

ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ



DEPARTMENT OF MARITIME STUDIES

MSc COURSE IN SHIPPING MANAGEMENT

**IMPLEMENTATION OF A SHIP
MANAGEMENT COMPANY'S QUALITY
CONTROL THROUGH KPIs**

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Abstract

Quality control is determining factor of all shipping companies' survival. Through quality control companies have the ability to control, evaluate and prevent the proper operation and consolidation of the products and services that they produce. The following study analyzes the way in which shipping companies can utilize the services which they provide through the ships at their disposal, with respect to the competitors and environment. The following procedures and studies which are based on data concerning all departments of the company and are mentioned on both theoretical and practical level. Through this analysis, the company comes to specific conclusions about the effectiveness of the tactics it uses. Then, taking into account all the necessary parameters, it concludes to the creation of a new customized plan and regulations in order to achieve the maximum possible result.

Περίληψη

Όπως κάθε επιχείρηση, έτσι και οι ναυτιλιακές εταιρίες βασίζουν την επιβίωσή τους κατά κύριο λόγο στον ποιοτικό έλεγχο. Μέσω του ποιοτικού ελέγχου οι εταιρίες έχουν την ικανότητα να ελέγχουν, να αξιολογούν καθώς και να προλαμβάνουν τη σωστή λειτουργία και την εδραίωση των προϊόντων και των υπηρεσιών που παράγουν. Στη μελέτη που ακολουθεί, αναλύεται ο τρόπος κατά τον οποίο οι ναυτιλιακές εταιρίες μπορούν να αξιοποιήσουν σωστά τις υπηρεσίες που παρέχουν μέσω των πλοίων που έχουν στη διάθεσή τους, με σεβασμό στους ανταγωνιστές και το περιβάλλον, ακολουθούν διαδικασίες και μελέτες βασισμένες σε δεδομένα που αφορούν όλα τα τμήματα της εταιρείας και βασίζονται τόσο σε θεωρητικό όσο και σε πρακτικό επίπεδο. Μέσω της ανάλυσης αυτής, οι εταιρία καταλήγει σε συγκεκριμένα συμπεράσματα για την αποδοτικότητα των τακτικών που χρησιμοποιεί. Στη συνέχεια, λαμβάνοντας υπόψη όλες τις απαραίτητες παραμέτρους, προχωρά στη δημιουργία νέου προσαρμοσμένου πλάνου και κανονισμών ώστε να επιτύχει το μέγιστο δυνατό αποτέλεσμα.

Chapter 1. Introduction

Introduction

Like any business, shipping industries rely heavily on quality control to succeed. Companies can manage, evaluate, and prevent proper operation and consolidation of the goods and services they generate through quality control. The following study how shipping companies can effectively use the services they offer through the vessels at their disposal, with respect to competitors and the environment, by using procedures and studies that are based on data, relating to all company parts and are based on both a theoretical and practical level. This study allows the business to reach new and vital points concerning the effectiveness of the strategies it adopts. In the first stage, it very important for the company to develop a quality control system, according to which will manage its ships in the most efficient way within a functional and financial sector. An efficient quality control system related to the proper distribution of responsibilities throughout the departments of the company. Each department should base the day-to-day task, as well as any undertaken projects, on data and act in accordance with the plan set by the company.

Great importance should be given to operation function of each company's department for compliance with international shipping rules and regulations. Every procedure that an organization decides to be implemented has to be based on a basic operational concept, which is the Quality assurance. Quality Assurance is a process in which a wide range of information is collected, monitored and classified in order to prevent problems and reduce the likelihood of any problems. The most common quality assurance system followed by shipping companies and many other companies in different industries is the ISO system. Most companies use it in order to improve their outputs and offer maximum customer satisfaction. This way the company can create an organizational chart. More specifically, such a pattern will make clear the separation of departments and the relevant responsibilities which will be more understandable by all employees. In addition, all operations will be more specific through this separation as this system includes specific procedures which is formulated and followed by the relevant forms that every department will have to follow in order to reach the possible results.

Shipping companies rely on their compliance with regulations to accommodate shipping interests as well as environmental protection. In addition, due to the frequent inspections by the flag, class and local authorities, shipping companies will have to establish a formula by which they can check and confirm that all necessary measures are implemented for the ship to com-

ply with the relevant regulations. BIMCO has created a guide according to which it suggests indicators. These indicators are specific and each company has the possibility to adjust them according to its own standards. The indicators are used for data collection and classification that are available in a shipping company. The company can determine a specific score through the collection of qualitative data. This procedure is very important for the company to evaluate the quality control in various aspects of the ship's management and to set targets for improvement. More specifically, the company can formulate a system of KPIs (Key Performance Indicators) to satisfy quality control needs. This way every company can measure, analyze and evaluate the efficiency of both the shore-based and shipboard in day-to-day operations. Each company has the ability to determine its own KPIs according to its object as well as the points that it considers to be most vulnerable. Every weakness could be recognized by using KPI system and all necessary actions can be easily taken.

In this dissertation, a KPI system is used in order to evaluate the quality control of a Shipping company. The collection of data summary is specific and includes vital information for company's operation. In addition, a case study that follows present the data for the practical approach and research of the case study that have been collected from the yearly sum of information of a shipping company's managed vessel. In this scenario the company has a fleet of five bulk carrier and general cargo vessels trading worldwide. The analysis will be done for one of the five ships of the company and the data that will be used are true and are collected through departments of the company. The company of case study in this thesis has been based on the standards of BIMCO and the analysis and procedures which will be carried out will be based same to BIMCO's standards. In first stage the dissertation will present a theoretical level of KPI and then, for a better understanding, at a practical level using an excel spreadsheet for calculations and results. The calculation module has been developed for the needs of the specific case study and is tailor made for this vessel and company which is under quality control. Therefore, based on the mentioned standards, KPIs that will be analyzed and evaluated are the main aspects of shipping management i.e., Operational, Technical, Environmental, Security, Port State Control, Navigational, Health and Safety etc.

Each of the main areas will be analyzed are broken down to key indicators which cover the majority of operations and will be managed tasks for shore-based personnel and the seafarers alike.

The purpose of the dissertation is to highlight how crucial is the role of quality control for the proper management for both company and vessels. Furthermore, the scope of thesis is to provide a way of practically implementing such analysis. Also, the issue focuses on the control

system that should be applied by the shipping companies based on the standards of BIMCO in order to create a formula that will calculate and analyze the degree of effectiveness of the company in the areas it has defined. Furthermore, the crucial part of the dissertation is to present any difficulties that possible a Shipping company will deal with and to result into any useful solution through the KPI standards.

In order to understand the above information, the diploma is divided into separate sections. More specifically, the second chapter includes the definition of quality, and analyzes what quality control is and why its role is so important in each type of company. More specifically, this chapter includes the definition of quality as well as the parameters of which it consists. For good understanding in this chapter the establishment of product or services in the market and the consumer's requirements will be discussed. Also, an important factor is the relationship between quality and price. The high quality of a product or service could be identified only when its efficiency meets the financial requirement of the manufacturer.

Through Company's decision – making process, all responsible departments are able to use the quality control system so to analyze related data and determine the most efficient choice concluding to the most high-quality service or product. In light of the above method, this procedure leads to goal-oriented and emphasize preventive measures, while taking into consideration historical inconsistencies, so they can remedy them and take proactive steps. During this chapter, we examine the fundamental theories and concepts of quality control in order to provide a framework upon which to implement the following analyses.

In the third chapter we present the specific principals of the quality control in shipping as per BIMCO standards. Moreover, the orientation of KPI's system is determine throughout quality data research while PI's collection plays fundamental role on KPI's system development.

Concerning the case study, turn to chapter four which starts with data collecting and moves on to performance indicator analysis, debriefing upon the final results, and drawing up a plan for corrective measures. The practical chapter also includes an excel file for data collecting, calculations, and results.

The research is analyzed in detail in the last chapter, along with its implications for future planning. To increase performance in each particular sector, the activities based on sub-standard results and the corrective action plan are revised and redesigned.

Chapter 2. Quality and Quality Control

2.1 Introduction

One of the most crucial aspects for the sustainable and prosperous operation of a business is the quality assurance of the goods and services that it provides to customers. A business must keep track of market trends and consumer needs in order to monitor and modify the products/services it produces. This can be performed through a complex system of interactions and functions amongst the various components that create the ability to give the desired outcome in the finished output. The high-level task of quality control is one of these tools. More specifically, a business consists of many departments such as research, advertising, etc., which are necessary to find and properly promote their products and services. There should be a strategy for the product's durability and defectiveness once it is ready to be delivered to the client. In order to retain its reputation for trustworthiness, the business should ensure that the products run without a hitch at least for the duration of the client's warranty.

2.2 Quality

There are various approaches to defining quality. Usually, the notion of quality refers to a product or service that has been created to go above and beyond what its customers expected. The level of demand for each type of good or service dictates how well that demand is shaped, and vice versa. When a product or service is in high demand, it usually signifies that the clients are satisfied and the quality is superior. There are more elements to help determine when a product or service seems to be of high quality.

Good quality depends on the following parameters:

- Meet the requirements of the consumer

- Cost and consequently on its selling price

- Delivery time

Meet the requirements of the consumer:

The final product or service should be performed in accordance with the customer's philosophy. It is important, the customer to be able meeting his needs with the product he chooses.

Cost and consequently on its selling price:

The cost of a product or service must be in accordance with its quality and design. The manufacturer's reputation and reliability will be deteriorated, if the product's quality falls far short of what was originally promised.

Delivery time:

The delivery time is determined at the time of purchase. Delivery schedule is a crucial aspect of the business. The business must satisfy its obligation to the consumer by delivering the order on the planned day and in the condition, it was promised.

2.3 Quality control:

Further to the above, the products' or services' quality needs to be constantly monitored to ensure continual quality improvement.

A product or service's smooth functioning should be assigned not only to their initial stage but also to their long-term, in accordance with the predetermined period of time. Sustaining credibility is a company's largest investment while producing or providing services. In addition to the aforementioned, it should work as effectively as feasible over time and under particular circumstances in order to be reliable. A corporation uses the following function to determine the accuracy of its statistics base:

Credibility = Number of products in operation in a specific time

÷ Total number of controlled products

Further to the above, it is important to note that reliability depends on many factors. The following are the three of the most important factors:

· **Design:** It is one of the most significant elements that determine how dependable a good or service is. This is so since major decisions about the development, manufacture, and servicing of products and services that are undertaken during the design stage. More specifically, one important consideration in this process is the company's willingness to invest in its product to improve the credibility of its reputation.

- **Maintenance:** To increase reliability, a product or service must be properly maintained as per the manufacturer's recommendations at a specified time period of time.

- **Quality control:** The best quality of the supply of goods and, consequently, their trustworthiness, are determined by the performance of a functional quality control during the manufacture of a product or the provision of a service.

A company must take several critical actions in order to raise the quality and reliability of a product.

The fundamental actions that a business must take to enhance its reputation and development are listed in the following table:

Actions	Description
Performance	the ability of a product or service to meet the needs for which it was created
Features	the special features that make it unique
Conformance	compliance with the specifications of its creation
Reliability	Operation that meets the manufacturer's specifications
Durability	satisfactory service life that meets the manufacturer's specifications
Serviceability	Immediate provision of services for the repair or replacement of the product
Aesthetics	the external appearance of the product to be liked by consumers
Reputation	the company's reputation for the quality of the specific product / service

Table 1: Actions that an organization has to follow in order to maintain the quality of products

It is important to note that the implementation of a quality control system is different for each product / service. Nevertheless, the general characteristics of all quality control systems are the same and are applied according to the following steps:

1. specification of the product
2. selection of the appropriate equipment according to the requirements of the product
3. production of the product according to the specifications

4. product inspection to avoid defects and damage
5. product improvement

A company is comprised of various departments that are in responsibility of identifying, improving, and creating the product or service in order to carry out the above procedures. The most important departments of a company that produces goods and services are as follows:



Figure 1:Departments of Organization

1. **The research department** depends on the international market and differs accordingly. Opportunities can be found and exploited through study. People who work in the research and development department should recognize when technology is changing, stay in constant communication with clients, and take immediate action to meet customers' expectations within a specified time frame.¹

2. The advertising department:

Every company has a unique structure that it bases on its corporate culture. Specifically, a company's culture is influenced by a number of variables, including perception, beliefs, and the reputation that every organization aspires to establish in the marketplace. The advertising department requires to

¹ https://books.google.gr/books?hl=el&lr=&id=vdR-cOvKOSEC&oi=fnd&pg=PR13&dq=market+research+department&ots=Fg_5DNOFzs&sig=tlo_c-nM685zXG12yh9r3MbZwz4&redir_

be adaptable and able to move straight into any change, due to the market's constant and rapid developments and changes as well as. The department's manager should have a few attributes in order to successfully meet the needs and goals of the employees. The management and employees should be able to predict developments given the erratic and unpredictable aspect of the advertising department. To adopt the strategy, the manager must be able to be focused on personal problems of the customers. The manager of this department should also possess qualities such as understanding, communication skills, and willingness to tackle new problems. It takes patience, effort, and understanding to properly analyze a marketing and advertising scenario. The advertiser should be involved and, in most cases, authorize the work, including methodology budget, regardless of the type of tests, surveys, evaluations, and comparisons that are conducted.²

3. Design department: must be both innovative and well-prepared.

A product or service should always be developed and implemented through the help of the design department. In order to establish the ideal conditions for the production and promotion of the good or service, the staff first gathers data on the requirements of the market and analyze all information. The design department is in charge of exploring multiple projects in order to come up with the most innovative scenario that will amaze the consumer and inspire any confidence. Once the final idea for both the product or service is implemented, the design department is no longer responsible for further processes.³

² <https://advertising-management-donald-jugenheimer-larry-kelley-fogarty-klein-monroe>

³ https://books.google.gr/books?hl=en&lr=&id=Hm5Tn1EjUWAC&oi=fnd&pg=PP2&dq=RESPONSIBILITIES+OF+A+DESIGN+DEPARTMENT+IN+A+COMPANY&ots=DdZYy8BS06&sig=d53yJZM6hl6LTUXBVy5XYtUowrQ&redir_esc=y#v=onepage&q=RESPONSIBILITIES%20OF%20A%20DESIGN%20DEPARTMENT%20IN%20A%20COMPANY&f=false

4. **The purchasing department** is responsible of discovering and supplying raw materials or other products. This division's objective is to find the highest products at the most affordable prices without jeopardizing the company's position or trustworthiness.⁴
5. **Production Department:** is in charge of transforming raw materials into finished products or services that could be given to the client. This division is responsible of both the reduction of manufacturing costs and production of commodities. The production department is a crucial pillar of a company since it investigates several strategies to select the strongest scenario and evaluates the potential at each stage. to effectively regulate the materials to prevent minor constructions. The department's main responsibility is to convert raw materials into a finished product that should be an exact copy of the original vision.⁵
6. **Service Department:** Customer service is responsible of the service department. More particular, the service department stays in touch with consumers to address any issues, such as showing them how to use a product properly or setting up a replacement if it is defective.

2.3.1 Quality control assurance system

Quality Assurance (QA) is a security system which is used to prevent any problems that may occur. The foundations of this whole process belong to the international standards. The purpose of this process is to ensure that there are not any significant differences between any

⁴ <https://smallbusiness.chron.com/functions-purchasing-department-organization-158.html>

⁵ **Production Management Kindle Edition by Introbooks (Author)
Format Kindle Edition)**

type of business for their effective operation and cooperation.¹ For instance, the German Institute for Standardization (DIN) was established in 1917 with the aim of supporting smoother global trade through its research and standards-setting efforts. These standards are designed to support the development of the front, but always with respect for the environment.²

2.3.1.1 ISO

One of the most widely well-known quality control systems is ISO. Most of businesses use this system to enhance their outputs and provide the highest level of client satisfaction. The company should create an organizational chart in which the division of departments and the related responsibilities are obvious, making the company's main vision understandable. Additionally, certain standards are defined, where a department must adhere to, in order to complete the necessary forms and achieve the best outcome. As a result of this process, the company is organized according to a particular operational pattern. Productivity increases and potential problems are examined, once special forms are used in all departments for each process.⁶

2.3.1.2 Example of Quality control assurance system

An illustration of how a shipping company's crew department functions under a quality assurance system is provided below.

Crew Performance Evaluation Process (ref. SMS Vol I GS-SP-07 "Crew Training & Evaluation")

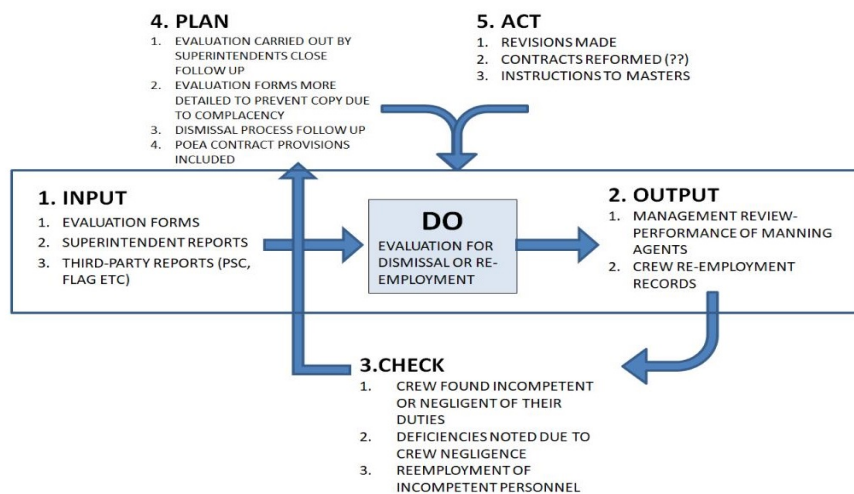


Figure 2: Crew Quality Performance System

⁶ <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100373.pdf>

The crew of the vessel has to fill up the relevant form in order to describe the situation on board. In the next step, the staff of the office should analyze and evaluate the mentioned forms, which should be forwarded to the management within a deadline, as the first and most fundamental step in the procedure.

Additionally, if the appropriate department determines that is necessary a superintendent does an inspection of the ship, he is required to fill out the relevant forms and record any issues that may arise with the crew or the ship. The department should investigate the situation and be able to identify what is triggering these issues. Frequently, the superintendent has to examine the ship once more in order to gather more proof. The department should implement a strategy with modifications that will be most advantageous for proper operation.

Chapter 3. Shipping KPIs

In the previous chapter, the quality and quality control of a good was analyzed, along with the methods to accomplish the right procedure as well. Key performance indicators (KPIs) are used by shipping, which is one of the most widely used quality control systems.⁷ Key performance indicators are a set of standards established by BIMCO to help the organization in recognizing and strengthening its weak points.

3.1 The BIMCO Standard



BIMCO is a large international shipping association in the world for the proper and efficient operation of shipping. BIMCO aims to ensure that company's operation is carried out properly and efficiently. In addition, the main point is to maintain healthy competition among the thousands of shipping firms operating globally. BIMCO is built through diverse of groups and members, stretching from huge ship-owning organizations with huge fleets to companies that even own ships. BIMCO's services came directly through a network of offices in worldwide markets. One of the BIMCO's major goals is to promote frequently updated standards and regulations for the prompt handling of situations and difficulties that may have a consequence on how the maritime industry operates.

More specifically, Complexity increases due to the huge amount of information and continuous technological development. In order to stay up-to-date BIMCO provides its own special contribution to the ongoing upkeep and development of the maritime sector, by using the following strategies:

- **Delivering Contracts, Clauses and Training:** The contract of BIMCO, which is the most common in the shipping industry, is made up of terms that are personalized to its members' requirements.

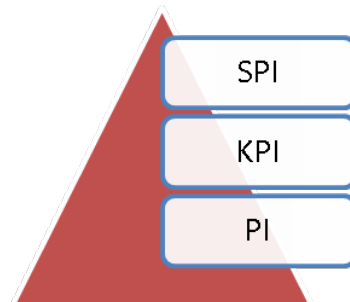
⁷ <https://www.shipping-kpi.org/about>

- **Shaping practical regulations, standardization and sharing knowledge:** BIMCO has a huge database with information that covers almost all shipping sectors, such as port information around the world and useful information for each cargo as well. BIMCO members have access to this database in order to minimize and prevent problems.
- **Expert Knowledge and Information:** BIMCO provides its members with a wealth of knowledge from qualified industry experts. In addition, BIMCO provides useful advice on various topics when necessary.⁸

3.2 Key Performance Indicator System

KPI is a performance indicator system that measures an organization's efficiency in respect to a static point decided by the business. KPI created a methodology that is available to shipping companies worldwide with the specific purpose of studying and evaluating the effectiveness of the company's operation of and its ships.⁹

The shipping KPI standard is based on a hierarchy which consists of three stages. The initial step is the gathering of relevant data (SPI), which could be useful to the company. The next step is determining the categories that each company will utilize to achieve the desired results. The last and most important step is the computation of KPIs using the gathered, as will be analyzed below.



⁸ <https://www.bimco.org/about-us-and-our-members>

⁹ <https://www.shipping-kpi.org/book/page?searchkey=introduction>

Figure 3:KPI Standards

- **Performance Indicators (PI):** It is the 3rd level of the hierarchy. PI is the principle of calculation of KPI based on data that already exists in shipping company. Each PI can be used to measure many KPIs, either for the same ship or a different one. More specifically, it corresponds to the collection of general data that is gathered in order to set up certain measurements and parameters for the control of each ship. Crew incidence and number of collisions is an instance of PI.
- **Key Performance Indicator (KPI):** is a metric that quantifies how well the company's established strategic methods have performed over the duration of a given period of time. KPI separates classification into two categories: absolute ranking and relative ranking. The company can distinguish the level of performance of its ships through the table of summary of results. This table the exact ranking as a return list that is sorted from greatest to lowest return price. The appropriate classification is made up of mathematical computations that give to percentage results and illustrate how well the ships performed in relation to predetermined standards. As mentioned above, it is a performance indicator that allows a business to assess its performance using its own criteria.
- **Shipping Performance Indexes (SPI):** KPI Groups is the official name according to the most recent changes. They are overall performance metrics that each cover a different field. For instance, a company may use the same PIs to analyze the Key performance indicators (KPI) for PSC and security performance, but the KPI results would be unique to each industry.

3.3 Shipping KPI Quick Sheet, Version 4.0

In order the companies to have a more precise approach to measure their success in various areas, BIMCO has established several criteria that are updated throughout time.

The Company's primary objective is to create a proactive approach to efficiency management enhancing the performance of vessels and voyage operation. The intention of complying with the regulations through controls and measurements resulting from particular procedures established by the Company's management.

In the following table is presented the main default areas as per BIMCO’s standards version 4.0, in which the KPI group is used in order to provide more information about the vessel’s performance:

1. Environmental Performance	5. Operational Performance
2. Health and Safety Performance	6. Security Performance
3. HR Management Performance	7. Technical Performance
4. Navigational Safety Performance	8. Port State Control Performance

Table 2:KPIs Group

In lights of the above of the above, the following analysis of BIMCO’s standards has a result the absolute understanding and utility of each KPI.

3.3.1 Environmental Performance:

Environmental Performance is a performance metric that evaluates a company's environmental awareness in order to use the outcomes of the evaluation to make decisions that will protect both human health and biosecurity of the ecosystem. It is a benchmark for measuring and monitoring performance and strives to implement specific measures that is going to be well known, through the collection and classification of data (PIs).¹⁰

The first Pi (PI053) is the “Number of releases of substances to the environment”. The mentioned PI, measures the number of substances that a vessel releases into the environment during its operation. Those data derive from the books on board, in which the ship is required to keep record of the fuel it uses and the substances it releases into the environment. The second PI (PI055) is the “Number of oil spills” and measures the total number of oil spills that the vessel releases into the environment. This information should be recorded in the oil records book, by the engine crew, and reported to the local authorities of each port. The result from the above two sums is the KPI (KPI028) “Releases of substances”.

¹⁰ <https://onlinelibrary.wiley.com/doi/10.1002/9781118445112.stat03789.pub2>

**Releases of substances (KPI028) = Number of releases of substances to the environment
(PI053) + Number of oil spills (PI055)**

"Ballast water management violations" is the next KPI (KPI001). When the ship is not loaded or whether the amount of cargo is insufficient to effectively stabilize the hull throughout the voyage, the ballast water system is used to stabilize the vessel. In the process of this process, the ship takes water from the ocean, which forces it to pump a multiplicity of microorganism species and microbial species into foreign territorial waters. This movement allows marine animals to evolve and change the smooth operation of the bio-system. The consequences of this procedure, is the increase of a number diseases of human and animals along with significant issues in the economic and ecological fields as well.

The International Convention was established with the goal of developing global rules for the movement of territorial waters as a result of the abovementioned consequences. Specific rules that apply to the management and pumping of ballast water are set out in the International Convention. In particular, older vessels have to redistribute ballast water over large distances from any coast, whilst younger vessels should be equipped with a high-tech ballast water management system.¹¹

The KPI (KPI001) expresses the percentage of performance of a company to comply with international convention. The degree of effectiveness depends on the number of cases in which the regulations have been violated (PI015).

The next KPI is the "Contained spills" (KPI007) and expresses the company's ability to apply the appropriate procedures in order to avoid any case of leakage that may be occurred on board. This KPI consists of only one PI which is the "Number of contained spills of liquid" (PI024). The mentioned PI presents the total number of leaks caused to the ship during a given quarter. The information in this PI was gathered using certain procedures that need to be documented in the company's security management system in order for it to conduct audits. The company only uses the ship's records to acquire data, which makes the task complicated. The company will consequently have to carefully investigate the ship's data.

Additionally, the KPI "Environmental Deficiencies" (KPI011) measures how well a business performs in terms of following environmental standards. Environmental deficiencies KPI is

¹¹ <https://www.imo.org/en/OurWork/Environment/Pages/BallastWaterManagement.aspx>

comprised of Pi "Number of environmental deficiencies" (PI027), which measures the number of the number of violations and non-compliance with respect to environmental protection. However, as third parties, including the vessel's flag, class, and local authorities, make observations, data collection should be done with prudence. The "Number of Recorded External Inspections" is the second Pi (PI052) which presents the sum of the inspections that the authorities have recorded, as previously noted, is the relevant Pi.

KPI is determined by the following relationship:

$$\textit{Environmental deficiencies (KPI011)} = \frac{\textit{Number of environmental deficiencies (PI027)}}{\textit{Number of recorded external inspections (PI052)}}$$

3.3.2 Health and Safety:

Health and Safety metrics evaluate how well a business performs in relation those two sections and the precautions it takes. This measurement's goal is to analyze and retain control over prevention strategies so that the business performs at its peak level. Due to the influence of safety and the quality of life of the crew is huge, health and safety is one of the most crucial KPI groups. Every company should use a well-organized safety management system that anticipates possible threats on board and defines the necessary safety measures. With continuous monitoring of equipment, the onboard operations and maintenance, the company will ensure the KPI's maximum performance.

The first KPI is the "Fire and explosions" (KPI013). Fires and explosions may occur on board as a result of incorrect handling and storage of hazardous materials on board or insufficient equipment maintenance. Crew awareness of emergency procedures is a significant contributing factor to the aforementioned effects.¹² The KPI (KPI013) calculated from the sum of two PIs. The first Pi is the "Number of fire incidents" (PI032) which includes the total number of fire incidents recorded on the ship due to repair. The size of the fire and its origin should be considered and recorded as information which will be analyzed. In this case, it is less essential to understand what triggered the specific accident. The second Pi is the "Number of explosion incidents" (PI028), which measures the total number of explosions in

¹² <https://safety4sea.com/the-main-causes-of-fire-and-explosions-on-vessels-in-ntsb-investigations-of-2019/>

the ship's equipment, such as parts of the engine and compressors. In this situation, the measurement is performed in the same method as in the previous case, with the explosion's consequence playing a larger role than its cause. As was already mentioned, only the result is significant in this situation; the cause is irrelevant. More particular, only a fire accident is documented when an explosion triggers a fire, and vice versa.

The above theory is analyzed by the following function:

$$\textit{Fire and explosions (KPI013)} = \textit{Number of fire incidents (PI032)} + \textit{Number of explosion incidents (PI028)}$$

The second KPI, "Lost time injury frequency" (KPI017), evaluates a company's potential to protect its crew against serious and possibly fatal injuries. The following function, which is the outcome of a plethora of data and Pi categories, estimates the total time lost due to crew injury per million hours of exposure.

$$\textit{Lost time injury frequency (KPI017)} = \frac{\textit{PI030} + \textit{PI037} + \textit{PI046} + \textit{PI047}}{\textit{PI063} * 10^{-6}}$$

The first PI is the "Number of fatalities due to work injuries" (PI030), which presents the total number of deaths caused to the ship due to an accident at work. The second PI is the "Number of lost workday cases" (PI037), it describes the total number of injuries that make the injured seaman unable to perform his duties not only on the following day but also the next day. The third Pi is the "Number of permanent partial disabilities" (PI046). This Pi records incidents involving injuries to crew members that resulted either in temporary or permanent disability to a particular bodily component. Any potential pre-existing hurt or disability in the affected area is not related to the accident damage and examination by a doctor. It is necessary in order to make the precise diagnosis and confirm the degree of disability. The seafarer is compensated in the event that the accident causes a partial or total disability that prevents him from working or carrying out his obligations.

KPI "Number of permanent total disabilities (PTD)" (PI047), presents the case of permanent total disability of seaman. The mentioned case results in the inability of the seafarer to work

again either at sea or on land. Cases of permanent total disability can be the loss of vision or some limb or even some cerebral palsy. The last Pi which is included in this KPI is the “Total exposure hours” (PI063). This Pi expresses the relation of the total number of the crew on a particular vessel for a specific period of time. More specifically, in order the data to be corrected, the total number of seamen on board should be multiplied by the total number of hours in a default quarter.

The next KPI is the “Health and Safety deficiencies” (KPI015) which presents the percentage of health and safety performance that a company provides to its vessels. Data from two categories of pi should be collected in order this KPI to be created. The first KPI is the “Number of health and safety related deficiencies” (PI034) which includes the number of deficiencies recorded on a particular ship in a predetermined quarter. Specifically, this report presents the deficiencies and non-compliance under the specific conditions and procedures, concerning the health and safety of the crew. The mentioned analyses, it should mandatory to be recorded by external audits. In the second category of Pi, which is the “Number of recorded external inspections” (PI052), provides the number of external inspections by the authorities of each port, the flag as and other third parties are recorded as well. The above inspections were carried out in order to monitor and improve the crew's health and safety-related circumstances. According to the above the percentage of performance of the KPI “Health and Safety deficiencies” results from the below relation:

$$\text{Health and Safety deficiencies (KPI015)} = \frac{\text{Number of health and safety related deficiencies (PI034)}}{\text{Number of recorded external inspections” (PI052)}}$$

In this sector one more KPI is included, which is the “Lost Time Sickness Frequency” (KPI018). This KPI expresses the company's ability to implement appropriate measures to prevent accidents and deaths on board through the following PIs. The first PI is the “Number of cases where a crew member is sick for more than 24 hours” (PI019), which presents the cases where seafarers are ill and unable to carry out their duties for more than one day, provided that they are on board for more than four days. The next PI is the “Number of fatalities due to sickness” (PI031), which includes the number of recorded deaths due to illness of a crew member. In cases of death from disease, the possibility of suicide is included. The last PI is the “Total exposure hours” (PI063). This PI expresses the relation of the total number of the crew on a specific ship for a specific period of time. More specifically, in order the data to be corrected, the total number of seamen on board must be multiplied by the total

number of hours in a default quarter as also mentioned in a previous PI. In order to conclude in the percentage result of this KPI have to be used the following relation:

$$\text{Lost Time Sickness Frequency" (KPI018)} = \frac{\text{PI019} + \text{PI031}}{\text{PI063} * 10^{-6}}$$

One additional KPI is the “Passenger injury ratio” (KPI025). This index is used only by companies that own ships that serve passengers. It refers to the passengers who are likely to have been injured during the arrival on the ship, during the voyage as well as at their departure, in relation to the length of time where the passengers are on the specific ship. This comparison does not have to be made only between ships of the same size and capacity. More specifically, this indicator expresses the ability of the company to prevent any injury to passengers, without including in this measurement vessel’s crew and their relatives. In addition, it is important to note that the indicator does not focus on the severity of the injury but only on the fact. In order to generate this index, data from two pi are used. The first Pi is the “Number of passengers injured” (PI045). A passenger is defined as the person who has paid the price for obtaining the ticket and is officially registered in the list of passengers. The data which are used for the use of this pi are mainly based on the list of passengers as well as the incidents of injuries that have been officially recorded. Another category that is included in this pi is the case that an accident is so serious that it can cause the death of the passenger. The second Pi is the “Passenger exposure hours” (PI061). This PI refers to the total length of time a passenger has remained on the ship, from the time of arrival until the time of departure of the passenger, in a predetermined quarter. To calculate the exposure of each passenger, the exact hours where the passenger remained on the ship must be counted and multiplied by the number of hours per day. The two above pi create the kpi “Passenger injury ratio” with the following relation:

$$\text{Passenger injury ratio (KPI025)} = \frac{\text{Number of passengers injured (PI045)}}{\text{Passenger exposure hours (PI061)} * 10^{-6}}$$

The penultimate kpi of this category is the “Total Recordable Case Frequency” (KPI034), which measures the company's percentage of performance for injury prevention as well as the time it can waste due to those injuries. It also measures the degree of efficiency for prevention activities carried out to prevent deaths due to an accident at work and aims to maximize

medical care. The method of finding this Kpi is similar to what was recorded for the finding of “Lost time injury frequency” (KPI017) through the below relation:

$$\textit{Total Recordable Case Frequency} \textit{ (KPI034)} = \underline{\textit{PI030} + \textit{PI037} + \textit{PI046} + \textit{PI047}}$$

$$\textit{PI063} * 10^{-6}$$

The last KPI in sector Health and Safety is the “Total Recordable Case Frequency including First Aid Cases” . This KPI describes all the incidents related to accidents at work, the deaths resulting from accidents at work, as well as the working time lost due to these accidents as mentioned in previous PIs of this category as are Number of lost workday cases, Number of fatalities due to work injuries, Number of permanent partial disabilities, Number of permanent total disabilities (PTD) and Total exposure hours. Furthermore, this category consists of two more in order to collect more and more specific data. The PI “Medical Treatment Cases” (PI066). This includes all cases of injury to a crew member who received immediate assistance and medical care either on board or on shore. The next PI is “First Aid Cases” (PI067) and presents the total number of cases where a crew member received at least one first aid after an injury. In order to measure the performance of the company in relation of the KPI “Total Recordable Case Frequency including First Aid Cases” is the following relation:

$$\textit{KPI035} = \underline{\textit{PI030} + \textit{PI037} + \textit{PI046} + \textit{PI047} + \textit{PI066} + \textit{PI067}}$$

$$\textit{PI063} * 10^{-6}$$

3.3.3. HR Management:

It is a department that is particularly significant to a company's organizational structure, especially for shipping companies. This department is in charge of investigating into the crew to make sure that they are qualified and able to perform the duties that have been allocated to them aboard the vessel. Additionally, this department is in charge of overseeing the crew's necessary training and validating their credentials as well.

The first KPI of this sector is the “Crew disciplinary frequency” (KPI008), which describes the total of the violations committed by the crew and relate to the company's regulations. The action of the company to deal with these violations is also recorded. To evaluate the situation

more properly, the total number of hours lost as a result of the violations committed is considered. This category includes six PIs, in order to describe the procedures and optimize its operation. In this KPI belongs the PI “Number of absconded crew” (PI013). All seamen are obliged to refer to their chief and ask for his approval in case they wish to go to a port for a few hours. This is the total number of seafarers who depart the vessel without the ship's master being notified or given permission for them to leave. Another PI is the “Number of charges of criminal offences” (PI020). In this instance, incidences in which one of the crew members is accused of participating in behavior that is against the law have been recorded. The PI number is unaffected if this category is retired. The next PI is the” Number of cases where drugs or alcohol is abused” (PI021), which shows the crew members who use alcohol and drugs aboard in violation of the company's and the local authorities' current policies. The purpose of this PI is the recorded report of seafarers who are affected by the use of prohibited substances in their seafaring. Furthermore, the PI “Number of dismissals”, records cases where one of the crew members violated a predetermined regulation of the company and this violation results in the expiration of his contract and his immediate the prompt repatriation before the expiration of a certain period of time. In addition, the PI “Number of logged warnings” (PI036), refers to observations a superior has made in writing or verbally against to a crew member. This reprimand must be substantiated and can be explained by specific incidents. If the seafarer chooses to ignore observations, his contract automatically expires and is recorded with the company authorities as being non-rehireable. In order to calculate the mentioned KPI, “Total exposure hours” (PI063) should be used, as the denominator of the function. This PI, refers the total number of the crew on a specific ship and for a specific period of time in a default quarter as mentioned previous.

$$**KPI008 = \frac{PI013 + PI020 + PI021 + PI026 + PI036}{PI063} * 24 * 90**$$

PI063

The Maritime Labor Convention (MLC), which was adopted by the International Labor Organization (ILO), established these rules in order to ensure equality among seafarers and to defend their rights, including the right to compensation, health care, and working conditions.¹³

¹³ https://www.ilo.org/global/standards/maritime-labour-convention/what-it-does/WCMS_219665/lang--en/index.htm

This KPI expresses the percentage of performance of the company to comply with the standards of MLC and to respect the rights of seafarers regarding working conditions and the hours they have to work and rest. The PI “Number of seafarers not relieved on time” (PI025), is able to calculate the number of sailors who were not repatriated in the agreed time. It includes only the extensions imposed by the company and not the extensions requested or agreed by the seafarer. The next PI which is necessary in order to calculate the above KPI is the "Number of violations of rest hours” (PI060). This PI calculates the total number of infringements committed in relation to the hours the crew is entitled to rest. Non-compliance with MLC rules is also considered a violation even if the sailor agrees. It is important to note that this PI consists of data collected from internal and external infringement reports. The above PI works cumulatively in order to arrive at the most objective result for the performance of the company as per the below function:

$$\begin{aligned} \text{Crew planning (KPI009)} &= \text{Number of seafarers not relieved on time (PI025)} \\ &+ \text{Number of violations of rest hours (PI060)} \end{aligned}$$

The third KPI is the “HR deficiencies” (KPI016), which concerns the percentage of performance of the company in relation to its human resources. In particular, measures the shortcomings and non-compliance with the pre-defined measures of the human resources which result from external inspections. This KPI is derived from (PI035) considering also (PI052). More specific, the PI “Number of HR related deficiencies” (PI035), presents the number of deficiencies and non-compliance concerning the human resources of the company. The above deficiencies were recorded by inspections outside the company or by the respective authorities as well as from inspections that must take place compulsorily. This measurement refers to the deficiencies recorded in a specific quarter that had been predetermined. The PI “Number of recorded external inspections” (PI052), describes the number of inspections, mandatory and non-mandatory, that took place within a specific quarter. This includes inspections by all external taxes such as the flag, the Class and port authorities but inspections made by the charterers and concern the cargo and the improvement of its conditions. The above KPI can be calculated with the following relation:

HR deficiencies (KPI016) = Number of HR related deficiencies (PI035)

Number of recorded external inspections (PI052)

The fourth KPI is the “Cadets per ship” (KPI003), which presents the company’s percentage of performance to include cadets as member in its fleet. The cadets must have in their possession the Document of Compliance (DOC). This document is the certificate which certifies that the company is complied with ISM regulations and is issued by the Flag. The DoC is issued for every type of the fleet owned by the company.¹⁴ The first PI of this Kpi is the “Number of cadets under training with the DOC holder” (PI017), which includes the total number of tests available on all ships in the fleet at a given time (three months). This measurement is made by collecting the total number of tests on all the company's ships on the last day before the end of the predetermined quarter. The second PI is the “Number of ships operated under the DOC holder” (PI057), which describes the total number of ships that make up a company that owns the Document of Compliance. For the correct measurement of PI, the total number of ships for which the specific certificate was issued should be calculated, even if one of them no longer belongs to the fleet. This “Cadets per ship” KPI results from the following relation:

Cadets per ship (KPI003) = Number of cadets under training with the DOC holder (PI017)

Number of ships operated under the DOC holder (PI057)

The fifth of KPI is the “Officer retention rate” (KPI022). This KPI expresses the efficiency of the company to maintain professional relations with the crew that has been signed on a ship in the past. In addition, the percentage of “Officer retention rate” KPI could be changed even with small changes that occur in the size of the fleet. PI “Number of officer terminations from whatever cause” (PI041), concerns the number of employees who has worked for a company in the past, whether they chose it and resigned or the company decided and fired him. PI “Number of unavoidable officer terminations” (PI056), presents the summary of seafarers whose dismissal could not be avoided More specifically, the contract's expiration or retirement may be the cause of the mandatory dismissal. The next PI is “Number of beneficial officer terminations” (PI016). The profitable benefits of terminating a partnership with a

¹⁴ <https://shipfever.com/what-is-doc-certificate-document-of-compliance>

company are usually in favor of the company. This conclusion arises in the case that the termination concerns people whose performance was not satisfactory and generally did not comply with company policy. The last PI is “Number of officers employed” (PI006), which presents the total number of certificates that have been signed on all ships available to the company. The relation that results from the pi mentioned above is the following and expresses the value of KPI “Officer retention rate” (KPI022):

$$KPI \text{ “Officer retention rate (KPI022)} = 100\% - \frac{(PI041 - (PI056) + PI016)}{PI006} * 100\%$$

PI006

The sixth KPI is “Officers experience rate” (KPI023), which presents the degree of experience with the Security Management System (SMS) of the company. The mentioned KPI refers to the ratings that are currently on board. In order to calculate the degree of experience, the company creates a table that includes a scale which expresses with the corresponding degree the experience of each value. This scale is based on how long the officer has been on board. Twelve months is the longest period of time that may be represented on this scale. Any officer remains on the ship longer than the above-mentioned time of period is not counted. Through the PI “Number of officer experience points” (PI040), the company can calculate and lead at more accurate scores for the evaluation of each seafarer. The experience points of each officer depend on the length of time spent on the ship and are recorded on the last day of each quarter. It is not a basic criterion that the value be on the same ship all the time, but the measurement is valid only if the officer remains on one of the ships owned by the same company. The table below shows the order of seafarers' ratings:

Points	Months
1	0-5
2	6-8
3	9-11
4	12

Table 3:Seafarer's Rating

The limit of this scale cannot exceed four points regardless of how long the seafarer will remain on board after more than twelve months, and this happens in order to exist objectivity between the scores of all officers. PI “Number of officers onboard” (PI043), presents the total number of officers on board on the last day of the quarter, which is also the day the measurement is made. The number of seafarers' tests on board is not an element and is not included in this measurement. According to the two PIs which are mentioned above the KPI “Officers experience rate” (KPI023) results from the following relation:

$$\text{Officers experience rate (KPI023)} = \frac{\text{Number of officer experience points (PI040)} * 100}{4 * \text{Number of officers onboard (PI043)}}$$

The last KPI of this sector is the “Training days per officer” (KPI031), which expresses the degree of satisfaction of the executives and their development according to the standards followed by the company. The total number of days that each sailor spent aboard the ship is utilized as a determining component since it is impossible to objectively represent the level and quality of an officer's training and ability. Due to the existence of the Document of Compliance standards, this practice is seen as being required in shipping. These standards indicate that every company has an obligation to maintain and develop the competence of seafarers so that they can meet the obligations of their duties. The first PI is the “Number of officer trainee man days” (PI042). Each seafarer must undertake specific training before joining a ship in order to be instructed and prepared in accordance with the regulations so that he can perform his duties. This training includes attending seminars on legal knowledge, ship maintenance theory, and handling a variety of issues that can happen on the ship. The next step is training on a ship under the direction of a qualified trainer. The sailor certifies his training by getting the required certificate after completing his theoretical and practical instruction, assuming he has done so successfully. This PI presents the total number of days where an officer trained both on land and at sea. In addition, after calculating the total number of trainings of each sailor separately, the total number of training days for all members of the crew of the company that owns the Document of Compliance is calculated. The next PI is the “Number of officer days onboard all ships with the DOC holder” (PI039). This PI expresses the total number of days the officers are enlisted on all the company's ships. More specific, measures the number of valuables on each ship of the company and then multiplies the result obtained by the total number of days in the specific quarter that has been pre-selected. The

KPI expresses the ratio between the officer training days over the total number of officers working days, basically the average number of training days per officer day at sea through the following relation:

Training days per officer (KPI031) = Number of officer trainee man days (PI042)

Number of officer days onboard all ships with the DOC holder (PI039)

3.3.4 Navigational Safety:

In shipping sector, in order to avoid many accidents or adverse situations, many measures and procedures are applied where the company and the ships must follow. Initially, all vessels have a navigation system in which nautical charts and nautical publications are entered, containing data adapted to the criteria for safe navigation.¹⁵

The navigation system replaces the printed maps as they now exist in electronic form and are in accordance with the IMO regulations. The use of this system optimizes the safety of navigation as there are automated procedures, such as the automatic planning of the route and the calculation of the arrival of the ship in the port.¹⁶ In addition, the use of radar is vital to the operation and navigation of the ship. Radar is used by all ships that have a total capacity of more than three thousand tons and its main function is to locate and monitor ships. Specifically, radars are used by ships in order to be able to perceive what their location is and to avoid a collision. Furthermore, Radar makes it easier for all those working on land, such as the company and the coast guard, to determine the ship's precise position. External inspections should be done in order to prevent any weaknesses or faults in navigation systems and procedures.¹⁷

The KPI “Navigational deficiencies” (KPI019), presents the number of deficiencies recorded by external inspections on the vessel. The KPI “Navigational deficiencies” is the ratio of the deficiencies recorded on the ship by the external audits carried in relation to the total number

¹⁵ <https://www.imo.org/en/OurWork/Safety/Pages/NavigationDefault.aspx>

¹⁶ <https://www.marineinsight.com/marine-navigation/what-is-electronic-chart-display-and-information-system-ecdis>

¹⁷ <https://www.marineinsight.com/marine-navigation/marine-radars-and-their-use-in-the-shipping-industry/>

of inspections. This KPI expresses the ability of the company and consequently of the ship to avoid recording comments and to comply with international regulations for navigation. To PI “Number of navigational related deficiencies” (PI038), expresses the number of shortages in navigation vessels recorded on board by external audits carried out during a predetermined quarter. External inspections can be considered the control by the competent authorities of each port and by the flag to which the ship belongs. The PI “Number of recorded external inspections” (PI052) presents the number of recorded inspections carried out on board by the competent authorities during a given quarter. The KPI “Navigational deficiencies” (KPI019) is calculated from the following relation of the two PI:

$$\text{Navigational deficiencies (KPI019)} = \frac{\text{Number of navigational related deficiencies (PI038)}}{\text{Number of recorded external inspections (PI052)}}$$

The second KPI is the “Navigational incidents” (KPI020), presents the rate of return of the company to avoid any navigational incidents involving collision, allision or grounding. Only the incidence, not the reason, should be considered when calculating this Kpi. Accidental collisions between two ships or one ship and land are referred as ship collisions. These incidents frequently result from human error. More specifically, such incidents can be occurred either due to poor judgment of the captain or due to poor navigation.¹⁸ The next case is the allision. This term refers When a ship intentionally collides with another ship or a shore. The second incidence is when a ship ground owing to low draft, which happens when the ship gets stuck. More particular, not all ships can approach some ports due to the lower water level there. The tide is another factor that might cause the ship to fall into the sea. As the consequence, the mud that was produced as a result of the tide mixing the water's bottom to the vessel's hull.¹⁹

The first PI is the “Number of collisions” (PI022) which expresses incidents where one ship collides with another ship or a moving object. The collection of data results from the reports of events recorded by the ship as well as from official reports in a specific quarter which shape the navigation performance of the ship. The second PI is the “Number of allisions”

¹⁸ <https://www.marineinsight.com/maritime-law/what-is-collision-of-a-ship/>

¹⁹ <https://www.brighthubengineering.com/seafaring/35933-what-is-ship-grounding>

(PI014), which occurs when a ship hits a fixed object. Fixed items include floating buoys, fixed mooring facilities, moored ships and offshore facilities. The data will be collected from the internal report as well as from any official incident reports in a specific quarter in order to provide a good and valid expression of the ship's naval performance. The third PI is the “Number of groundings” (PI033) presents when the ship comes into any contact with the seabed and / or shore, including reefs or marine supports. The data will be collected from the internal report as well as from any official incident reports in a specific quarter in order to provide a good and valid expression of the ship's naval performance. KPI is the “Navigational incidents” (KPI020) results from the following relation:

Navigational incidents (KPI020) = Number of collisions (PI022)

+ Number of allisions (PI014)

+ Number of groundings (PI033)

3.3.5 Operational:

One of the most crucial departments in the maritime industry is the operations department. In order to direct the captain of the ship for the cargo and various ship activities, this department is in charge of daily communication with him. Additionally, the operations division is responsible of maintaining constant contact with the ship's agent regarding all of the activities that will be occurred in the port. Furthermore, this department calculates the freight, hire, demurrages, etc. In order to run the business efficiently and make money for the company, the operations department is in charge of making sure the ship is properly available to charterers. Planning the drydocking of the ship within a specific time frame is a crucial duty for the department.²⁰

The first KPI of this sector is the “Budget performance” (KPI002), calculates the overall budget deviation. More particularly, it represents the company's efficiency in relation to its operational costs based on the company's income from ship voyages and the overall costs the company incurred. This KPI consists of the following 3 PIs in order to collect the required data. The first PI is the “Last year’s running cost budget” (PI012), which includes the total operating budget cost of each ship separately, recorded by the company the previous year. This includes maintenance, repair, crewing, spares /stores, management cost and /or fee and

²⁰ [Shipping Operations Management by I.D. Visvikis, P.M. Panayides](#)

lubricants. Insurance and capital expenses, such as modifications and drydocking expenses shall be excluded. The next PI is the “Last year’s actual running costs and accruals” (PI011), which presents the total actual operating costs and accruals of the last year per ship. This includes maintenance, repair, crew changes, spare parts / warehouses, management costs, agent’s fee and lubricants. excludes insurance and capital spending, such as tank and conversion costs. The last PI is the “Last year’s AAE (Additional Authorized Expenses)” (PI010) including the additional expenditure agreed on the budget of the current costs referred to the mentioned PI for the previous financial year. The calculation of KPI “Budget performance” comes from the following relation:

$$\text{Budget performance (KPI002)} = \underline{\underline{\text{PI012} - (\text{PI011} - \text{PI010})}}$$

PI012

The second KPI is the “Drydocking planning performance” (KPI010). This KPI, expresses the ability of a company to plan the tanking process, in terms of planning, expected costs as well as the necessary budget that the company must take seriously. The drydocking strategy contains the anticipated cost and time as well as a variance of 0–10% that has not been factored into the company's total cost. This will make it easier to understand how much it will cost and how long it will take. This is so that there is a clearer picture of the cost and duration required. This KPI specifically monitors the number of deviations from the plan, including both positive and negative outcomes, which are always transformed to positive for the right computation. The PI “Agreed drydocking duration” (PI005), expresses the agreement under which the shipowner or management company agrees with the yard on the procedures to be followed as well as the length of time the ship must remain on the shipyard. Any additional work approved after the start of the drydock will not be considered. In addition, the PI “Actual drydocking duration” (PI002), which presents the exact duration of the drydock. It includes the total time it took for all the work and repairs to be carried out on the ship. The next PI is the “Agreed drydocking budget” (PI004), presents the total amount of the budget associated with the vessel’s drydocking, as agreed between the ship manager and the owner before the drydocking. This will include water research, and repairs, which are not included in the current routine cost. Any additional work approved after the start of the drydock will not be considered. The PI of this sector is the “Actual Drydocking costs” (PI001) which expresses the total actual cost associated with drydocking. This will include water research, modifications and repairs, which are not included in the current routine cost. It also includes

the cost of any additional work not planned prior to the dock. According to the above PIs, the KPI "Drydocking planning performance" results from the following relation:

$$KPI10 = \frac{(|PI002 - PI005| + |PI001 - PI004|)}{PI005 + PI004} * 100\%$$

PI005

PI004

The third KPI, "Cargo related incidents" (KPI004), measures the company's capacity to provide services involving the operation and transportation of cargo while avoiding the recording of any issues. This indicator shows the total number of accidents that were reported to the business and had to do with cargo transport and construction activities. One PI makes up the KPI "Cargo related occurrences." The number of incidents during cargo operations that were due to the ship was stated by PI "Number of cargo related incidents" (PI018). Here are a few of the categories this PI falls under:

- Rejection of ship or holds/tank prior to loading
- Inability to load full agreed quantity
- Failures/underperformance of ship's cargo equipment
- Cargo contamination
- Any other cargo incident caused by:
 - Negligence by ship's crew
 - Inadequate company and ship board procedures and practices

However, there are some cases that do not fall under this PI, some of which are as follows:

- Stevedore/shore staff
- Inherent vice (nature of cargo)
- Shore equipment
- False or incorrect declarations by the shipper, etc.

The next KPI is the “Operational deficiencies” (KPI024), which presents the company’s ability to avoid operational related deficiencies. This KPI measures the number of operational deficiencies, including any substandard acts, practices or conditions (excluding deficiencies in human resources, safety, health, safety and environment) recorded during external inspections and controls. Then the number of deficiencies in relation to the total number of external inspections is made. The Pi “Number of operational related deficiencies” (PI044) includes the total operational related deficiencies which are recorded during given quarter. Specifically, it records the deficiencies or non-compliance of the company through acts and conditions that must be observed. These observations have been recorded by inspections carried out on the ship by external authorities, such as class, port State, flag State. The next Pi is the “Number of recorded external inspections” (PI052) captures the total number of recorded external inspections by external authorities. From the two PIs which are mentioned above, the KPI “Operational deficiencies” is emerged as per the following relation:

$$\text{Operational deficiencies (KPI024)} = \frac{\text{Number of operational related deficiencies (PI044)}}{\text{Number of recorded external inspections (PI052)}}$$

The fifth KPI is the “Ship availability” (KPI032). This KPI expresses the discrepancy between the actual non-availability of the ship and the planned non-availability. More specifically, the mentioned KPI measures the use of the ship as a percentage of the total usage time available during the quarter. This reduces the sensitivity of the KPI to small changes in the PI, while at the same time covering the case of zero programmed non-availability (PI062). The PI “Actual unavailability” (PI003) presents the total number of operating hours lost during a given quarter. The lost operating time results from any incident that resulted in the scheduled operation of the ship. Some universal reasons that can cause this outage are maintenance of hull, engine failure, crew disease, etc. The adverse weather conditions are not included in this PI if it is already set to the Charter Party. In addition, the PI “Planned unavailability” (PI062) includes the total hours of a particular quarter in which the shipowner or operator has agreed that the ship will not be operational for work such as drydocking. KPI “Operational deficiencies” calculated as per the following relation:

$$\text{Operational deficiencies (KPI024)} = 1 - \frac{\text{Planned unavailability (PI062)} - \text{Actual unavailability (PI003)}}{\text{Planned unavailability (PI062)}} * 100$$

The last KPI is the “Vetting deficiencies” (KPI033). Through third party inspections, a risk assessment is performed in order to avoid the use of deficient vessels. Essentially, this KPI is a control system for the quality operation of the ship, which concerns not only its commercial operation in relation to charterers but also the improvement of operation in terms of health and the environment. This KPI expresses the ability of the ship operator to avoid observations during commercial inspections. More specifically, it counts the number of all observations recorded for this ship from all external parties.²¹

The first PI is the “Number of observations during commercial inspections” (PI058) which records the number of observations during trade observations, such as inspections carried out by charterers. Specifically, this Pi expresses the number of observations recorded during voluntary inspections made for quality or commercial reasons. In the case of multiple voluntary and commercial inspections in the same quarter, then observations are aggregated and taken into account for that quarter. External statutory inspections and controls by external bodies such as category, port state, flag state, insurers, ITF are excluded. The second Pi is the “Number of observations during commercial inspections” (PI059) which records the number of commercial inspections. This Pi includes the number of recorded voluntary inspections carried out for the purpose of quality improvement or for commercial purposes and includes all types of charter inspections. Data on this PI can be obtained from a summary of all voluntary and commercial inspections recorded on board for a specific period as is mentioned in previous Pi. KPI “Vetting deficiencies” can be calculated through the following relation:

$$\text{Vetting deficiencies (KPI033)} = \frac{\text{Number of observations during commercial inspections (PI058)}}{\text{Number of observations during commercial inspections (PI059)}}$$

²¹ <https://cefic.org/app/uploads/2011/01/Good-Practice-for-Ship-Vetting-ersion-2011-revised-2020.pdf>

3.3.6 Security:

The security system differs from company to company depending on the subject matter as well as the needs that arise. To create this system, a large amount of information is collected, which must be processed by the appropriate department and divided into relevant and irrelevant. The collection of information is increasing day by day and the monitoring of new data has a crucial role. Uncontrolled volume of data is likely to change a company's firms in the way it handles a situation resulting in improved and greater company efficiency. By processing these data and the statistics that result from them, the company manages to take new measures and create new perspectives.²²

The KPI that this category includes is the “Security deficiencies” (KPI029) which expresses the company's ability to anticipate security-related deficiencies. This KPI counts the number of security related deficiencies including any substandard act, practice or condition which are recorded during external inspections and audits. The number of deficiencies is then made relative to the total number of external inspections and audits. The first Pi is the “Number of security related deficiencies” (PI054) which presents the number of safety-related deficiencies (excluding operational, marine, environmental, human and health and safety), including any substandard acts, practices or conditions recorded during external inspections and controls by external bodies (category, flag State, insurers, ITFs) including statutory audits. The second Pi is the “Number of recorded external inspections” (PI052) presents the number of recorded inspections carried out on board by the competent authorities during a given quarter as is mentioned in a previous Pi. This KPI is presented with the following relation:

Security deficiencies (KPI029) = Number of security related deficiencies (PI054)

Number of recorded external inspections (PI052)

²² <https://www.securityinfowatch.com/security-executives/article/21247498/security-kpis-measures-and-metrics>

3.3.7 Technical:

The technical department of a company is responsible for the parts of the ships that mainly concern its engine and what it entails with it. Nevertheless, this department deals not only with the pure technical and mechanical issues of the ship but also with issues concerning the class and the proper operation of the ship. More specifically, the technical department is responsible for the compliance of the ship in terms of class and the necessary certificates that the ship must have in its possession. Also, the responsibilities of this department include the inspection of many parts of the ship's equipment, as well as their maintenance. The KPI "Condition of class" (KPI06) expressed the percentage of company's performance to minimize the number of conditions of class. It is important to note that all categories of conditions of class are weighted and regarded equally. Firstly, the Pi "Number of conditions of class" (PI023) which is used to measure Condition of class that are issued to a ship at any given time in a specific quarter. The Condition of Class (CoC) is a written statement from class. The "Condition of Class" definition might differ between class societies, as some use term "Condition of Class", others use term "recommendation". The data of this Pi can be obtained from the files of the class and relate only to the files related to the inspections carried out in the specific quarter. The next KPI is the "Failure of critical equipment and systems" (KPI012). This KPI measures the company's performance in keeping the ship's equipment in good condition. Specifically, it records the failures that have occurred in the equipment and concern the security system of the company. The Pi "Number of failures of critical equipment and systems" (PI029) is included in this KPI and captures total number of failures of critical equipment and systems. If multiple errors lead to the same unavailability, all should be counted, as this PI indicator measures the state of the system and not the consequences of failure. The last KPI is the "Overdue tasks in PMS" (KPI036) which expresses the company's ability to capture the percentage of outstanding Planned Maintenance Tasks for individual vessels. The Pi "Overdue tasks in PMS" (PI065) presents the number of outstanding planned maintenance tasks of non-critical equipment expressed as a percentage of the total number of monthly planned maintenance tasks per ship.

3.3.8 Port State Control:

Port state control (PSC) is the inspection which is carried out on ships holding a foreign flag. The inspection is carried out in national ports in order to avoid violations of international regulations and to verify that all ships operate in accordance with these regulations. Also, the purpose of these inspections is to determine that the ships are equipped with the necessary equipment for better operation and compliance with international standards. The ship's flag bears the greatest responsibility for the ship's compliance with the rules, however inspections by local authorities provide additional control over the conditions and procedures that must prevail on a ship. The inspections take place in all international ports and on as many ships as possible but without causing delays in the operation of the ship. Delays can only occur if inspectors find that the ship has not complied with the rules to the point where it is dangerous to leave the port without corrective action. The first KPI of this sector is the "Port state control detention" (KPI027). This KPI describes the ship's ability and therefore the company to complete a vessel's KPI inspection without a reservation. More specifically, this CPI counts the total number of bookings that resulted from inspections that resulted in the booking of the ship. This KPI consists of two PI in order to collect the relevant data. The PI "Number of PSC detentions" (PI050) presents the number of PSC inspections that which resulted in the detention of the ship. The inspection carried out in order to check the already recorded observations but also the ship being reserved is not considered a new element for this PI. The PI "Number of PSC inspections" (PI049) records the number of inspections carried out in a given quarter by PCS. The of PSC inspection along with the number of PSC deficiencies are used to measure the number of PSC inspections that resulted in the detention of the ship through the following relation:

Number of PSC deficiencies (PI050), if the Number of PSC inspections (PI049) > 0

The second KPI is the "Port state control deficiency ratio" (KPI026) expresses the ability of the company and consequently the ship to avoid deficiencies and observations from PSC inspections, by carrying out the necessary procedures so that they comply in a timely manner with the necessary regulations. This KPI represents a ratio between the number of reported deficiencies in relation to the number of Port State inspection inspections per se the average number of deficiencies per inspection. PI "Number of PSC deficiencies" (PI048) presents the number of omissions and comments recorded by PSC inspections in a specific quarter. In the case that PSC inspections are carried out more than once in the same quarter, then all deficiencies that have been identified are taken into account. This PI along with the PI "Number

of PSC inspections” (PI049) which is mentioned above, create the KPI “Port state control deficiency ratio” as follows:

Port state control deficiency ratio (KPI026) = Number of PSC deficiencies (PI048)

Number of PSC inspections (PI049)

The third and last KPI of the sector is the “Port state control performance” (KPI014) presents the percentage of performance of the company and its ships to have done all the necessary procedures so that no deficiencies and remarks arise in the PSC inspections. The Pi “Number of PSC inspections resulting in zero deficiencies” (PI048) includes the total number carried out by the local authorities and the deficiencies found on the ship were zero. The last Pi is the “Number of PSC inspections” (PI049) which is mentioned above, create the KPI “Port state control deficiency ratio” as follows:

Port state control performance (KPI014) = Number of PSC inspections resulting in zero deficiencies (PI048) / Number of PSC inspections (PI049)

Chapter 4

4.1 KPI's case study

In the previous chapter we analyzed what is the meaning and significance of KPI in a shipping business at a theoretical level. In this chapter we will present an example with numerical data so that the use of the system is fully understood and how the companies come to a conclusion through the KPI system. The following example analyzes the performance indicators consisting of a bulk carrier vessel. As mentioned in the previous chapter, the final results are produced by data collection and processing. Through this analysis results will be obtained which will be desirable and within the goal and will be outside the limits set by the company. For the results that will occur and will be outside the framework that the company has defined as satisfactory, there should be additional analysis and new parameters that will lead to their maximum performance. In the table below there is a detailed data categories (PIs) that were collected and cover all the KPI mentioned above. The following PIs analysis is applied to data collected for one year and in most categories the data is divided into four quarters. The KPIs table will be followed in summary form and will be based on the PIs table data and the range that the company the company has defined as target and minimum required. The KPIs table is formatted in an excel table where all the necessary relationships and data calculations have been performed, as analyzed in the previous chapter. The prices of the KPS which will not be within the desired limits set by the company will be analyzed in relation to the cause that caused the undesirable efficiency as well as what may be the next plan in order to change the result.

Aliki Maritime Co Ltd
Annual KPI Results

VESSEL NAME:		MV DRA				
Code	Description	Q1	Q2	Q3	Q4	Units
PI001	Actual drydocking costs	0	0	350000	0	USD
PI002	Actual drydocking duration	0	0	30	0	Days
PI003	Actual unavailability	16	0	408	19	Hours
PI004	Agreed drydocking budget	0	0	200000	0	USD
PI005	Agreed drydocking duration	0	0	14	0	Days
PI010	Last Year's additional authorized expens			547500		USD
PI011	Last Year's actual running costs			1752000		USD
PI012	Last Year's running cost budget			1460000		USD
PI013	Number of absented crew	0	0	0	0	crew
PI014	Number of allisions	0	0	0	0	allisions
PI015	Number of ballast water violations	0	0	0	0	violations
PI018	Number of cargo related incidents	3	0	1	1	incidents
PI019	Number of cases where crew member	2	3	1	1	crew
PI021	Number of cases where drugs or alcoho	1	2	0	1	cases
PI020	Number of charges of criminal offences	0	0	0	0	offences
PI022	Number of collisions	0	0	0	0	collisions
PI023	Number of conditions of class	0	0	6	0	conditions
PI024	Number of contained spills	0	0	0	0	cases
PI025	Number of seafarers not relieved in time	2	0	4	0	crew
PI026	Number of dismissals	0	0	0	0	crew
PI027	Number of environmental related deficiencies	1	1	2	1	deficiencies
PI028	Number of explosion incidents	0	0	0	0	incidents
PI029	Number of failures of critical	2	0	0	3	defects
PI030	Number of fatalities due to work injuries	0	0	0	0	crew
PI031	Number of fatalities due to sickness	0	0	0	0	crew
PI032	Number of fire incidents	0	0	0	0	incidents
PI033	Number of groundings	0	0	0	0	incidents
PI034	Number of health and safety related def	4	2	8	1	deficiencies
PI035	Number of HR related deficiencies	0	0	3	0	deficiencies
PI036	Number of logged warnings	0	0	0	0	warnings
PI037	Number of lost workday cases	1	0	2	1	cases
PI038	Number of navigational related deficien	2	0	0	0	deficiencies
PI040	Number of officer experience points	20	18	32	10	points
PI043	Number of officers on board	8	8	8	8	Officers
PI044	Number of operational related deficienc	2	0	4	0	deficiencies
PI045	Number of passengers injured	N/A	N/A	N/A	N/A	cases
PI046	Number of permanent partial disabilities	0	0	0	0	crew
PI047	Number of permanent total disabilities	0	0	0	0	crew

Table 4: Quarterly PIs

Aliki Maritime Co Ltd
Annual KPI Results

PI048	Number of PSC deficiencies	14	8	20	12	deficiencies
PI049	Number of PSC inspections	4	5	2	7	inspections
PI050	Number of PSC detentions	0	0	0	0	detentions
PI049	Number of PSC inspections resulting in	1	2	0	4	inspections
PI052	Number of recorded external inspection	8	4	9	11	inspections
PI053	Number of releases of substances to	0	0	0	0	cases
PI054	Number of security related deficiencies	5	7	2	1	deficiencies
PI055	Number of oil spills	0	0	0	0	cases
PI058	Number of observations during commer	3	2	1	2	obs
PI059	Number of commercial inspections	2	1	1	1	inspections
PI060	Number of violation of rest hours	3	1	6	4	cases
PI061	Passenger exposure hours	N/A	N/A	N/A	N/A	hours
PI062	Planned unavailability	5	5	14	5	days
PI063	Total exposure hours	43200	43200	43200	43200	hours

COMPANY SCOPE PIs

PI006	Number of officers employed	40	40	40	40	Officers
PI016	Number of beneficial officer termination	1	0	8	1	Officers
PI017	Number of cadets under the training	0	0	0	0	Cadets
PI039	Number of officer days on board all	3600	3600	3600	3600	Days
PI041	Number of officer terminations from	5	5	8	3	Cases
PI042	Number of officer trainee man days	0	0	0	0	Days
PI056	Number of unavoidable officer terminat	4	5	0	2	Cases
PI057	Number of ships operated under the DOC holder	1	1	1	1	Ships

Ahiki Maritime Co Ltd
Annual KPI Results

Code	Description	Value Q1	Value Q2	Value Q3	Value Q4	Unit	MinReq	Target
KPI 001	Ballast Water Management Violations	0.0	0.0	0.0	0.0	Violations	1	0
KPI 002	Budget performance	2.0				%	10	2
KPI 003	Cadets per Ship	0.0	0.0	0.0	0.0	Cadets	0	3
KPI 004	Cargo Related Incidents	3.0	0.0	1.0	1.0	Number of Cargo related incidents	2	0
KPI 006	Condition of Class	0.0	0.0	6.0	0.0	Conditions of class	1	0
KPI 007	Contained Spills	0.0	0.0	0.0	0.0	Number of contained spills	3	0
KPI 008	Crew Disciplinary Frequency	0.1	0.1	0.0	0.1	Breaches/ total crew	0.02	0
KPI 009	Crew Planning	5.0	1.0	10.0	4.0	Breaches	15	0
KPI 010	Drydocking Planning Performance	n/a	n/a	1.9	n/a	%	10	2
KPI 011	Environmental Deficiencies	0.1	0.3	0.2	0.1	Number of deficiencies/ Ext. Inspection	5	0
KPI 012	Failure of Critical Equipment and Systems	2.0	0.0	0.0	3.0	Failures	1	0
KPI 013	Fire and Explosions	0.0	0.0	0.0	0.0	Number of incidents	1	0
KPI 014	Port State Control Performance	0.3	0.4	0.0	0.6	Flawless Inspections/Inspections	0.33	1
KPI 015	Health and Safety Deficiencies	0.5	0.5	0.9	0.1	Deficiencies/Inspection	5	0
KPI 016	HR Deficiencies	0.0	0.0	0.3	0.0	Deficiencies/Inspection	5	0
KPI 017	Lost Time Injury Frequency	23.1	0.0	46.3	23.1	Cases/Million Hours	25	5
KPI 018	Lost Time Sickness Frequency	46.3	69.4	23.1	23.1	Cases/Million Hours	25	0
KPI 019	Navigational Deficiencies	0.3	0.0	0.0	0.0	Deficiencies/Inspection	5	0
KPI 020	Navigational Incidents	0.0	0.0	0.0	0.0	Incidents	1	0
KPI 022	Officer Retention Rate	100.0	100.0	100.0	100.0	%	70	95
KPI 023	Officer Experience Rate	62.5	56.3	100.0	31.3	%	60	90
KPI 024	Operational Deficiencies	0.3	0.0	0.4	0.0	Deficiencies/Inspection	5	0
KPI 025	Passenger Injury Ratio	N/A	N/A	N/A	N/A	Cases/Million Hours	N/A	N/A
KPI 026	Port State Control Deficiency Ratio	3.5	1.6	10.0	1.7	Deficiencies/Inspection	8	0
KPI 027	Port State Control Detention	0.0	0.0	0.0	0.0	Detentions	1	0
KPI 028	Release of Substances	0.0	0.0	0.0	0.0	Releases	1	0
KPI 029	Security Deficiencies	0.6	1.8	0.2	0.1	Deficiencies/Inspection	5	0
KPI 031	Training Days per Officer	N/A	N/A	N/A	N/A	Days	0	0.03
KPI 032	Ship Availability	2.2	1.0	28.1	2.8	%	97	100
KPI 033	Vetting Deficiencies	1.5	2.0	1.0	2.0	Observations/Inspections	5	0

Table 5: Quarterly KPIs

4.2 Analysis and goal setting for substandard results

KPI 003 - Cadets per Ship

For this KPI according to the standard we are using the *Minimum required is 0* and the *Target Score is 3*. Our result for all quarters of the reporting period was 0, due to the fact that the company did not embark any cadets. The root cause for this fact was the global pandemic

precautions which were implemented and dictated minimum required crew on board. Improvement of this Index will be discussed in the next Management Review Meeting of the Company and will be set for the first applicable period when the circumstances allow for same.

KPI 004 - Cargo Related Incidents

For this KPI according to the standard we are using the ***Minimum required is 2*** and the ***Target Score is 0***. Our result for the first quarter of the reporting period was 3. All incidents were related to disputes with the cargo quantity and none related to damages of the cargo. The root cause for all cases was the error margin between shore scales and draft surveys. Improvement of this Index can be the better training of deck officers in cargo handling and draft survey procedures and will be discussed in the next Management Review Meeting of the Company. Index improvement actions will be implemented during next reporting period.

KPI008- Crew Disciplinary Frequency

For this KPI according to the standard we are using the ***Minimum required is 0*** and the ***Target Score is 0***. Our results for the first, second and fourth quarters were over and above due to the fact that we had incidents of insubordinate or improper behavior on board. Although the situations were contained and appropriate actions taken the root cause was the poor selection of seafarers in terms of attitude. Improvement of this Index can be the better screening procedures for ratings and interviews for officers. Same to be communicated to the manning agent and discussed in the next Management Review Meeting of the Company. Index improvement actions will be implemented during next reporting period.

KPI012- Failure of Critical Equipment and Systems

For this KPI according to the standard we are using the ***Minimum required is 1*** and the ***Target Score is 0***. Our results for the first and fourth quarters were 2 and 3 respectively. The root cause for all cases was poor maintenance due to the schedule of the vessel on some occasions. Improvement of this Index can be the closer monitoring of the preventive maintenance by the shore-based personnel as well as better training of Engine Officers in maintenance procedures as dictated in the SMS. Same to be discussed in the next

Management Review Meeting of the Company and will be set for the first applicable period when the circumstances allow for same

KPI014- Port State Control Performance

For this KPI according to the standard we are using the ***Minimum required is 0.3*** and the ***Target Score is 1***. Our results for the first, second and fourth quarters were over and above. The root causes vary from case to case, as the deficiencies were noted in various PSC examinations. Due to the nature of this index pertaining to deficiencies and non-conformities already handled as per company's relevant procedure, detailed Corrective action plan and root cause for all cases can be found in the relevant follow up forms ISM-04 C.A.P. Improvement of this Index can be the better preparation and monitoring of vessel condition especially when PSC examination is expected. Same to be discussed in the next Management Review Meeting of the Company and will be set for the first applicable period when the circumstances allow for same.

KPI017- Lost Time Injury Frequency

For this KPI according to the standard we are using the ***Minimum required is 25*** and the ***Target Score is 5***. Our results for the fourth quarter were far above the desired result. Although the situations were contained and appropriate actions taken the root cause was the bad weather phenomena that prevailed at that time in combination with the difficult maintenance of the cargo. Improving this indicator may be the best crew training for safety in a place where the ship is in the midst of extreme weather conditions. Index improvement actions will be implemented during next reporting period.

KPI018- Lost Time Sickness Frequency

For this KPI according to the standard we are using the ***Minimum required is 25*** and the ***Target Score is 0***. Our result for the first and second quarters were above the desired result. Although the situations were contained and appropriate actions taken the root cause was the outbreak of the covid-19 pandemic. The crew changed for the first two quarters and despite the precautionary measures taken, the pandemic penetrated inside the vessel. An improvement in this indicator could be the increase in virus prevention measures and the imposition of quarantine on the new crew for a few days. Index improvement actions will be implemented during next reporting period.

KPI023- Officer Experience Rate

For this KPI according to the standard we are using the ***Minimum required is 60*** and the ***Target Score is 90***. Our results during all quarters and fourth quarters were over and above. Although the situations were contained and appropriate actions taken the root cause was the poor selection of seafarers in terms of experience. Improvement of this Index can be the better screening procedures for ratings and interviews for officers in order to confirm the working skills of the seamen. Same to be communicated to the manning agent and discussed in the next Management Review Meeting of the Company. Index improvement actions will be implemented during next reporting period.

KPI026- Port State Control Deficiency Ratio

For this KPI according to the standard we are using the ***Minimum required is 8*** and the ***Target Score is 0***. Our results for the third quarter were over and above. Although, the company has a flawless performance policy same is not always possible to achieve. Although exceeding the minimum required deficiency ratio needs immediate attention. The root causes vary from case to case, as the deficiencies were noted in various PSC examinations. Due to the nature of this index pertaining to deficiencies and non-conformities already handled as per company's relevant procedure, detailed Corrective action plan and root cause for all cases can be found in the relevant follow up forms ISM-04 C.A.P. Improvement of this Index can be the better preparation and monitoring of vessel condition especially when PSC examination is expected. Same to be discussed in the next Management Review Meeting of the Company and will be set for the first applicable period when the circumstances allow for same.

4.3 Energy Efficiency Design Index (EEDI)

Further to the above, there is also a second category of indicators which includes Kpi which pertain to energy related data. The Energy Efficiency Design Index (EEDI) provides a mechanism to be used so as to increase the energy efficiency of vessels. The value of the Energy Efficiency Planning Index is in the International Ship Energy Performance Certificate and will be applied to the Shipping KPI as an item for the ship's characteristics.

The primary goal of a Shipping Company is to create a precautionary approach to Energy Efficiency Management that includes improving the efficiency of ships and voyages, with the aim of reducing the greenhouse gas emissions emitted by the Company's ships. This can be

achieved by creating a plan and implementing it so that the company can achieve the desired result. For the company in this case-study the important criteria for the creation of the plan is the following:

- Effectively reduce CO₂, SOX and NOX emissions
- Be based on sustainable development without restricting trade and growth
- Be cost effective
- Not distort competition
- Be goal-based and leave space for additional methods
- Take into account new technology
- Provide adequate resources to all parties
- Be practical, transparent, free of fraud and easy to administer
- Be binding and include all flag states
- Establish a holistic 'Green' environmental organisational culture

According to the above criteria, the company has established and maintains procedures for measuring and limiting the use of energy in its activities, which include provisions for:

- Minimizing energy waste
- Promoting energy efficiency awareness

- Implementing energy efficiency strategy for ships and voyages to minimize energy use
- Promoting collaboration with charterers and others to facilitate energy efficient operations.
- Ensuring compliance with all legislation on National, International and Administrative Legislation
- Adhering to all relevant guidelines, standards, codes and publications as applicable
- Providing adequate resources for the effective implementation of Ship Energy Efficiency Management Plan (SEEMP)
- Improving SEEMP by taking the necessary actions for identified problem areas through the implementation of Internal Control and Management Inspection systems.

All involved parties, on board and ashore, are required to work in a systematic and structured methodology with the aim of continuously improving energy efficiency.

After the final design of the measures to be implemented in order to create the appropriate plan for the company, a system is created for the implementation of these measures and the definition of tasks and their assignment to qualified personnel. Monitoring and measuring to evaluate plan performance through regular comparisons of actual and expected consumption is an important part. Continuous and consistent data collection is the foundation of monitoring. The energy efficiency of the ship will be monitored quantitatively. Many organizations experience seasonal fluctuations in production and environmental factors, so at least one year of data should be used to create an objective profile. The initial profile (power baseline) serves as the starting point and includes data related to the conditions up to that point and then based on the new data included in the plan, future improvements are measured. Significant organizational changes that affect the validity of KPIs may be reasons to adapt (change) the baseline, such as the new energy resources and creation of comparison of actual and expected energy consumption.

The steps described above can be further understood through the following figure:



4.3.1 Energy Efficiency Design Index

The Energy Efficiency Design Index after rearrangements made to facilitate companies is the key indicator that measures and evaluates ship emissions. The reduction of GHG by a ship is monitored under its SEEMP and BIMCO has implemented data collection methods to simplify environmental reporting. The Energy Efficiency Planning Index (EEDI), as quoted by the IMO, "provides a powerful mechanism that can be used to increase the energy efficiency of ships." To simplify environmental reporting, the following Key Performance Indicators are removed from version 4 of the BIMCO Shipping KPI:

KPI005: CO₂ efficiency shows the energy efficiency of the ship by comparing the CO₂ emitted mass with the total transport activity of the ship

KPI021: NO_x yield expresses the amount of NO_x emitted in relation to the transport project performed

KPI030: SO_x efficiency expresses the energy efficiency of a ship by comparing the SO_x emitted mass emitted in relation to the transport project being performed

According to the above description of BIMCO for the four KPIs, due to their abolitions, consequently the performance indicators related to them are abolished (work transportation).

BIMCO Shipping KPI's Environmental Performance aims to express a company's ability to avoid leaks and reduce emissions caused by ship operations that affect the environment. This is recorded for each ship. Both of the above elements, NO_x and SO_x, vary depending on the operating range. Therefore, the average NO_x or SO_x emissions per transport project will mainly reflect the operating area of a ship despite its environmental performance. Rearranging performance indicators, key performance indicators and vessel characteristics will make data collection and submission more efficient and simplify the use of the BIMCO Shipping KPI system, while allowing for details of environmental benchmarking.²³

²³ https://www.bimco.org/news/shipping-kpi/20201005_implementing_eedi

Chapter 5

Summary & Conclusion:

In the contemporary environment of the maritime industry the standards of international rules and regulations and the focus on quality is ever-changing to the stricter side. New regulations are implemented almost every year and the market stakeholders as well as responsible organizations and authorities are pushing for compliance and measurable results. As derived from this situation, the need for quality control has never been higher. The focus on seamanship is shifting to that of analytics because of the numerous parameters to be taken into consideration for the management of the vessels.

The manual developed and data collected and analyzed in this dissertation is a tool for achieving a substantial level of compliance with the requirements of quality in shipping. The manual covers the theory and description of the quality indicators required, the data collection process and analysis of results while concluding with action plans for the sub-standard values. It covers the main aspects of shipping management i.e., Operational, Environmental, Technical, Financial and Personnel. It has been developed using the acclaimed industry guidance and simulated data collection from realistic management scenarios.

This chapter presents the summary of the research work which undertaken, the conclusion and recommendation has been made through this study as well.

The substandard values are to be discussed and improved through established company procedures.

Such procedures usually, for shipping companies, include a management review meeting with a fixed agenda, compiled around the procedures and performances in need of alteration or improvement. Such meeting are initiated by the top management and all department heads need to participate as the quality control of operations and management tactics pertain to all departments of the company.

The Management Review meeting usually consists on a typical agenda around the main management factors of the shipping company. Such factors are:

- Safety, security, environment protection, regulatory compliance and policy objectives.
- Overall effectiveness of Safety Management System and revisions required
- Repetitive Non conformity Notes and deficiencies i.e. inspection performance of the vessels.
- Statutory / Class Surveys outcome and condition of the vessels

- Technical performance of the vessels and matters of planned maintenance and repairs
- Agreement on responsibility and time schedule of future action.

All the above factors are based on data that may be practically extracted but not measurable or analyzed in an absolute mathematical manner. For example there may be a consideration and discussion of latest deficiencies noted on the fleet but without analysis of how many per category, there could not be a meaningful corrective action plan as to which category suffers the most and which kind measures for prevention need to be focused upon. Also the lack of a mathematical model for analysis prevents the company to show trends in performance and does not allow for higher than basic level of strategic planning. One of the positive outcomes of strategic planning is achieving a higher level of safety, to go from re-active to preventive i.e. SAFETY-I to SAFETY-II, which is impossible without statistics on safety related defects.

The above highlights the importance of implementing the KPI model in the management review, presenting and discussing the values produced by the data and planning ahead based on such data.

As a proper summary of the KPI implementation process the below Management Review Meeting was compiled including the substandard Performance Indicators in the agenda. In this management review analysis, it is demonstrated how the planning of corrective and preventive actions is affected by the KPI values

The minutes of the minute include not only the typical matters of SMS revisions, inspection outcomes and organizational matters but are also enhanced with the data provided by the KPI analysis.

The accuracy and effectiveness of the KPI system and results are directly linked with the accuracy of the data collected as well as the time period and population of vessels i.e. the actual data amount. This means that with the collection of more data over the years the Company's trends as well as the vessel performance become clearer whereas with the collection of data from more than one vessel the Company's trends become more accurate and the strategic planning and growth on a corporate level is more efficient.

Due to the fact that sample data and case study pertain to a single vessel company there is a restriction in analyzing the factor of strategic growth as we may not be able to determine the performance of current Management on a more demanding fleet. Although one aspect that may be derived is that if the company performs well with

the current fleet for several years and in several factors, it may be feasible to gradually increase the fleet with similar success. Upon that a new set of KPIs and analysis model would have to be determined taking into account also the office management performance. The KPI model should always be a living organism ever evolving depending on the demands of the management and the peculiarities of the fleet. For different vessel types a differentiation of the KPIs should occur. For different trade routes and cargo types the operational and safety/ security KPIs should be adaptive.

The importance of the KPI model is that it applies to all types of vessel management schemes and may be implemented to improve the management performance even in the most demanding markets and areas of operation.

APPENDIX 1 – Management Review Meeting Minutes Report

FROM: DPA/CSO	DATE: 30/01/2022
TO:	MANAGEMENT REVIEW TEAM
	COMMENCING : Date : Time : 14:00 HRS
	COMPLETING : Date : Time : 16:00 HRS
	NEXT MEETING: Date : N/A
TOPICS TO BE DISCUSSED	
<ol style="list-style-type: none"> 1. PREVIOUS MANAGEMENT REVIEW MEETING AGENDA ITEMS 2. FLAG / CLASS / NATIONAL REQUIREMENTS 3. DEPARTMENTS ORGANIZATION AND OPERATION 4. EXTERNAL / INTERNAL AUDITS PERFORMANCE 5. PCS / FLAG INSPECTIONS PERFORMANCE 6. EFFECTIVENESS OF THE SMS AND REVISIONS 7. ACCIDENTS/ INCIDENTS AND NEAR MISSES 8. EMERGENCY PREPAREDNESS AND DRILL PERFORMANCE 9. PREVENTIVE MAINTENANCE / DEFECTS / TECHNICAL MATTERS 10. MANING AGENTS PERFORMANCE 11. UPCOMING REGULATIONS 12. KPIs ANALYSIS 	
<p style="text-align: center;"><i>KPIs Analysis</i></p> <p>During the meeting the entirety of KPIs discussed and almost all values found to be inside or over the respective goal setting with the exception of the ones further discussed below</p> <ol style="list-style-type: none"> 1. <i>KPI 004 - Cargo Related Incidents.</i> Our result for the first quarter of the reporting period was 3. After due investigation all the incidents were related to disputes with the cargo quantity. This derives from error margins between shore scales and draft surveys. 2. <i>KPI012- Failure of Critical Equipment and Systems.</i> Our results for the first and fourth quarters were 2 and 3 respectively. The root cause for all cases was poor maintenance due to the schedule and turnover of the vessel during the past year. 	

REMARKS	
	<p>DEPARTMENT MANAGERS SUGGESTED THE TOPICS FOR DISCUSSION, AND THE ABOVE ITEMS WERE AGREED BETWEEN THE MEMBERS OF THE MANAGEMENT REVIEW TEAM.</p> <p style="text-align: center;"><u>LIST OF ACTIONS AGREED</u></p> <ol style="list-style-type: none"> <i>1.</i> KPI004 -Training campaign will be launched for the fleet’s deck officers in cargo handling and draft survey procedures so as we minimize the room for such errors <i>2.</i> KPI 012 -Improvement of this Index will be achieved with the closer monitoring of the preventive maintenance by the shore-based personnel as well as better training of Engine Officers in maintenance procedures as dictated in the SMS.

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