowledge to handle and operate the systems. If this kind of culture is accomplished, then the reporting culture must be accomplished, which ensures that information relative to the safety is concentrated and summarized. The third kind of culture that can be accomplished is the just culture, prerequisite of which is the confidence environment and the understanding of the personnel of what is the mean of the acceptable or unacceptable behaviour. In shipping companies that there is a safety culture all the personnel act and behave according to the idea of the safety. It is very significant for all the employees to understand and incorporate the safety culture, because the written procedures and rules may not ensure the safe operation of the vessel and the company of course, if there is not commitment of the employees that will follow the established culture and work according to the safety standards.

4.1 DEFINITION OF TMSA

In the past the oil trading companies used the vessels emphasizing only to vetting procedures, according to which the companies decided if they would charter the vessel or not. In order the procedures of inspections to be more effective, the OCIMF members decided on 1993 the establishment of Ship Inspection Report Program (SIRE) and on 1997 the establishment of a new procedure of inspections, according to inspection protocol, which is determined by a total of documents. The importance of the outcome of TMSA is huge as the capability of the vessel to complete a voyage is affected by these metrics. Although TMSA is implemented mostly in tankers vessels, they are designed to be used in other shipping sectors. Particularly, TMSA estimates the level of risk according to some metrics – KPIs that are used and includes four levels of estimation. Level 1 is the minimum level and there are other three levels which contribute to the increase of best practice

guidance. There are different kinds of editions for TMSA, which are evolved year by year. TMSA will continue to evolve and new KPIs will be added to ensure with this way the high level of safety. Practically, TMSA procedure consists of a book, an online tool, and a database, which is used for creating reports. SIRE is one of the initiatives introduced by OCIMF and is a tanker risk assessment tool. TMSA is included in the category of MSA, which is a tool created and developed by OCIMF to assess management systems risks against industry best practices. Each MSA consists of elements, used for the performance calculation and these consist of a range of questions, related with each element. These stages indicate the standard of management that the company is operating at, for example the higher the stage the higher the standard. When the elements and the stages for each MSA are determined, then a great range of questions are answered according to the determined KPIs, which show the final performance and assessed against best practices. The levels that are achieved for each stage are then calculated so as to have the overall performance of the MSA. Especially, MSA for Tanker Vessels, is consisted of 13 elements and the performance – risk can be calculated according to different KPIs that are defined in each element. The results of this estimation show us a clear summary of the performance, gaps are identified and through these, actions may be suggested to enhance the performance.

4.2 TMSA EDITIONS

There are many editions of TMSA, with the most recent the edition 3. Edition 3 (2017) has included many updates comparing to the TMSA edition 2, published in 2008. This edition had new updates and changes as it included updated guidance based on the experience from OCIMF members, vessel operators and other Industry Organisations. It also provided consistency with the market practices and encouraged in a high level the use of this programme by tanker vessel operators, including small coastal vessels and barges. In TMSA edition 3 the below elements have been added:

- Introduction of new requirements
- Changes in element 6 and element 6A. Addition of new KPIs
- Changes in element 10. New edition includes the OCIMF Energy Efficiency and Fuel Management paper, which is not included in edition 2.

- Introduction of new element 13

TMSA 3 expands the safety levels compared to TMSA editions 1 & 2 by adopting a not so much deterministic approach as adopted by the previous editions of TMSA. In specific, the previous editions of TMSA through the deterministic approach they had, tried to ensure the minimum level of compliance to the safety rules, without a provision for Human Factors and Behavioural Safety. There are 266 KPIs in TMSA 3 edition. The main differences between TMSA 2 & TMSA 3 are mainly the below (Antonis Iordanidis, 2017):

- Specialized questions of oil producers have been incorporated to the new edition
- Some KPIs have been shifted to lower stage
- There is more analytical description of best guidelines for each stage, ensuring higher clarity for each stage
- New legislation has been incorporated to the stages.

Consequently, there are many updates which have contributed to a high-level frame, under which TMSA works today.

4.3 TMSA ADVANTAGES

The introduction of TMSA tool offers many advantages to the vessel operators, some of them are the below:

- KPIs are offered, which help in a high level to the risk estimation, and further guidelines are offered according to each stage of the assessment
- New objectives are determined, according to the best practices, described for each stage
- TMSA applies only to the company's management according to management standards
- Estimation of the risk and performance is accomplished according to quantified criteria, after an extended market research
- TMSA gives opportunities to each member of OCIMF to charter vessel's operators, who have succeeded high overall performance in the assessment and provide high safety standards and practices about protection of environment.

Therefore, TMSA is defined as systemic, methodical, motivated, and highly structured in its process. It is a significant assessment tool of vessel's operator and offers guidelines to meet the requirements of each element.

4.4 CONTINUAL IMPROVEMENT

TMSA elements are designed to help companies improve the SMS. This can be completed through the below steps:

- Plan

Companies must set reliable, effective plans that will be completed in a short-term period. In addition, responsibilities must be assigned to appropriate persons who will have the knowledge, ability, and experience to complete the plans and objectives, that have been sat.

- Act

Personnel must act and complete all the plans effectively, with a few errors as possible as it can be. Policies and procedures must be communicated to personnel to have knowledge of how the company operates at normal and special cases.

- Measure

Company evaluates the outcome of previous stage and searches for any gaps or changes may result from the activity

- Improve

At this stage new actions and targets are defined to lead to improvements. Plans should be adjusted to incorporate the measures which have been suggested at the previous stage.

5. KPIS AND PERFORMANCE MANAGEMENT SYSTEMS

5.1 A PERFORMANCE MANAGEMENT SYSTEM

Performance management is used to review a decision related to training and career development aspects and set clear and specific performance expectations, providing feedback for the employee's performance compared with the goals that have been assigned. Nowadays, the performance management focuses more on

feedback provision and coaching, rather than a classic paper tail. The performance management is primarily linked with other organizational systems like:

- Strategic planning: This system is used mainly for the assessment of the working conditions and whether the company attracts and retains talented employees
- Total compensation: Many companies use performance management systems to determine the compensation processes, based on personnel's performance
- Individual and team development: A plan of individual and team development is used as a final step of the procedure to assist in goal setting individual and team development, which will enhance employees' career and professional development
- Succession Planning: The analysis of performance data is highly significant for the organization's planning for a long term period and the current structure of the organization.
- HR Technology systems: Many organizations use new systems to evaluate personnel's performance, and review goal setting

Companies have the ability to prevent many problems by ensuring that a daily and interactive communication between managers and employees resulting in a complete understanding of what is required, which are the problems and how measures should be taken. Their relationship should be based on cooperation, coordination, focussing at the same time on the organization's goals. An effective performance management system is consisted of a range of elements like: Goal setting, performance review, and performance improvement plans. The estimation and detection of possible hazards and improvement needs is conducted through performance management systems and according to predefined KPIs.

5.2 PERFORMANCE MANAGEMENT IN SHIPPING INDUSTRY

Many procedures have been designed and developed by Shipping Operators to evaluate the performance of the company both onshore and ashore. However, procedures for the evaluation of performance of vessels during their daily operation is significant too. The most common procedures evaluating the vessel's performance, are these that measure the daily fuel consumption and the daily

distance covered, for example. Under this procedure the daily mean power and mean speed may be calculated. An example of this procedure is explained in the below diagram, where metrics of the vessel's performance are compared:
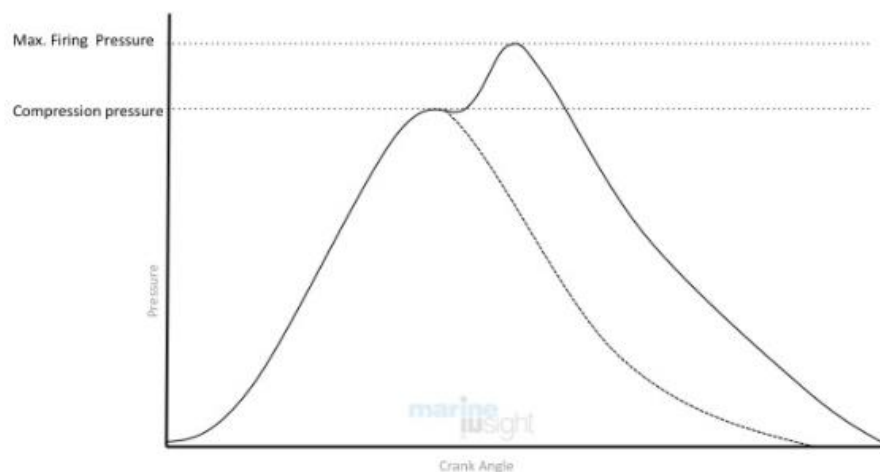
Figure 2: Metrics for the vessel's performance (Anish, 2021)

There are also many other procedures which belong to this category. Many studies have shown that Performance Management has driven to efficiency improvements up to 38 percent. Although may shipowners find that following a similar system is very costly for their companies. Owners and Operators who are open to new technology opportunities can deliver the most and it is concluded that the vessels are fitted with many systems, which monitor the equipment, and have a scope of improving their performance and reducing the corresponding costs. A recent study which was taken by DNV GL, tried to show how significant are the benefits resulting from the implementation of an effective Performance Management System. It was concluded that there are both environmental benefits and financial savings of 25 million dollars for the container fleets, as explained in the below diagram:
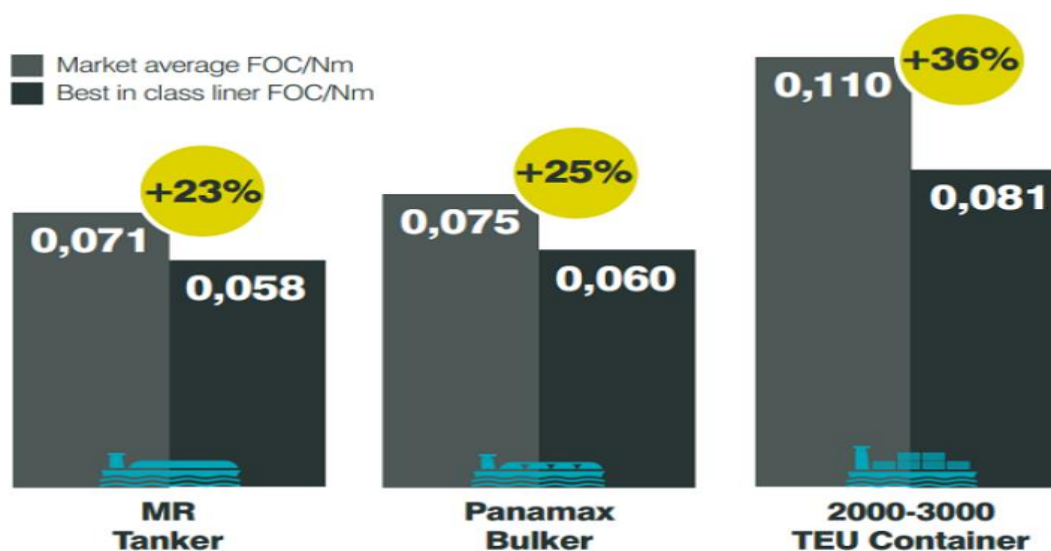
Figure 3: Study taken by DNV GL (DNV GL, 2020)

Performance Management systems should enable shipowners to identify trends and significant gains can be obtained if the complexities met are handled effectively and under coordination. There are many advantages of the adoption of this system, only if the shipowners and operators have understood all the required aspects. These aspects include: the objectives, the current situation of the company, the characteristics of the fleet, the method of collecting the data, the hardware systems used to collect data, the insight of the company, the behavioural changes and the actions of the management. A typical performance system must be characterized by the aspects that have been referred previously, but also must include the below standardized steps, in order to be direct and effective:

- Target and Goal setting: Targeting of goals is of high importance for a shipping company. These goals must be realistic and achievable. All the personnel must be aware of the corporate strategy and the assigned goals as well as of the steps which are scheduled to take place in a short term period. Only if the employees have acknowledged and incorporated the company's objectives will have motivation to contribute to the company's strategy implementation

- Rewards and performance linking: Shipping companies must combine the systems of performance appraisals and rewards provision. If performance evaluation is held without a positive or negative impact, then the system is

weakened. Rewards must be offered at a continuous basis to high motivated employees.

- Discussion of appraisal: After the completion of the performance evaluation, a discussion of the appraisal procedure and its conclusions must be held between the employee and the management. After this discussion the employee will have comprehended more the hazards, the strategy and goals of the company. Furthermore, the employee will be assigned with new responsibilities and have the opportunity to discuss about the faults and his achievements during the appraisal period.

A performance management system, in order to be effective in the shipping industry must: ensure quality of the required data, be easily used by the crew, be compared against industry's average and monitor KPIs as a basis for motivating people to change behaviour.

5.3 GENERAL DEFINITION OF KPI

KPIs include setting targets and tracking progress against that performance that an organization has to attain. They are used, in a wide range, especially nowadays, in different sectors of economy to evaluate the performance of the company. Such sectors are sales, marketing, HR, support, and finance. Especially in the shipping industry, performance is mostly evaluated and estimated through KPIs. Some examples of the most significant and vital KPIs that are used in shipping industry are: Average length of time between failures, which gives clear benchmark for costs, and loss of time for ships out of commission for repairs, unit Costs, which provides us with information about labour and material costs per vessel in the fleet, Vessel utilization, which amounts of time the vessel is in use, can help us to identify if vessels are being underused or overused and failure response time, which provides information about the improvement of cost-effectiveness and reduction of the time that vessels are in repair.

5.4 KPIS IN THE SHIPPING SECTOR

There is a variety of KPIs that are used in many sectors of the economy daily to measure the performance and the results. In the shipping sector many KPIs are used to measure and track the process of the shipment (especially when we refer to the logistics process of the company) and monitor supply chain, warehouse and

transportation data to estimate if the processes are working appropriately. There are three types of KPIs which are used mostly in Shipping (especially in logistics field). The first category is the procurement KPIs, which track costs, like the inventory cost, the arrival time, and reorder time. These KPIs are helpful for managing and tracking inventory in a warehouse, for example, and ensure that all of the shipments are completed in time, without disruptions of the scheduled shipment program. The second category includes the logistics indicators, which track the picking, tracking process, and the order accuracy per worker. The third category includes the transportation indicators which try to evaluate the freight picks ups and delivery times, freight costs, as well as cost from order to delivery placement. Other categories of KPIs that are used in the shipping industry are the voyage performance KPIs, which evaluate the fuel consumption, the speed profile, the weather conditions, the trim adherence, the energy efficiency and emissions. Furthermore, there is the category of KPIs which evaluate the engine and systems performance.

5.5 KPIS & TMSA

In the context of TMSA, KPIs are used so as the company to evaluate the performance. Practically, performance evaluation is conducted from level 1 to level 4 for each of the 13 elements. Not all of the KPIs that are used in shipping sector can be used in TMSA, as this assessment is designed for companies which manage tankers or barges. If a KPI is considered as not applicable to the TMSA process, then the company must justify why this is not included in the process. Once the assessment is completed, then the company will have a clear summary of performance assessment. If the results are not satisfactory, then the company to identify gaps and may probably recommend new plans to improve the performance and meet other criteria that have not met during the previous assessment.

6.1 HOW TMSA WORKS

Each of the 13 components of which the TMSA consists of, includes some KPIs which are classified from level 1 (the lowest level) to level 4 (the highest level). Companies should match the SMS based on KPIs and the higher the level of each item, the more the company accomplishes the purpose for which the specific TMSA item has been established and fulfils the desired performance. At the same time,

each section includes the Best Practice Guidance section, which describes the best practices for achieving the required level to which the specific section of the TMSA relates. If the TMSA elements are not fulfilled, then this will be an occasion for the company to propose new improvements and changes in order to increase its performance as much as possible. The 13 components of the TMSA are:

1) Leadership and the SMS

2) Recruitment and Management of shore-based personnel

3) Recruitment, Management, and wellbeing of vessel personnel

4) Vessel Maintenance, including critical equipment

5) Navigational safety

6) Cargo, Ballast, Tank Cleaning, Bunkering, Mooring and Anchoring Operations

7) Management of Change

8) Incident reporting, investigation, and analysis

9) Safety Management

10) Environmental and Energy management

11) Emergency preparedness and contingency planning

12) Measurement, Analysis, and Improvement

13) Maritime Security

From the above data of TMSA, it is concluded that specific data concern the management of human capital, such as elements 2 & 3. Therefore, human resources and the way they are treated are crucial for assessing the performance and risk of the organization. ExxonMobil's International Marine Transportation's statement on the importance of TMSA is typical, as it states that the use of TMSA has greatly contributed to the reduction of accidents in recent years. At the same time, the company plans to introduce a new element that concerns the human factor. Specifically, a team of specialist psychologists will work with a corresponding team of experts in order to achieve the highest possible return and reduce risk.

6.2 VERIFICATION PROCESS AND SUBMITTING OF REPORTS

The TMSA results may be submitted to verification review by external assessors. Most of the times, the agreement for the verification of the assessment, is confidential between the company conducting the assessment and the external assessors. Company may use the results of the assessment, in case that the performance is estimated in high level, to demonstrate that the elements of TMSA have been met according to KPIs. When the assessment is completed, then the company must submit the report with the results to the TMSA online tool, choosing by this way who will be able to have access and read the report. No other companies have the ability to access this report and publish information resulting from the submitted report.

7. DESCRIPTION OF TMSA ELEMENTS

7.1 ELEMENT 1 & 1A - LEADERSHIP AND THE SAFETY MANAGEMENT SYSTEM

This element describes accurately the responsibilities that all the level of management have in a company, ensuring that all the tasks and jobs are clearly described, understood, and fairly assigned to all the employees. It is also required an effective communication system to be established between the employees working on shore and the company's fleet. The way that the SMS works must be communicated and understood by all the members of the company. The importance of HSSE, which has been previously analysed, will be promoted through leadership and the appropriate use of and effective SMS. All managers, at all levels and departments of the company are held responsible for the implementation of the SMS both ta sea and at the office. Element 1 is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
1.1	1.1.1	Documented procedures define the management commitment	Mission statements contain goals (like zero accidents, environmental protection, reduction in emissions), long term aspirations. HSSE excellence is defined, continual improvement is achieved
	1.1.2	Senior management demonstrates commitment to implement SMS	Senior management conducts reviews
	1.1.3	HSSE excellence is implement by the onshore and vessel's personnel	Management must communicate all the requested information to the company

1.2	1.2.1	HSEE excellence must be described by all the personnel	All the members of the company what HSEE excellence means and how it is related with their role. Example of HSSE communication are: continuous training, vessel/office visits, seminars, meetings, and interviews
	1.2.2	Management should improve safety and environmental performance	Management has a plan to complete long term goals regarding safety and environmental performance, Management measures the performance through statistical records of incidents, such as injuries to personnel, oil spills, mooring incidents, incidents related to cargo and ballast transfer etc.
	1.2.3	Management promotes HSSE excellence	Strong leadership is demonstrated. Examples of HSEE promoting are: leading by example, safety inspections, ship visit by senior managers, Recognition and rewarding of HSSE performance

1.3	1.3.1	Targets should be established according to HSSE performance	KPIs that are used: Number of injuries, number of inspections, numbers of incidents etc.
	1.3.2	The steps required to reach HSSE excellence are defined by management	There is a plan which explains the steps for the fulfilment of goals for different periods of time
1.4	1.4.1	HSSE targets should be discussed at least quarterly	If performance is below the expectations, then management must realign performance with targets.
	1.4.2	HSSE excellence is controlled according to KPIs	Performance is monitored through new systems.
	1.4.3	Commitment to HSSE excellence should be demonstrated	Examples of commitment to HSSE excellence: reward systems, like bonus salary etc., a behaviour-based safety system.
	1.4.4	Continual improvements in HSSE performance should be included	The plan identifies: aims & objectives, strengths, weakness, opportunities, and progress against the plan

The primary aim of section 1A is to accept responsibility for developing and maintaining a dynamic SMS to implement policy and deliver HSSE excellence.

1A.1	1A.1.1	Management tries to ensure that all the activities are undertaken according to company's policies and procedures	The policy reflects the company's position on: safety protection, security, health and welfare and social responsibility
	1A.1.2	Policies and procedures should ensure effectiveness	Policy and procedures are revied and amended if necessary, receiving feedback from management or onboard safety meetings
	1A.1.3	Procedures should be written in common language	Procedures and policies are clear and are in the working language of the vessel.

			Additionally, policies and procedures must be explained in a logical manner
	1A.1.4	Procedures are accessible to personnel	Procedures should be accessible in written form by all the personnel
	1A.1.5	A SMS documentation is available, through a formal document control system	There is a procedure of revision of the SMS. The formal document control system includes: an index of numbered revision etc
1A.2	1A.2.1	Meetings that review these procedures take place	Keeping records of the meeting, its minutes and details about the changes that have been made to the procedures, and any other required information. Such information is: Recommendation following incident inspection, results of risk assessments, new legislation, suggestions for continual improvement
	1A.2.2	SMS defines the managers' responsibilities	Ways of demonstrating that the responsibilities are defined: organizational charts, job descriptions and KPI targets assigned to individual roles.
	1A.2.3	Relevant documents as a supplementary to the SMS both onboard and ashore	Documents include regulatory publications and industry lines
1A.3	1A.3.1	Dialogue is required between the vessel and onshore personnel to improve the effectiveness of SMS	Feedback is encouraged from users, who are related with the SMS. This may be related with: industry alert bulletins, seminars, open reporting programmes, customer, and contractor feedback forms
	1A.3.2	Procedures are covering shore and vessel operations are developed	Personnel are involved in procedures to develop new guidelines
1A.4	1A.4.1	Benchmarking is used to suggest SMS improvements	Safety and environmental standards from other companies are benchmarked, to confirm if practices require improvements or not
	1A.4.2	New innovations are required to improve the delivery of SMS	More effective ways of delivering the SMS to personnel are: the clarification and simplification of the language, new graphics and more attractive presentations, effective us of Information Technology
	1A.4.3	Senior management must verify the effectiveness of SMS	The assurance programme for checking of the effectiveness of SMS should include: an independent auditing body, third party consultancy etc

7.2 ELEMENT 2 – RECRUITMENT AND MANAGEMENT OF SHORE – BASED PERSONNEL

The main objective of this element is to ensure that there is the appropriate and adequate personnel to implement the SMS and meet the future needs of the company. The implementation of SMS must be effective, decreasing the levels of the risk and enhancing the levels of safety. As Shore – Based Personnel is defined the total of all the employees who are involved in the management of the vessels and the shore-based offices. DPA, CSO superintendents, technical managers and

human resources managers may also be included in the shore personnel. Element 2 defines the procedures which must be followed in the recruitment, selection and training of the shore-based personnel. This element also includes the calculation of retention rates and comparison of the actual rates with the targets that have been assigned by the management. Retention Rate determines the percentage retention of fleet and office personnel. According to INTERTANKO given formula, if the average number of employees working for a period of 12 months is increased, then the ratio is also increased. If the total number of employees leaving the company for whatever reason increases, then the ratio is decreased. The opposite for the ratio is occurred, when the number of retirements and under-performers employees is increased. Specifically, the element's included procedures try to:

- Verify that all of the employees meet the medical requirements, which are requested for their recruitment
- Set criteria for promotion and a system of appraisal
- Ensure that all the records for personnel's qualifications, experience and training are maintained
- Promote the idea of continuity, that personnel in key roles must be trained and equipped with all the requested skills, contributing with this method to the development of new executives dedicated to fulfil all the assigned tasks effectively

This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
2.1	2.1.1	A pre- recruitment process must be defined to ensure that all the candidates have all the requested knowledge, skills to meet the criteria for the recruitment	The minimum criteria required for this role are identified by the management systems
	2.1.2	The company has a written recruitment process	The process includes: verifying qualification with the issuing authorities, verifying experience with former employers, identifying training needs, and screening of candidates profiles
	2.1.3	A familiarisation process is required for new employees	This process includes: business ethics, HSSE policies
	2.1.4	There is a documented written procedure for shore-based personnel	The scope of this process is determined by the personnel's responsibilities

	2.1.5	Records of qualifications, experience for all the personnel is maintained	
2.2	2.2.1	Performance assessment is conducted at least annually	Performance assessment may include: Annual target setting, performance review - discussion, and discussion for any matter occurs after the completion of the assessment
	2.2.2	Retention rates are calculated for a period of two years are calculated	The method for the calculation of the retention rates must be demonstrated and new trends will be identified
2.3	2.3.1	Technical skills are improved through training and seminars	Individual training plans are designed for each employee
	2.3.2	Shore-based personnel must meet the requirements to implement the SMS effectively	Significant changes like, changes in the legislation and unprecedent, huge loss of personnel, may be taken into consideration and contribute to the estimation of the required number of employees, without disrupting the completing the tasks
	2.3.3	Retention rates and the targets must be reviewed	A benchmarking analysis is conducted comparing the actual retention rates according to the targets. The company tries to maintain the retention rates in a high level, through giving new opportunities to the employees and promoting them to new roles
2.4	2.4.1	Continual development of personnel should be conducted	Development of employees will be completed through educational programmes, coaching, cross – functional training
	2.4.2	Positions onshore should be filled	Suitable candidates are identified through temporary shore-based assignments, feedback from superintendents, and reviews
	2.4.3	Interpersonal skill training is promoted by the company	This kind of training develops: presentation skills, cultural diversity, negotiation skills, and effective communication

7.3 ELEMENT 3 & 3A – RECRUITMENT MANAGEMENT AND WELLBEING OF VESSEL PERSONNEL

In the previous element all the procedures and standards were analysed relating to the management and wellbeing of shore-based personnel. Elements 3 & 3A include similar procedures for the selection, recruitment and wellbeing of the Vessel personnel. The procedures included in this element are designed to:

- Ensure that all the employees have received the appropriate training and have all the required skills and experience, according to their records, to complete their tasks

- Ensures that the employees' working hours are recorded and supervised by the management and rest hours included in the everyday working program of each employee

- Promote the retention of the personnel in the company

- Determine the common language used onboard and ensure that all the employees have the ability to communicate through this language

- Promote cultural awareness and teamwork

In case that all the responsibilities are outsourced to third parties, then TMSA will handle these as they were performed by the personnel.

The primary aim of the Element 3 is to ensure that qualified personnel is recruited and trained accordingly to provide their services onboard, dedicated to complete the company's objectives. This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
3.1	3.1.1	Procedures for the recruitment, development and appraisal should be determined	The company has determined sufficient and detailed procedures for the responsibilities of the personnel.
	3.1.2	Medical certificates should be in place according to the flag in which the vessel is registered	a procedure that all of the certificates are approved by a medical practitioner, is in place
	3.1.3	Mandatory training needs are in place	Analysis of the training needs should be conducted
	3.1.4	Familiarization procedures are in place for vessel personnel	
	3.1.5	Handover procedures for key vessel personnel are provided	
3.2	3.2.1	Appraisal procedures are in place	The procedures may include: frequency of appraisals, the content of the appraisal
	3.2.2	Procedures provide additional training	Personnel career development requests are included in these procedures
	3.2.3	All the personnel's requirements are verified	Verification process may include checking of: experience, training, appraisal records and compliance with the legislation
	3.2.4	Procedures to identify training requirements for personnel are in place	New training needs are created if there is a change in legislation.
	3.2.5	There is a more complicated recruitment procedure for senior officers	The procedure must include an explanation of the company structure and philosophy.
	3.2.6	The company monitors training effectiveness and impact to the personnel	The effectiveness can be measured by review of vessel performance trends, and review of audit and inspections trends. The effectiveness is measured and monitored in a regular basis and

			improvement actions are suggested by the management
	3.2.7	There is a detailed written promotion procedure in place	
3.3	3.3.1	There are detailed and more complicated appraisal procedures for senior officers	Appraisal procedures must focus on: Leadership, personnel management, communication, shipboard operational performance, and the requested requirements
	3.3.2	The company focus on further career development of junior officers and promotion of senior officers to a more complicated and more demanding role	Career development guidance is provided to the personnel and the requirements for their promotion are analytically determined
	3.3.3	Training for the personnel should exceed the minimum requirements of International Convention on STCW	Additional training needs for the development of personnel are identified
	3.3.4	Personal selection and recruitment is reviewed to ensure the compliance with company's policies and procedures	Personnel departments are audited at their premised at least annually, according to ISM requirements.
3.4	3.4.1	Procedures to assess the crew competency for each position are in place	These procedures include: psychometric assessments and assessments based on specific criteria determined by the company
	3.4.2	A detailed written procedure is provided to ensure that manning needs are covered	This procedure includes ways to estimate the possible retirements and hiring of new employees.
	3.4.3	Multicultural and interpersonal skills are developed	Interpersonal skills are enhanced and developed by training which include:, communication styles, and new tools may be used to enhance these skills

Element 3A tries to ensure that safety, health, and wellbeing of the personnel is effectively managed. This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
3A.1	3A.1.1	The vessel is adequately manned to ensure safe operation onboard	Manning levels should be adequate to satisfy vessel's needs for the
	3A.1.2	Resources to ensure the wellbeing of the vessel's personnel are provided	Management ensures that there are many resources to care for the vessel's personnel wellbeing. There are many aspects of wellbeing like quality of food, accommodation, facilities, the relaxing time, access to medical help etc.
	3A.1.3	Ensures that the working and resting hours are compatible with the STCW	Non-compliance with these requirements is identified and new improvement actions are suggested. In case that additional manning is required for a specific voyage.

	3A.1.4	D&A policy is monitored and implemented	The policy complies with OCIMF guidelines
3A.2	3A.2.1	Personnel's complaints should be provided through formal procedures	The process must comply with the flag, be acknowledged by the personnel at any time and the complaints must be handled in an effective manner and improvement actions to be suggested
	3A.2.2	A documented disciplinary procedure is in place	This procedure must be compliant with legislation and give clear guidance to the master
	3A.2.3	High standards of hygiene are satisfied	Procedures may include: taking responsibilities for ensuring hygiene standards in storages, decks and cabins, at the same time with the requested inspections by the relative authorities
	3A.2.4	Retention Rates for Senior Officers over a two-year period are calculated	The company calculates the retention rate according to a published method (has been previously analysed). Conclusions are drawn after the completion of the retention rate calculation
3A.3	3A.3.1	Seminars are held for senior officers promoting the principles and the significance of SMS implementation	The content of these seminars is related to new legislation, environmental management, company's culture and safety – human issues
	3A.3.2	An enhanced disciplinary procedure is in place	
	3A.3.3	Health awareness campaigns are implemented	These campaigns include: weight loss, healthy living, stop smoking, precautions related to extreme temperatures and humid climate
	3A.3.4	Retention rates for officers are calculated for a period over than two years	The company calculates the retention rate according to a published method (has been previously analysed). Conclusions are drawn after the completion of the retention rate calculation
3A.4	3A.4.1	Seminars take place for all the officers to enhance the idea and the significance of the SMS	The content of these seminars is related to new legislation, environmental management, company's culture and safety – human issues, as referred in section 3A.3.1.
	3A.4.2	A detailed procedure is in place to conduct health risk assessment	Risk assessments may include: exposure to various stressful conditions.
	3A.4.3	Career development opportunities are provided	

7.4 ELEMENT 4 & 4A – VESSEL RELIABILITY AND MAINTENANCE INCLUDING CRITICAL EQUIPMENT

The main aim of this element is to ensure that the vessels of the fleet have the capability to operate safely, efficiently without the possibility of disruption in the daily operation of the vessel. In addition, control measures are developed for critical equipment. Maintenance includes periodic inspection or inspection which

are held in more regular basis. Unplanned maintenance may be also held due to an unusual condition or a breakdown. The reliability of the vessel is depended on design, construction and operating practices and programmed maintenance tactic which is followed by the management. The vessel is subject to a variety of risks due to its daily operation, which may be harmful for the personnel. For this reason, there are procedures which have been determined by the company to hedge and mitigate the risk. In detail, these procedures:

- Ensure that certifications remain valid
- Ensure the availability and sufficiency of the spare parts and other materials necessary to carry out the maintenance process
- Have a system in place to monitor overdue maintenance

This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
4.1	4.1.1	Each vessel is covered by a planned maintenance system	All the equipment, machinery and sparts required for the maintenance must be included in the used system.
	4.1.2	A reporting system should also be provided to each vessel	The reporting system covers required onboard equipment and includes condition of Class.
	4.1.3	The status of fleet maintenance must be reviewed	The review includes: status of defects, the number and nature of any outstanding, the identification of any assistance required, such as spare parts or shore technicians. If the tasks cannot be completed, then there is the possibility to reorganize the program for maintenance
	4.1.4	The company monitors the planned maintenance procedure	The number of planned maintenance tasks, included in the maintenance process, are recorded both for vessels and the fleet. Data must be recorded monthly, and then be reviewed accordingly if a shore assistance is required
4.2	4.2.1	This procedure ensures that the stature and Classification certificates are valid	The procedure provides with: class status reports, planning for surveys, dispensation and exemptions
	4.2.2	Cargo and ballast spaces are inspected	The frequency of each inspection is determined by regulations of Class, Flag State and national authorities. Guidance for inspections may also be provided, which may include Class publications
	4.2.3	Maintenance is verified by Superintendents	Superintendents verify that the required maintenance has been completed, check the engineering practices and verify that all the defects have been recorded suitably
	4.2.4	The company has a system to develop dry-dock specification	The system include guidance for shore and vessel personnel on: suggestions and new regulatory requirements

4.3	4.3.1	A computer – based maintenance system onboard records all maintenance tasks	
	4.3.2	The company policy is to maintain an optimum spare parts inventory for all vessels	Sufficient spare parts are maintained onboard and ashore.
	4.3.3	Performance indicators have been used, which are measured for each vessel and for the fleet in total to measure the fleet reliability	Some examples of what these indicators include are: breakdowns related to critical equipment, loss of manoeuvrability occurrences, blackout occurrences, unplanned maintenance as a percentage of total maintenance.
	4.3.4	The frequency and the level of high level inspections are determined	
4.4	4.4.1	The maintenance reporting system integrates the spare parts inventory management	The system: automatically updates the inventory for usage and replenishment,
	4.4.2	The maintenance and defect reporting system tracks all deferred repair items for inclusion in the dry-dock specification	This system may be integrated with other system to generate the required specifications
	4.4.3	The maintenance and defect reporting systems provide management with a real time status of fleet maintenance	Reports for vessels and for the fleet may include: defects, requisitions and inventory status
	4.4.4	The planned maintenance system tries to ensure best equipment performance	Records are available to demonstrate: performance monitoring, remote diagnostics. The results of system's monitoring are evaluated
	4.4.5	Engineering audits are completed by a suitable representative	The purpose of the audit is to: review and confirm that practices are in compliance with industry standards.

The main objective of element 4A is to manage the maintenance of critical equipment and systems. This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
4A.1	4A.1.1	Equipment and systems are identified according to SMS and the planned maintenance system	Possible operational failure which will contribute to the harm of the vessel, or the personnel is identified.
	4A.1.2	The maintenance of equipment and systems is determined by various procedures	In case that the planned maintenance is not completed, risk assessment must be conducted
	4A.1.3	A procedure is determined which informs shore management when a problem or failure is noticed for the critical equipment and then the	

		management must schedule an unplanned maintenance	
	4A.1.4	Procedures are included which conduct the testing of equipment	Testing is performed according to mandatory requirements
4A.2	4A.2.1	Maintenance on critical equipment and systems which take them out of service, must be submitted to risk assessment	Apart from the risks related to the tasks, the risk assessment must also focus on the hazards provoked by taking the equipment out of service.
	4A.2.2	Work instructions are available in the planned maintenance system for critical equipment and systems	Planned maintenance is always carried out according to the work instructions
4A.3	4A.3.1	Maintenance of critical equipment must be conducted by specified personnel	The personnel responsible for the maintenance of the vessel must have all the appropriate knowledge, skills and requirements to fulfil this task
	4A.3.2	A procedure records all the performance data for all critical equipment and systems	Equipment Healthy is estimated through comparison between performance date and manufacturer's test
	4A.4.1	The reliability of critical equipment re maintenance system is monitored in continuous basis	The company tries to improve the maintenance system by forecasting the necessary improvements of critical systems

7.5 ELEMENT 5 – NAVIGATIONAL SAFETY

The primary aim of this element is to ensure that company's vessels operate and are navigated safely at a daily basis. Shore-based management must ensure that: the SMS includes navigational procedures that cover each stage of vessel's voyage, there is the sufficient personnel responsible for maintaining the navigational standards on shore, the management team of the vessel is appropriately trained, vessel's equipment is well maintained. Navigational standards are appropriate for the safety of vessels. This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
5.1	5.1.1	Appropriate personnel is designated for navigational standards	The responsible persons must be qualified, experienced and have the authority to ensure navigational standards
	5.1.2	Many procedures that ensure the safe navigation have been determined	These procedures include actions upon equipment failure, supporting checklists, berth to berth passage planning and actions upon meeting rainy weather, low visibility and ice
	5.1.3	Procedures to ensure effective resource management are in place	These procedures include handovers, navigation with pilot aboard etc.
	5.1.4	Procedures to ensure that navigational equipment is	Procedures include: defecting reporting, provision of spares as appropriate.

		maintained appropriately are in place	
5.2	5.2.1	The Master conducts a navigational audit to ensure that navigational procedures and regulations are met	The company provides an audit format and sets the frequency for completion. The frequency of the audit varies and depends on the voyage duration. However, the frequency must not exceed 12 months
	5.2.2	Navigational assessments are undertaken according to detailed procedures	Master's navigational audit is verified and updated according to new legislations and updates.
	5.2.3	Navigation procedures are checked that have been updated recently	The procedures must be updated according to new requirements and legislation
	5.2.4	A procedure is included to identify deficits in navigational equipment	
5.3	5.3.1	Charts and licences are provided by a recognised chart agent	
	5.3.2	Appropriate training is received by Senior Officers before their promotion	Ship handling experience is obtained through training and through a competency development system designed by the company
	5.3.3	Navigational Audits are conducted by an experienced executive	All the vessels must be audited at a period that does not exceed the two years
5.4	5.4.1	Navigational Audits are conducted by an experienced executive	The audit process may be similar to the process followed on 5.3.3
	5.4.2	Audit Reports are analysed, and conclusions are drawn	Reports analysis tries to identify problems and weaknesses in navigational procedures
	5.4.3	Masters and navigation officers should maintain the appropriate skills according to the assessment programmes	The assessment may include: knowledge, response to special and emergency situations
	5.4.4	Simulator training is conducted by navigation officers	

7.6 ELEMENT 6 & 6A – CARGO, BALLAST, TANK CLEANING, BUNKERING, MOORING AND ANCHORING OPERATIONS

The main aim of this element is to establish planning and operational procedures to ensure that the above operations are conducted effectively and safely. The standards of execution of these operations are highly significant and their importance for the vessels and personnel's safety and protection of the environment is huge. Therefore, shore-based management must ensure the below:

- Procedure cover cargo requirements and tests and checks are conducted

- All cargo and ballast tank cleaning is scheduled to be executed efficiently and quickly

- Compliance with procedures is assured by an audit plan

- Procedures cover all of the required mooring and anchoring activities

- Vessel personnel receive familiarisation, training and mentoring

This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
6.1	6.1.1	Procedures for cargo, ballast, tank clearing, and bunkering operations are in place for all the vessels	These procedures include role and responsibilities, planning, cargo and ballast handling, maintaining tank atmospheres, bunkering and record keeping
	6.1.2	For all vessel types, procedures have been determined for the check of cargo and bunkering equipment	Tests and checks of equipment may include: ESD system operation, cargo line pressure testing, loading computer and alternative calculations, cargo and ballast pump tests and gas monitoring equipment
	6.1.3	Management verifies that the above procedures are conducted appropriately	Verification is conducted through analysis of third-party inspections, remote sampling of records by shore management and terminal feedback
	6.1.4	The company has procedures that address cargo specific hazards for all vessels types within the fleet	Cargoes with specific hazards may be disastrous for the environment and sea provoking, toxic pollution, aromatic hydrocarbons and high vapour pressure cargoes
6.2	6.2.1	The procedures must be in place as referred in section 6.1.1	These procedures include the same characteristics as the section 6.1.1, with more complicated some procedures which are referred in this section
	6.2.2	All types of vessels and cargo transferred must be specified according to the established procedures	The transfer procedures are determined according to the cargo and vessel type
	6.2.3	Ballast Handling procedures are established	Many procedures like ballast, deballasting operations, ballast water exchange etc. are included
	6.2.4	Tank cleaning operations are explained in detailed procedures	Cargo grade change, dry dock preparation, tank inspection and repair are some reasons which contribute to tank cleaning
	6.2.5	Procedures are established for bunkering operations	These procedures include: terminal pipeline, bunker barge alongside, LNG bunkering, packaged lubricants.
6.3	6.3.1	Templates are used for keeping records	Templates are developed for different operations like, cargo, ballast, and bunker operations
	6.3.2	Tank atmospheres required levels are maintained according to the procedures established in this section	There are two categories for vessel: vessels fitted with an IGS, and these which are not fitted with IGS.
	6.3.3	Procedures for the transfer of unusual cargo and the corresponding operations are established	These operations may include: STS operations, inhibited cargoes and cargo dosing etc.

	6.3.4	The involvement of Junior Officers is presented in this section, in procedures that are related with tank cleaning, bunkering and other vessel's operations	An effective management system for these operations is established for Junior Officers
6.4	6.4.1	Courses which provide training in response to special and emergency situations are provided to the officers	These courses are used to train junior & senior officers. In addition, they try to familiarize the personnel with the new equipment and systems
	6.4.2	Audits are completed by an experienced company's representative, who observes all the above vessel operations	All vessels are audited once per year and after the completion of the process a report is written to recommend improvement actions

The element 6A is called Mooring and Anchoring Operations and its primary aim is to establish planning and operational procedures for mooring and anchoring operations. Procedures ensure that the vessel remains safely moored and the safety of the personnel involved in mooring and anchoring operations.

Element	Section	KPIs	Best Practice Guidance
6A.1	6A.1.1	Mooring and anchoring operations are determined according to detailed procedures	In these procedures guidance is included which ensures the protection of personnel and safe operation of equipment
	6A.1.2	Maintenance of mooring and anchoring equipment is provided	The planned maintenance system must cover all mooring equipment
	6A.1.3	The company has procedures to manage the condition of mooring ropes, wires and mooring tails	Instructions about the handling of the equipment is included in these procedures
	6A.1.4	Procedures are included for the use of tugs	The safe handling of ships' lines or tug lines is satisfied by these procedures
6A.2	6A.2.1	All the types of mooring operations are implemented	Procedures have been developed for all the mooring operations
	6A.2.2	Procedures address different types of anchoring operations	
	6A.2.3	Vessels remain safely moored at each stage	Procedures are included which ensure: sufficient personnel are retained onboard to tend moorings, passing traffic is monitored, changes to environmental conditions are monitored.
	6A.2.4	Replacement of wires ropes and tails takes place	Inspection methods which ensure the maintenance requirements, the minimum number of spares that are required for vessel's operations, are determined in this section
6A.3	6A.3.1	Appropriate requirements are identified for personnel involved in mooring	Such requirements are: designated person in charge at each location, minimum numbers of personnel required at each location

	6A.3.2	Measures should be taken to ensure the safety of vessel personnel, involved in mooring operations	Hazards, deficits and failures in the mooring equipment are identified
	6A.3.3	The use of ancillary craft is promoted	These procedures include: harbour tugs, line handling boats, escort tugs
	6A.3.4	Mooring equipment should comply with the latest provisions and legislations	The process includes: new build design review and amendments, during construction and modification
6A.4	6A.4.1	Mooring equipment manufacturing, like ropes and wires, is searched	Manufacturers' involvement includes: guidance on equipment specification, selection, and replacement, training of personnel
	6A.4.2	Procedures should ensure that the vessel may safely moor to the terminal, where the vessel moors for the first time. A range of means are used for this purpose	The means include: available information from port agents and port authorities, past records, company information for previous fleet visits
	6A.4.3	Audits are completed by experienced executives.	All fleet vessels are audited annually
	6A.4.4	Safe mooring operations are achieved through the technology innovations	Design improvements are promoted and suggested according to the new build specifications, an upgraded as required.

7.7 ELEMENT 7 – MANAGEMENT OF CHANGE

The main objective of this element is to ensure that all the relevant risks are identified properly. The company has established a formal process to evaluate and process permanent changes that could impact their operations. Changes to equipment, suppliers, personnel or major changes in the fleet's size can fully increase the risk of an incident. Management of change must ensure that:

- New training requirements are identified
- Relevant documentation is amended following changes which are identified by this element
- There is an appropriate procedure for onshore – onboard personnel's familiarisation,
- Results of changes are reviewed to that all the objectives are satisfied

This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
7.1	7.1.1	Procedures for management of change are in place	They are related to permanent and temporary changes
	7.1.2	The impact of any change is estimated according to specific procedures	The assessment includes the following factors: justification for change, risk reduction measures and any additional resources required

	7.1.3	The level of authorities that have the right of approval are determined by these procedures	Any change is approved by a specific person or by the person related to the change
	7.1.4	Emerging requirements are identified by these procedures	These requirements are probably imposed by the law and may be permanent or temporary
7.2	7.2.1	All the changes should be effective according to the management of change	Risk assessment identifies all kinds of hazards
	7.2.2	Management of change tries to identify if the personnel is affected	The management of changes tries to ensure that personnel is involved in the appropriate programs and their implementation for their development
	7.2.3	Management of Change ensures that training needs are identified and documented	Personnel may be affected by changes in the training and familiarization needs
	7.2.4	All documentation and records that are affected by the changes are identified	The permanent changes resulting from the management of change are identified and documented
	7.2.5	Management of change is conducted at a regular basis	The plans are documented to facilitate the review of the process
7.3	7.3.1	New procedures should be established when new vessels are purchased	The procedures here are implemented to existing vessels and new acquirements
	7.3.2	This section is a detailed review that all changes have been implemented	The company reviews the changes implemented to verify that objectives have been completed. The findings may be included in the periodic reviews
	7.3.3	There is a software system to cover both onboard and shore needs	The procedures resulting from this system include: performance tests following software upgrades and training requirements
7.4	7.4.1	If there are major changes in the shore's personnel, then these procedures must ensure that manning and executives skills and experience are maintained	Major changes may be: major changes in the fleet's size, introduction of new vessels types in the market or significant changes for the restructuring and reorganisation of the company
	7.4.2	Improvements for new designs are suggested	Existing vessels are upgraded with the new designs, and these are taken into consideration for the future designs.

7.8 ELEMENT 8 – INCIDENT REPORTING, INVESTIGATION AND ANALYSIS

This element is used in TMSA for the appropriate establishment of procedures that ensure the effective reporting, investigation of incidents to prevent them. According to this element, all incidents and extraordinary cases can be handled as soon as possible. Another significant aim of this element is to ensure that the incidents have been communicated in time to all the personnel and reoccurrence of

these incidents is provoked. With this way, creation of new problems is significantly decreased, and the risk is not too high. Especially, these procedures:

- Provide reporting and further investigation for the reasons have provoked an incident and the consequences of them
- Authorize the appropriate personnel who will be responsible for the identification of the incidents and for the further reporting
- Provide additional training to the personnel who have the responsibility for the incident reporting
- Ensure that the reasons provoking the incidents have been identified and analysed to avoid similar situations in the future
- Include procedures to determine the actions required to reduce the risk of incidents
- Ensure that new improvements in the methods used in the SMS are recommended
- Include directions on the classification of all incidents

Element 8 is primarily used for the investigation and analysis of methods to learn from the incidents and their consequences. This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
8.1	8.1.1	Investigation of incidents and reporting are suggested according to established procedures	These include: definition of incidents, definition of personnel responsible for the analysis of the incidents
	8.1.2	The investigation procedures ensure that required notification are carried out	Examples of mandatory reports are the reports which include notifications to: DPA – CSO, Flag State, Classification Society
	8.1.3	The fleet is notified of urgent information	An incident occurred and the company was identified
	8.1.4	Incidents are investigated and improvement actions are suggested	The basic causes of the incident are determined
	8.1.5	Personnel receive the appropriate training to identify the incidents properly	New training programs are recognised, appropriate training by a trainer is conducted and there is also computer-based training
8.2	8.2.1	The main causes of an incident are determined by the investigation procedure	This procedure includes a well-designed methodology to determine root causes

	8.2.2	The structure of the investigation team is determined according to the type of the incident	The personnel who are selected as members of the investigation team should not be related with the incidents
	8.2.3	Investigation training should be provided to at least one member of shore based management	Courses regarding incident and investigation analysis is provided to the personnel
	8.2.4	The safety culture encourages reporting for all incidents	The reporting system is user friendly and encourages full participation from vessel personnel
	8.2.5	Determining the causes of an incident prevent for any recurrence	A process is provided which tries to analyse root causes of incidents and draw conclusions
8.3	8.3.1	After drawing conclusions from incidents, safety performance statistics are promulgated	Analysis from the statistics is used to drive improvements in HSSE performance
	8.3.2	Analysis of incidents is conducted at periodic intervals	New trends are identified by this analysis. Furthermore, the effectiveness of the measures and new improvements are examined
	8.3.3	Incidents are reported directly to vetting departments	OCIMF may also have access and use the data
	8.3.4	Incident investigation takes place after an appropriate period	The appropriate period is defined by the company
8.4	8.4.1	Incident analysis is shared with industry groups	Such groups are classification societies, peer group associations and manufacturers
	8.4.2	Trained personnel have the opportunity to participate in incident investigation analysis, according to predetermined procedures	Trained personnel have the opportunity to participate in incident analysis, according to their skills, experience and knowledge

7.9 ELEMENT 9 & 9A – SAFETY MANAGEMENT

This element develops a safety culture both for board and ashore operations, that includes identification and mitigation of risks. It is also required that these procedures will promote the effectiveness of safety management systems and motivate the personnel to understand its significance.

This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
9.1	9.1.1	Safety standards are monitored by shore based management executives	A safety element is ensured that is included by conducting the inspections
	9.1.2	Promoting of strong safety culture is promoted across the fleet	Meetings regarding safety issues with vessel's personnel are conducted. The results of these meetings are conducted during sore management visits to vessels

	9.1.3	Procedures include a detailed risk assessment system	Hazards in both onshore and ashore operations are recognized by the risk assessment systems
	9.1.4	A documented permit to work system is in place	The permit is used to control, restrict all the hazards resulting from ashore and onshore activities
9.2	9.2.1	Safe working procedures are developed by risk assessments for routine tasks	Risk mitigation measures identify potential hazards
	9.2.2	The risk assessment system should recognize and identify new tasks, planned or unplanned	The risk assessment process results in alternative methods of work being considered and documented where the risk is identified
	9.2.3	Risk assessment systems for new and unplanned tasks are accessible by all the personnel	These risk assessment systems are used by shore based personnel. In addition, all the personnel should be familiarized with the content and way that these systems work
	9.2.4	All mitigation measures should be implemented prior to commencing work	Such procedures include permit to work and extensive use of the risk assessment system
	9.2.5	Safety onboard is conducted by procedures	These procedures include: define and identify onboard contractors, establishment of responsibilities
9.3	9.3.1	There is a process designated to review the risk assessments	The review process ensures that all risk assessments have a relationship with the impact of new legislation, the changes in manning levels and non-routing tasks
	9.3.2	Safety tools are used to ensure safety awareness through the organisation	These tools include: unsafe awareness programmes, behaviour-based safety systems and new courses – campaigns which promote the strong safety culture among the company
	9.3.3	A list of approved contractors maintained by the company	These procedures work as a guideline for the selection of contractors and in case that the contractors are not included on the approved list, then corresponding actions must be taken
9.4	9.4.1	The improvement of safety culture is completed by management and the use of risk management systems	Common areas of risk management are identified among the company and are shared across the organization
	9.4.2	Safety publications must be issued at a periodic frequency, for example quarterly	Publications which analyse past case of incidents are shared across the personnel and analyse the main causes of these incidents
	9.4.3	HSSE management system is used	Procedures for contractor management are established, which include: creating appropriate KPIs to evaluate further the performance, role assignment to the contractors and creating the appropriate KPIs to evaluate further the performance.

The main role of element 9A is to establish an active safety culture onboard through the introduction of hazard identification incentives, risk management systems and reporting programmes. This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
9A.1	9A.1.1	Safety inspections are conducted by a designated Officer, according to the procedures	Safety inspections of the vessel: identify hazards and the consequences to the safety, health of personnel and environment, are recorded and reviewed at a constant basis. Procedures provide details about the frequency and format of the inspections.
	9A.1.2	Hazards should be acknowledged, identified and be reported	When hazards are identified, the managements is informed and takes all the necessary actions
	9A.1.3	Safety meetings are held onboard at least monthly. In case that an emergent issue has been raised, then extraordinary meetings will be held and problem or the new situation will be handled and solved	In this kind of meetings all the personnel have the right to participate and have an interactive – active discussion analysing different issues regarding safety awareness, voice safety concerns and corrective actions
	9A.1.4	Work planning meetings should be held, to ensure consistency with organization's goals	In these meetings operational or departmental conflict, required equipment and personnel requirements are identified and compliance with work and rest hours is ensured
9A.2	9A.2.1	The prevention of unsafe and risky actions is promoted through determined procedures	Safety intervention techniques are used, and the progress is reviewed at the monthly safety meetings
	9A.2.2	Training regarding training and hazard identification is offered to the personnel	The kind of training which is provided is based on the responsibilities, experiences and the roles of the personnel
9A.3	9A.3.1	The reporting of safety practices is promoted	Safety best practices are reviewed to the fleet and if there are deemed as appropriate then they are incorporated into the revised procedures
	9A.3.2	The impact of safety across the organization and especially the vessels is estimated and possible improvements are suggested	Procedures measure: incident free days, safety regulations, identified hazards, behaviour-based safety system observations and safety suggestions. The results are communicated to all the personnel
	9A.3.3	Opportunities are identified by the management to ensure that the current levels of safety are satisfied.	Methods of interaction between the personnel are: seminars, webinars, safety magazines, or company produced videos
9A.4	9A.4.1	Indicators of safety performance are analysed on a vessel or the fleet totally. With this analysis areas which lack of the required safety culture are identified and improvements are suggested	The analysis is used to identify weaknesses, to generate safety campaigns and the level of safety performance is fed back to the management review.
	9A.4.2	Safety culture is promoted by safety trainers during the training sessions	The main responsibilities of the safety trainer is to assess the level of safety culture onboard, reinforce the company's

		safety initiatives and provide training as requested. After the completion of the procedure, the trainer prepares a report and the company reviews and analyses this report to identify areas for improvement

7.10 ELEMENT 10 – ENVIRONMENTAL AND ENERGY MANAGEMENT

The main objective of this element is to establish procedures that promote the balanced environmental and energy management and include identification of sources of environmental emissions. In addition, new measures are suggested to avoid the impacts to the environment. Companies establish the right procedures to reduce the negative impact to the environment. These procedures include:

- Development of environmental protection policy
- The identification and assessment of environmental emissions
- Effective fuel management
- Optimising energy efficiency
- Establishing requirements for ballast water exchange
- Internal and external benchmarking of environmental performance

This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
10.1	10.1.1	An environmental protection policy and management system is in place	This policy is undertaken by senior management and tries to minimize the environmental impact of the operations.
	10.1.2	All sources of environmental emissions have been systematically identified	A variety of emissions are included such as: funnel emissions, greenhouse gases, cargo residues, garbage, oil emissions, ballast water, sewage and antifouling paints
	10.1.3	Emissions are decreased to the lowest level that is permitted according to the established procedures	Procedures include: methods of minimizing emissions, identification of applicable regulations, emissions monitoring, and fuel analysis
10.2	10.2.1	Energy efficiency and fuel management are also significant for the environmental management	Energy management may include monitoring for the following: daily fuel consumption including main engine, boilers, vessel's speed and distance travelled, vessel's condition and weather or climate changes.
	10.2.2	Through the environmental management plan measures are suggested to improve environmental performance	These actions include many measures for example: establishing baseline criteria and targets to be achieved,

Element	Section	KPIs	Best Practice Guidance
	10.2.3	Energy efficiency should by optimised by these procedures and measures	Measures include: optimisation of vessel trim, speed optimisation, weather routeing, optimising onboard power management such as the use of generators and boilers, propeller and hull cleaning
	10.2.4	Energy efficiency and reduced emissions are achieved by the environmental management plan	These procedures try to ensure quality control of fuel
10.3	10.3.1	The environmental impact of organization's activities is subject to appraisal	This appraisal includes: measurement of all emissions, acceptable impact levels, and impact upon marine life. There are also procedures which include mitigating measures to minimize the environmental impact
	10.3.2	Emissions reduction targets are set in the environmental management plan	Targets may be set for: Greenhouse gases, garbage, oil emissions etc
	10.3.3	Environmental plan is created in a long-time basis	Long-term objectives, short-term targets are included in the environmental plan
	10.3.4	Environmentally ship recycling practices are used	
	10.3.5	Improvements that are environmentally friendly are incorporated in the new ship building designs	This may include: clean fuel technology and waste reduction equipment
10.4	10.4.1	Energy efficiency is maximized by available technology	This may include: emerging coating technologies, alternative energy efficient fuels
	10.4.2	New ideas are explored, investigated and suggested regarding the environmental performance. Some of these ideas are incorporated to the vessel's design	Examples may include new propulsion concepts and new – innovative ideas for engineering
	10.4.3	Benchmarking analysis is conducted for environmental performance and energy efficiency	Measurement and benchmarking of the performance is undertaken

7.11 ELEMENT 11 – EMERGENCY PREPAREDNESS AND CONTINGENCY PLANNING

The main aim of this element is to establish a detailed emergency system and the management to ensure that this system has the ability to manage incidents.

This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
11.1	11.1.1	Vessel emergency response plans must cover all emergency scenarios and	Vessel emergency response plans must be up to date. For this reason, they are updated at least once per year, to incorporate all the changes in the

		include notification procedures	company's procedures, changes in the legislation and the equipment.
	11.1.2	A shore-based emergency should cover all the possible emergency scenarios	The shore plan includes effective notification procedures and internal systems to promote the effective communication
	11.1.3	According to the shore-based emergency response plan and the relevant procedures, responsibilities and roles have been assigned to the appropriate personnel	Personnel are trained in their emergency special roles, according to the responsibilities that are assigned by the plan
11.2	11.2.1	The company provides suitable emergency response facilities	This includes a dedicated room with facilities such as: phone lines, sufficient computer work stations, electronic or paper charts, satellite and breakout rooms.
	11.2.2	The number and type of vessels determine the scope and frequency of drills	Exercises should be completed within the time frame
	11.2.3	Procedures are also included which analyse the significance of interaction with the media	Personnel receive the appropriate media training corresponding to their assigned role. Outsourcing for these trainings may be assigned to external companies
	11.2.4	The conclusions that have been drawn from the incident analysis and reports, are included in the emergency response plans	Issues and potential improvements are identified and suggested, and exercises of incidents are discussed at the management levels
11.3	11.3.1	The record of participants' data who have been involved in emergency drills and exercises should be kept	Despite the members of the company, external resources may also participate to in exercises and drills
	11.3.2	Procedures are ready to be used, in order external resources to participate in an emergency case	Contact details must be available at any time for all the relevant personnel like: salvage – towage contractors, emergency response services, flag states, legal resources, agents etc.
	11.3.3	Drills and exercises test the effectiveness of procedures in order external resources to participate in an emergency case	External resources are mobilised at least annually.
	11.3.4	Business continuity has been processed	Detailed documentation is kept by the company so as to ensure that safe management of the fleet is maintained
	11.3.5	Procedures address recovery following an incident	Procedures include: assessment of the vessel's and personnel's ability to procced on voyage, the need to preserve evidence and engagement with external agencies as appropriate
11.4	11.4.1	A plan that identifies and reports cases that provoke serious problems to the company's activities is in place	The plan is used on as regular basis, providing also alternative scenarios and emergency cases
	11.4.2	Emergency exercises and scenarios are implemented,	In these exercises, apart from the local authorities, the company or the charterer participate

| | 11.4.3 | New means to support the communication of emergency responses have been introduced | Some examples of these means are: managing accommodation and transportation of the corresponding – response team and review of the response |
| | 11.4.4 | New additional resources to support crisis management are introduced | The resources may include: trained negotiators and family Liaison officers |

7.12 ELEMENT 12 & 12A – MEASUREMENT, ANALYSIS AND IMPROVEMENT

The main objective of this element is to establish effective inspection and audit programmes that are compliant with the SMS. Analysis of the result drives continual improvement. Its role is crucial for at the core business as a document of high significance.

This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
12.1	12.1.1	A determined format is used for conducting vessel inspections	The format is controlled through the company document control system
	12.1.2	According to the inspection plan, inspection should be conducted twice a year	Inspections are completed by experienced superintendents, who are responsible for this procedure. After the completion of the process, the superintendents review the outcome of the inspections, and their conclusions are referred in a detailed written report
12.2	12.2.1	There is a standard inspection format which is equivalent to the vessel inspection reports issued by organisations like OCIMF	The format is reviewed according to other industry's formats, and this includes specific details for the company
	12.2.2	A system records deficiencies identified by the inspections and tracks them to close out	After the completion of inspections, the outcomes are recorded, and the deficiencies are identified. In addition, open items regarding the deficiencies are checked and resolved
12.3	12.3.1	An analysis of the inspection results comparisons for the fleet are made, to improve vessel standards	If weaknesses or anomalies are identified, then corrective measures should be taken in order the idea of continual improvement to be adopted. If best practices are identified, then they should be communicated within the organization
	12.3.2	Inspection Analysis results are compared with the data resulting from other similar inspection analysis	The aim of this comparison is to find areas of weakness and differences between the two assessments. After the completion of the comparison, vessel inspection process is reviewed and improved
	12.3.3	Weakness regarding personnel familiarity with	In case that after the publishing of the inspection report, it is concluded that the

		operations and equipment are identified	main cause of the problems is the lack of personnel's familiarity, then this problem should be communicated to the upper management
12.4	12.4.1	Continual Improvement process is always fed by the feedback received from the Inspection report	The data received from the analysis are used for the improvement of SMS, the further analysis and benchmarking against other companies
	12.4.2	Information technology is used to enhance the inspection process	Enhancements include: use of portable devises, purpose built software and application, automated reporting processes

The main aim of element 12A is to establish a detailed process to conduct systematic audits of vessels and company's offices onshore. This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
12A.1	12A.1.1	Documented audit procedures and audit formats are in place for each company	The formats are established according to ISM, ISPS Code and ISO Standards.
	12A.1.2	Auditors should be appropriately trained and qualified	The auditors must receive the appropriate training and a record of audits must be conducted by them
	12A.1.3	An audit plan covers both vessels and company offices	The plan provides for audits of the entire company organisation and fleet
12A.2	12A.2.1	Management should be notified of the audit results with a specific time frame	A performance goal is set by this procedure for a specified time frame between the time producing the report and the time distributing the report
	12A.2.2	Audits are performed according to the audit plan	Only senior management have the right to approve modifications to the audit plan, after the provision of corresponding justifications for the reason that the audit plan should be modified
12A.3	12A.3.1	All audit non-conformities are closed out within the prescribed time frame	An audit status report must be reported to senior management on a quarterly basis.
12A.4	12A.4.1	Analysis of audit results should be discussed at least once per year. The main aim of this analysis and discussion is to provide enhancement to the continual improvement	The data resulting from the analysis are used to identify new trends, areas for improvement and suggest corrective actions
	12A.4.2	Information technology is used in audit	Enhancements may include: use of portable devices, automated reporting processes etc.
	12A.4.3	Procedures establish the use of a contractor management system	Audit of: shipyards, dry docks and third-party service providers are required for this management system

7.13 ELEMENT 13 – MARITIME SECURITY

The main objective of this element is to provide secure working environment. Effective security management requires the systematic identification of risks, and hazards that create problems to the daily operation of the organization. The company should also adopt measures to minimize the level of risk, as possible as it is. A system is in place for monitoring and control of change, as there are continual changes in the legislation and the maritime security situation. The company ensures that:

- There are procedures which ma identify the potential risks and threats
- Measures to minimise the risk are used
- Detailed procedures are in place to report in detail the incidents and the risks
- Risk assessments are undertaken to identify the risks
- Personnel receive appropriate training, promoting the safety culture of the company
- Security procedures are updated with the most recent trends, legislations and guidelines
- Vessels are provided with the appropriate equipment

This element is consisted of the below sections:

Element	Section	KPIs	Best Practice Guidance
13.1	13.1.1	Security plans procedures are established	The plans cover all aspects of activities including: company's activity both ashore and onshore. Personnel etc.
	13.1.2	Procedures are established to identify shore based risks	Examples of possible threats are: vandalism, cargo theft, cyber threat, piracy etc
	13.1.3	Measures have been developed to mitigate all threats applicable to vessels and company's offices	These measures include: access control, security patrols, physical security measures and training
	13.1.4	Procedures are established to incorporate new trends, updates related to security information	The responsible persons review the information and issues relevant guidance to shore-based locations, personnel, and vessels
	13.1.5	Potential security risks and incidents should be reported	These reports include: internal reporting, and reports related to the vessel and the company
13.2	13.2.1	Potential risks will be identified through risk assessments	Risk assessments are reviewed and updated if it is necessary. If increased risk is noticed, then hardening measures are developed to face with this situation
	13.2.2	The corresponding personnel for security must	Training must meet the minimum international legislative requirements. A

		receive the appropriate training to acknowledge their responsibilities	security briefing must also be provided to all personnel as part of their familiarisation process
	13.2.3	Procedures are in place for cyber security risk mitigation and provision of required guidance	Potential risks to company's systems may be created. Some of these systems are identified
	13.2.4	Cyber security awareness is promoted	Responsible behaviour should be encouraged for shore based, and ashore personnel as well as for third parties
13.3	13.3.1	A travel policy to minimise the security threats is used	The travel policy should be taken into consideration and updated in case that there are changes for this policy.
	13.3.2	Security procedures should be updated according to the current guidelines	Guidelines, which include and analyse the latest safety procedures, are provided to all the vessels of the company
	13.3.3	The internal audit programme includes the security policy and other related policies	The audit assesses compliance with all aspects of company security procedures
13.4	13.4.1	Assessments are conducted to measure the security performance	The assessments may be conducted by company's personnel or through outsourcing (by external resources)
	13.4.2	Security threats are mitigated through independent support	Any contracts for specialist support both onboard and ashore, are supported by a detailed scope of work. Such support may be contracted for activities that include training, security and threat assessments
	13.4.3	Security equipment is provided to the vessels	Examples of such equipment are the water cannons, stern radars, thermal imaging systems, keypad entry systems etc.
	13.4.4	New-build designs include the security enhancements that are provided through new technology and innovations	Enhancements and specification may vary according to: vessel type and size, manning levels
	13.4.5	The company performs test for the installation of new security equipment and technology	Measures that should be taken, may be physical or enhancements to IT systems, to improve the security

8. REQUIREMENTS FOR THE SUCCESSFUL IMPLEMENTATION OF TMSA

8.1 HUMAN FACTOR AND ERRORS

Many accidents and problems in the daily operation, are provoked due to the false estimations and handling by the human capital, as previously has been referred. Human error can be defined as "not intended by the factor; not desired by a set of rules or an external observer; or that held the task or system outside its acceptable limits" (Senders, Moray 1991). The human error can be analysed through two approaches: the human approach, which tries to estimate and identify the errors,

the practices and the conditions the errors have been occurred and the system approach which tries to recognize any potential improvements and new practices will contribute to the avoidance of potential errors in the future. Studies have shown the primary factor that results to accidents in global shipping industry is the human element, as 80-85 % of accidents are provoked by human errors. In contrast to the above referred approaches, the human element seems to be neglected by the ship design, a fact that will contribute more to the operational problems and accidents. A new concept has been recently recommended to face with this problem, and its name is Human Centred Design (HCD). This concept focuses mostly on making the required systems usable, by exploiting the knowledge skills and experience of the users, mitigating with this way the risks potential hazards. HCD is a process of systemically applying human factor, and its qualifications, trying to enhance the working conditions, the effectiveness of the personnel, and ensure the minimum healthcare provisions to the employees.

8.2 HUMAN ERRORS CATEGORIES

There are three main categories of human failures which can lead to major incidents. The first category is the Errors (slips/lapse), that are unpredicted human actions. These may occur during the fulfilment of an ordinary task and may not be eliminated by training. The second category is the Mistakes, which are also errors, however, result from judging or decision-making, in contrary to the common errors. These appear when behaviour focuses on rules or procedures and therefore decisions lead to miscalculations or misdiagnoses. The first two categories are referred as unintentional errors. The third category is the violations which differ from the other two categories is that these errors are intentional failures, usually meaning most of the times, are rarely wilful and usually are characterized by the tend to complete the task or the assigned job despite the consequences. The category of violations is divided to three subcategories, which are the below:

- Routine Violations: A behaviour of an individual or a group which is against the rules and policies and tends to be the standard way of behaviour within an organisation

- Exceptional Violations: The violations happen in special and extraordinary circumstances, when something goes wrong in unpredicted cases, for example an emergency situation

- Situational Violations: These violations result of factors led by personnel's working environment and immediate work space.

- Acts of sabotage: These are not as frequent as the other subcategories, however their causes are more complex ranging from rules violation to vandalism and terrorism.

8.3 EFFORTS TO REDUCE THE HUMAN ERRORS

Shipping operations are designed according to certain criteria, rules, regulations which are determined most of the times by the flag state's authorities or by the classification societies. Several documents are listed in shipping industry, which are used, regarding the design, the hull form and human- machine interface. In an attempt to mitigate the risk, many companies have developed a new methodology integrating a risk-based approach relating to ship designs and ship systems. However, the human factor and how the errors are related were not included in this methodology. This gap between the methodology and the human error was eliminated through studies which summarized that the main causes of the errors, which have a huge impact to human behaviour, were ship motion, noise, and vibration. Ship motion is identified as the most significant factor, having an impact to crew's behaviour, and disrupting the sleep quality. Approaches to mitigate and prevent adverse effects of ship motion to crew were designed and suggested. These approaches were divided into five categories: ship design and system engineering, human factors engineering, enhancing natural human resistance to motion effects, modifying adverse physiological reactions to motion and operation solutions.

There are three serious concerns about the management of the risk and human capital errors, which are: an imbalance between hardware and human issues and focussing only one engineering (concern 1), focussing on the human contribution to personal safety rather than to the initiation and control of major accident hazards (concern 2) and focussing on operating errors on behalf of system management failures (concern 3).

Concern 1: Due to the increased accidents resulting from the human failures, there is more focus on engineering and hardware aspects. However, the exclusive use of engineering is not absolutely riskless. The concept of automation has been incorporated in the majority of the systems, however most of them are designed, developed and maintained by the human capital.

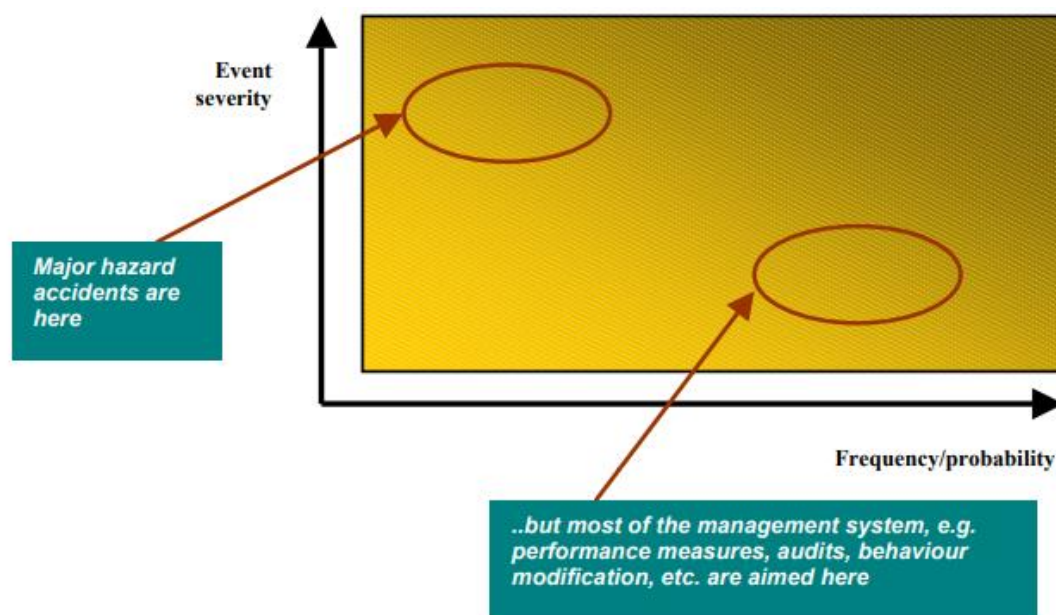**Concern 2:** The following diagram provides us with information focusing on the management system on major hazard cases:

Figure 4: Management System and Major Hazard Cases (Jackson, 2018)

From the above figure we conclude that the majority of hazard sites tend to focus on occupational safety and those sites considering human factor issues rarely focus on those aspects that are relevant to the management of major risks. For example, sites consider the personal safety rather than how human errors in maintenance operations are the primary cause of major accidents. In general, a safety management system which does not manage the right aspects, has the same operational role in controlling accidents as well as the no use of any system.

Concern 3: In complex systems, the operation and the required practices focus on the actions of most operators. Nevertheless, operators often tend to fail making organizational and management failures. The management and organizational factors must be firstly considered and then responsibilities must be assigned to the corresponding operators. Furthermore, the concept of safety culture must be considered

as an appropriate element for the effective mitigation of the risk. For this reason, management should understand that the establishment and communication of the safety culture across the organization must be a task of high significance, assigned to them, following the investigation of new accidents.

Many methodologies and procedures have been designed and developed to mitigate risks relating to human capital. Some of the most frequent procedures used in the management of human capital are referred below.

8.4 SAFETY CRITICAL TASKS

An example of these methodologies is Safety Critical Tasks. These are related to a process, which identifies those tasks associated with potential hazards, where human capital may fail to report hazards and mitigate the risks of them. Furthermore, this procedure will involve the identification of safety critical rules and responsibilities of personnel within the organisation.

8.5 MAJOR ACCIDENT HAZARD SCENARIOS

These scenarios try to determine potential hazards and the consequences resulting from them under special and extraordinary circumstances for the organization. After the completion of the assessment process, a safety report which includes the conclusions is produced. For sites of the organization that have not produced this report, the main hazards may be identified by a risk management system.

8.6 TASK ANALYSIS

If an organization has identified the safety critical tasks, then a task analysis must be conducted in order these tasks to be analysed and understood. Task Analysis may be conducted through informal conversation between management and employees, to identify the hazards, the time, the way and the conditions under which, the human errors occurred. Conversations may include new practices and suggestions provided to the personnel, to avoid similar situations in the future. For more complex responsibilities and situations a more formal task analysis is required.

8.7 HUMAN ERROR ANALYSIS AND PIF

If the personnel's tasks have been identified, each task can be assessed for the potential of human failure and the opportunity to recover from human failure. After the completion of Human Error Analysis it is important to consider those factors that which contribute at a high level to the human capital's failure or not. The name of this procedure is Operational Performance Influencing Factors (PIF). Examples of this procedure are: Ergonomics Design, and Human machine interfaces.

8.8 ENGINEERING – AUTOMATION CONTROLS

The first step of this process is to engineer out the human failure and provide further protection which do not rely on human factor. In addition, the continual assurance must be audited and tested in a constant basis.

8.9 INSPECTION, TESTING AND MAINTENANCE

Replacing human capital with engineering systems does not remove the personnel's responsibilities and tasks from the risk management system. The main role and scope of these systems are to mitigate the risk and human capital failure away from the operational activities and into Inspection, Testing and Maintenance.

8.10 TASK ANALYSIS (MAINTENANCE)

This process has the same characteristics and steps as the procedure of Task Analysis, referred above. The only difference between the two processes is that Maintenance Task Analysis is that it may identify latent errors which may not result to immediate failure.

8.11 PROCEDURES

Procedures have a significant role in determining the personnel's safety critical tasks. The process of task analysis includes detailed description for the assignment of responsibilities to the human capital, which can be easily converted to formal procedures – description of tasks within the organisation. The main aim of the procedures is to identify possible gaps in knowledge, which drive to mistakes and as there are different types of procedures, the human failures may be controlled more effectively. Simplified, detailed procedures and job aids like checklists, provide controls for potential lapses and must monitored very frequently.

8.12 TRAINING

In the TMSA elements, the role of Training for both onshore and ashore personnel was analysed. It is a significant factor which contributes to the effective implementation of the procedures and appropriate risk management. Adequate training and development of the employees will help to avoid future harmful situation, with a negative impact to the organisation. It also provides with the required knowledge for the personnel to carry out the safety critical tasks. A complete training program also includes information on why the understanding of a major hazard risk is necessary. Training can also be related with the procedures, as the description of how a task can be completed, can be converted to a detailed training manual, which is very helpful for the personnel.

As IMO and the global community have understood the significance of training for the personnel, a range of training programs have been introduced to cover all the potential needs for the development of the employees. Two main categories of training programs have been introduced: shore-based and shipboard trainings.

Shore-based trainings: Companies try to offer their personnel all the up to date knowledge, being aware of all the changes in the market, and new legislation. It is very significant for the employees to be aware of the current trends in the shipping industry, due to the fact that shipping is a highly volatile field of the economy, with consecutive changes. Some of the topics covered by the training programs are:

- Changes in the current legislation and estimations of potential changes in the future
- Management reviews
- Operational, safety, environmental issues etc.
- Customers' complaints
- Company strategy, aims and philosophy
- Security and cyber security
- Accidents - incidents investigation, analysis and conclusions

Shore-based trainings may include and other subcategories like: Company Run Seminar, and Company In-house Refreshment Training.

Shipboard Trainings: For this category it must be referred that the Master has the responsibility for the successful implementation of the training program. If there is need for additional training, then the program and the requirements may probably change. Master must ensure that all the requirements and the legislation imposed by the flag-state, are met. For example, tanker companies follow methods like: Familiarization Trainings, during which all the seafarers are provided with the training as referred to the following table:

Familiarization	Master	Deck Officer	Chief Eng	Engine Officer	Ratings	3rd Party Contractor
Elementary Basic Safety Familiarization	24 hour	24 hour	24 hour	24 hour	24 hour	
Specific Shipboard Familiarization	2 weeks	2 weeks	2 weeks	2 weeks	2 weeks	
Engine Room Familiarization			First week			
Cargo Control Room and Cargo System Familiarization		First week				
Bridge and Bridge Equipment Familiarization	Before first watch	Before first watch				
3rd Party contractors & visitors Familiarization						On arrival

Figure 5: Familiarization Trainings (E. Bal Besikci1, 2019)

Additional training programs are included in shipboard trainings like: Onboard Computer Based Training (CBT), Training During Drills, Brief Meetings, and Training by Superintendents during shipboard visits.

Onboard Computer Based Training (CBT): Companies should include a training matrix to cover all rank ranges of crew members. For the successful implementation of this training, the required equipment must be ready to be used (such as computers or other PC devices). Additional material, like training videos or courses will help the Master or the management to complete the trainings effectively. Explanations or comments about the assessments may be required to be submitted by the Master.

Training During Drills: Real-life scenarios should be reflected by Training During Drills, and should be considered as realistic, as they are held with the hypothesis of real-time conditions to be taken into consideration. After the completion of the process, a brief meeting should take place, to identify corrective

actions and possible improvements. Through these trainings, the crew will focus on emergency procedures of the vessel, and emergency duties - responsibilities, will be educated about the content of different global conventions, like SOLAS, Life Saving Appliances (LSA), Fire Fighting Equipment (FFE) and operation of fire-extinguishing appliances.

Brief/Debrief Meetings: Brief/Debrief Meetings offer the opportunity to the personnel to discuss about the risks, the emergency scenarios, and what goes wrong after the completion of an operation. A Brief Meeting takes place before the commencement of the operational process and is characterized by a discussion about possible risks and the precautionary measures to be taken, to avoid the risks in the future. The Debrief Meeting takes place after the completion of the operational process and its aim is mistakes, which were identified during this procedure and corrective actions to be discussed, in order to avoid similar failures or problems in the future. Both of the above meetings focus on: operations before and after the voyage, unmooring and mooring operations, cargo operations, bunkering operations, anchoring operations etc.

Training by Superintendents during shipboard visits: This program includes training for superintendents, who are joining the vessels and the necessary training is required to be completed, in order to improve the performance level of the vessel. Some of the objectives of this program are: the maintenance of the operational safety, ensuring that the crew is familiar with HSSEQ policies and SMS, improvement of the crew's awareness on environmental issues and reinforcement of the company's safety initiatives, campaigns and programs.

8.13 CONSOLIDATION

The knowledge obtained by training program must be incorporated and applied to each job, in order to develop the skills and complete the tasks safely and successfully. During the consolidation period, trained people will need extra support from good procedures and supervision.

8.14 COMPETENCE ASSURANCE, MONITOR AND REVIEW

An effective Competence Assurance System should monitor the performance and how the personnel will respond to standards of performance and predetermined

criteria. During the full operation of an organization, many administrative changes may occur to the structure, number and characteristics of the employees. Management reorganisations, and modifications to existing plants may also occur. To keep up with these changes, the risk profile of the organisation should be estimated after the changes, the demonstration of assured performance of human capital engaged on safety critical tasks should be reviewed.

8.15 ASSURED HUMAN PERFORMANCE

Having completed all the precedent steps of the human errors handling, it should be possible to provide evidence to demonstrate the assured performance of personnel engaged on safety critical tasks, which have an impact risk mitigation. The produced safety report for human errors has to include the above as its main demonstration. Having firstly determined the steps required for the Task Analysis, Human Error Analysis etc., a more structured - systematic approach can be demonstrated, which will be clearly communicated through the safety report to make the necessary demonstrations that the measures taken will contribute to the avoidance of human errors in the future.

The below figure shows all the methods analysed, and summarized above and how they are related to each other:
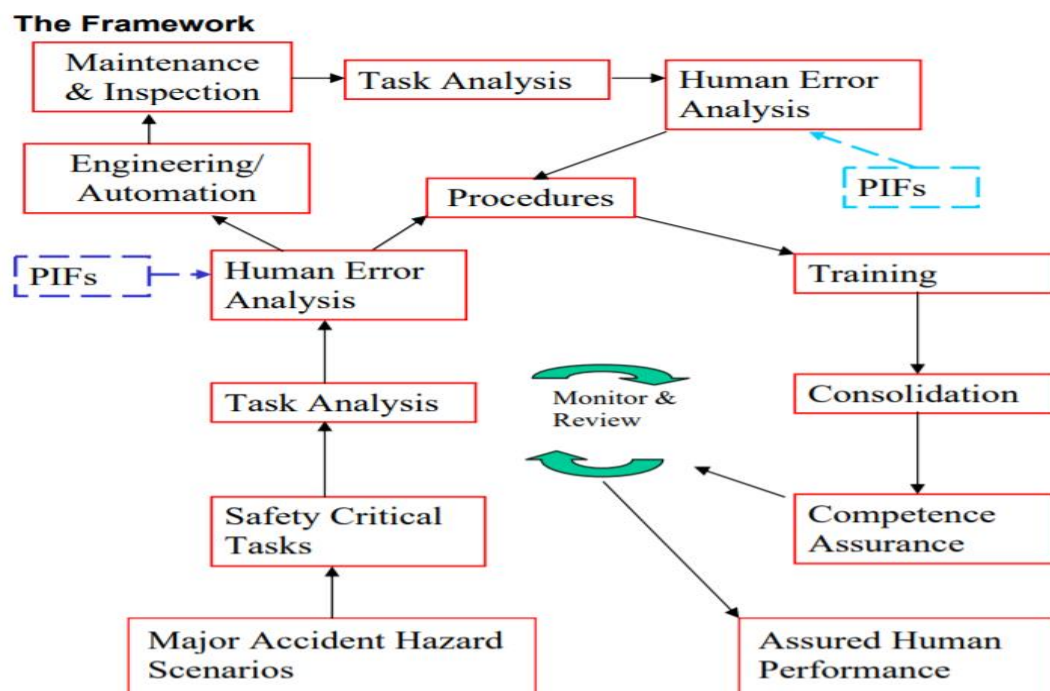
Figure 6: Methods used for the effective implementation of TMSA (Jackson, 2018)

8.16 STOP WORK AUTHORITY (SWA)

SWA is an essential element for the successful implementation of the procedures defined by the organization and has a significant relation with the implementation of TMSA. SWA is defined as an element of SMS and was incorporated to the management system after an increase in the maritime incidents. Typically, is a concept that let employees to provide with their opinion and express their concern, when there is a problem with the operation, a failure has occurred, a task is not undertaken according to the safety policies and rules. If an employee recognizes a failure, he should directly refer the case to the upper management for further consideration. Practically, SWA places authority and responsibly on each member of vessel's crew. It is very difficult for the SWA to be implemented without vacuum. The team spirit and the encouragement approach must be communicated to all the personnel. It is very significant these concepts to be adopted by all the employees, as the effectiveness of the SWA is depended on it. Merely posting the policy on a bulkhead does not constitute an effective implementation. A good starting point for the implementation of SWA is the recalling of previous similar cases, form the past, when an employee stopped his tasks after the release of a new issue. A SWA program must define all the responsibilities and roles, which are the below:

- Senior Management: Creates a culture that defines exactly the responsibilities and the roles. In addition, Management must resolve conflicts for SWA issues and ensures that all the personnel is compliant with SWA procedures and standards.

- Managers and Supervisors: They should promote a concept and culture, where SWA is exercised, without disruptions and resolved before the operations are completed.

- HSE Department: The main aim of this department is to ensure that compliance with SWA program is satisfied, and training or support is also provided

- Company employees and contractors: They should stop work to meet the requirements of SWA and support the stop of other employees when there is a need for the consistency of SWA.

The monitoring and identification of the conditions, under which SWA must work, is very significant, because they will increase the risk and threaten danger to the company's operations. Such conditions are: changes to the scope of working plan, emergency situations, lack of knowledge, understanding and information, and unsafe conditions. The steps for the successful implementation of SWA are the below:

- Stop: When an employee perceives cases that pose danger to the equipment, the organization or the environment he must initiate a stop work procedure with the personnel subject to risk.

- Notify: Under this step, the affected personnel and management must stop working, if their tasks are affected by the potential risks. Removing of the personnel subject to risk, is a recommended alternative solution to stabilize the situation and ensure that the risk is monitored.

- Investigate: All the affected personnel will reach an agreement and stop the work action. If there is an agreement between all the affected personnel, then the safe concept of thought is to proceed without modifications, and the affected personnel should show appreciation to the SWA and then resume work. If the SWA is valid and then accepted, a stop work form should be filled out. If the issues provoking problems to the equipment, organization or environment have not been resolved, then the work is not permitted to restart. Working tasks will remain in suspension status, until the issues are resolved.

- Correct: Corrective actions should be made according to the improvements that are suggested in the Stop Work Issuance Form. After the completion of the process, the improvements and changes will be assessed by experts to estimate whether the conditions let the work tasks to resume.

- Resume: The affected areas will continue the working tasks, according to the restart authority. All the personnel should be notified that the working tasks will restart, which issues have been resolved and what changes have been made.

- Follow-up: The management will conduct an analysis and identify other potential opportunities for improvement. The Safety Manager will publish the outcomes of this analysis, including the issues, the improvements and

the suggested actions for the working tasks to restart, and of course to remind which the issues are to be avoided in a similar future situation.

8.17 BEHAVIOURAL COMPETENCY ASSESSMENT SYSTEM

The shipping industry faces with many changes in legislation, operations and potential risks, as these have previously been referred. Personnel in order to achieve to meet the requirements, requested by the organization, must have received the appropriate training and acquire new experiences and both technical (hard skills) and non-technical (soft skills). Especially, Tanker sector recognizes that the personnel should focus more on soft skills. Thus, a behavioural competency assessment system is required to be developed. Competence framework provides a common approach for assessment of skills, improvement of performance, recommendation of corrective actions and promotion of organization's culture. The competency framework is consisted by six fields, analysed below: Team working, communication and influencing, situation awareness, decision making, results focus, and leadership – managerial skills.

Team Working: This section is characterized by building effective working relationships, treating others with respect, resolving conflicts between the employees.

Communication and influencing: Daily communication is required between all the personnel, especially between the employees and the managers. Effective interaction and communication is a prerequisite for the organization's survival.

Situation Awareness: All the personnel must distinguish the external and internal factors that have an impact to the daily operations. Effective strategies must be developed to manage the future threats and mitigate the risks.

Decision Making: Systematic and rational judgements are chosen based on drawn conclusions by analysing relevant issues and through the benchmarking process taking place within the organization.

Results Focus: Focusing on achieving the best and most effective results is highly desired by the organization. Flexibility, emotional toughness and using initiative

and energy are also required. This section is also characterized by accountability, and dependability.

Leadership and Managerial Skills: Personnel must be empowered to perform at their best and complete their tasks effectively.

The sections of a five-rating scale assessment are the below:

- **Exceptional:** This section is recognized as outstanding in this competency, the performances must exceed the expected results and its role is crucial in order to ensure that the required level of competence is accomplished.

- **Exceeds expectations:** Under this stage, the assessment is based on try to exceed the expected results to help others to develop this competency. It meets all and often exceeds expectations.

- **Meets Expectations:** The expected results are consistently met. The level of competency is demonstrated, and expected results are awaited to be met. Furthermore, this stage is reliably and consistently successful.

- **Needs improvement:** The competency, in order to meet the expectations and the required levels by the management, needs further development, guidance or evaluation and sometimes meets the expectations. Corrective actions may be required to be taken to strengthen the competency and achieve better results.

- **Unsatisfactory:** In this stage, expectations are not met and regularly fail to achieve the required results. Furthermore, behaviours are inconsistent with this competency and further training, and analysis for the inconsistencies of this competency is not undertaken.

8.18 THE IMPACT OF CONTINUAL IMPROVEMENT PRACTICES TO TMSA

All the above practices which have been analysed, contribute to the effective implementation of the TMSA. Trying to minimize the risk resulting from the human factor and the failures resulting from its tasks, organizations have developed many practices to face with the potentials of the risks. The tool of TMSA was designed in order to identify these potentials, escalate them to the management and reach the correct decisions for the organization. TMSA only recognizes the risks and

measures the capability of the organization to achieve to deal with these risks. However, TMSA is not the tool that can change the safety culture, develop the personnel's skills and introduce new concepts to organization's culture. The corrective actions, changes and improvements will be completed through the above practices, like training, SWA, Task Analysis etc. Therefore, many of these practices are included in the TMSA Best Practice Guidance. To sum up, TMSA is used for the identification of the risks and the insufficiency of the organization to respond to risky situations, as the practices included in the Guidance may help the organization to escape from this situation and achieve the risks reduction.

9. PERFORMANCE MEASUREMENT & MANAGEMENT

9.1 PERFORMANCE MEASUREMENT

Performance measurement is used from many organizations as a method to measure performance, the effectiveness of this organization, and its main aim is to evaluate how well the companies achieve their aims. KPIs, Performance Indicators (PI), Key Result Indicators (KRI), and Result Indicators (RI), are used by the organizations in the stage of performance measurement, to estimate the organization's results and performance. Due to the fact that KPIs have analysed, as they are used in TMSA, we will focus more on other performance indicators.

Result Indicators (RI): RIs provides with a summary of the activities and actions taken by the teams, cooperating together and producing the final result. RIs focus on the practices and ways that are used for the coordination of the teams and how effective the team-work will be. These indicators may be also used to estimate the financial performance. Examples of these indicators are: yesterday sales, number of educated workers (for the use of a specific system), and complaints from key-customers.

Key Result Indicators (KRI): A KRI is an indicator which is used to compare the activities of various teams and departments across an organization. The main disadvantage of these indicators is that they do not provide with the reason of taking an action, but only provide the results of the action. Therefore, this information is reported too late to take an action and report further.

Performance Indicators (PI): PIs are non-financial indicators that refer to a specific, process, task, team or an employee. PIs are very vital for the company's organization (not so important for the company's overall wellbeing), as they set the principles regarding the company's strategy and policies.

9.2 LEADING AND LAGGING INDICATORS

Another classification of the performance measurement indicators is their division to: Leading and Lagging Indicators. A lagging indicator focuses more on past performance and conclusions are drawn about the past activities and which were the faults of the organization. Leading Indicators focus more on future performance, making predictions and affecting the future activities, operating as a proactive measurement.

9.3 PERFORMANCE MEASUREMENT INDICATORS AND COMPANY'S STRATEGY

One of the most significant aspects for the use of Performance Measurement Indicators is that they should be compatible with the organization's strategies, according to factors and objectives of sucess, ensuring that drive the company to the right direction. Many studies have shown that KPIs are cascaded usually in two or three organizational levels. However, two approaches are the most predominant for the cascading of performance indicators: vertical cascading and horizontal cascading.
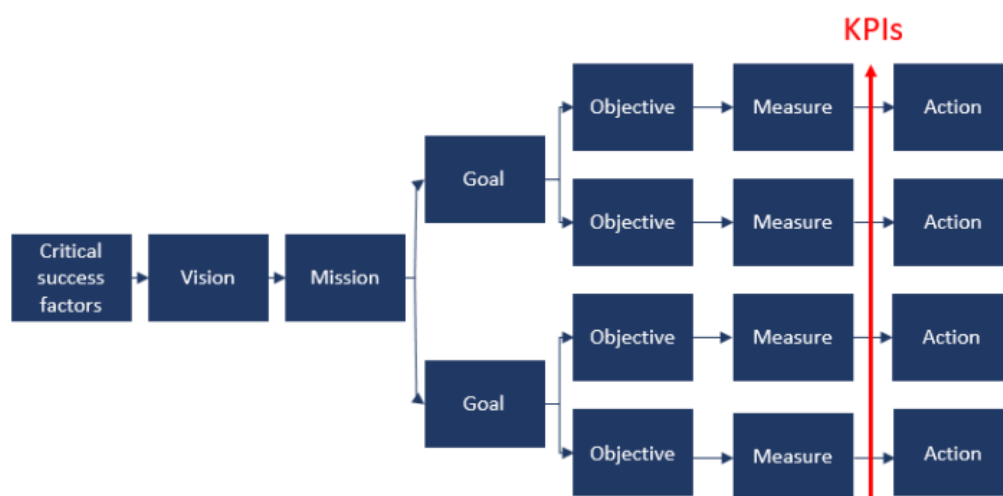
Figure 7: Performance Indicators & Strategy (Philip Sundström, 2018)

The above figure explains in detail how performance indicators, and especially KPIs are aligned with strategy.

Vertical Cascading: The main idea of this process is that the strategy is rolled down in the company, as well as the metrics are rolled up. This method provides the management the opportunity to control the actions and the implementation of the procedures across all the levels of an organization. It should also be referred that there are many methods to roll up metrics. An example of this methods is adding two lower-level measures to one higher level or by deriving lower-level measures, as for the same activity that might be measured in different ways.

Horizontal Cascading: This method aims to align the KPIs between dashboards and scorecards to achieve the required coordination.

There are many methods developed for the performance measurement, with the most significant the Performance Measurement System and the SCOR Model. Performance Measurement System is a tool which is used to monitor and evaluate the company's performance. Many approaches and editions of PMS have been developed, however the most predominant is these that promotes the connection of strategic objectives with performance indicators and metrics across multiple levels. Performance Measurement System can also connect targets, goals and actions across the company. In addition, PMS can be divided to many categories according to specified criteria. Some of these categories are: vertical or hierarchal systems, systems operating with more different perspective like scorecards, models that are distinguished between internal and external performance, and models that are related to value chains, taking into account the internal customers. Another very known system is the Scor Model, which is consisted of five components: Plan, Source, Make, Deliver and Return. Plan is referred to the processes that are linked to planning, sourcing, and delivering according to the demand. Source processes are related to procurement of materials, so that the company's products and services can meet the demand. Make processes are linked with the transformation of inputs to a complete final product or service. Deliver processes ensure that all finished products are delivered according to demand. The Return processes are related with the handling of the return of products to suppliers. There are three levels of metrics, analysing the effectiveness of the system, included in SCOR Model. Level 1

includes all the strategic KPIs, Level 2 has a supportive role to Level 1, helping to identify the causes and the roots provoking different issues, and Level 3 also has a supportive role for Level 2.

9.4 PERFORMANCE MANAGEMENT

Performance Management is the procedure of use of performance measurement information to provide with recommendations for improvements and corrective actions to company's structure, processes, and culture. KPIs are an important part of performance management, as guidelines are provided by this method's system framework on the way of measurement and performance management. This framework is a suitable starting point for the development of a measurement system. Performance management is consisted of four different steps, which are: the creation of strategy, planning of how to achieve strategies, monitor execution of activities and plans and making of adjustments and activities on problems. Performance Management is consisted also of 3 levels. In Level 1 there is a focus on visualizing the measurements. Some initial KPIs are included in visualization reports and tools. The measure that are used may not be compatible with the strategic objectives. Level 2 focuses on management of the performance. Measures are taken at this stage, which are used to identify issues, suggest improvements and monitor performance across all the teams of the organization. Finally, in Level 3 the measures are used to achieve strategic goals and objectives, according to both lagging and leading indicators. Furthermore, an analysis between behaviour and outcomes is conducted.

9.5 PERFORMANCE REPORTING

Upon completion of Performance Measurement and Management processes, reporting tools are required to ensure that the conclusions drawn after these processes are reported and communicated directly and effectively across all the organization. Definition Sheet is one of these tools and provides with a record of all the indicators satisfying and explaining to the personnel how these indicators are handled, how they work, and which is their significance. Other, with similar use, tools are the balanced scorecard and dashboard, the primary aim of which is to report the metrics after the completion of researching of performance measurements. Balance Scoreboard is one of the most commonly used PMS

models, as it incorporates detailed perspectives into the performance measurement. The Dashboard, in contrast to Balance Scoreboard, focuses more on short-term goals, as the Balance Scoreboard focuses more on long-term goals. Therefore, a dashboard may evaluate the organization's performance in real-time frame and are used by the management to achieve these goals. This tool is also very helpful when the management tries to visualize the data.

9.6 PERFORMANCE & KNOWLEDGE MANAGEMENT, BUSINESS INTELLIGENCE

Nowadays, there are many challenges for an organization to survive and grow up across a highly competitive market and among other organization or companies, which try to increase their profits, minimise their risks and enhance their market share. Consequently, the companies must have and develop a comparative advantage to be determined as the dominator of the market. As the organization emphasizes more on the significance of the human factor, the development and the required knowledge and skills, new tools have designed such as the concept of performance management (previously analysed), the business intelligence and the knowledge management. These tools are expected to be implemented more effectively in a modern business environment, where performance management is related with the implementation of the organization's strategy, business intelligence is related with the procedure of data gathering and their analysis and knowledge management is required for the management of competencies and information within the organization.
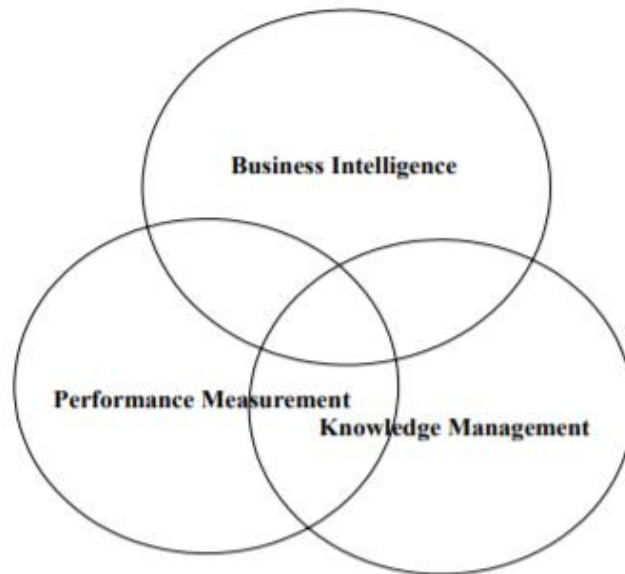
Figure 8: Business Intelligence, Performance Measurement & Knowledge Measurement
(Jussi Okkonen, 2018)

The above figure shows us how the three referred tools are related with each other, and how significant is the procedure of each tool for the implementation of the other procedure. Knowledge Management, in more details, is the process of managing knowledge in organizations and tries to maximize organisational performance by creating, sharing experience from external and internal sources. Furthermore, this system is required for the improvement of organization's efficiency by providing framework changes, new tools and techniques for capturing the intellectual assets. Knowledge management is not a tool that will solve all the problems regarding the communication of the problems, the information providing and the detection of the deficits of knowledge, which are noticed. However, the utilization of this system will help in ensuring higher performance and efficiency for the organization. The greatest benefit which is provided through the use of the knowledge management systems is that it does not face with the time waste, in contrast to other organizations that do not use this system. Business Intelligence is defined as one of the applications that are used for enabling the active and passive delivery of information, by turning received data to actionable intelligence, through converting specifically data, information and knowledge to valuable information, acknowledged as intelligence. Through BI tool, new knowledge is also gained about important matters and around the organization in order to provide more

information to decision-makers. Comparing performance measurement, knowledge management and business intelligence, it is noticed that there are many purposes for the use of each tool. In case that the organization operates for a short-term period, the rationale for using these tools is presented below:

Performance Measurement: The main rationale in this circumstance is the motivation, control and guidance quality management, personnel etc. In this case TMSA is used as a performance measurement system.

Knowledge Management: Effective knowledge is shared between the personnel and knowledge level is estimated, and if any enhancements – changes are required.

Business Intelligence: Better and well established information is provided within the organization.

If the organization operates for a long-term period, then the rationale for using these tools is presented below:

Performance Measurement: Implementation of the strategy and feedback is received for the formulation of the strategy. In this case TMSA is also used as a performance measurement system.

Knowledge Management: Employees' competencies are developed according to the implemented strategy.

Business Intelligence: Gaining knowledge about important matters and around the organization that make emergent strategies invalid.

All of the three tools are used simultaneously within an organization, unnecessary, as well as, overlapping activities are eliminated and the tool tries to leverage the each of the three tools' contribution to the total performance. Effective knowledge management requires continuous performance measurement. Measurements are mostly required for the continuous improvement set by the organization and make the required knowledge more apparent for all the personnel related with it. Performance Measurement and Knowledge Management are internal processes and components of each process are dependent to each other. The connection between measurement and business intelligence should be identified by comparing an organization to other organization, as performance management is used for

generating data for the BI system. This process is defined as benchmarking procedure. Performance measurement should not be conducted if comparison of performance with the performance of other organizations is not undertaken. When BI tool is used effectively, it generates a wide database, while processing in BI is also required to convert data from information into intelligence. BI presents a future perspective which is used for gaining the comparative advantage against the other competitors. Performance Measurement and BI are connected with each other, as well as important information on the knowledge is mediated to the business intelligence process within an organization. Secondly, Knowledge Management is used to manage the competencies. BI is connected to knowledge management, as well as information is derived through the BI process into personnel's knowledge. Thirdly, it should be referred that performance measurement is firstly used for strategy implementation, while there is a focus on critical success factors and performance drivers. Measurement is very important due to the evaluation of sufficient levels. Furthermore, it is used for strategy formulations at the same time with business intelligence.

10. TMSA IMPLEMENTATION IN SHIPPING INDUSTRY

10.1 METHODOLOGY OF THE SURVEY

In an attempt, to understand how TMSA works in a real time basis across Shipping Industry, we conducted a survey using real data and answers through a survey undertaken with executives from the industry, through filling out a short-time questionnaire. In this section of our survey, we tried to be aware of which TMSA element is considered more difficult to be adapted, how the companies achieved to incorporate the changes from the previous editions of TMSA to the current edition, which element is measured with the lower ratio and which element is measured with the higher ratio most of the times. Furthermore, in our survey the participants had the opportunity to answer 10 questions regarding the elements of the TMSA, the difficulties they face, how sufficient is the education and development the personnel receive, and which is the element which is considered the most significant for a shipping company. Participants filled out the questionnaire with all the included questions, filling out and their current job position, in order to draw the appropriate conclusions according to the participants' job specification,

knowledge and expertise in the industry. The survey took place for 20 days, from 18.11.2021 to 08.12.2021, and 21 participants filled out our questionnaire. Some of the questions gave the option to the participants to select one of the TMSA elements for their answer and other questions gave the option to select an answer from a grade 1 – 5. After the completion of the survey, all the data were gathered and the conclusions were presented, comments added for the outcome of the survey and conclusions were drawn for the implementation of TMSA. The ten questions which included in the survey were the below:

1. Which TMSA element is considered the most difficult to be implemented in a shipping company?

2. Which TMSA element is considered the most significant for a shipping company?

3. How difficult is for a shipping company to implement TMSA efficiently?

4. Is there any increase in company's operating costs from the implementation of TMSA?

5. Have you received the appropriate training, empowerment of your skills according to TMSA criteria?

6. Do you consider that the results of TMSA have an impact to the charterer's decisions and/or the shipping market in general?

7. Are changes and the new edition of TMSA 3 sufficient for the estimation of the shipping company's risk?

8. Which TMSA element is considered the most significant from the aspect of external stakeholders (like charterers, flag state authorities, investors etc.)?

9. How efficiently the onshore personnel adapt and implement the TMSA elements?

10. How efficiently the vessel's personnel adapt and implement the TMSA elements?

10.2 THE OUTCOME OF THE SURVEY

After the completion of the survey and the submission of the answers by all the participants, we gathered the data and tried to analyze them. Firstly, we tried to ensure that the majority of the participants have a working experience or are currently working in shipping industry. Students with undergraduate or post-graduate students were also welcomed to fill out the questionnaire. From the 21 participants, 17 participants were related with shipping industry (81 %) and 4 participants were not (19 %), as the below figure shows:

Do you work or have a relationship with Shipping Industry?
21 απαντήσεις
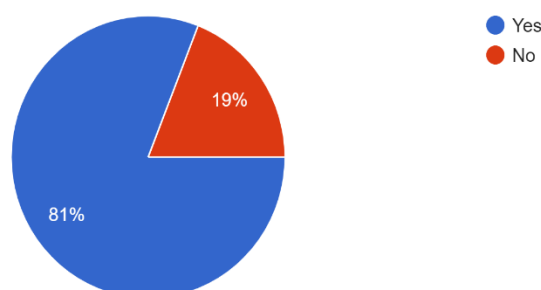
Figure 9: Distribution of survey participants, according to their professional background

Furthermore, we tried to locate the professional background from the participants in order to estimate in which departments the participants belong to, and which department was the predominant. From the below figure, it is concluded that the majority of the participants come from the operations and chartering department, including 6 participants overall, and the minority of participants come from the HSQE and Freight Collections Department.
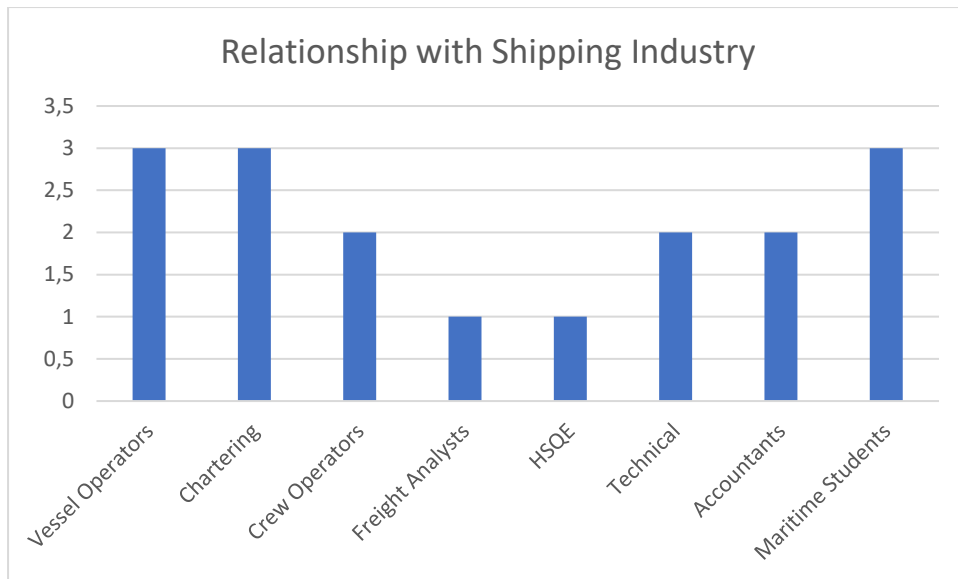
Figure 10: Relationship with Shipping Industry

Furthermore, it is also concluded that the majority of the participants, have worked in Shipping Industry for 3-6 years at a percentage of 52.9%. The percentage of participants with 0-2 working experience was 29.4%, while the percentage of participants with 7+ working experience was 17.6%. These details are included in the below figure:
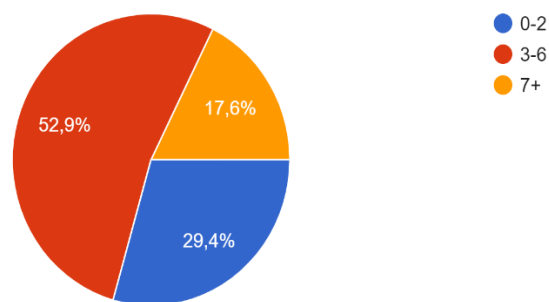
Figure 11: Years of professional experience

After the submission of the answers regarding the background and the general characteristics of the participants, they tried to answer 10 general questions related with TMSA. For the first question 'Which TMSA element is considered the most difficult to be implemented in a shipping company?', the majority of the

participants answered that element 3 is considered the most difficult to be implemented as is shown in the below figure:
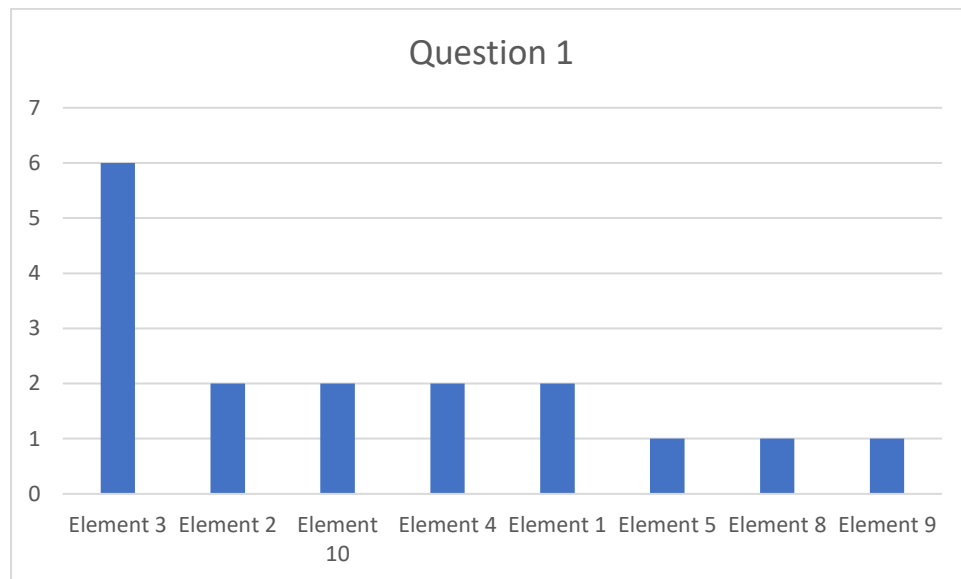
Figure 12: Which TMSA element is considered the most difficult to be implemented in a shipping company?

However, elements 5,8 & 9 were considered difficult to be implemented at a lower level than element 3. For question 2 'Which TMSA element is considered the most significant for a shipping company?', the majority of the participants selected the element 3 again for their answer, exactly the same as in question 1. They consider that this element, which is related with the recruitment and management of the vessel personnel, is both the most significant and the most difficult to be implemented for a shipping company. The figure below provides us with these details:
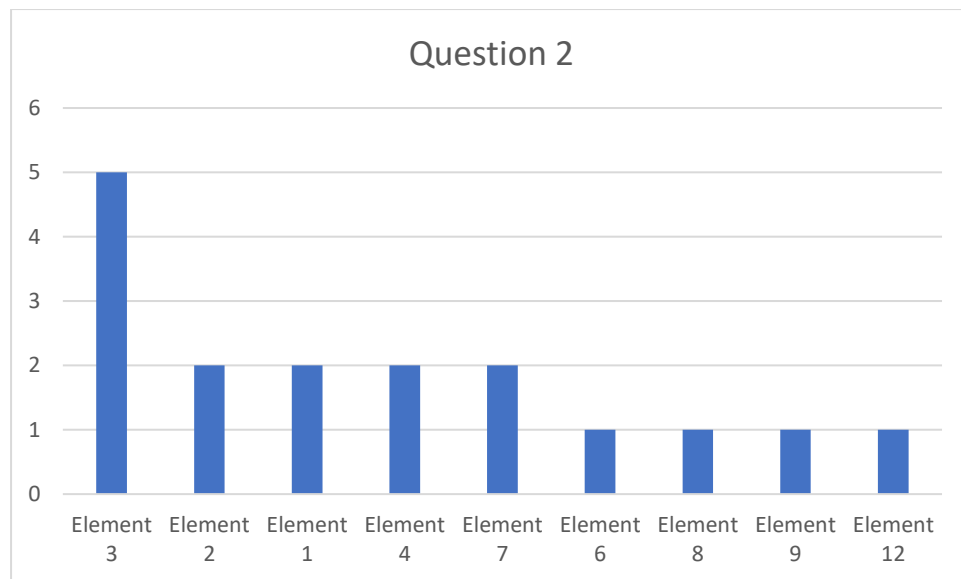
Figure 13: Which TMSA element is considered the most significant for a shipping company?

Details about question 3 are included in the below figure:

How difficult is for a shipping company to implement TMSA efficiently?
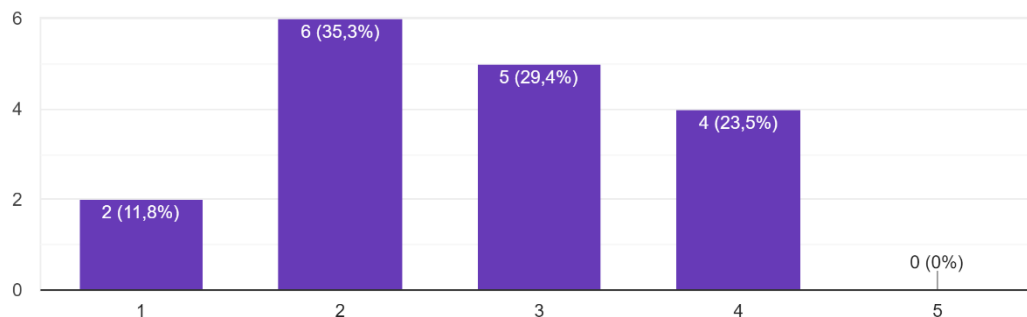17 απαντήσεις

Figure 14: How difficult is for a shipping company to implement TMSA efficiently?

We noticed that the majority of the participants believed that the implementation of whole the TMSA is not extremely difficult, and the shipping companies have the ability to incorporate TMSA to their management systems. Participants believed that TMSA is implemented in a moderate level of difficulty, as explained in the above diagram. The following figure shows the results for question 4 'Is there any increase in company's operating costs from the implementation of TMSA?':

Is there any increase in company's operating costs from the implementation of TMSA?
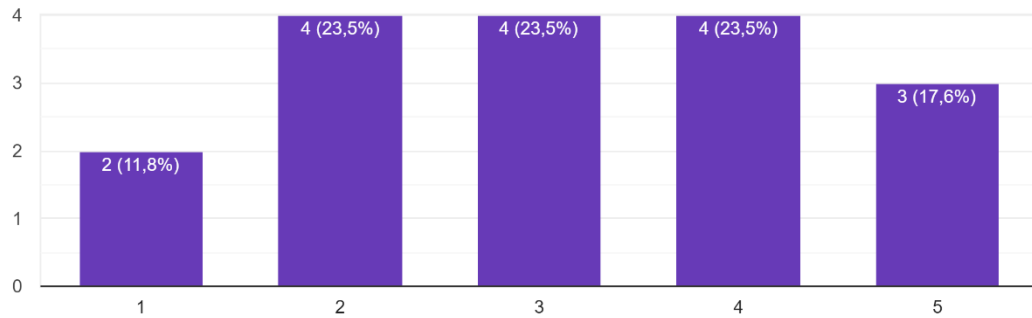
17 απαντήσεις

Figure 15: Is there any increase in company's operating costs from the implementation of TMSA?

Participants believe that there is an increase in operating costs from the implementation of TMSA. However, there is a range of answers for this issue. It is concluded that the participants do not consider the implementation of TMSA as a costless procedure for a shipping company. For question 5, there was a great range of answers from the grade 1 to grade 5. A clear conclusion should not be drawn, as some of the participants believe that the appropriate training and direction to implement TMSA were received, while other participants believe that the received training was not adequate enough to be prepared for the implementation. These details are shown in the below figure:

Have you received the appropriate training, empowerment of your skills according to TMSA criteria?
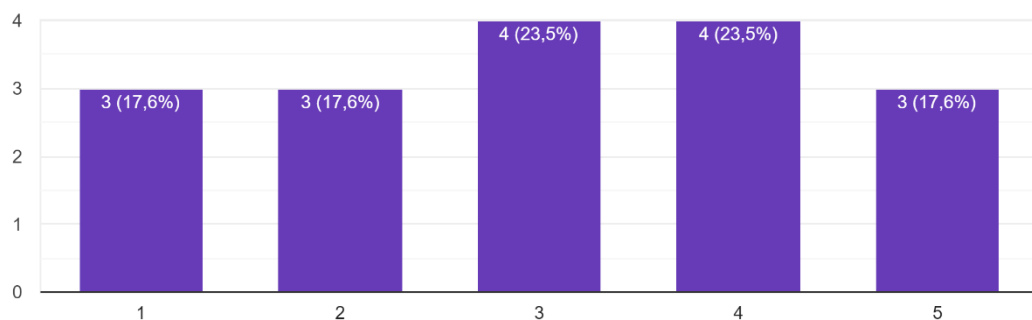
17 απαντήσεις

Figure 16: Have you received the appropriate training, empowerment of your skills according to TMSA criteria?

For question 6 'Do you consider that the results of TMSA have an impact to the charterer's decisions and/or the shipping market in general?', the extreme majority of the participants believe that the outcome of the TMSA is vital for the charterers and the shipping market. They believe at a percentage of 47.1% that all the stakeholders take into consideration the results of TMSA procedure, before they make a decision to enhance or not their relations with this company. The below figure shows these conclusions:

Do you consider that the results of TMSA have an impact to the charterer's decisions and/or the shipping market in general?
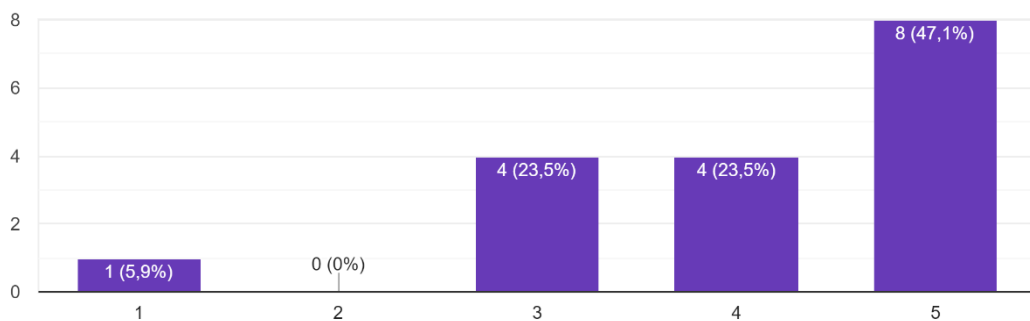
17 απαντήσεις

Figure 17: Do you consider that the results of TMSA have an impact to the charterer's decisions and/or the shipping market in general?

For question 7 'Are changes and the new edition of TMSA 3 sufficient for the estimation of the shipping company's risk?', the majority of the participants responded that the changes occurred due to the new edition of TMSA, are not sufficient for the estimation of the risk. The new edition is probably considered as a tool that is developed to the right direction for risk estimation, however most of the shipping industry's executives believe that additional measures must be taken for the effective estimation and risk hedging. Although the edition 3 of TMSA made changes, faced problems and covered gaps that were not covered by previous editions, there are probably more changes to be included in a future edition of TMSA that will be published. These conclusions are drawn from the below figure, where the majority of participants (47.1 %) believes that TMSA is not sufficient for the estimation of the risk.

Are changes and the new edition of TMSA 3 sufficient for the estimation of the shipping company's risk?
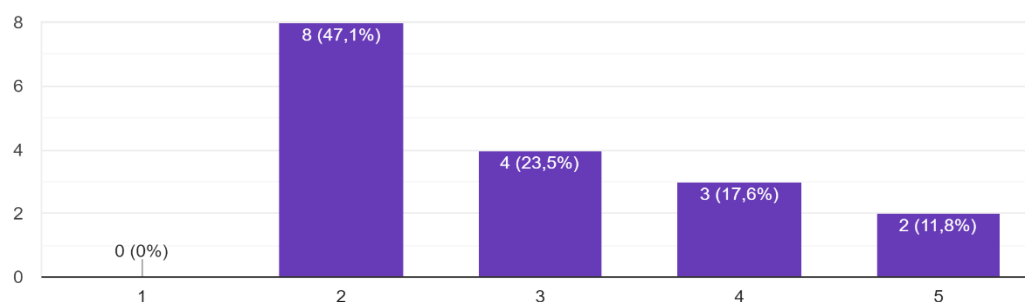
17 απαντήσεις

Figure 18: Are changes and the new edition of TMSA 3 sufficient for the estimation of the shipping company's risk?

With question 8 'Which TMSA element is considered the most significant from the aspect of external stakeholders?', we tried to identify which TMSA element is highly important for external stakeholders, like charterers, local authorities, investors, bunker traders, society etc. We received a range of answers for this question, the same as both in questions 1 & 2, for which there is also a range of answers from the participants. Most of the participants consider that element 10, which is related with environmental and energy management, is highly significant especially for the society and the local authorities. In a period that the decarbonization of vessels' bunkers and the use of alternative, more eco-friendly bunkers, is an issue of high importance for the shipping companies, the establishment of a highly motivated social profile, through the adoption and implementation of all the necessary environmental changes, is vital for a shipping company. Consequently, for this reason the majority of the participants may consider too significant the element 11 from the aspect of external stakeholders, as depicted in the below figure. Furthermore, participants believe that after the element 11, the element 6 is significant too, which is related with the daily vessel's operations.
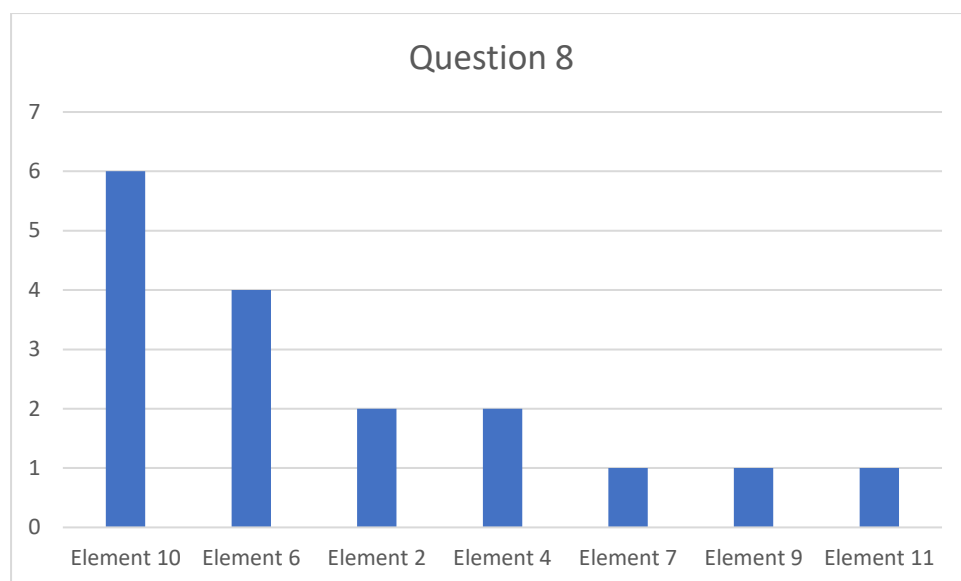
Figure 19: Which TMSA element is considered the most significant from the aspect of external stakeholders?

Finally, with questions 9 & 10 we tried to estimate how efficiently TMSA elements are implemented from onshore and vessel's personnel. We noticed from the answers, that the participants consider the onshore personnel more prepared, educated, and efficient at implementation of TMSA than the vessel's personnel. This conclusion is drawn probably from the fact that there is a gap between the knowledge and training that onshore personnel receive, and knowledge and training that vessel's personnel receive. Moreover, vessel's personnel may have lack of experience or appropriate knowledge for the implementation of TMSA. The above trends in participants' opinion are explained by the below figures, where more of the 58.8% of the participants believe that the onshore personnel implement effectively TMSA and more of the 40% of the participants believe that the vessel's personnel do not implement effectively TMSA:

How efficiently the onshore personnel adapt and implement the TMSA elements?
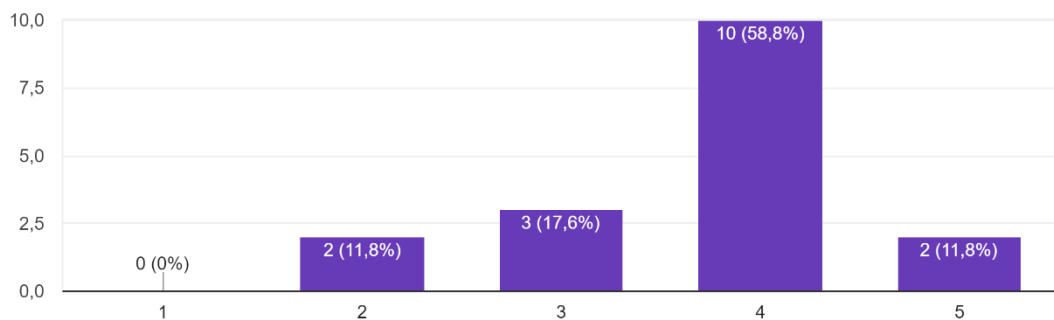17 απαντήσεις

Figure 20: How efficiently the onshore personnel adapt and implement the TMSA elements?

How efficiently the vessel's personnel adapt and implement the TMSA elements?
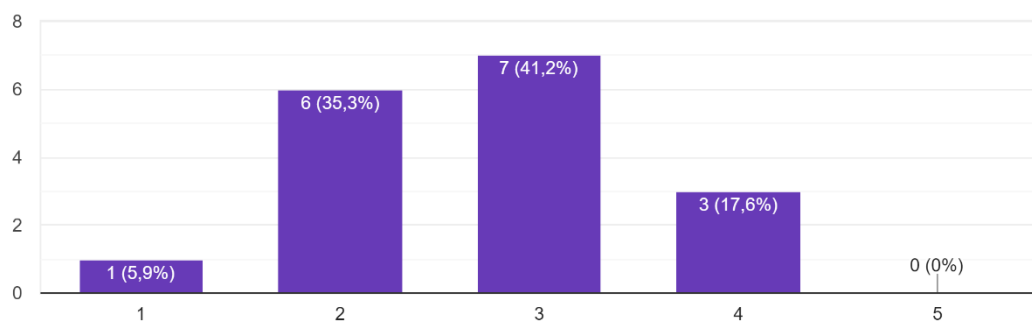17 απαντήσεις

Figure 21: How efficiently the vessel's personnel adapt and implement the TMSA elements?

10.3 CALCULATION OF TMSA

TMSA elements are consisted of 266 KPIs (according to the third edition published on 2017). However, some of these KPIs can be calculated through specific formulas, as they considered as arithmetic values. There are many KPIs which are not considered as arithmetic values and therefore, cannot be estimated through arithmetic formulas. Element 1.2.1 is an example of these KPIs, which defines the level of HSSE excellence and the level that is satisfied is not evaluated through a formula. This KPI is a dummy variable and estimation of the level will be completed through analysis, comments, and conclusions. The Best Practice

Guidance is also used and contributes to the estimation of the level that these KPIs (like the element 1.2.1) are satisfied. For arithmetic KPIs, a Value variable is estimated. For example, element 2.3.2 determines the number of shore-based personnel that is required for the effective implementation of SMS. This number is affected by several factors like, the change in the size of the fleet, changes in the legislation, introduction of new shipping designs etc. Another example is element 4.3.3, which evaluates the fleet reliability through performance indicators measurement. We may define as a performance indicator the number of failures of critical equipment, which is symbolized with *KPI Value*. KPIs takes a value from range between 0 and 100. KPI Rating is calculated according to the below formula:

$$\text{KPI Rating} = 100 \times \frac{\text{KPI Value} - \text{KPI MinReq}}{\text{KPI Target} - \text{KPI MinReq}}$$

KPI MinReq is the value that should be the lowest value between the range of 0-100. Therefore, KPI MinReq is equal to 1. However, KPI Target should be estimated with the maximum value from the range of $0 - 100$ and its value is equal to 0. Further to the above assumptions, if we assume that the KPI Value is equal to 1 then KPI Rating should be equal to 0 or 0%:

$$\text{KPI Rating} = 100 \times \frac{1 - 1}{0 - 1} = 0$$

Another example for the measurement of TMSA may be considered the element 1.3.1, which is referred to the establishment of targets related to HSSE performance. In this element KPI Value may be considered the number of personnel injuries, the number of pollution incidents etc. KPI MinReq is equal to 1 and KPI Target is set equal to 0. Further to the above assumptions, if we assume that the KPI Value is equal to 1 then KPI Rating should be equal to 0 or 0%:

$$\text{KPI Rating} = 100 \times \frac{1 - 1}{0 - 1} = 0$$

In many TMSA elements the idea of retention ratio is referred and used for the measurement of KPIs. Some examples are the elements 2.2.2, 2.3.3, 3A.2.A & 3A.3.4., where the retention rate is used. This rate is defined as below:

$$\text{Retention Rate} = 100 - \frac{\{S - (UT + BT)\}}{AE} \times 100$$

Variable S is equal to the number of employees that have terminated their cooperation with the shipping company, variable UT is equal to personnel's retirements or termination of employment due to long term sickness. BT is equal to the less efficient employees who decided to leave the company and AE is the average number of employees working for the company, calculated for a period of 12 months.

$$\frac{\{S - (UT + BT)\}}{AE} \times 100$$

CONCLUSIONS

TMSA is the main tool used by shipping companies to determine the level of risk and one of the most predominant methods to identify the problems and suggest solutions and corrective measures. It is a tool which is related with the implementation of Safety Management Systems and tries to help the shipping companies to improve the implementation of SMS. The improvement of the effectiveness is accomplished through Continual Improvement procedure and Plan, Act, Measure, Improve steps, and the efficiency is practically measured with KPIs. The frequent update of TMSA elements allow the shipping companies to be up to date with the new risks and challenges that arise. One also conclusion which has been drawn, is that the majority of the failures and cases of risks are provoked by the human activity and the errors. Shipping companies are aware of this fact, consequently they try to develop and implement methods to decrease the risk to the lowest level. Some examples of these methods are Task Analysis, Human Error Analysis, Stop Work Authority and Behavioral Competency Systems. The role of these methods is crucial for minimizing the effects of human errors. Despite the identification of the human errors, the development of performance measurement and management systems is also required. This chain including these procedures is an appropriate element for successful implementation of TMSA. In some cases, there are deviations between the ideas, the methods and how many professionals work, not only in shipping industry, but also in different areas of economy. In order to minimize this gap, we tried to record the opinion of shipping professional regarding TMSA. It should be referred that in some aspects of TMSA there is a range of opinions, although in other aspects there is the same trend in how professionals consider many aspects of TMSA.

All external inspections such as TMSA, Vetting, Port State Control and Class surveys are all equally important, but each kind of inspection must be conducted separately and never in combination with each other. As has been mentioned before a maritime accident has an impact on economic, political, personal, environmental level. For this reason, full attention should be given to every inspection.

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