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"HUMAN FACTOR ANALYSIS AS A KEY PERFORMANCE INDICATOR IN MARITIME TRANSPORT"

by

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Abstract

The central contribution of this thesis is to prove, through qualitative analysis, that "Human Factor" is one of the most significant parameters in maritime business and more specifically in maritime transport.

The current interest in Human Factor, in the maritime sector, arises from the fact, that technological, environmental and safety developments, have focused attention, on the need to consider human beings and their interaction with machines, materials, information, procedures and environments, in such developments and in designing a technological system.

First comes safety, so there is a great need that companies and personnel, familiarize with the anthropocentric evolution of SAFETY I, known as SAFETY II. The aforementioned, when combined together, they can develop a secure SMS, when human element is involved in a proactive way.

The OCIMF's newest tool, TMSA 3, brings up revolutionary changes as far as the implementation of specific KPI's and their best practice, for oil companies. Innovations arise, through the benchmarking of TMSA 2 and TMSA 3.

Concepts such as "human error", "human reliability", "resilience", "human resource management", and "leadership" are brought up in the forefront and with a human element analysis are being decoded.

What is more, through the analysis of the implementation of those new concepts, "Human Factor" is validated as a KPI.

"Keep Ithaca always in mind.

Arriving there is what you are destined for."

Excerpt from Ithaca

Written in Greek by C. P. Cavafy

Translated by Edmund Keeley and Philip Sherrard

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May God bless you all.

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Abbreviations

ACSNI: Advisory Committee on the Safety of Nuclear Installations

BRM: Bridge Resource Management

DP: Designated Person

HCI: Human–Computer Interaction

HEP: Human Error Probability

HR: Human Resources

HRM: Human Resource Management

HSQE: Health, Safety, Quality Environment

IMCO: Inter-Governmental Maritime Consultative Organization

IMO: International Maritime Organization

ILO: International Labor Organization

ISM: International Safety Management

ISO: International Organization for Standardization

KPI: Key Performance Indicator

MARPOL: Marine Pollution

MOC: Management of Change

OHSAS: Occupational Health & Safety Management System

PI: Performance Indicator

SOLAS: International Convention for the Safety of Life at Sea

SPI: Shipping Performance Indicators

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

TMSA: Tanker Management and Self-Assessment

TQM: Total Quality Management

Introduction

The international regulations that affect safety, quality and management in the maritime sector are being presented, in the first chapter. In the shipping industry, rules and regulations are very important anchors, every company should comply with, in order to achieve best functional results.

In the second chapter hierarchy pyramid presents, PIs, KPIs and SPIs as TMSA's tools. TMSA3 and it's 13 element format mentions the stages and the procedures that companies should come into compliance. What is more, TMSA3 brings up innovations. Human element occurs as a significant factor and key role in vetting.

Everything arises from the great need of safety in every single function, in maritime affairs. The need to changeover from Safety I to Safety II and the way that happened is unfolded, and the main points, of Safety and Just Culture, are also presented.

Human element is extensively analyzed in this fourth chapter. The ideas of human error, human reliability, resilience and leadership interact with each other, as they are the domains that fulfil the matrix of a competent maritime structure.

Finally, the results of the human element analysis decode, that human factor is a KPI. Each company should implement this KPI, in a different way, depending on the needs and peculiarities. Proposals of what may should be done in the future, are adduced in this dissertation.

1. International Organizations, Conventions and Regulations

Humans have depended on seas, lakes and waterways, to transport products from one end to another all through the recorded history. Nowadays, over 90% of the world's cargo is transported by merchant ships due to various reasons, counting that it is the cheapest form of transportation. In fact, from the early 1920s through the end of the century, the overall number of merchant ships within the world, expanded from beneath 30,000 to around 90,000. Moreover, nowadays a large number of ships are being used for different military purposes all through the world. A modern ship is comprised of numerous components (systems), each of which features a varying degree of impact on the overall performance of the ship. In spite of the fact that numerous of these frameworks may be completely robotized, they still require a degree of human intercession (e.g., set starting resistances or react to alerts). Also, the non-automated frameworks may require direct human inputs for their operation and maintenance, people to get associated with other people, etc. As humans are not one hundred percent reliable, the past experiences indicate that in the shipping industry around 80% of all accidents are rooted in human error.

The sinking of the Titanic on 15 April 1912, the Exxon Valdez oil spill on 24 March 1989 and the sinking of the Costa Concordia on 13 January 2012 are three maritime tragedies during the past hundred years. They were main reasons for the establishment of several international organization and the enactment and development of regulations in order to enhance the safety of human life and protect the environment.

1.1 IMO

Maritime operations are commonly categorized as one of the foremost complex and unsafe industry inside the expansive industrial divisions globally (Celik, 2009; Hetherington et al., 2006). For this reason, the International Maritime Organization (IMO) ceaselessly endeavors to guarantee the safety of maritime operations by providing international conventions such as the International Convention for the Safety of Life at Sea (SOLAS) and particular safety management guidelines such as the International Management Code for the Safe Operation of Ships and Pollution

prevention (ISM Code). These and other regulations have brought a progressive enhancement of the security of maritime operations and maritime organizations in general (Kristiansen, 2013). Be that as it may, the impact of these security directions and rules on having a real proactive approach to sea security is still being addressed (Schröder-Hinrichs et al., 2013). Besides, in certain divisions of the maritime industry, the design and implementation of their safety management systems (SMS) are still impacted by a common restricted approach which focuses on satisfying the requests of the regulations appropriate to the organization (Schröder-Hinrichs,2010).

The mission of the International Maritime Organization (IMO), as a United Nations specialized agency, is to advance secure, safe, ecologically sound, effective and sustainable shipping through participation. This will be fulfilled by embracing the highest practicable measures of maritime security and safety, efficiency of navigation and prevention and control of pollution from ships, as well as through consideration of the related legitimate things and successful usage of IMO instruments, with a view to their universal and uniform application (IMO, 2019). IMO will maintain its authority part as the worldwide controller of shipping, advance more noteworthy acknowledgment of the sector's significance and empower the headway of shipping, whereas tending to the challenges of proceeding improvements in innovation and world exchange and the need to meet the 2030 Agenda for Sustainable Development.

To achieve this, IMO will center on the survey, advancement and implementation of and compliance with IMO instruments in its interest to proactively distinguish, analyze and address rising issues and back up Member States in their implementation of the 2030 Agenda for Sustainable Development (IMO, 2019).

1.2 ILO

Since its creation International Labor Organization (ILO) has had special machinery for seafarers such as the Joint Maritime Commission and the special Maritime Session of the International Labor Conference (ILC) (ILO, 2010, p.1). Moreover, human element has been the “raison d’être" for ILO since its formation (Bolle, 2006; Doumbia-

Henry, 2010). As a result of this legacy on 23rd February 2006 during the 94th session of ILC at its 10th Maritime session we saw the advent of the Maritime Labor Convention (MLC) – 2006 (Orbie and Tortell, 2009; ILO, 2010). MLC – 2006 also known as, the "super convention" (DCOMM, 2010, p.1; ILO, 2010), solidifies and overhaul more than 65 international labor standards pertaining to seafarers (ILO, 2010). In view of Pierola (2010) and ILO (2010), the convention covers a wide range of issues ranging from decent working conditions to welfare and social security assurance etc. and creates a fair playing field for the proprietors. MLC – 2006 is being referred as the "fourth pillar" of the IMO and it will compliment key conventions such as SOLAS, STCW and the International Convention for the Prevention of Pollution from Ships, 73/78 (MARPOL) (Somavia, 2006)

The collaboration between ILO and IMO dates back to 1959 as under Article I and III the two organizations are to participate on things of common interest (ILO, 2010). A similar cooperation is seen between the two in addressing the human element, i.e. the Joint Working Group on the human element to address the role of the human element in shipping IMO (2009). Such participation between the two will lead to developed maritime safety, labor and social conditions in the industry. Furthermore, Joint IMO/ILO Ad Hoc Expert Working Group on Fair Treatment of Seafarers and Joint IMO/ILO Ad Hoc Expert Working Group on liability and compensation regarding claims for death, personal injury and abandonment of seafarers are examples of the efforts in dealing with human element. In view of Doumbia-Henry (2010, p.2), the implementation of MLC – 2006 will give human element a "front and central role in the maritime industry."

1.3 SOLAS

Among all international conventions that deal with maritime safety, the most significant is the International Convention for the Safety of Life at Sea (SOLAS). Moreover, it is one of the oldest, the first version having been adopted at a conference held in London in 1914. Since then there have been four other SOLAS conventions: the second was adopted in 1929 and entered into force in 1933; the third was adopted in 1948 and entered into force in 1952; the fourth was adopted (under the auspices of IMO) in 1960 and entered into force in 1965; and the present version was adopted in 1974 and entered

into force in 1980. All of the SOLAS conventions have covered aspects of safety at sea. The 1914 version, for example, included chapters on safety of navigation, construction, radiotelegraphy, life-saving appliances and fire protection (SOLAS, 1998).

These subjects are still dealt with, in separate chapters in the 1974 version. The 1914 Convention was, as implied by its title, concerned primarily with the safety of human life. The late 19th and early 20th centuries represented the golden age of passenger travel by sea: there were no aircraft, and emigration, from Europe to the Americas and other parts of the world, was still taking place on a massive scale. Traveler ships were hence much more common than they are nowadays, and mishaps habitually driven to overwhelming casualties (SOLAS, 1998). The yearly misfortune of life from British ships alone found the middle value of between 700 and 800 amid this period. The occurrence which driven to the assembling of the 1914 universal SOLAS conference was the sinking of the White Star liner Titanic on her maiden voyage in April 1912. More than 1,500 travelers and crew passed on, and the fiasco raised so numerous questions about the safety standards in constrain that the United Kingdom Government proposed holding a conference to develop international regulations. The Conference was attended by agents of 13 countries and the SOLAS Convention which resulted was adopted on 20 January 1914. It introduced new international requirements dealing with safety of navigation for all merchant ships; the provision of watertight and fire-resistant bulkheads; life-saving appliances; and fire prevention and firefighting appliances on passenger ships (SOLAS, 1998).

Other requirements dealt with the carriage of radiotelegraph equipment for ships carrying more than 50 persons (had the Titanic's distress messages not been picked up by other ships the loss of life would probably have been even greater); the Conference also agreed on the establishment of a North Atlantic ice patrol. The Convention was to enter into force in July 1915, but by at that point, war had broken out in Europe and it did not do so, in spite of the fact that numerous of its arrangements were embraced by individual nations. In 1927, be that as it may, propositions were made for another conference which was held in London in 1929 (SOLAS, 1998). This time 18 countries attended. The conference adopted a new SOLAS convention new regulations. It entered into force in 1933. One of the two

annexes to the convention revised the international regulations for preventing collisions at sea (Collision Regulations).

By 1948 the 1929 convention had been overwhelmed by United Kingdom once more facilitated an international conference which adopted the third SOLAS Convention. It taken after the as of now set up design but secured a more extensive run of ships and went into impressively more noteworthy detail. Imperative changes were made in such things as, watertight subdivision in passenger ships; stability standards; the maintenance of essential services in emergencies; structural fire protection, including the introduction of three alternative methods of subdivision by means of fire-resistant bulkheads, and the enclosure of main stairways. An international safety equipment certificate for cargo ships of 500 gross tons and above was introduced - an indication of the growing importance of cargo ships relative to passenger ships, which were already facing competition from aircraft (SOLAS, 1998). The Collision Regulations were moreover changed and controls concerning the security of navigation, meteorology and ice patrols were brought up to date. An isolated chapter was included managing with the carriage of grain and unsafe products, including the explosives. There had been considerable developments in radio since 1929 and the 1948 Convention took these into account (the title of the relevant chapter made specific reference to radiotelephony as well as radiotelegraphy). The year 1948 was very important because a conference held in Geneva under the watch of the United Nations adopted a convention establishing IMO - or the Inter-Governmental Maritime Consultative Organization (IMCO), as it was known back then (SOLAS, 1998).

The 1948 SOLAS Convention recognized that the creation of this new Organization would, for the first time, mean that there was a changeless international body competent of receiving enactment on all things related to maritime security. It was initially planned that the Convention would be kept up to date by occasional alterations received beneath the auspices of IMO but within the occasion it took so long to secure the approvals required to bring the IMO Convention into drive that the new Organization did not meet until 1959. It was at that point chosen that instead of correcting the 1948 Tradition it would be way better to embrace a totally new instrument - the fourth SOLAS Convention (SOLAS, 1998)

The 1974 adaptation incorporates the implied acknowledgment strategy - which gives that a revision should enter into constrain on an indicated date unless, complaints to the correction are received, before that date, from a concurred number of Parties

As a result, the 1974 Convention has been upgraded and revised on various occasions. The Convention in constrain nowadays is in some cases alluded to as SOLAS, 1974, as revised. (IMO, 2019).

1.4 ISM

Known as the International Safety Management Code, the ISM Code is one of the aforementioned required regulations in the marine industry. From the year 1994, it has been a very vital component of the SOLAS Convention (Safety of Life at Sea). It was in this year that this code was formally adopted and integrated as a part of the SOLAS Convention.

In other words, it can be also highlighted that the ISM Code Shipping is an intrinsic part of the International Maritime Organization (IMO) in its endeavors to guarantee, keep up and effectuate security for the seafarers as well as at the same time giving a pollution free zone for the division totally (ISM, 2014).

It can be said that the code centers on bringing the perspective of marine security to a common platform for vessels of all nationalities. This dispenses with any disparities that might emerge approximately the maintenance of a much-needed safety protocol.

According to the stipulations of the Code it is obligatory that all ships take after this code. In order to execute its fitting usefulness, the International Safety Management Code is supported by a Safety Management System.

This system, abbreviated as SMS, details the various requirements that need to be followed like:

- Establishment of a managerial committee to oversee the various proceedings

- Ensure that the managerial officers carry out their outlined duties appropriately
- Corroborate the differences between the outlined responsibilities and the actual performance to resolve them
- Audit the vessel – both internally and externally so as to eliminate all possibilities of safety problems

The perspective mentioned last comes beneath the ambit of Planned Maintenance System. It is anticipated of each shipping organization that it carries out auditory analyses of its management system and implements the same, wherever missing. Whereas the internal auditing is carried out by the company itself, the external auditing is carried out, every second year, by the authorities of the nation where the vessel is enlisted to. On the off chance that the vessel has effectively consolidated all the safety prerequisites, at that point the authorities issue it with a Certification of Safety Management or the Safety Management Certificate which brings the complete chain of prepare to a productive completion (ISM, 2014).

1.5 STCW

International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978 was adopted on 7 July 1978 and entered into force on 28 April 1984. The main purpose of the Convention is to promote safety of life and property at sea and the protection of the marine environment by establishing in common agreement international standards of training, certification and watch-keeping for seafarers (IMO, 2019).

1.5.1 STCW 78

Before the adoption of STCW 78, maritime nations had diverse frameworks of preparing and certification, that were educated by their own national instructive, educational and professional approaches, driving to differing sea preparing strategies (Ashmawy, 2006; Morrison, 1997). In spite of the fact that, this demonstrated a

respectable begin, it may have not been perfect for the worldwide nature of shipping and its changing needs, that required a more unified maritime educational and training approach. Thus, the STCW 78 was first adopted on 7th July, 1978, with the goal of developing international standards of maritime education, training and certification and boosting professional standards of seafaring globally (IMO, 2011; International Transport Workers' Federation, 2013).

Contrariwise, International Transport Workers' Federation (2013) posits that the STCW 78 tended to center basically on developing mariners' knowledge. While the fulfillment of knowledge by seafarers is significant, it is additionally fundamental that they illustrate their adeptness in what they learn. Furthermore, it appears that the adoption of STCW 78 was centered on standards instead of practical desires subsequently, the likely reason for the location of its insufficiencies by IMO member States.

1.5.2 STCW 95

Ironically, it shows up that the STCW 78 did not resolve all the deterrents of accomplishing the required universality in MET and conferring professionalism in seafaring as expected. Subsequently, it was changed impressively in 1995 with the deliberate of tackling the insufficiencies of the starting STCW by complementing practical skills, abilities and competence, pivoted on theoretical knowledge and least required standards of competency (Worldwide Transport Workers' League, 2013; Jorgens, 2012). In addition, concurring to Jorgens (2012), the 1995 changes were also made against the backdrop that the STCW 78 comprised various vague articulations that driven to shifted interpretations by IMO member States. Moreover, International Shipping Federation (2007) asserts that the STCW 78 was respected as a compromise between nations craving tall benchmarks and those concerned almost their capacity to influence its arrangements. In spite of the fact that the reasons for the amendment of the STCW 95 were justified, it unveils the challenges of defining 'universal' laws, especially because it relates to the IMO, which may emerge due to issues of national boundaries, sovereignty, accessibility of assets or specialized skill, subjective interface and assorted levels of comprehension.. Thus, it may be outlandish to anticipate that the STCW would be immaculate at any given time. Also, it may too be irrational to

anticipate its equal implementation by nations. However still, calculated compromise and mulled over included esteem may have guided agreement to the corrections.

1.5.3 STCW 2010

On the other hand, in spite of the well-intended reason of the STCW 95, it shows up that it was still inadequately to address the rising advancements inside the maritime sector. As a result, the most recent of the previously mentioned modifications, are the 2010 amendments, also known as the "Manila amendments' (IMO, 2011)

In this respect, the 2010 amendments were planning to make improvements on the STCW, as corrected in 1995, by tending to recent technology, inconsistencies, translations and out-of-date arrangements (International Chamber of Shipping & International Shipping Federation, 2011; International Transport Workers' Federation, 2013; Jorgens, 2012). Subsequently, the Manila amendments emphasize seafarers' competency and a competence-based approach to the training of seafarers (Fisher & Muirhead, 2013; Universal Shipping Alliance, 2011).

The industry requires well qualified and high caliber seafarers competent of adjusting to alter and dealing with the wide extend of tasks presently required of them. Any training program given must guarantee quality isn't compromised within the journey for expanding quantity. In a sense, the 2010 Manila amendments appear to request that seafarers demonstrate their capabilities before they are formally employed on board ships. Usually coherent considering the current noticeable quality given to safe and secure shipping practices inside the maritime domain. Other than, with almost 90% of the world's add up to exchange of merchandise in tons being transported by ocean (Shuo, 2014) and the potential dangers ocean disasters posture to human life, the environment and worldwide economies, it appears significant to have competent sailors on board ships.

1.5.4 Manila amendment requirements

Subsequently the 2010 amendments:

i) introduced modern training and certification prerequisites and techniques,

ii) updated the measures of competency crucial in tending to rising technologies,

iii) augmented instruments for authorization of its arrangements and

iv) revised necessities on hours of work and rest, anticipation of drug and alcohol abuse and medical wellness standards for seafarers (IMO, 2011).

Particularly, the Drewry Maritime Research (2014), the International Chamber of Shipping and the International Shipping Federation (2011), note that the Manila amendments contain the taking after modern preparing requirements:

1) Improved methods to prevent false hones connected with certificates of competency and a fortification of the assessment handle (checking of parties' compliance with the Convention),
2) Revised necessities on hours of work and rest and unused necessities for the avoidance of drug and alcohol mishandle, as well as upgraded benchmarks relating to restorative wellness measures for seafarers,
3) New certification prerequisites for able seafarers,
4) New necessities relating to preparing in advanced innovation such as electronic charts and data frameworks (ECDIS),
5) New necessities for marine environment training and preparing in authority (leadership) and teamwork,
6) New training and certification prerequisites for electro-technical officers,
7) Updating of competence necessities for personnel serving on board all sorts of tankers, including modern necessities for staff serving on liquified gas tankers,
8) New necessities for security training, as well as arrangements to guarantee that seafarers are appropriately prepared to manage on the off chance that their transport comes beneath assault by pirates,

9) Introduction of advanced training technique including distance learning and web-based learning,
10) New training direction for staff serving on ships working in polar waters,
11) New training direction for staff working and operating Dynamic Positioning Systems, and
12) Refresher training to demonstrate seafarers have ceaselessly kept up their competencies

1.6 ISO

The International Standardization Organization (ISO) was shaped in 1947 as a nongovernmental organization with the reason of advancing, the improvement of guidelines to encourage the universal trade of products and administrations. It also will look for worldwide co-operation in scientific, mechanical, technological and financial activities. ISO comprises of approximately 100 nations as individual members in spite of the fact that its number keeps growing and these member countries are generally represented to in ISO by their national standard organizations (Madu, 1998).

ISO is used as the brief frame for the International Organization for Standardization instead of 105. The term ISO is inferred from the Greek word 'isos' which suggests 'equal,' therefore the utilization of equal standards as guidelines to direct the worldwide trade of merchandise and benefits (Madu, 1998).

As defined by the Central Secretariat of ISO, the purpose of international standardization of facilitating trade exchange and technology transfer can be achieved through (Madu, 1998):

1. enhanced product quality and reliability at a reasonable price
2. enhanced item quality and unwavering quality at a sensible cost;
3. improved wellbeing, security and environmental assurance and lessening of waste;
4. greater compatibility and interoperability of products and services;
5. simplification for progressed usability;
6. reduction within the number of models and hence lessening in costs;

7. increased dissemination proficiency and ease of maintenance ('Introduction to ISO' from ISO Online).

International standards serve a basic function in today's worldwide markets. They expel essentially, as ISO notes, 'technical boundaries to trade.' Such obstructions may be anticipated when there's no consistency in standards among comparable businesses and advances around the world. Progressively, countries within the same regions are adjusting themselves to secure their advertise turf and without standardization of industrial practices, it'll be greatly troublesome to compete exterior one's locales. Universal standardization is anticipated to proceed to develop in its popularity around the world (Madu, 1998)

1.6.1 ISO 9001

ISO 9001 alludes to quality management, which alludes to all those highlights of an item or service which are required by the client. Moreover, quality management, implies what the organization does to guarantee that its products or services fulfill the customer’s quality prerequisites and comply with any directions pertinent to those products or services. Quality management has to do, also, with what the organization does to improve client fulfillment to realize persistent advancement of its performance (Seifollahy, 2013).

1.6.2 ISO 14001

ISO 14001 alludes to environmental management. This implies what the organization does in purpose to play down destructive impacts on the environment caused by its activities and to comply to applicable administrative necessities. Moreover, company takes after ISO 14001, must proceed in progress of its environmental performance (Ramasubramanian, 2016).

1.6.3 OHSAS 18001 – ISO 45001

The OHSAS 18001 (Occupational Health & Safety Management System) was published in 1999, revised in 2007 and is one of the most recognized standards internationally for health and safety management systems at work. In some countries, the application of a health and safety management system to work is a legislative requirement. Recent developments in international systems standards have made it imperative to create a new ' ISO ' standard for health and safety at work – which in fact has a common structure and approach to international standards of management systems e.g. ISO 14001:2015, ISO 9001:2015 etc.

The OHSAS 18001 provides a structured approach to risk identification and management in order to help reduce accidents or other occupational health problems by establishing a safer working environment (Piotr Kafel 2016). ISO 45001 is the new international standard that defines the requirements of an H&A management system at work, published in February 2018, replacing OHSAS 18001.

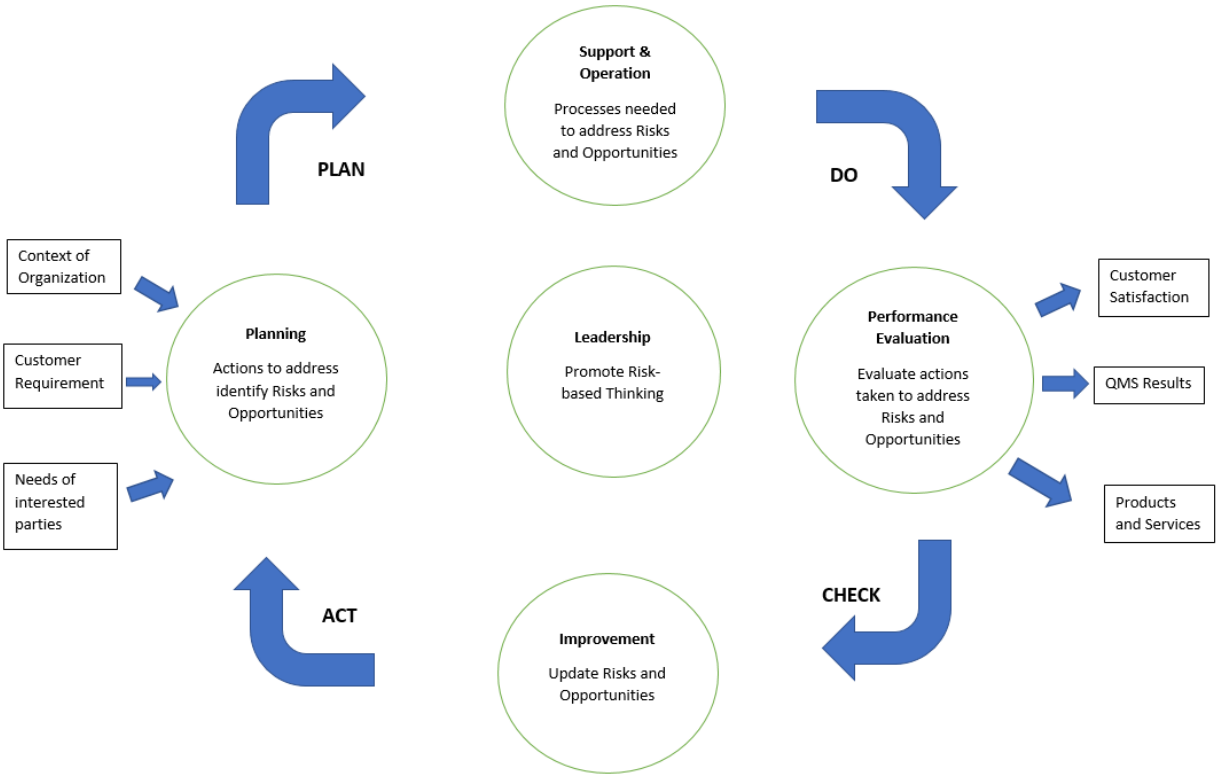
Main changes from OHSAS 18001 to ISO 45001

- ISO 45001 will have a common structure, common terms and definitions with ISO 9001 and ISO 14001
- This structure aims to facilitate the implementation process and the consolidation of various management systems in a harmonized, structured and effective manner.
- Active participation and increased obligations of the organization’s high authority
- Replacement of ' Hazard Identification ' with the term ' risk recognition ' (Risk Identification) to cover a broader field.
- Expanding the word risk and how suppliers – subcontractors manage their risks.
- Change the term "employee – workplace" There are also new definitions of terms such as: monitoring, measurement, efficacy, performance and process

What is most significant to be mentioned is that ISO 45001 vs OSHAS 18001 brings up proactivity instead of reactivity.

Both ISO 9001,14001 and 45001 are based on PDCA cycle and its process as follows:

Figure 1: PDCA Cycle



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The PDCA cycle means:

- "PLAN": what you are in progress to do
- "DO": according to your Plan
- "CHECK": so that you see if it is done what was initially planned
- "ACT": alter or develop the part of your Plan or Do that did not give you the results you intended.

The key concept that occurs is: "Say what you do and do what you say".

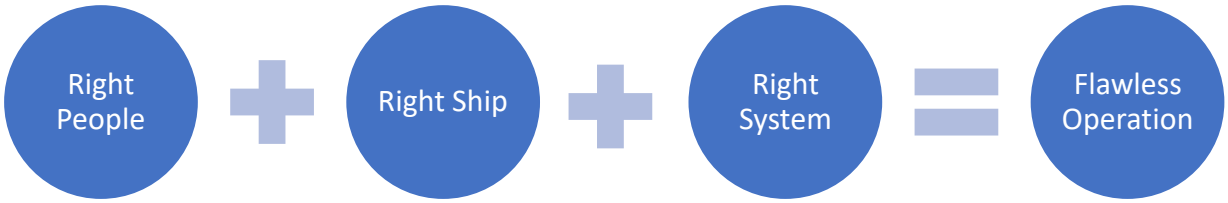
1.7 Total Quality Management

The logic of total quality management (TQM) in presently broadly diffused in all sorts of trade organizations, whereas its fruitful usage leads to an assortment of positive results or has vital suggestions for the receiving companies, since it targets at continuous change with the cooperation of all workers in order to guarantee inside and outside customer satisfaction (Sitkin et al., 1994). The significance of TQM is profoundly uncovered through the expanding number of scholarly ponders rising particularly after the early 1990s, in a time period when Dean and Bowen (1994) viewed total quality as "as a philosophy or an approach to management that can be characterized by its principles, practices, and techniques." (p. 394). Concurring to Dean and Bowen (1994) the three standards of total quality are, customer focus, ceaseless enhancement and collaboration, whereas the practices encourage the implementation of the principles and incorporate the collection of client data or process analysis. At long last, these hones are at that point bolstered by a certain number of strategies and techniques. Besides, the presence of certain basic success elements for the usage of quality management systems, such as leadership, participation learning, process management, nonstop change, employee fulfillment and customer satisfaction, has also been recognized back in time (Anderson et al., 1994), driving a significant number of creator-writers to carefully assess the special practices that best characterize the complexities of a TQM framework (Dark and Doorman, 1996)

1.7.1 TQM and organizational characteristics relationship.

Numerous studies from the past, uncover that the size of a company (Gagnon & Toulouse, 1996; Germain, 1996) and principal ownership (Ahire et al., 1995) are related to management and administration activities in the implementation of TQM.

Figure 2: Modern Ship Management Equation with TQM characteristics



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Organizational culture implies to attitudes, beliefs, and situational interactions. It has been impacted by diverse sorts of proprietorship. As a result, the degree of TQM utilization is diverse

2. TMSA

During the last decades the shipping industry and especially the tanker industry has experienced a significant change in the direction to a quality orientated industry. It can be said that this was caused by the dramatic ship and especially tanker accidents in the 1980s and -90s. This change in industry behavior has led to different tools in order to ensure quality with regard to a safe and environmentally friendly operation of vessels. Vetting of tankers is a crucial part of this, also the International Safety Management Code (ISM Code) must be considered as an important part of this new quality orientated industry. Furthermore, has the tanker industry established during the years the Tanker Management and Self-Assessment (TMSA) in order to ensure that the tanker operators are complying with the ISM Code and additionally to mandatory high-level tanker industry standards.

TMSA guide is a tool created by OCIMF to help Tanker operators to assess and improve their SMS and is intended to encourage self-regulation and to promote continuous improvement. TMSA brought along a new culture in the industry and achieved its goal since now almost all Companies management systems are more or less in compliance with the most advanced industry standards. Being a standard imposed by the Oil Majors, TMSA implementation is mandatory. In fact, it is a less flexible system than the one based on the ISM requirements, because ISM relies on international rules which may be rightfully challenged, whilst the TMSA compliance relates to auditors' approach and instant behavior, which may well be arbitrary and non-negotiable (OCIMF, 2019)

The TMSA has to be seen in connection with the before described tanker vetting. It was developed to include also the tanker operator into the vetting process. Turker (Turker & Er 2008, p. 129) stated that the need for a scheme focusing on the tanker operators was necessary due to the criticism which was given that the requirements of the ISM code were not being followed properly. According to Knowles (2010), the TMSA was originally developed by a single oil major, which was not further named, and then adopted by OCIMF as a best practice guide in 2004. In 2008, the TMSA was revised and, thus, a second version was published referred to as TMSA2. He also mentioned that: "OCIMF believes that TMSA2 provides a comprehensive and invaluable tool to

help ship operators measure and improve their safety management systems. It encourages ship operators to assess their safety management systems against listed key performance indicators (KPIs) as a guide and measure of best practice".

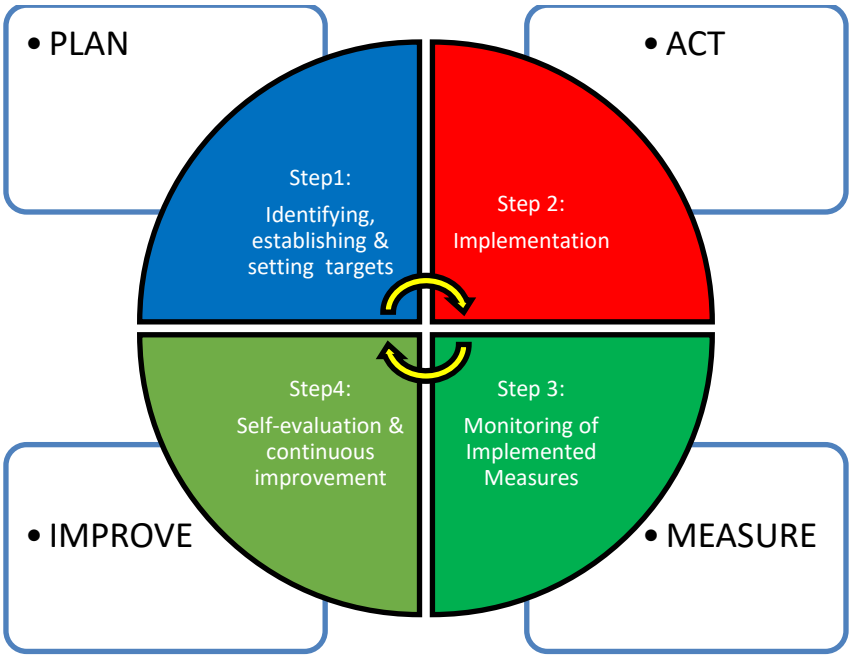
Within the above quotation the direct link between the TMSA and the ISM Code and its SMS respectively can be seen. In addition to this internal use for performance improvement of a ship operator, it has to be said that the TMSA, since its introduction, is playing a major role in the vetting process. Because this scheme gives, as mentioned above, the oil majors the first tool to assess the operator's shore operation and has been playing a major role in the vetting process since its introduction. This does not mean that this had not been considered by the oil majors in the pre TMSA era. In fact, a ship operator's management capability and performance is playing an important role in the vetting regimes since its appearance, but the TMSA allows the charterer to the judge a ship operator's self-assessment, and, thus, the awareness of an tanker operator against his actual performance, as validated by the vessel's inspections rather than to base an operator's assessment only on the overall performance of his fleet.

Knowles (Knowles 2010) states that an increasing number of vetting organizations and, consequently, charterers are requiring the TMSA. Furthermore, it is expected by these vetting organizations that the companies who are preparing the TMSA will use same for a performance measurement and consequently for the improvement of their shore-based organization and specially to improve their SMS. Due to the fact that the TMSA encourage a continuous improvement it is not only a tool like the ISO standards, in fact it is, due to the continuous improvement, already in-line with the ISM Code, which is of course understandable because it was established to monitor a company's ISM Code compliance.

Whereas the tanker vetting is a compliance examination and is, therefore, done on a fail or pass basis, the TMSA audit should lead, through the attribute of continuous improvement, to a more systematic assessment by the oil majors. That implies that the TMSA audit cannot be done on a pass or fail basis because the self-assessment is evaluated, and, thus, it is inspected whether or not the ship-owner has incorporated the soul of ISM Code and continuous performance improvement or if he is just running his business on minimum requirements.

The TMSA is designed to help companies continually improve their SMS through regular self-assessment following the key components of a continual improvement cycle.

Figure 3: Plan- Act- Improve- Measure Components



Source: Author generated

Sang (1998) emphasized the importance of measuring performance through performance indicators, stating "If you can't measure it, you cannot manage it". KPI is an objective performance tool that helps organizations find deficiencies, benchmark improvements, and maintain self-improvement (Parmenter, 2015). Performance indicators are a key component as a measuring tool for organizations because it is not possible to determine the success or failure of a performance goal if the achievement is not accurately measured. KPI is commonly implemented to monitor and review performance in practice (Reiman and Pietikäinen, 2012). Performance indicators are widely used in the shipping industry, such as shipping companies, ports, and administrations to measure performance for continuous improvement (Graziano, in press).

2.1 Hierarchy of indicators (The Shipping KPI Standard)

The Shipping KPI Standard is built up hierarchical with 8 Shipping Performance Indexes (SPIs), 33 Key Performance Indicators and 64 Performance Indicators (PIs). There is a mathematical relation between SPIs (high level indexes) which are calculated from Key Performance Indicators, and KPIs which are calculated from Performance Indicators (lowest level).

On the lowest level you find the PIs, which are based on data capture (measurements or counters) directly from a ship or from the shipping management. Data is collected once and re-used within the Shipping KPI Standard in order to reduce the amount of data (BIMCO, 2018). On KPI level a form of normalization take place. The KPI are scaled into a range from 0-100, where zero indicates unacceptable and 100 is outstanding performance. This makes it possible to compare ships with different characteristics or amount of data captured (BIMCO, 2018).

Finally, on the highest level the KPIs are combining into Shipping Performance Indexes in order to express performance within specific main areas.

2.2.1 Shipping Performance Indicators (SPI)

The Shipping Performance Indexes (SPIs) are aggregated expressions of performance within a particular area. The SPIs are expressed as a weighted average of relevant KPI Ratings on a scale between 0 and 100. Some Key Performance Indicators (KPI) can be included in several SPIs. An example is the KPI Crew planning which is used in calculation of all SPI Ratings. The objective of the SPIs is to give external stakeholders information about the overall performance of a ship in one of the following areas (BIMCO, 2018).:

- Environmental Performance
- Health and Safety Performance
- HR Management Performance
- Navigational Safety Performance
- Operational Performance
- Security Performance

- Technical Performance
- Port State Control Performance

2.1.2 Key Performance Indicators (KPI)

The Key Performance Indicators (KPIs) are expressions of performance within a specific area. The KPI's ratings will form basis for the Shipping Performance Index (SPI) score. The KPI's can be expressed in two ways; a KPI Value which is a mathematical combination of relevant Performance Indicators Values and a KPI Rating which is an expression of the KPI Value on scale between 0 and 100 where a high rating (100) is a result of high/excellent performance. Some PI Values can be included in the calculation of more than one KPI Value. Examples of KPIs are: Budget performance, Dry-docking planning performance and Ship availability (BIMCO, 2018).

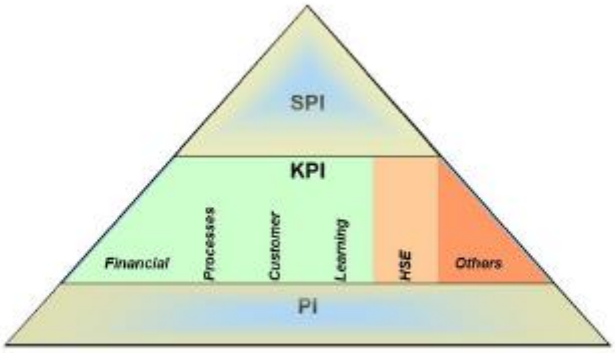
A KPI is:

- a numerical, objective measure of performance
- key to the strategic business objective
- actionable and influenced by the relevant stakeholder/manager
- accountable to stakeholder/manager
- output oriented, not focused on input or activity
- possible to calculate with limited efforts and within limited time

The objectives of KPIs are to:

- measure for continuous improvement
- measure for internal and external benchmarking
- measure to set incentives

Figure 4: KPI Focus



Source: BIMCO, 2018

The literature commonly divides KPIs into so-called leading and lagging indicators. Leading KPIs refer to measures for continuously monitoring identified inputs, which are needed to achieve a planned safety target and/or objective (Reiman and Pietikäinen, 2012). Lagging KPIs are measurements that perform reactive monitoring to identify e.g. when a planned objective or target has not been reached (Øien, 2001). In this study, KPIs are categorized into three groups based on Reiman and Pietikäinen (2012):

- Drive indicators. The definition and monitoring of these KPIs focus on implementing and reviewing certain actions used to change, maintain and reinforce different elements of the system. Their main function is to guide the socio-technical aspect of the system by motivating certain safety-related activities.
- Monitor indicators. These are used for monitoring the function of the system, including but not limited to the efficiency of the safety management practices in the organization. Monitor indicators reflect the capacity of the organization to perform safely.
- Outcome indicators. These reflect a temporary end result of a process and/or an activity in the SMS. An outcome is always the result or consequence of some other factor or combination of factors and circumstances. These indicators focus on the result or consequence of the tasks or processes in the organization.

The Key Performance Indicator (KPI) is built combining a set of PIs. As the KPIs is a mathematical combination of PIs no additional data gathering is required. In the model 33 KPIs are defined. The KPIs are expressed in two forms: The calculated KPI Value and a conversion of the KPI Value into a 0-100 KPI Rating. (BIMCO, 2018).:

The following KPI were defined:

- KP Ballast water management violations
- Budget performance
- Cadets per ship
- Cargo related incidents
- CO2 efficiency
- Condition of class
- Contained spills
- Crew disciplinary frequency
- Crew planning
- Dry-docking planning performance
- Environmental deficiencies
- Failure of critical equipment and systems
- Fire and Explosions
- Port state control performance
- Health and Safety deficiencies
- HR deficiencies
- Lost Time Injury Frequency
- Lost Time Sickness Frequency
- Navigational deficiencies
- Navigational incidents
- NOx efficiency
- Officer retention rate
- Officers experience rate
- Operational deficiencies
- Passenger injury ratio
- Port state control deficiency ratio

- Port state control detention
- Releases of substances
- Security deficiencies
- SOx efficiency
- Training days per officer
- Ship availability
- Vetting deficiencies

2.1.3 Performance Indicators (PI)

The Performance Indicators (PIs) are the building blocks giving the basis for KPI Value calculations. PIs are directly observable parameters (measurements) for each ship under management, e.g. Number of dismissals, Number of collisions and Number of fire incidents.

The Performance Indicators are the only elements that must be reported manually or by means of implemented ICT solutions. Focus has been to provide the hierarchy with unambiguous definitions of measurable low level parameters based on existing measurements in the industry. Each PI may be used in the calculation of several Key Performance Indicators (KPIs). An example is the PI Number of recorded external inspections which is used as a denominator in the calculation of several KPI Values.

2.2 The TMSA3 ELEMENTS

Following OCIMF (2019) guidelines there are 13 specific elements with which every company and vessel must comply.

Element 1 and 1A– Leadership and the Safety Management System:

A statement of commitment from the company chief executive is a fundamental foundation of any safety management system. Element one acknowledges this fact and outlines the responsibilities of company management to develop and maintain a dynamic SMS that promotes excellence in the fields of health, safety, security and the environment (HSSE). The SMS should consist of clear and concise documented procedures that identify the roles, responsibilities and accountabilities for all staff, ashore and afloat.

Element 2 – Recruitment and Management of Shore-Based Personnel:

A mechanism to control the assessment of competence and certification of seafarers has, to some extent, been addressed with the introduction and continued revision of the IMO 1978 Standards of Training and Certification and Watch-keeping (STCW) Regulations (as amended). Element two of TMSA identifies the need for a similar approach to the qualification and appointment of shore-based personnel. A formalized pre-employment process should determine the suitability of applicants for all appointments to shore-side posts. The selection process should ensure that candidates are medically fit, technically competent, suitably qualified and experienced to undertake the roles for which they are recruited. Appraisal, training, continuous development and succession planning programs should be integral parts of the SMS. Personnel continuity, with an emphasis on staff retention and development are key factors in ensuring effective committed and motivated shore management. Personnel records should include a training portfolio for each member of staff, which can be used to ensure that they are kept up to date on recent developments within the industry.

Element 3 and 3A – Recruitment Management and Wellbeing of Vessel Personnel:

The competence, motivation health and well-being of a ship's crew are critical factors in ensuring the safe and efficient operation of any vessel. Pre-recruitment checks by the employer need to determine the accuracy of an applicant's qualifications and experience. Pre-employment medical screening of crew members, such as those offered by the Association have been shown to significantly reduce claim costs for medical and repatriation expenses. Regular crew appraisal procedures adopted by an employer will help identify those individuals who work well as team and can be used to ensure crew members are provided with programs of continuous professional development suitable for their own, and the company's objectives. Continuous appraisal should be used to identify and correct weaknesses in competence and to encourage and develop candidates for promotion.

Element 4 – Vessel Reliability and Maintenance:

Including Critical Equipment Robust and well applied repair and maintenance procedures are important in ensuring safe, efficient and reliable vessel operation. The ISM Code calls for additional control measures to be established for mechanical, electrical and other items of equipment that could, in the event of failure, result in a hazardous situation. This 'critical equipment' may include, but not be limited to main propulsion systems, steering gear and cargo handling equipment. Efficient planned maintenance systems (PMS) that incorporate defect reporting and close-out procedures will assist with maintaining a vessel's classification status. Effective PMS should also ensure that suitable spares are available for the timely completion of planned work. There should be a close working relationship between a vessel's crew and the designated superintendent. Regular vessel visits, including sailing visits, by superintendents reinforce this relationship. Procedures for out-of-service repair periods, e.g. dry-dockings, should be formally developed and involve close collaboration between ship and shore staff.

Element 5 –Navigational Safety:

Although the master is ultimately responsible for the safe navigation of the vessel, the company are obliged to establish and maintain navigational procedures that ensure the safety of the vessel. These are likely to reflect the content of publications such as the International Chamber of Shipping publication 'Bridge Procedures Guide', and ensure that navigational techniques appropriate to the circumstances of the voyage, are implemented fully. Implementation of industry best practices would include the regular conduct of comprehensive navigational audits, conducted on passage by suitably qualified and experienced personnel from the company. Company audits should be backed-up by and bench-marked with, independent audits performed by suitably qualified, specialist contractors.

Element 6 and 6A – Cargo, Ballast, Tank Cleaning, Bunkering, Mooring and Anchoring Operations:

The driving factor behind TMSA Elements 6 and 6A is the desire to ensure that on board operations associated with cargo, bunkering and mooring are conducted safely and efficiently. To that end, comprehensive procedures covering all aspects of the applicable operations need to be in place. Furthermore, those procedures need to be understood and applied by all relevant staff. Junior officers should be actively engaged in the planning and execution of cargo, bunkering and mooring operations, as part of their personal development plans. Crew members should receive suitable training prior to being placed in charge of cargo and ballasting operations, this may include the use of computer based or simulator training ashore. Mooring operations are a frequent source of personal injuries. These accidents are often caused by poor working practices and a lack of a proactive safety culture. Robust company mooring procedures will reflect the contents of the OCIMF Mooring Equipment Guidelines and information papers and the UK MCA publication 'Code of Safe Working Practice for Merchant Seamen (COSWP)', Chapter 26 – 'Anchoring, Mooring and Towing Operations'. North of England's Loss Prevention Briefings on 'Mooring Operations' and 'Wire Ropes and Their Uses' also highlight some best industry practices.

Element 7 – Management of Change:

Change of any description within an organization or on board a ship introduces the possibility of additional risk. An evaluation of the impact that change may have on operational matters and procedural tasks will assist in identifying those areas that will be affected most. Suitable risk assessments will then be necessary to control the implementation of this process. COSWP Chapter 1 - 'Managing Occupational Health and Safety' – Annex 1.1 'Management of change' - provides detailed instructions on how this should be carried out. Technical changes may require the provision of revised drawings, plus revisions to operational and technical manuals. Required changes need to be properly recorded and effectively linked with the vessel's document control system. In this way important controlled documentation will remain relevant and up-to-date. There should be a periodic review of all implemented changes, to evaluate the outcome of those changes and to measure the extent to which planned objectives have been met.

Element 8 – Incident Reporting, Investigation and Analysis:

The fundamental principle underpinning Element 8 is that all incidents are preventable. Therefore, the company needs to have procedures in place that incidents and near misses are always reported, investigated and analyzed, so as to prevent recurrence. Incident investigation needs to delve down into the actual root causes. Measures to effectively eliminate the causes and prevent further incidents need to be implemented and promulgated. Element 8 highlights the importance of crew and shore staff involved in accident investigation receiving suitable training and support from the company and third-party subject specialists. Training programs should include suitable refresher training and this should form part of the individual's personal training program. Company reflection and review practices must ensure that incident information and analysis findings are promulgated efficiently to the other vessels within the fleet and details are discussed with crew members during safety committee meetings and onboard training drills.

Element 9 and 9A – Safety Management

TMSA principles are intended to enhance the implementation of the spirit of the ISM Code and the adoption of a proactive safety culture on board. Monitoring the implementation of safety management systems requires a review by shore-based managers of working practices carried out on board. Completed risk assessments should be reviewed by technically competent company representatives. Common risk assessments should be introduced throughout the fleet. A comprehensive program of near miss reporting should be adopted. All of these measures serve to promote the safety culture on board. Best practices include the implementation of concentrated safety awareness campaigns, detailed procedures for the management of third party contractors and the employment of fleet safety trainers to conduct onboard training and to promote company values and safety culture.

Element 10 – Environmental and Energy Management:

Fundamental to effective environmental practices are the systematic identification, assessment and minimization of sources of marine and atmospheric pollution, and the environmentally responsible disposal of potentially damaging residual waste. Reference in company protocols to the requirements of MARPOL and/or national and regional limitations should be supported by regular reviews of action necessary to ensure present and future compliance. A long-term environmental plan should be maintained and reviewed and updated regularly. The environmental management plan should include fleet-wide energy efficiency and fuel management practices. Ship recycling practices should adhere to environmentally sound principles.

Element 11 – Emergency Preparedness and Contingency Planning:

An emergency response system that deals with shipboard and company emergencies needs to be established. The system requires regular and robust testing to ensure that is fit for the purpose of adequately responding to and dealing with incidents. Companies should develop a comprehensive program of drills that test the response to all foreseeable emergencies. A shore-based response team should be integral to a structured training program. Element 11 of TMSA identifies the need for media training, business continuity and recovery following a major incident Plans for incident

management must account for the twenty-four hour operational practices of most companies and provide shore-based emergency response personnel with the resources they need to manage an incident. Contact details for relevant members of company and external staff including third party salvage and towing specialists should be available to the person in charge. Designated members of the team should receive media training appropriate to their role, to ensure the control of information passed to the press. A relationship should be established with media professionals to support company staff. Realistic, regular and robust emergency exercises and drills should be undertaken that reflect the nature of vessel and fleet operation. Drills and exercises should be designed to test the effectiveness of arrangements to call on external personnel and resources.

Element 12 and 12A – Measurement, Analysis and Improvement:

Perhaps the most important feature of any effective safety management system is the dynamic nature of its implementation. TMSA refers to an effective company SMS as a "living document at the core of the business". Operators must strive to ensure their system manuals do not sit on the shelves gathering dust; they should be used as a tool in the daily operation of the processes and procedures they refer to. The effectiveness of that tool must be reviewed and assessed on a regular basis to make sure that it accurately reflects the nature of the work in hand and has not become outdated and irrelevant. Vessel inspections, checks on legislative compliance by ships' crews, and a review of actions closed out following audit will all give an indication of how well the system is performing. A fleet standard format of inspection that satisfies the requirements of industry best practice guidelines should be used for internal audits performed on all vessels and shore support offices associated with the system. Staff members with responsibility for performing audits should be suitably experienced and given formal auditor training, a record of audits performed should be held for future reference by management and numbers of audits performed in keeping with those planned monitored. The effectiveness and status of corrective actions recommended in previous audits need to be assessed as part of this process and systems should include a documented process that can be used for this purpose. An analysis of inspection results and the operator's ability to satisfy ISM requirements as well as regulatory and legislative amendments should form part of periodic management reviews of the SMS.

Element 13– Maritime Security

The maritime security situation is dynamic and continually changing. In order to monitor and manage the changes the ship operator needs to have an effective security management system in place. The system should be such that threats to security in all areas of the business are identified and risks posed thereby are mitigated to the lowest practicable level. Security management should be included in the internal audit program. External specialist support should be provided to deal with identified threats as and when appropriate. Vessels should be provided with enhanced security and monitoring arrangements and provisions should be in place to consider, test and install innovative security measures onboard existing and new build ships where appropriate. Procedures should be implemented with respect to cyber security. These procedures should include the identification of threats to onboard and company electronic systems. The procedures should include guidance on cyber security awareness and measures to counteract threats posed by cyber-attacks.

2.3 Generic Presentation of TMSA3 Innovation (Human Factor appearance in each element and stage)

At each of the aforementioned elements, TMSA3 introduces a very significant and role-playing factor, for the modern maritime industry. This is the “human factor”, and its appearance emerge in assorted ways through the KPIs and their Best Practice Guide.

Table1: Element 1- Management, Leadership and Accountability

Element 1: Management, Leadership and Accountability		
STAGE	**KPIs**	**BEST PRACTICE GUIDE**
2.3	Vessel and shore-based management teams promote HSSE excellence.	Strong, effective leadership is visibly demonstrated through: • Leading by example. • Empowering personnel to intervene to prevent hazardous situations developing
4.3	All personnel demonstrate commitment to HSSE excellence	Examples of commitment include participation in: A Behavior-Based Safety system. Managers and S/Ts demonstrate commitment by their behavior

Table 2: Element 2 - Recruitment and Management of Shore- Based Personnel

Element 2: Recruitment and Management of Shore- Based Personnel		
STAGE	**KPIs**	**BEST PRACTICE GUIDE**
1.1- 1.2	Recruitment process ensures candidates for key shore positions have the appropriate qualifications, experience and competence	This process includes interviews to asses competence.
4.3	The company promotes appropriate interpersonal skills training	Training may include: • Team Building • Cultural diversity • Effective communication

Table 3: Element 3- Recruitment and Management of Vessel Personnel

Element 3: Recruitment and Management of Vessel Personnel		
STAGE	**KPIs**	**BEST PRACTICE GUIDE**
1.1	Procedures for the section, recruitment and promotion of all vessel personnel	Procedures, with rank specific requirements, may include: • A review of experience and competence by suitably qualified personnel • Cross cultural values and attitudes
2.4	Procedures identify additional training needs for individual personnel	The need for additional training may be identified by the following: • Review of vessel performance trend •Assessment of competence in rank or in preparation for promotion.

2.6	The company monitors and records training results and effectiveness	The effectiveness of training may be measured by: • Feedback from trainees • Review of appraisals • Review of vessel performance trends
2.7	There is a promotion procedure	Procedures cover a range of factors including: • Competency assessment
3.1	Enhanced appraisals for Senior Officers	Appraisals by appropriate personnel may include: • Leadership • Personal Management • Communications styles
4.1	Procedures to assess crew members for job competency	Procedures may include: • On the job observation • Written/ Oral/ Computer- based assessments • Scenario- based simulator assessments • Psychometric assessments
4.3	Cross- cultural interpersonal skills are promoted	Interpersonal skills training include: • Cultural awareness • Cross- cultural management skills • Communications styles
3A.3.1	Seminars for senior officers promote, emphasize and enhance the SMS	Regular seminars for Senior Officers include: • Company culture, ethics and values • Safety and human element

Table 4: Element 4- Vessel Reliability and Maintenance

Element 4: Vessel Reliability and Maintenance		
STAGE	**KPIs**	**BEST PRACTICE GUIDE**
4.5	Engineering audits by a suitably qualified and experienced company representative while on passage.	The purpose of the annual audit is to: • Assess the skills of the engineering team members. • Evaluate the effec8ve functioning of the engineering team. • Identify any addi8onal training needs, whether they are specific to an individual, a vessel, or a fleet wide need.

Table 5: Element 5 - Navigational Safety

Element 5: Navigational Safety		
STAGE	**KPIs**	**BEST PRACTICE GUIDE**
3.2	Senior Officers receive appropriate ship-handling training before promotion to Master or assignment to a new vessel type.	Ship-handling experience is gained by training as a part of a competency development system
3.3	Navigational audits while on passage by a suitably qualified and experienced company representative.	Assess the skills of the bridge team members. • Evaluate the effective functioning of the bridge team. • Identify any additional training needs.

4.3	Competency assessment programs ensure that Masters and navigation officers maintain core and specialist skills.	The assessment program, which may be simulator based, includes an assessment of: • Bridge team management behaviors.
4.4	Navigator officers undertake periodic refresher BRM simulator training.	The training team composition reflects the nationalities of the bridge teams in the fleet. The BRM training is used to enhance the dynamics within bridge team members and to increase awareness of cultural diversity, communica8on style and hierarchy bias among the team.

Table 6: Element 6 - Cargo, Ballast, Tank Cleaning, Bunkering and Mooring operations

Element 6: Cargo, Ballast, Tank Cleaning, Bunkering and Mooring operations		
STAGE	**KPIs**	**BEST PRACTICE GUIDE**
4.2	Audits by a qualified and experienced company representative include observation of cargo, ballast, tank cleaning, bunker handling and mooring ops.	Annual audits may look at: • Skills and proficiency levels of the personnel. • Leadership and effectiveness of team. • Identifying additional training needs.

Table 7: Element 9 -Safety Management- Shore based Monitoring

Element 9: Safety Management- Shore based Monitoring		
STAGE	**KPIs**	**BEST PRACTICE GUIDE**
3.2	Proprietary safety tools are used to encourage hazard identfication and to improve safety awareness.	Such tools may include: • Unsafe Act Awareness programs. • Behavior-based safety system.
9A.1.2	The company safety culture encourages all personnel to identify, report and address hazards.	Procedures require that any identified hazards are addressed
9A.2.1	Intervention to prevent unsafe acts and conditions is encouraged.	Safety intervention techniques may include: • Unsafe Act Awareness and intervention. • Stop work authority. • Safety observations.
9A.3.1	Procedures encourage the reporting of safety best practices.	Personnel are actively encouraged to submit safety ideas by methods such as personnel competitions or individual recognition.
9A.3.2	Procedures measure and compare the strength of safety culture across the fleet to identify areas for improvement and to provide motivation to crew.	Procedures measure: • Near miss reports. • BBS system observations. • Best practices identified. • Hazards identified. • Unsafe acts identified. • Safety suggestions.
3.3	Management identifies opportunities to strengthen the safety culture through interaction with fleet personnel.	Examples of methods of interaction might include presentations via: • Safety themed seminars. • Telephone conferences. • Webinars. • Safety magazines. • Company produced videos.

4.1	Leading and lagging indicators of safety performance are analyzed across the fleet and on an individual vessel basis to identify areas where the safety culture can be improved.	The analysis is used to: • Identify weaknesses across the fleet. • Prioritise vessel for targeted training

Source: Author generated

2.4 TMSA 1-3 Evolution

TMSA 1 & 2 focused on ensuring a minimum level of compliance for all the Tanker companies, by imposing a deterministic approach. At first sight, the differences between TMSA2 and TMSA 3 are the following:

- Specialized questions of Oil Majors own questionnaires have been incorporated.
- Frequent observations raised by TMSA auditors during Office audits have been implemented as new requirements.
- Certain KPIs have been shifted to a lower stage, rendering their implementation elementary.

Last but not least, the level of difficulty has been raised and compliance to TMSA3 is definitely more laborious than TMSA2 compliance. But the real difference is that TMSA3 makes one step beyond by reducing the burden imposed by fixed term deterministic approaches, focusing on the Human Factors and Behavioral Safety, and promoting a competence management system as a tool for assessing crew competence, training requirements and managing from the crew selection process up to promotions.

Summarizing the above, the basic and most important idea to be noticed is that, TMSA1 was introduced to enhance Company Systems, TMSA2 to improve Company Systems, TMSA3 is clearly targeting Human Behaviors.

3. The Human Element and Safety

When considering of safety, it is a common rule to refer to its absence. The conventional view of safety, called Safety-I, has, thus, been characterized by the non-appearance of mishaps and episodes, or as the '*freedom from unacceptable risk"* (Hollnagel, 2013). As a result, the focus of safety research and safety management has, as a rule, been on unsafe system operation rather than on secure operation framework. In controversy with the traditional view, resilience engineering maintains that 'things go wrong' and 'things go right' for the same fundamental purposes. In correspondence to the aforementioned view of safety, there comes Safety-II, which declares safety as the ability to succeed under varying conditions. The understanding of ordinary working is in this manner, a vital prerequisite for the understanding of the safety performance of an organization.

3.1 The Causality Credo

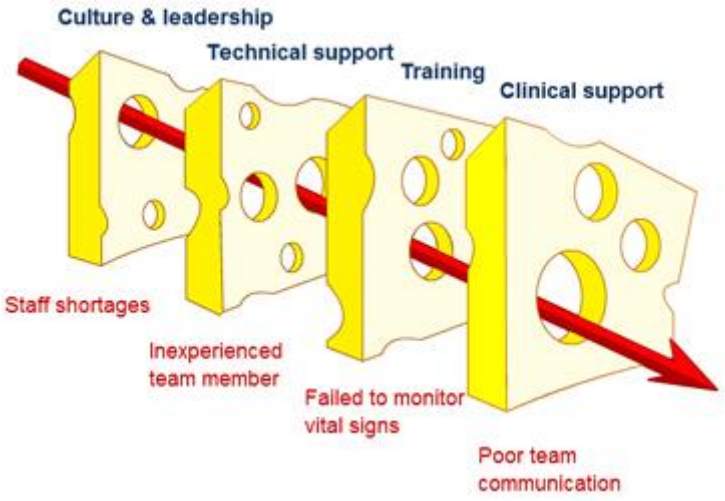
Consumption about how causes lead to effects should be included in any explanation of how accidents happen. These patterns are so called accident models. A well know accident model is the Domino model, despite the fact that it is as old as mankind itself. In the Domino model simple liner causality is shown by using the analogy of a set of domino pieces that drop one after the other. According to the logic of these models, the purpose of event analysis is to reason backwards from the injury to find the 'root cause'. Risk analysis search if something may malfunction, meaning that a component may break or fail, either by itself or when combined with another malfunction

Figure 5.: The domino Model

Source: (Heinrich, 1931)

Simple, linear models were superseded in the 1980s by the composite linear models, where the best-known example is the Swiss cheese model. In accordance with these models adverse outcomes can be explained as combinations of active failures (or unsafe acts) and latent conditions (hazards). An event analysis hence looks for how debased boundaries or resistances can combine with active (human) mishaps. At the same way risk analysis centers on finding the conditions under which combinations of single failures and idle conditions may reach an unfavorable result, where the latent conditions are conceived of as debased boundaries or debilitated resistances.

Figure 6: The Swiss Cheese Model



Source: Reason, 1990.

The Domino model and the Swiss cheese model are typical examples of accident models,

but many others exist. Common to them all is the unspoken assumption that outcomes can be understood as effects that follow from prior causes. Since that corresponds to a belief – or even a faith – in the laws of causality, it may be called a causality credo. The causality credo can be expressed as follows:

- Adverse results happen since something has gone off-base. Adverse outcomes have causes.
- It is conceivable to discover these causes given sufficient prove is collected. Once the causes have been found, they can be dispensed with, typified, or something else neutralized

.

- Since all adverse outcomes have causes, and since all causes can be found, it follows

that all mischances can be anticipated. Usually the vision of zero accidents that numerous companies discover appealing (Reason, 1990).

Whereas thinking in this way may be conceivable for frameworks that are moderately basic, it does not suffice for more complicated frameworks. And since most frameworks nowadays are complicated instead of uncomplicated, as recognized by Perrow as of now in 1984, the causality credo is not sustainable.

3.2 Safety-I: Avoiding Things that Go Wrong

To most people safety implies the nonappearance of undesirable results such as occurrences or mishaps. Safety is blandly characterized as the framework quality that's essential and adequate to guarantee that the number of occasions that can be hurtful to workers, the public, or the environment is acceptably low. ICAO (2013), for instance, defines safety as: "*The state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management".*

Historically speaking, the beginning point for safety concerns has been the occurance of mischances (genuine unfavorable results) or recognized dangers (potential unfavorable results). Adverse results – things that go wrong – have ordinarily been clarified by indicating to their causes, and the reaction has been to either dispose of or contain them. New sorts of mishaps have additionally been accounted for, by presenting new sorts of causes – either relating to innovation (e.g., mental weariness), to human components (e.g., workload, 'human error'), or to the organization (e.g., safety culture). Since this has been viable in giving brief term solutions, human through centuries, have ended up so usual to clarifying mischances in terms of cause-effect relations, that no longer notice it. And we cling relentlessly to this convention, in spite of the fact that it has gotten to be progressively difficult to accommodate with reality.

Figure 7: The imbalance between things that go right and things that go wrong

1 - 10-4: = 9.999 non-failure
in 10.000 events

Source: ICAO (2013)

The case where the (statistical) probability of a failure is 1 out of 10,000 is represented by the thin red line, in the above figure. But this moreover implies that one ought to anticipate things to go right 9,999 times out of 10,000 – comparing to the green zone.

Safety efforts focus on what goes wrong, i.e., the one event out of 10.000, and this focus is reinforced in many ways. Controllers and specialists require detailed reports on mischances, occurrences, and indeed so-called unintended occasions, and uncommon organizations, offices, and organizational parts are devoted to scrutinizing adverse results. Numerous models claim they can explain how things go wrong and a considerable number of methods are offered to find and address the causes. Accident and incident data are collected in large databases (Hollnagel, 2015). Accidents and incidents are depicted and clarified in thousands of papers, books, and wrangled about in specialized national conferences. The net result may be a downpour of data both almost how things go off-base and approximately what must be done to anticipate this from happening. The common solution is known as ‘find and fix’: seek for breakdowns and failures, attempt to discover their causes, and after that dispose of causes and/or enlarge boundaries.

The situation is quite different for the 9,999 events that go right. In spite of their crucial importance, they don’t really receive the appropriate attention in safety management

activities such as safety risk management, safety assurance and safety promotion. There are no requirements from authorities and regulators to look at what works well and therefore few agencies and departments that do it. Possible exceptions are audits and surveys, which may include a focus on strengths. However, information is not easily discovered, there are few models, and even fewer methods, and the lexicon is meager in comparison to that for what goes wrong. There are as it were few books and papers, and for all intents and purposes no meetings (Hollnagel, 2015). Looking at how things go right also clashes with the traditional focus on failures, and therefore receives little encouragement. This makes a genuine issue since we cannot make beyond any doubt things go right fair by anticipating them from going wrong. We moreover need to get to know how they go right.

The current state of affairs represents a common understanding of safety, which we shall call Safety-I. This defines safety as a condition where the number of adverse outcomes is as low as possible. Since the purpose of safety management is to achieve and maintain that condition, safety goals are defined in terms of a reduction of the measured outcomes over a given period of time. Safety-I promotes a bimodal view of work and activities, according to which acceptable and unacceptable outcomes are due to different modes of functioning.

When things go right it is as if the system functions as it ought to and because people work as envisioned; when things go wrong it is because something has failed or fizzled. The two modes are expected to be unmistakably diverse, and the reason of safety management is normally to guarantee that the system remains in the first mode and never wanders into the second.

In Safety-I, the starting point for safety management is either that something has gone wrong or that something has been identified as a risk. The above-mentioned ‘find and fix’ approach is used in both cases. In the first one by finding the causes and then developing an appropriate response, and in the second one by identifying the hazards in order to eliminate or contain them. Preventing a transition from a ‘normal’ to an ‘abnormal’ state (or malfunction) is another acceptable solution, regardless of whether this is due to a sudden transition or a gradual ‘drift into failure’. This can be finished by obliging performance within the ‘normal’ state, by strengthening compliance and by

dispensing with changeability. The last step is to check whether the number of unfavorable results (airproxes, runway attacks, etc.) goes down. On the off chance that nothing happens for a while, at that point the system is considered to be secure. From now on, Safety-I will be characterized by looking at its appearances, its basic components, and its hypothetical establishments.

As it is proposed by resilience engineering, systems work because people are able to adjust what they do, to match the conditions of work. People learn to identify and overcome design flaws and functional glitches, they can recognize the actual demands and adjust their performance accordingly, interpretation and applied procedures are also made in order to match the conditions.

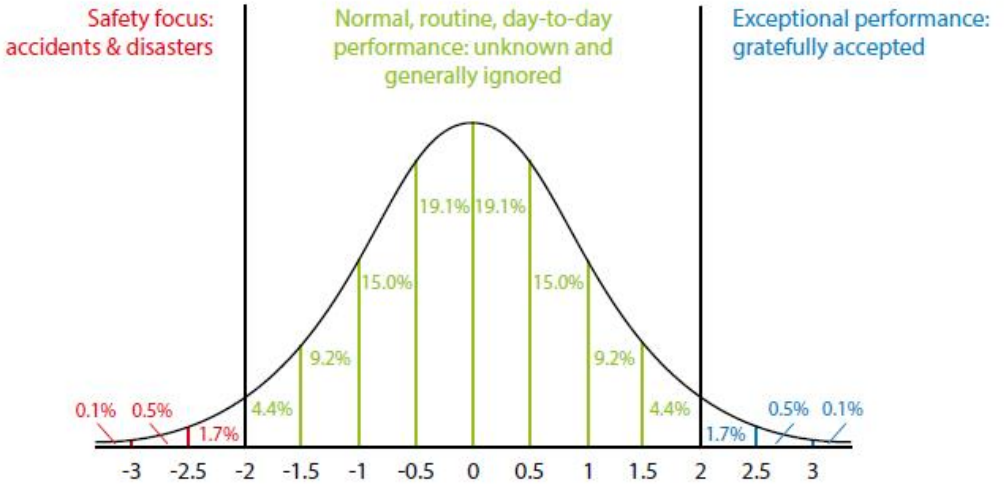
People can also detect and correct when something is about to go wrong, hence intervene before the situation becomes grave. This can be described as performance variability, not in the negative sense of deviations from some norm or standard, but in the sense of the smooth adjustments that are necessary for safety and productivity (Hollnagel, 2013).

Performance variability or performance adjustments are a *sine qua non* for the functioning of today's socio-technical systems. Unacceptable outcomes or failures can therefore not be prevented by eliminating or constraining performance variability since that would also affect the desired acceptable outcomes. Instead efforts are needed to facilitate the necessary performance adjustments by clearly representing resources and constraints of a situation and by making it easier to anticipate the consequences of actions. Performance variability should be managed by attenuation (dampening) if it seems to go in the wrong direction and by strengthening (amplification) if is seems to go in the right direction. In order to do so it is necessary first to acknowledge the inevitability and necessity of performance variability, second to monitor it, and third to control it (Hollnagel, 2013).

3.3 Safety-II: Repeating things that go right

The definition of Safety-II means that the manifestations are all the possible outcomes, as illustrated by Figure 8 and especially the typical or high frequency outcomes that usually are ignored by safety management. A system is still deemed to be unsafe if adverse outcomes occur, yet it is more important to understand how it is safe when things go right: safety is consequently defined by what happens when it is present, rather than by what happens when it is absent, and is thus directly related to the high frequency, acceptable outcomes (Hollnagel, 2015).

Figure 8: Relation between event probability and ease of perception



Source: Hollnagel, 2015

In other words, the more manifestations there are, the higher the level of safety is and vice versa. This makes it conceivable to illustrate that endeavors to progress safety have worked, thus less demanding to contend for proceeded assets. (It also resolves the possible conflict between safety and productivity, but that is another matter (Hollnagel, 2015). Few typologies are currently available in describing the manifestations of Safety-II. Even though things go right all the time, we fail to notice it because we become used to it. But since everyday performance is unexceptional, it can be explained in relatively simple terms. For instance, everyday performance can be portrayed as performance alterations that serve to make or keep up required working conditions, that compensate for a lack of time, materials, data, etc., which attempt to dodge conditions

that are known to be destructive to work. As a result, regular execution changeability is omnipresent, and it is less demanding to monitor and oversee.

Juxtaposing Safety-I and Safety-II targets to draw attention to the consequences of basing safety management on one or the other. The basic differences are summarized in the table below.

Table 8: Overview of Safety-I and Safety-II

	SAFETY- 1	**SAFETY- II**
Definition	That as few things as possible go wrong.	That as many things as possible go right.
Safety Management Principle	Reactive, respond when something happens or is categorized as an unacceptable risk.	Proactive, continuously trying to anticipate developments and events.
View of the Human Factor in Safety Management	Humans are predominantly seen as a liability or hazard.	Humans are seen as a resource necessary for system flexibility and resilience.
Accident Investigation	Accidents are caused by failures and malfunctions. The purpose of an investigation is to identify the causes.	Things basically happen in the same way, regardless of the outcome. The purpose of an investigation is to understand how things usually go right as a basis for explaining how things occasionally go wrong.
Risk Assessment	Accidents are caused by failures and malfunctions. The purpose of an investigation is to identify causes and contributory factors.	To understand the conditions where performance variability can become difficult or impossible to monitor and control.

Source: Author generated

Safety-I and Safety-II are two complementary views of safety. They do not clash or conflict with each other. What is more, the second completes the first. As a result, the existing practices can still be in use, but with a diverse emphasis

A quick and summarizing benchmarking table, as follows below, will explain the evolution, brought up by Safety-II plus it will give prominence to the challenges and the facts, maritime industry should focus in the future.

Table 9: Safety I and Safety II Benchmarking

Safety I	Safety II
Learn from our errors	Learn from our successes
Safety defined by absence	Safety defined by presence
Reactive approach	Proactive approach
Understand what goes wrong	Understand what goes right
Accident causation	Repeat what goes right
Avoid errors	Enforce successful behaviors
Reduce losses	Create new process on successful behavior

Source: Author generated

3.4 Safety II upside-down

Looking at a successful performance is not enough so that we can say that Safety II is established. Safety II is referring to all possible outcomes, including the everyday, normal, routine performance. Near-miss accidents and catastrophes are equally involved so as exceptionally good performance. Our traditional approach, Safety-I, has largely limited itself to the latter – the accidents (actual or potential) at the tail end of the distribution. Safety-II is about the whole distribution, and its profile. But we normally ignore 'normal performance' (Shorrock, 2014). Focusing more on normal performance and targeting frequent events, is the way to improve system performance, because they can be easily altered and managed

3.4.1 Safety-II is not “just a trend”

Most populist managements trends, are just trade-marked commercialism of nowadays or sometimes money-spinning packages. Unlike to them Safety II, is built in severe theoretical foundation. Decades of research and practice in safety, emerging resilience over the past ten years, plus human factors, are Safety II substances (Shorrock, 2014). Safety II is not condemned to disappear like other fads and trends as it is not one of them. Several major organizations and even regulators are starting to embrace the core ideas.

3.4.2 Safety-II is not “a theory”

Business used to be unfamiliar with theory due to the fact that theory is being mistaken with hypothesis or idea along with a kind of anti-intellectualism or anti-innovation mindset that rejects new thinking. Safety-II does comprise theory – on performance variability, trade-offs, emergence, etc (and if didn’t, then it should be discarded immediately) – and unapologetically so: as the saying goes, there is nothing so practical as a good theory. Theory – of systems, people, and time – provides a way of explaining and making sense of the world. So, Safety II is not a theoretical trend, neither “just theory”

3.4.3 Safety-II is not the end of Safety-I

It is a fact that through the past decades Safety I was the tool to establish SMS and it would not be wise to discard the practices based on Safety I assumptions. Safety II tends to complete Safety I, and “Many of the existing practices can therefore continue to be used, although possibly with a different emphasis” (Shorrock, 2014). The core assumptions of Safety-I (focus on failure, causality credo, human as hazard, bimodality of outcomes and decomposability of systems), should be taken into consideration, as also the extent to which they are valid with respect to the systems and situations in which we work. This does not necessarily mean abandoning practices that are founded on these assumptions, but perhaps modifying them and including new types of practice (but not ‘best practice’).

3.4.4 Safety-II is not about ‘best practice’

Dealing with complex systems we have to comprehend that there is no such thing as “best practice”. There is only practice implemented in the best way, in a certain context, at a certain time – the best that could be done, regarding the given assets the constraints and the demand. The best practice we can hope for is contextual practice – practice that fits the context.

3.4.5 Safety-II is not what ‘we already do’

Several times, people say “Oh, yes, we already do that!”, having just been exposed to Safety-II thinking (perhaps a short presentation or a few pages of reading). “We already do that” often acts as a defensive shield to protect an existing paradigm, method or approach that is deep-rooted, cherished, and perhaps profitable. Often, “We already do that” practices are not really consistent with Safety-II thinking, though they may well be very useful and even progressive. But “We already do that” acts as a thought-stopper and prevents reflection about just exactly what it is that we already do, and – perhaps more to the point – why we do it (Shorrock, 2014).

Safety II is based on the idea that performance, both good and bad, is systematically connected to the operational and organizational environment people work in. Given that perspective, instead of looking separately at compliance or standards, or to simply try and stay away from failures, the focus should be on identifying the aspects that help and hinder performance

In ‘Safety II’, people are an asset, vital, for adaptability and resilience. But in times where human mistake is credited to the larger part of maritime casualties, the view of people as a defend and not a risk will be the foremost challenge.

Positive reporting was not the field that the maritime industry used to focus on, in order to claim liability but care less on praising exceptionally good performance. As a result, there should be strong efforts and a considerable timeframe until there is a change of mentality

3.5 Safety Culture

According to IMO (2003) safety culture can be defined as, *"a culture in which there is considerable informed endeavor to reduce risks to the individual, ships and the marine environment to a level that is as low as is reasonably practicable. Specifically, for an organization making efforts to attain such a goal, economic and social benefits will be forthcoming, as a sound balance between safety and commerce will be maintained."*

Safety culture is frequently seen as a subset of organizational culture where the values and beliefs allude particularly to things of safety and health (Clarke, 1999). The fields where safety culture and safety climate defer, as well as organizational culture and organizational climate isn't clear-cut. A few definitions of safety culture/climate concepts exist: Guldenmund (2000) records 16 definitions, but he proposes that safety climate alludes to the demeanors towards safety inside an organization, whereas safety culture concerns the fundamental beliefs and feelings of those states of mind. For the most part, the term safety culture is more embracing than that of safety climate (HSL, 2002) and a safety climate can be seen as detecting surface highlights of employees' demeanors and recognitions at a given point in time (Cox and Flin, 1998). The terms safety culture and safety climate are frequently utilized as equal (Cox and Flin, 1998).

The Advisory Committee on the Safety of Nuclear Installations (ACSNI) (HSC, 1993) has set the most widely used definition of safety culture:

"*The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management.* "

Communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures, is what characterizes most the organizations with a true positive safety culture

The shipping industry is ran by people and for the people. Thus, people tend to vary in all sorts of ways, as human beings, hey still have the same basic vulnerabilities and capabilities. Although weather and other factors are treated like simple elements, people are the center of the shipping enterprise. What is the secret of its successes and the

victims of its failures? It's the human element that drives what happens every day at work – from the routine tasks of a ship's rating, right through to the policy decisions of the IMO. Human nature is well studied and fortunately a lot of practical things can be done so that people avoid pitfalls and enhance their strengths.

Human behavior needs to be managed at all levels, ranging from ordinary seafarers to regulators developing national and international regulations. It is these policies and strategies that govern how ships and their crews operate, how safely they operate and lead to success.

Leadership and management are usually treated as the same thing. Although it is true that the most effective manager will almost certainly be an effective leader and that leading essential function of managers, there is more to managing than just leading. However, if managers do not know the way to lead people and how to comprehend the parameter of human factor in their operations, in a way so that desired results are produced, all the managerial functions are to accomplish little.

Developing safety culture with the effective and correct application of human factors plays a vital role in the implementation of health, safety and environmental protection policies. Safety culture as defined by Hale (2000) states as "*The attitudes, beliefs and perceptions shared by natural groups as defining norms and values, which determine how they act and react in relation to risks and risk control systems."*

The HSQE personnel in a company are entrusted with the responsibility and the task to monitor and develop the safety culture, so that the requirements of the ISM code are in compliance.

3.6 Just Culture

As said by Lord Denning English Judge: *"There are activities in which the degree of professional skill which must be required is so high, and the potential consequences of the smallest departure from that high standard are so serious, that one failure to perform in accordance with those standards is enough to justify dismissal."*

Don Norman (2013) at his book "The Design of Everyday Things" wrote: *"People make errors, which lead to accidents. Accidents lead to deaths. The standard solution*

is to blame the people involved. If we find out who made the errors and punish them, we solve the problem, right? Wrong. The problem is seldom the fault of an individual; it is the fault of the system. Change the people without changing the system and the problems will continue."

An engineering approach to "just culture" reference, involves the following

- A just culture has zero resilience for rash behavior.
- A just culture recognizes numerous mistakes speak to unsurprising intuitive between human administrators and the frameworks in which they work. Recognizes that competent experts make mistakes too.
- A just culture recognizes that professionals should not be held responsible for system failings over which they have no control.
- A just culture recognizes that indeed competent experts will create unhealthy norms.

Three perspectives that create the Just Culture Model are:

- Engineering
- Human Factors
- Legal

A Fair and Just Culture is always, a necessary component of a Culture of Safety. A Just and Fair Culture is one that learns and improves by transparent identification and examination of its own weaknesses; it is transparent in that those within it are as willing to expose weaknesses as they are to expose areas of excellence. Employees feel safe and protected, when in a just culture, when voicing concerns about safety and have the freedom to discuss their own actions, or the actions of others in the environment, with regard to an actual or potential adverse event. Human error is not viewed as the cause of an adverse event, but rather a symptom of deeper trouble in an imperfect system (Reason, 2008). When employees are involved in errors or mishaps, the leaders and the high authority are not judging so as to punish them, but in order to seek and find the hidden failures or the individual or system vulnerabilities. The above mentioned does

not mean that people are not accountable of their own actions, neither that discipline is not established, but this is to say that a Just Culture does not default to punishing individuals. In fact, one can say that a critical aspect of a Just Culture is the perceived fairness of the procedures used to draw the line between conduct deserving of discipline and conduct for which discipline is neither appropriate nor helpful.

4. Human Element Analysis

A wide range of topics is covered by the term human element and can mean a variety of different things depending on the background of the user. It can variously be used as a synonym for "human factors," "human resource," or even "human error." The human element covers a number of different academic disciplines, of which the most common are applied and/or occupational psychology, organizational behavior, ergonomics and human–computer interaction (HCI), safety science, business and management theory, health sciences, legal aspects, sociology, and anthropology.

The most cited definition for "human element", as it is applied in shipping, is probably the one adopted by IMO (2003) in its most recent resolution on the subject: A.947(23) in 2003

The human element is a complex multi-dimensional issue that affects maritime safety, security and marine environmental protection. It involves the entire spectrum of human activities performed by ships' crews, shore-based management, regulatory bodies, recognized organizations, shipyards, legislators, and other relevant parties, all of whom need to co-operate to address human element issues effectively.

From the given definition, can be identified the reflection of the complexity and multidisciplinary nature of the subject, but, the deal between people and their working environment, is also emphasized. It is also indicated that the appliance of the term does not refer only to individuals working in a specific company, but also to different organizations in the sectors of the industry, and not only to ships' crews, but also to shore-based staff. IMO has set a primary goal in addressing human element issues, the enhancement of maritime security, safety, and thus, the marine environment's quality.

IMO's main aim is described as:

To provide a framework for understanding the very complex system of interrelated human element factors, incorporating operational objectives, personal endurance concerns, organizational policies and practices, and environmental factors, in order to facilitate the identification and management of risk factors in a holistic and systematic manner. (IMO, 2003).

Moreover, "*human element*" meets up with the ideas of individual, team and organization, both safety and human resource in a way explained in the table below

Table 10: The different faces of the *"Human Element."*

	INDIVIDUAL	**TEAM**	**ORGANIZATION**
SAFETY	*Accident Causation and Human Error*	*Maritime Ergonomics*	*Safety Culture*
	Crew resource management (CRM) and crisis/ emergency management	User- centered design concepts	Organizational Culture
	Risk Management: System reliability and resilience engineering	Human- Computer Interaction (HIC)	Safety maturity models
	Training and assessment of competence	Habitability issues: noise and vibration	
HUMAN RESOURCE	*Health, Well- being and Working Conditions*	*HRM Practices*	*Coorporate Social Responsibility*
	Performance influencing factors (PIFs). For example, fatigue, alcohol and drugs	Recruitment, selection,retention	National cultural differences
	Performance Measurement		

Source: Author generated

4.1 Human Factor issues

Applying human factors to the design and operation of a ship or its systems means taking account of human capabilities, skills, limitations and needs. Human Factors should not be confused with the term Human Resources, which is a closely related activity that addresses the supply of suitably qualified and experienced staff. But when considering the operation or design of any ship and its systems both of these domains should be considered:

- Human Factors to account for the use of people as a component of the system
- Human Resources for the selection and preparation of staff able to do the required work.

Both domains contain a number of sub-domains:

Human Factors (Fitting the job to the person):

- Human Factors Engineering – The comprehensive integration of human characteristics into the definition, design development, and evaluation of a system to optimize Human-Machine performance under specified conditions.
- Health Hazards - The identification, assessment and the removal or reduction of short or long-term hazards to health occurring as a result of normal operation of a system.
- System Safety - The human contribution to risk when the system is functioning in a normal or abnormal manner.

Human Resources (Fitting the person to the job):

- Manpower - the number of personnel required, and potentially available, to operate, maintain, sustain and provide training for a system.
- Personnel - The cognitive (trainability and mental aptitude) and physical (fitness levels, physical size, gender) capabilities required of a person to train for, operate, maintain and sustain a system, and to provide optimum quality and quantity of the crews to man the ship.
- Training - The instruction or the education, and on-the-job or part-task or full mission training required to provide personnel with their essential job skills, knowledge, values and attitudes.

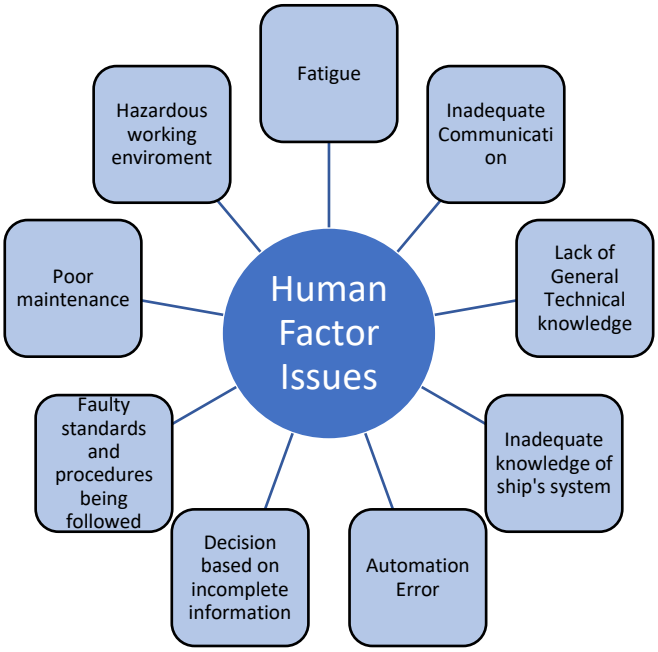
Many human factor issues are also covered in the new IMO Maritime Labor Convention, which represents the "fourth pillar" of maritime regulation covering international shipping, alongside the Convention for the SOLAS; the Convention for the Prevention of Pollution from Ships (MARPOL); and the Convention for the Training, Certification and Watch-keeping of Seafarers (STCW).

Statistics show that the most common accident types for commercial vessels are, fire/explosions, mechanical problems, collisions, groundings and hull damages. Moreover, the pivotal cause for the occurrence of these accident lies on human behavior and performance; that is on human element. Its interference can militate on various procedures and event chains, causing more problems and provoking unpleasant

consequences, or on the other hand improving difficult situations and even preventing the escalation of threatening incidents (Martinez and Ventikos, 2016)

Today, there are many human factors issues facing the marine industry that directly or indirectly influence the occurrence of human error. Some of the important ones are shown in the following figure.

Figure 9: Human Factor Issues



Source: Author generated

Fatigue.

The NTSB has identified fatigue to be an important cross-modal issue, being just as pertinent and in need of improvement in the maritime industry as it is in the aviation, rail, and automotive industries. Fatigue has been cited as the "number one" concern of mariners in two different studies. A new study has objectively substantiated these anecdotal fears: in a study of critical vessel casualties[1] and personnel injuries, it was found that fatigue contributed to 16% of the vessel casualties and 33% of the injuries.

Inadequate Communications

Another area for improvement is communications--between shipmates, between masters and pilots, ship-to-ship, and ship-to-VTS. An NTSB report stated that 70% of major marine collisions and allisions occurred while a State or federal pilot was directing one or both vessels. Better procedures and training can be designed to promote better communications and coordination on and between vessels. Bridge Resource Management (BRM) is a first step towards improvement.

Inadequate General Technical Knowledge

In one study, this problem was responsible for 35% of casualties. The main contributor to this category was a lack of knowledge of the proper use of technology, such as radar. Mariners often do not understand how the automation works or under what set of operating conditions it was designed to work effectively. The unfortunate result is that mariners sometimes make errors in using the equipment or depend on a piece of equipment when they should be getting information from alternate sources.

Inadequate Knowledge of Own Ship Systems

A frequent contributing factor to marine casualties is inadequate knowledge of own ship operations and equipment. Several studies and casualty reports have warned of the difficulties encountered by crews and pilots who are constantly working on ships of different sizes, with different equipment, and carrying different cargoes. The lack of ship-specific knowledge was cited as a problem by 78% of the mariners surveyed. A combination of better training, standardized equipment design, and an overhaul of the present method of assigning crew to ships can help solve this problem.

Poor Design of Automation

One challenge is to improve the design of shipboard automation. Poor design pervades almost all shipboard automation, leading to collisions from misinterpretation of radar displays, oil spills from poorly designed overfill devices, and allisions due to poor design of bow thrusters. Poor equipment design was cited as a causal factor in one-third of major marine casualties. The “fix” is relatively simple: equipment designers need to consider how a given piece of equipment will support the mariner’s task and how that piece of equipment will fit into the entire equipment “suite” used by the mariner.

Human factors engineering methods and principles are in routine use in other industries to ensure human-centered equipment design and evaluation. The maritime industry needs to follow suit. This topic is discussed further in a subsequent chapter.

Decisions Based on Inadequate Information

Mariners are charged with making navigation decisions based on all available information. Too often, we have a tendency to rely on either a favored piece of equipment or our memory. Many casualties result from the failure to consult available information (such as that from a radar or an echo-sounder). In other cases, critical information may be lacking or incorrect, leading to navigation errors (for example, bridge supports often are not marked, or buoys may be off-station).

Faulty standards, policies, or practices

This is an off-cited category and covers a variety of problems. Included in this category is the lack of available, precise, written, and comprehensible operational procedures aboard ship (if something goes wrong, and if a well-written manual is not immediately available, a correct and timely response is much less likely). Other problems in this category include management policies which encourage risk-taking (like pressure to meet schedules at all costs) and the lack of consistent traffic rules from port to port.

Poor maintenance

Published reports and survey results expressed concern regarding the poor maintenance of ships. Poor maintenance can result in a dangerous work environment, lack of working backup systems, and crew fatigue from the need to make emergency repairs. Poor maintenance is also a leading cause of fires and explosions.

Hazardous natural environment

The marine environment is not a forgiving one. Currents, winds, and fog make for treacherous working conditions. When we fail to incorporate these factors into the design of our ships and equipment, and when we fail to adjust our operations based on hazardous environmental conditions, we are at greater risk for casualties.

4.2 Human Error

Today's ship systems are technologically advanced and highly reliable. Yet, the maritime casualty rate is still high. Why is it, with all these improvements, we have not significantly reduced the risk of accidents? It is because ship structure and system reliability are a relatively small part of the safety equation. The maritime system is a people system, and human errors figure prominently in casualty situations. About 75-96% of marine casualties are caused, at least in part, by some form of human error. Studies have shown that human error contributes to:

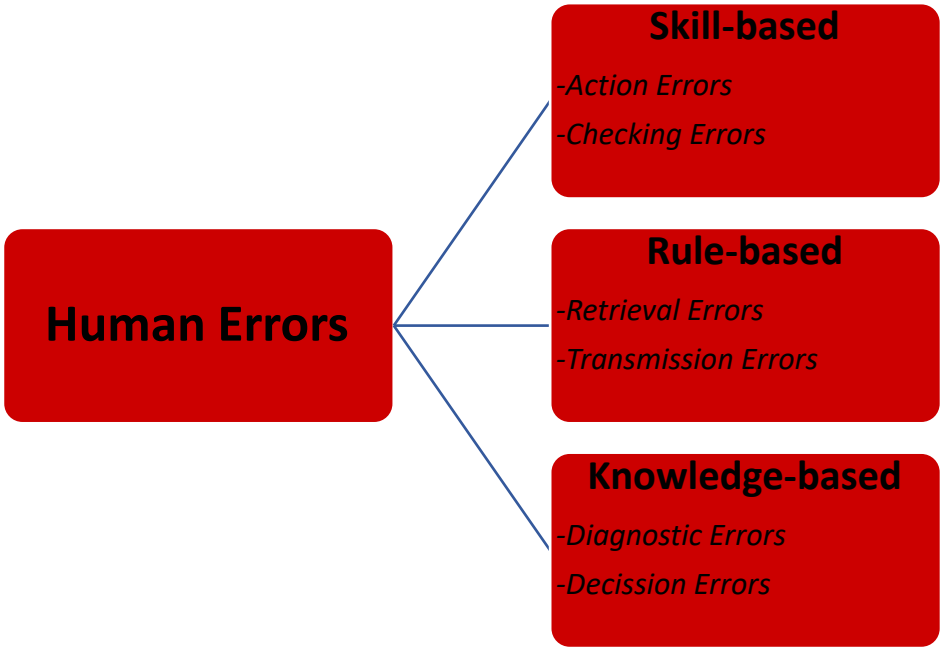
- 84-88% of tanker accidents
- 79% of towing vessel groundings
- 89-96% of collisions
- 75% of allisions
- 75% of fires and explosions

Therefore, if we want to make greater strides towards reducing marine casualties, we must begin to focus on the types of human errors that cause casualties. One way to identify the types of human errors relevant to the maritime industry is to study marine accidents and determine how they happen. These events are not usually caused by a single failure or mistake; more specifically, they represent a sum of errors.

Therefore, marine accidents do not occur due to one human error. Usually, there are a lot of small mistakes that accumulate and may produce large-scale consequences. Error causation can be attributed to defects in design, procedures, training, maintenance, or management at the "*blunt end*" (Sheridan, 1992), even though most applications have focused on the "*sharp end*" (e.g., pilot, driver, surgeon, soldier, or other machine operator). Most often, causation is manifested as a lack of timely and sufficient feedback to the human or machine that "errs." Alternatively, a person with an incorrect mental model of how a system works is likely to err in using it. Mental workload, emotional stress, or physical incapacitation of one kind or another surely contributes to error. For automation that can be operated in two or more modes, inadvertent operation in one mode, concurrent with belief that the system is in a different mode, is a common cause of error.

Some authors proposed an analytical foundation for human factors analysis and classification system where they characterized the role of human errors. Their results yield the following conclusion: the skill-based errors are on the first level for causing the accidents. It comprises the incompetence of engine room personnel; followed by the lack of preconditions such as coordination, communication and planning, disorganization and maintenance. To define the level of 'nearest' the accident, it understands human errors and violations. There are three error types and two forms of violations. The error types include the skill-based error described as operating skill that occurs with little conscious thought. The second is the rule-based (decision) errors which are the action or in-action of an individual who does not have the knowledge and makes wrong choices. The latter is knowledge-based (perceptual) error when the individual perception is different from reality. This results in illusions and spatial disorientation.

Figure 10: Error types



Source: Author generated

On the other hand, violations consist of routine/infractions that consider routine violations, optimizing violations, and situational violations. From the psychological aspects, the preconditions for the level of 'nearest' the accident are also treated in two

directions. The first is the substandard condition of humans (crew members) which considers adverse mental state of a member, followed by the adverse psychological state and physical/mental limitations. The second is a substandard practice of crew member categorized as crew resource mismanagement and personal readiness.

4.3 Human Reliability

The human characteristics are the human constraints for achieving tasks. There are constraints such as: humans seen as a whole component or composed of separate subcomponents; humans are overloaded or under-loaded; humans are hypo-vigilant; humans are not experienced etc. The factors that may affect the system performance are numerous and correlations between factors have to be identified in order to simplify their integration into a human reliability assessment. Moreover, the main difference between humans and machines is the possibility that humans do not respect voluntarily a given prescription for specific reasons due to organizational factors for example, or to create new tasks or functions by using the technical resources differently. In such cases, humans are not repaired or changed, but they adapt their own behaviors to specific or usual constraints they have to control.

Therefore, the definition of human reliability may be adapted as the ability of a human component to:

1) realize successfully the prescribed tasks in given operational conditions over an interval of time or at a given time and
2) not to realize additional task that may affect the performance of the human-machine system in terms of, for instance, safety, production, quality, or workload

As we note past experiences indicate that human behavior plays a crucial role in the success of an engineering system. Some of the typical behaviors are the following:

- Human are often quite reluctant to admit mistake
- Humans often overlook or misread instructions labels
- Most people fail to recheck specified procedures for mistakes

- Humans frequently respond irrationally in emergency situations
- Humans normally carry out tasks while thinking about other things
- Humans are normally poor estimators of clearance, distance, and speed
- A significant proportion of humans become quite complacent after successfully handling hazardous or dangerous items over a long period time
- People frequently use their hands first to test or explore
- People get easily confused with unfamiliar things
- Generally, people regard manufactured items as being safe
- Usually humans tend to hurry at one time or another.

Other important factor in the reliability of an individual performing is the stress. There are basically the following four types of occupational stressors:

- occupational change-related stressors
- occupational frustration-related stressors
- workload-related stressors
- miscellaneous stressors.

Human reliability assessment has always been a critical issue for safety and researchers, decision makers, safety engineers and practitioners. The reasons of that the HRA method, are subjective and the data concerning human factor, is impreciseness. The first probabilistic HRA studies were performed after Second World War to assess weapon system feasibility (Swain, 1990). Thereafter, the technique has adopted to the different industries such as nuclear power plant (Zubair and Zhijian, 2013), engine system (Chang et al., 2010), electronic system (Liang and Wang, 1993) defense industry (Hausken, 2008), manufacturing (Bertolini et al., 2010), transportation (Calhoun et al., 2014; Guo et al., 2012) and etc.

There have been a variety of HRA techniques developed to assess human reliability. The most of techniques based on empirical studies such as *THERP*- technique for human error rate prediction (Swain and Guttmann, 1983), *SLIM*- success likelihood index methodology (Embrey et al.,1984), *ATHEANA*- a technique for human error analysis (Cooper et al., 1996), *HEART*- human error assessment and reduction technique (Williams, 1988), CREAM- cognitive reliability and error analysis method

(Hollnagel, 1998), *SPAR-H* -simplified plant analysis risk human reliability assessment (Gertman et al.,2005) since human error data is scarce in the literature. Therefore, it is quite tough to apply stochastic models such as Bayesian Network (Almond, 1992) or Markov chain (Mennis et al., 2006) in order to predict human error probability (HEP).

In the context of human reliability assessment in marine industry, the researchers are quite limited. For instance, Yang et al. (2013) discussed a modified CREAM method by integrating Bayesian reasoning model. The method was demonstrated with an illustrative example of analyzing an oil tanker cargo oil pump shut down scenario. Likewise, another study was conducted by Martins and Maturana (2013) as a marine-case in conjunction with HRA.

Furthermore, HRA focuses on the "sharp end" of anomalous events and is only suggestive of safety considerations higher up the causation hierarchy of policy, procedure, software and hardware design, and management.

Summarizing the above written, human reliability is a cause of concern as hardware becomes increasingly reliable and relatively human error is rising in its share of causing an accident. Hence, the need to increase the safety of these systems calls for addressing human reliability.

4.4 Resilience

Companies and organizations are trying to develop reliable safety systems. So, they emphasize in the risk perception. There are, different points of view at risk. For example, if a company assumes of having a good safety program in place and it's compliant, it should better have a good culture of perception of risk on board too. And it's a great need to be across the board, from the Master to the Chief Engineer to the CEO and the MD. Otherwise, the result is ending up in a situation: compliance induced complacency and thinking well of achieving safety but not really having it. And then, when safety fails - because safety does fail, even with the best loss prevention programs in place, when having an incident, thus not having the ability to react to it, then, the real question will be: is there the ability to "get up" and continue operations? When somebody falls off the bike does he stay on the ground? Is he resilient enough to get

up? When running shipping business, it's very important to self-evaluate if you are an egg as a company, or you are like a tennis ball. Is there the ability to bounce, react and continue operations?

Furthermore, the significant idea, as implementing safety procedures, is the ability to recover. Safety is an incomplete cycle, if not having the ability to recover and continue operations. The term resilience is of outmost importance not only for the shipping industry but for every business.

Resilience as a concept was introduced in the early 1970s and was originally defined as an ecological system's ability to arrive at an equilibrium, or stable state, over time in a dynamic and changing environment (Holling,1973). In the context of STSs (human operators, technology and organizational settings), resilience is the ability to sustain required operations and achieve system goals under a large variety conditions, including anticipated and unanticipated events. Within the framework of resilience engineering, four cornerstones (monitor, respond, anticipate, and learn) are used to characterize and analyze system performance in the light of normal operations and disturbances. The focus is on the adaption of performance to the current operating conditions, with an emphasis on positive examples (Hollnagel, 2014), i.e. situations where the system successfully manages to meet production goals through adapted performance. Another line of research developing from resilience engineering with practical implications, are the concepts of safety-I and safety-II (Hollnagel, 2014). These two concepts represent different approaches to safety management in high hazardous industries. They represent complementary perspectives on how to define, measure, monitor and improve system safety in these industries. Safety-I is often associated with a traditional approach to safety based on quantitative risk assessment, while safety-II is associated with the theoretical concept of resilience and qualitative inquiries into how safety can be identified as the result of successful performance (Hollnagel 2014).Within the maritime domain, the research conducted with focus on resilience, safety-I and safety-II is, to the best of our knowledge, sparse and foremost limited to research concerning frontline operations and safety construction in everyday operations (Praetorius and Hollnagel, 2014) as well as addressing using resilience engineering to offer alternative explanations of the concept of human error (Lutzhoft, Sherwood-Jones, Earthy, & Bergquist, 2006). Further, the methodological approaches

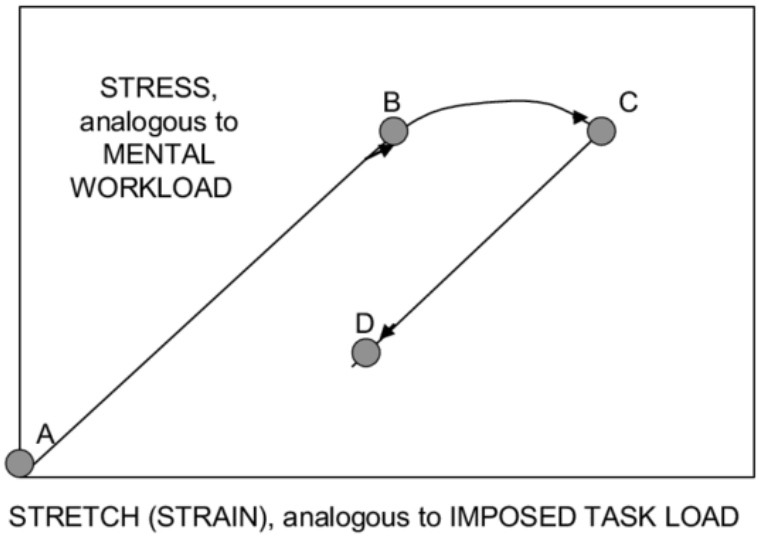
range from simulator studies (Morel & Chauvin, 2006) to qualitative inquiry as a basis for functional modelling (Praetorius, Hollnagel and Dahlman, 2015)

As outlined above, many of the safety-related efforts within the maritime domain focus on improving safety in accordance with a safety-I perspective. This section will therefore in contrast discuss how resilience engineering may contribute to a paradigm shift towards a safety-II perspective in the maritime domain. Following the capsizing of the Herald of Free Enterprise in 1987, the International Safety Management (ISM) Code (IMO, 2014) was introduced to the shipping industry. The main task of the Code is to clarify the role and the influence of shore-based and ship-based issues/factors in shipboard operations. This was probably one of the few accidents that has led to a systematic review of the STS 'ship' from a holistic perspective. The Code contains a few statements that can be used as an argument for the introduction of a safety-II perspective. Companies are required to provide for safe operational practices and develop related policies A designated person (DP) responsible for the implementation of the safety management system (SMS) has to be appointed with direct access to the highest management level (paragraph 4). It is furthermore stated that the ISM Code has a self-regulatory nature (IMO, 2014). However, the ISM Code is deeply rooted in safety-I paradigms. Companies are required to proceduralism the main functions and operations and thus directly pushed in a 'work as imagined' perspective. In the IMO context where a stronger focus is laid on the global eradication of sub-standard shipping this is an understandable objective. Certification guidelines for administrations require objective evidence (IMO, 2014), which typically is written procedures, documents etc. This cannot be avoided, but limits the flexibility of a company. The IMO recognizes that prescriptive criteria used by administrations for the verification of the implementation of the Code are counterproductive (IMO, 2014). '

One popular metaphor of resilience is the common stress-strain curve of solid mechanics. Many physical materials, when stretched by an external force (strained) from some length *A,* to a new length *B,* develop an intermolecular stress that enables the material to return to its original length when the external force is removed (in other words, a perfect spring). But when stretched beyond an elastic limit *C,* the

intermolecular stress will "give" and not increase linearly with stretch. In that case, when the external force is released, the material will not return to the original length but returns to a different point *D.* Stretch in terms of human or organizational behavior is analogous to imposed task load, and intermolecular stress is analogous to mental workload or organizational stress. For mechanical engineers, it is critical to know what the elastic limit is in terms of applied force or stretch, and for the safety engineer, it is critical to know the elastic limit in terms of task load and accompanying mental workload or stress.

Figure 11: Stress-strain metaphor for resilience



Source: Hollnagel & Rigaud, 2006

On the basis of generalizations published in the literature (Hollnagel & Rigaud, 2006) one may summarize as follows the management responsibilities necessary to maintain a resilient system:

- Emphasis on anticipating future possible incidents and on what actions were mitigating of negative consequences and aided recovery for past incidents
- Continuous measurement of system state variables (how "close to the edge" of safety boundaries)
- Appreciation of how formal policies and procedures differ from but nevertheless relate to the realities of worker actions; creation of a climate for openness to reporting and mutual respect between management and workers

- Encouragement of people with less status or authority to check on and make suggestions to those with greater status or authority
- Consideration of organizational mental workload, a measure that is already in common use for individuals and teams operating under stress. It is worth noting that a mental workload measure, even though it is likely to be subjective, is a better predictor of failure than a (more easily quantifiable) measure of system performance itself because an increase in mental workload anticipates a decrement in performance.
- Motivation and flexibility of a system: to learn and adapt. Flexibility presupposes sufficient training of both managers and workers so that they understand their nominal system (procedures, shortcomings, alternative means of recovery) and have confidence that they can improvise if necessary.
- Willingness to temporarily relax the efficiency goal for the safety goal when circumstances suggest doing so (e.g., an aircraft go-around, a spacecraft launch "scrub")
- Development of understandable abstract models of the workers, the team, and/or the organization that include representation of the salient control inputs and performance outputs and the relation between the two, to keep everyone in the organization "on board"
- Resource preparedness: ensuring availability of resources needed for serious anomalous events should they occur
- Top-level commitment to safety: willingness to invest in safety and keep imagination (of failures) active even without a recent history of accidents. The danger is that when a system is apparently operating smoothly and safely, the organization will lower its guard, and incentive for investment in safety will decline.

If resilience can be defined as the ability of the system to adjust its performance prior, during and after an unexpected event, a system must have the ability of being proactive. In a wider context, proactivity may indicate an early stage identification of problems or factors that may affect safety together with the development of regulatory actions before an accident occurs.

Even with robust data in hand, healthy communities can't be expected to anticipate all of the surprising, nonlinear ways in which systems behave when they are disturbed, any more than the experts do. What is needed is an inclusive way of thinking about various possible, probable, and preferable futures and their implications. Here again, new tools and technologies promise to help communities and organizations map critical thresholds, rehearse the consequences of disruption before they occur, and make better choices. (Zolli, 2013)

4.5 Human Resource Management

Human resource management (HRM) refers to the practices, systems, and policies that influence the behavior, performance, and attitudes of employees. Human resource practices include selecting human resource needs, screening, recruiting, training, rewarding, appraising as well as attending to labor relations, safety and health, and fairness concerns (Dessler, 2007). The recent years has shown a growing interest in the management of knowledge-based organizations. The effective implementation of HR practices in organizations is a key source of competitive advantage and has a positive relationship with organization performance (Collins, 2006). Studying topics of modern management, which includes recruitment and selection, training and development and the factors affecting the practice, is a new concept to developing countries.

Human resource management involves both strategic and comprehensive approaches to managing people, as well as workplace culture and environment. The role of human resources professionals is to ensure that a company's most important asset, its human capital, is being nurtured and supported through the creation and management of programs, policies, and procedures, and by fostering a positive work environment through effective employee-employer relations. The concept behind human resource management is that employees who are subject to effective human resource management are able to more effectively and productively contribute to a company's overall direction, thereby ensuring that company goals and objectives are accomplished.

The traditional method of human resource management involved planned exploitation of staffs. The new function of human resource management involves HRM Metrics and measurements and strategic direction to display value. Under the influence of giving away the traditional method, HRM has got a new terminology called Talent Management.

Human Resource Management functions can be of three types like Operative, Managerial, and Advisory as shown in the figure below.

Table 11: Functions of Human Resource Management

Functions of Human Resource Management		
Operative Functions	***Managerial Functions***	***Advisory Functions***
• Recruitment • Training and Development • Professional Development • Compensation and Benefits • Performance Appraisal • Ensuring Legal Compliance	• Planning • Organizing • Directing • Controlling	• Top Management Advice • Departmental Head advice

Source: Author generated

4.5.1 Human Resource Management Practices

The activities performed by human resources teams should directly correlate with HR practices. If they don't, the disconnection can illustrate the concept of being up a creek without a paddle: It is possible to function this way, but it is not very effective. Thriving HR departments exist as fine-tuned watercraft impelled to harvest and prepare the best catch within their capabilities.

Human resources practices are strategic in nature. They represent a vital guidance system that coordinates with an executive business plan. HR practices form the foundation, supporting the way a company's human capital will operate on their behalf. HR activities embody the directives set forth through HR practices. HR activity examples include engaging in taking competitive surveys to ensure your workers are fairly compensated and managing employee attendance and overtime. Further HR activity examples include recruitment, hiring and firing and the administration of health benefits.

Some of the most important and top listed HR practices are the following:

1. Safe, Healthy and Happy Workplace
2. Open Book Management Style
3. Performance Linked Bonuses
4. 360 Degree Performance Management Feedback System
5. Fair Evaluation System
6. Knowledge Sharing
7. Highlight Performers
8. Open House Discussions and Feedback Mechanism
9. Rewards

4.5.2 Organization performance

What is more, one of the main issues, focuses on the determinants of organization performance. Scholars from different backgrounds have explained organization performance and identified the sources of inter-organization performance differences. Organization performance is determined by measuring the actual outputs of an organization against its intended outputs (i.e., goals or objectives). According to Richard, Devinney, Yip, &Johnson (2009), organization performance comprises three areas of company outcomes, namely, financial performance (return on assets, return on investment, and profits), product market performance (sales and market share), and shareholder return. Organization performance also refers to strategic planning, operations, finance, legal, and organization developments. Several researchers relate organization performance to financial performance, which involves budgets, assets, operations, products, services, and markets (Thurbin, 1994).Some researchers identify several non-financial outputs that also contribute to organization performance, namely, management quality (De Waal and Frijns, 2011), long-term orientation (Steiss, 2003) continuous improvement (Arsad, 2012), workforce quality (Storey, 1989), and openness and action orientation (Pathak et al., 2005).

4.5.3 Recruitment and selection

Recruitment is the process of gathering qualified applicants for available positions within an organization (Mathis, 2004) and deciding whether to employ the qualified applicants or to reject them. Selection involves choosing the most suitable applicants who satisfy the requirements for a particular job. The practice of selection is a decision-making activity or a psychological calculation of appropriateness (Price, 2004). Organizations that adopt appropriate selection processes are guaranteed to hire employees with the right skills and levels of confidence for a particular job. Some researchers found that prerogative recruitment and selection practices positively affect organizational performance (Harel & Tzafrir, 1996). Delaney and Huselid (1996) found that effective recruitment and selection processes positively affect organization performance. By studying the employee recruitment, retention, and performance strategies in the Nigerian civil service, Gberevbie (2010) emphasized the importance of

adopting appropriate employee recruitment and retention strategies to improve organizational performance. Other researchers suggested that a significant and positive relationship exists between recruitment/selection and organization performance (Gberevbie, 2010).

4.5.4 Training and development

Training and development are important elements of HRM (Vlachos, 2009). Organizational performance may benefit from training and development in several ways (Subramaniam et al., 2011). Training is a marshaled activity that aims to impart instructions or information to improve the performance, knowledge, or skills of the trainee. Development refers to the activities that help individuals attain new knowledge or skills that are necessary for their personal growth. All-inclusive training and development programs help trainees to focus on the skills, attitudes, and knowledge that are necessary to achieve goals and to generate competitive advantages for an organization. Apospori, Nikandrou, Brewster, and Papalexandris (2008) found that training has a significant effect on organizational performance. Subramaniam et al. (2011), argued that training and development could influence the performance of an organization because the skills, knowledge, and abilities of employees could be improved continuously. AL-Qudah, Osman, Ab Halim, and Al-Shatanawi (2014) stated that a significant relationship exists between training and development and organizational performance. Investment on training and development could produce huge benefits for an organization. Several researchers have reported that training can positively affect productivity, and employees and employers can receive mutual benefits from training (Conti, 2005). A significant relationship between training/development and organizational performance was also established in several studies (Subramaniam et al., 2011; AL-Qudah et al., 2014)

4.5.5 Human resources Management (HRM) in maritime affairs

In addition to the before mentioned facts related to human resources management, it should be noted that all of the above can be applied to companies in the maritime sector. The study of human resource management in shipping includes staffing on board, which presents a specific, isolated environment whose working conditions cannot be

compared with usual operating conditions. The problem of managing people on board is specific due to the fact that the management of the shipping company is not directly present on board, but the management function is performed by officers of the highest rank (captain and chief engineer). The specifics of the working environment have led shipping companies to organize additional training covering individual work outs with candidates. The above includes a day-long psychological evaluation with feedback and situational training such as decision-making in times of crisis or emergency situations, issuing commands, allocating of business load or handling the ship. Among other things, candidates should acquire knowledge and abilities related to leadership skills, personal stability, and sociability or cooperation with the crew. Special attention is paid to the management of a multicultural crew, and a perspective on other cultures is set from the Western point of view. At seminars, the officers are instructed on existent means of describing, comparing and understanding of cultural and ethnic characteristics and differences. Such an approach should help officers in gaining deeper knowledge of different cultures, resulting in the improvement of the monitoring and management style. Diversity is manifested in attitudes, priorities, norms, beliefs and behavior.

In the ship's management, the workforce is the primary factor. Although saving on the crew is the easiest way to reduce the costs of companies by importing cheaper labor, one should keep in mind that people are a key factor in maritime affairs breakdowns (Baker, McCafferty, 2005). Training can improve the skills of seamen, but no training can help if the wrong person is selected. Therefore, it is essential to choose the right candidate for the right tasks. Successful shipping companies create a sense of belonging, while in the lower-rated the crew is mainly motivated only by money (Barsan et al., 2012). There are two basic approaches to the management of human resources. On the one hand is a classic staff management in which people are considered to be a cost to the company. Another approach is the modern HRM (Human Resources Management) that is broader than the previous one, and in which the people are viewed as a benefit to companies because they can contribute to competitiveness through technological and financial capital (Bilici et al., 2012). In this process, the right selection

of personnel is considered critical, but it includes more than just recruitment, and staff (crew)

are monitored at all stages of their careers. The very process begins by the candidate's application for a job at the shipping company, after which follows a thorough and rigorous assessment, testing and examination of various knowledge and making decisions about employment. After the employee's arrival aboard their work is valued through the existing system of evaluation, i.e., the results at ship training, or in other ways, which results in termination of employment, or progression and reward.

4.6 Leadership

The culture of an organization is defined by the beliefs and capabilities of the leader. In a time of accelerated change, organizations often look to leaders for guidance, as "in most companies, digital acceleration comes as a top-down ambition" (Camille Egloff, 2016). High quality leadership and excellent change management, therefore, is crucial for the success of the environmental and digital transformations in the maritime industry. "*Leaders must manage the change or it will manage them*. Weak leadership provides no guidance. It confuses people, demotivates them and creates poor working environments.

Leaders need to achieve their goals via their team members' work. When leader's team shines, leader shines. This is a significant mindset change, as it often means leaders need to subordinate ego or personal recognition to satisfy direct reports' needs, and to have a high performing team that can respond effectively to ever-changing work demands. The development of others is now proportionate to, or even greater than, a leader's own development. Clear goal setting and actively enabling team members is essential. How a leader treats his team is essential, too. Actively working to engage his talent will reduce turnover risk. Employee engagement and retention can be increased, by addressing three areas that get to the heart of what really matters to your team:

- Meaningful work: Assist team members in understanding how their unique role makes a difference. Agree on clear goals that link to the organization and their job. Support access to data and information needed to be effective. Empower, give freedom

- Positive environment: Show the team they work in a great place. Ask for respect for the contributions of others. Ensure collaboration for group goals. Make sure to treat each other fairly.
- Individual value: Appreciate and encourage team members. Support direct reports, don't control. Acknowledge their efforts towards their goals.

One of the most common pitfalls of organizations is promoting great technical experts into leadership roles and assuming they will automatically be successful. Leadership requires training and actively developing behaviors that your team values. Many of these behaviors tend to not feel natural, and new leaders are very rarely versed in all of them. More specifically, in these stressful times of volatility, uncertainty, and complexity, exceptional communication skills are required. And trust to set goals and then leave people alone. Trust time, trust space, and trust the team will contribute to achieving the goals that the organization sets.

4.6.1 Leadership styles

According to the Silva (2014), there are differences within academia regarding the variety of styles of leadership. Some researchers believe that leadership style is essential further noting that the best style is not static but should be adapted to the situation. On the other hand, others believe that changing leadership style is impossible or should be avoided (Lewin, Lippit & White, 1939)

Moreover, there is a belief, that the most important thing is not the style but the essence of leadership. There are also different opinions about the subject between academia and the wider industry and organizational life. For instance, some researchers believe that leadership style focusing on task is better than leadership style focusing on employee (Mitchell, Biglan, Oncken & Fiedler, 1970), leading to the development of different models of situational leadership (Hersey, Blanchard & Johnson, 2001).

The following are the ten popular leadership styles

1. Autocratic leadership

According to the Cooper (2008), autocratic leadership is controlling, and telling workers and/or followers what and how to do things. If it is used over time, it causes lack of trust and respect and prevents workers from thinking creatively and taking risks and creates conditions of fear through critical feedback. This style generally neither motivates workers positively nor increase loyalty (Cooper, 2008). On the other hand, Autocratic leaders provide clear expectations for what needs to be done and clear division between their followers. This could be best applied to the situation where there is little time for decision making with team, or leader is the most knowledgeable person in a group (Lewin, Lippit & White, 1939).

2. Bureaucratic leadership

Bureaucratic leaders work by following closely rules and procedure. This style is suitable for working in high risk environments, such as working with machinery, handling dangerous cargoes or working at dangerous heights (IMO, 2014). On the other hand, the disadvantage of this style is that it is ineffective on teams or organizations that rely on flexibility, creativity or innovation.

3. Charismatic leadership

A charismatic leader inspires enthusiasm and generates energy to lead others forward. In general, people tend to willingly follow this kind of leader. However, there is the risk that this style of leadership breeds inappropriate self-confidence and self-centeredness because followers believe that achieved success is highly attributable to the leader. A charismatic leader bears heavy responsibility, and there is a tendency for followers to leave things to the leader (IMO, 2014).

4. Democratic or participative leadership

This type of leader invites members to participate in decision-making, even though they take responsibility for the final decision. Members can feel involved and respected and individual development is encouraged. Indeed, it takes time to reach decision. However, it is likely to result in a satisfactory outcome (IMO, 2014). The

disadvantage of this style is that this type of leader can appear indecisive or unwilling to make a decision and decision-making is time consuming.

5. Laissez-faire leadership

The laissez-faire leader takes a back seat. They let their followers make their own decisions and give them freedom to work in the way they deem best. This can be applicable when leading experts and to facilitate creativity. However, it can lead to a lack of direction, a lack of urgency and followers' frustration when overused (Cooper, 2008).

6. Task-oriented leadership

A task-oriented leader focuses on tasks at hand, and all procedures necessary to achieve the task. This style of leader is less concerned about catering to employees and more concerned with finding progressive technical/operational solutions to achieve goals. A disadvantage associate with this style is that there is a possibility for workers to have their motivation decreased if they feel powerless to control any aspect of their jobs.

7. People-oriented or relation-oriented leadership

A leader with this style understands the importance of tasks, but also uses a tremendous time and focus on meeting the needs of employees involved in these tasks. This may include offering incentives, such as bonuses, providing mediation to deal with conflicts, spending individual time with employees to learn their strength and weakness, or just leading in an encouraging manner. A possible disadvantage is that if employees receive too much responsibility without management guidance, the decision making can be overwhelming.

8. Transactional leadership

Transactional leadership motivates followers by appealing to their self-interest and exchanging benefits (Yukl, 2013). The transaction is that work will be done in return of payment and other rewards. The leader has a right to penalize followers who do not meet the particular standard. (IMO, 2014). Transactional leaders can seem impersonal. The leader may see employees as completely replaceable, because the leader only focuses on the completion of tasks. Transactional leaders

don’t see employees as individuals with personal needs. As a result, moods, emotions and fatigue may become irrelevant to managerial decision making about productivity.

9. Transformational leadership

The transformational leader can effectively inspire the followers with shared vision of the future and encourage enthusiasm for situations to be changed (IMO, 2014). The
transformational leader appeals to the moral values of followers by attempting to raise
their consciousness about ethical issues (Yukl, 2013). However, this leadership style may lead to relying too much on emotion and passion and overlook truth and reality.

10. Servant leadership

A leader with this style is often not formally recognized as the leader. When someone
leads simply by meeting the needs of the team, he/she is described as a servant leader
(IMO, 2014). There are a number of disadvantages of servant leadership. One distinct disadvantage is the use of time. It takes time to implement this philosophy. Typically, an entire organization has to undergo a paradigm shift towards servant leadership. It starts at the top of organization, but change has to be made all throughout the organization.

4.6.2 Task-oriented Leadership vs People-oriented Leadership

Task-Oriented leadership places an emphasis on getting a very specific job done. This system of leadership can be described as autocratic. Autocratic leaders make decisions without consulting their team. Task driven leadership requires its leader to have a clear definition of productivity and roles required. Task-oriented leadership does not place the well-being of staff members as its main priority. Performance goals and deadlines

are what motivate task driven leaders to succeed. Since autocratic leaders don't typically consult their team before making a decision, the task-oriented style can be beneficial since it allows decisions to be made very quickly. This is helpful in crisis situations, but it may lead to employees feeling disenfranchised.

The people-oriented approach is the exact opposite of the task-oriented approach. The people-oriented approach involves supporting and developing people in their team. This style requires a high level of participation from leadership. People-orientated leaders consider how their decisions will affect others and weights their decisions heavily against any final action. Democratic leadership is characterized by the leader's willingness to allow team members to provide input on decision making. This form of leadership requires a high level of communication with staff members. Everyone feels ownership of the decision that is taken, which equates to much greater buy in. On the downside, it can take an incredibly long time for a decision to be made and there may be conflict as people with competing viewpoints try to have their opinions heard.

It is extremely difficult to access the effectiveness of leadership styles on a company. Some researchers have argued that the influence of leaders on an organization is overrated. Although task- and people- orientated approaches to leadership contrast greatly, the effects of these two styles on a company's performance are basically identical. Generally, organizations will be content as long as team members have some sort of leader to guide them. Choosing a leadership style is not a simple process. Leaders are expected to guide and motivate team members to perform at an acceptable level. There is no single leadership style that will guarantee the success of a business. Nevertheless, a chosen style is needed so that allows to convey direction and maintains the authority.

4.6.3 The leadership development process

Leadership development is a lifelong process and the necessary skills are not for senior management personnel only. Leadership skills are necessary for everyone who has responsibility for others. Human beings are keen observers and mimics. We learn by

observing and replicating what we see around us, acquiring good and bad habits by watching and copying others (Jeffery, 2007).

According to Bell (2012) "*even the most experienced leaders should always expose themselves to new ideas, confront new challenges, and rethink their leadership style*". Robert (2005) states that it is becoming increasingly clear that experience is the best teacher of leadership development.

Devitt and Holford (2010) suggested that international maritime industry has unique aspects which make it difficult to apply the concept of leadership training in other industries into the maritime context. The reasons he gives are indicated below;

- Development and maintenance of situation awareness on sea passages, differing from the regulation and control present within aviation.

- Ships' teams 'hand over' to each other at regular intervals and are augmented as required. This does not routinely happen outside the maritime industry.

- Communication, including the use of interventions and challenges. Ships' teams can more culturally diverse, with less utilization of standard communication phrases.

- Organizational, professional, departmental and national cross-cultural issues associated with the globalization of the maritime industry.

- Leadership and teamwork are impacted by the duration of the working relationship. The transitory nature of ships' crew, where teams are constantly changing due to leave rotations, can differ from other industries.

- Dynamic workload issues onboard a vessel operating routinely are influenced by external environmental factors, voyage duration, cargo operation and administration requirements and available support mechanism.

4.6.4 Leadership on-board

For good leadership, traits such as maturity, bearing, fair-minded, tact, justice, integrity, confidence, coolness, goodwill, and candor must be the guiding light. Bellefontaine (2008), in this regard notes that emotional stability and intelligence and passion are key

traits for a superior leadership. Finally, Northouse (2004) maintains that good leaders respect and serve others, build good cooperation, and promote impartiality. In this respect, it is submitted that all these crucial traits are essential for maritime officers' leadership style. Nonetheless, from the above discussion, conclusions may be drawn that perhaps there is no perfect leadership style that might be suitable for all sorts of situations. Therefore, the effectiveness of the leadership style depends on the demand of the situation; particularly, in the maritime working environment, which implies high risk for accidents, harsh weather and working conditions, extra responsibility, increased fatigue and stress, and social isolation. Thus, the Autocratic style of leadership may be only appropriate where decisions need to be made quickly and decisively, as well as when total absence of discipline exists among subordinates. As a result, although maritime officers, as leaders, should be generally characterized by an autocratic leadership type, yet, young maritime officers' behavior is sometime inappropriate and ineffective; because, on board a ship is not only the senior officer alone who needs to be viewed as a leader, but also petty officers, cadets and sailors too need to demonstrate good leadership if the ship as a whole is to perform exceptionally (Richard, 2007). Richard (2007) also asserts that the 'big stick' must be avoided by a good leader, and that instead, recognition, respect and encouragement must be promoted among crew members. Additionally, excellent leadership depends basically on constituent cooperation and support, successful delegation of the authority and on the communication effectiveness (Platow at al, 2007) On the other hand, the pre-dominated view is that the Democratic style appears to be more suitable for good leadership (Dixon, 2003), but in changing situations may be ineffective towards rapid decision-making (Bellefontaine, 2008). Similarly, in spite of the fact that Laissez Faire style might embrace effective traits necessary for a good leadership, this approach may again offer minimum direction and discipline, particularly, for emergency situations

4.7 Fatigue

Fatigue can occur to anyone. It is not related with the skill or capability of the person. However, a strong person can withstand work pressures better and fatigue will come in him much later than a weak person. Same goes true with his mental strength. Out at

sea, the conditions are tougher and most people working out there are bound to have some fatigue issues. When the fatigue goes high beyond his tolerance, it can have disastrous effect on the work which can result into accidents and creation of dangerous situations. Lot of work is done by IMO to mitigate and manage the fatigue of seafarers.

Dictionary meaning of fatigue is, “Extreme tiredness resulting from mental or physical exertion or illness”. With fatigue, you have unexplained, persistent, and relapsing exhaustion.

Fatigue is also identified as part of human error chains. Human fatigue is broadly divided to physical fatigue and mental fatigue. They are both complimentary to each other and both will affect people adversely. Physiological and psychological factors can also result in human fatigue. All of us have some amount of fatigue which we can overcome from time to time. But when it becomes heavy, then our capabilities start diminishing. Medically Fatigue is considered as a symptom, not a condition.

Fatigue has been a difficult problem to investigate. Many seafarers though experience fatigue; they do not report it, basically because they do not clearly understand it. Effectively dealing with fatigue in the maritime environment requires a comprehensive and holistic approach that recognizes ship design, and the roles and responsibilities of all stakeholders in the mitigation and management of fatigue. An effective fatigue management strategy begins with determining operational workload requirements and matching onboard manning levels and onshore support resources, combined with efficient management of workload and hours of work and rest on board the ship. There is no one-system approach to addressing fatigue, but there are certain principles that should be addressed in order to gain the knowledge and the understanding to manage this human element issue

Working in harsh and/or uncomfortable environmental conditions can contribute to the risk of fatigue in a number of ways. Heat, cold, noise and vibration are some of the environmental conditions that can make ship staff to tire quicker and impair their performance. The mental and physical demands of work can contribute to fatigue in a number of ways. Concentrating for extended periods of time, performing repetitious or monotonous work or performing work that requires continued physical effort can

increase the risk of fatigue by producing mental and/or physical tiredness. Ships movements such as heave, surge, sway, roll, pitch, yaw all can affect the people on board.

The IMO guidelines defines fatigue as, " a state of physical and/or mental impairment resulting from factors such as inadequate sleep, extended wakefulness, work/rest requirements, out of sync with circadian rhythms and physical, mental or emotional exertion that can impair alertness and the ability to safely operate a ship or perform safety-related duties. IMO recognizes fatigue as a hazard and that it is not an-in-thing of maritime occupation.

Then is the effect of circadian rhythms. Most seafarers have a work cycle of 4 hours duty and then eight-hour rest continued with 4 hours duty and 8 hours rest in a day's cycle. But most of the time they must take care of other work, documentation and the personal requirements. They are on call during their stay on board. The work load will go high during port operations, cargo operations, and emergency situations and during break downs, without mentioning unforeseen situations like war, piracy or rescue operations.

Seafarers lack "quality sleep", even though they may try to rest. Hence so-called rest hours shown need not be the indication of quality sleep. Sleep deficit can lead to problems of sleep apnea. Along with fatigue generation, it can lead to long term degeneration of brain and psychological problems. What is more, change of geological locations, effect of time variations resulting in so called jetlag, etc. can also be some factors to consider.

Fatigue can also result from and also result in some long-term health problems, such as:

- digestive problems
- heart disease
- stress
- harmful drug and alcohol use, and
- mental illness.

Ship staff needs to remain alert all the time to identify fatigue build-up of themselves and their colleagues. Any change in their usual-self must be reported and remedial action must be taken.

Indicators of fatigue:

- Mood changes – low energy, lethargy, tired, weariness
- Mental changes – forgetfulness, distraction, fear, frustration, low alert, cognitive reduction
- Physical – headache, body pain, sleep apnea, lack of appetite

5. Implementation

The implementation of the TMSA program has brought up notable changes and significant results to maritime management companies. The differentiations imposed by TMSA are not the same for each company, as each one presents unique characteristics (fleet number, code of safe management, quality level that it wants to achieve). In addition, each managing company selects the extent to which the program will be used and thus the level of safety and environmental excellence it seeks to reach. The most updated version of the program has offered the companies options and advantages that were not at their disposal and additional tools that help in the success of fewer errors and failures.

5.1. Human factor's significant role in TMSA3 's elements

It is largely supported that if TMSA3 is used as a customer attracting tool, it can deliver significant profits to one company. This is due to the fact that it is a form of "advertising" for the company itself. Through this, an organization can communicate to a customer, the level that the first one handles the different situations that occur. In addition, many times, companies come faced with many gaps that occur when using the program. When these gaps are perceived by the competent authorities, immediate solutions and guidelines are created to improve their procedures and the way they face potential difficulties. Thus, with these changes, each organism is positively differentiated and achieves higher levels of safety and quality. Essentially, the more a company complies with the renewed guidelines and the standards of the program, the higher levels of environmental excellence it achieves. Moreover, it is argued that because this company is moving in the spirit of continuous improvement, it does not consider that excellence in safety and environmental awareness can be achieved but says that TMSA3 is a helper in the effort. This, since it is based on "Best Practices" that have been observed in the shipping industry. As the TMSA3 considers "acquired" the verses of TMSA2, it sets the bar high enough and therefore creates the need for more complete procedures which in turn, lead to better performances in possible inspections (e.g. Vetting). Although, TMSA2 has set KPIs that encapsulated human factor in a precocious way, TMSA3 has clearly targeted to demonstrate human factor in every

possible way. The following table, summarizes the cited KPIs in both TMSA2 and TMSA3, plus it mentions the new KPIs set by TMSA3 regarding the Human Factor.

Table 12: **TMSA2-3's KPI gap analysis regarding "Human Factor"**

ELEMENT	STAGE	KPI	TMSA 2	TMSA 3
1. Management, Leadership and Accountability	**2.3**	Vessel and shore-based management teams promote HSSE excellence.	+	+
	4.3	All personnel demonstrate commitment to HSSE excellence	+	+
2. Recruitment and Management of Shore- Based Personnel	**1.1-1.2**	Recruitment process ensures candidates for key shore positions have the appropriate qualifications, experience and competence	+	+
	4.3	The company promotes appropriate interpersonal skills training	+	+
3. Recruitment and Management of Vessel Personnel	**1.1**	Procedures for the section, recruitment and promotion of all vessel personnel	+	+
	2.4	Procedures identify additional training needs for individual personnel	-	+
	2.6	The company monitors and records training results and effectiveness	-	+
	2.7	There is a promotion procedure	+	+
	3.1	Enhanced appraisals for Senior Officers	+	+
	4.1	Procedures to assess crew members for job competency	+	+
	4.3	Cross- cultural interpersonal skills are promoted	-	+
3A. Wellbeing of Vessel Personnel	**3.1**	Seminars for senior officers promote, emphasize and enhance the SMS	+	+
4. Vessel Reliability and Maintenance	**4.5**	Engineering audits by a suitably qualified and experienced company representative while on passage.	-	+
5. Navigational Safety	**3.2**	Senior Officers receive appropriate ship-handling training before promotion to Master or assignment to a new vessel type.	-	+
	3.3	Navigational audits while on passage by a suitably qualified and experienced company representative.	-	+
	4.3	Competency assessment programs ensure that Masters and navigation	-	+

		officers maintain core and specialist skills.		
	4.4	Navigator officers undertake periodic refresher BRM simulator training	+	+
6. Cargo, Ballast, Tank Cleaning, Bunkering and Mooring operations	**4.2**	Audits by a qualified and experienced company representative include observation of cargo, ballast, tank cleaning, bunker handling and mooring ops.	-	+
9. Safety Management- Shore based Monitoring	**3.2**	Proprietary safety tools are used to encourage hazard identification and to improve safety awareness.	-	+
	3.3	Management identifies opportunities to strengthen the safety culture through interaction with fleet personnel.	-	+
	4.1	Leading and lagging indicators of safety performance are analyzed across the fleet and on an individual vessel basis to identify areas where the safety culture can be improved.	-	+
9A. Safety Management- Fleet Monitoring	**1.2**	The company safety culture encourages all personnel to identify, report and address hazards.	-	+
	2.1	Intervention to prevent unsafe acts and conditions is encouraged.	-	+
	3.1	Procedures encourage the reporting of safety best practices.	-	+
	3.2	Procedures measure and compare the strength of safety culture across the fleet to identify areas for improvement and to provide motivation to crew.	+	+
13. Maritime Security	**TOTALLY NEW ELEMENT**			

Source: Author generated

Companies are getting in compliance with the new TMSA guidelines, but the question is, what are the steps that the shipping managers follow to prepare their fleet and office for an imminent inspection? Taking into account the changes from TMSA3 the following movements are identified based on the additional requirements and changes of this new TMSA. What is more, according to the best practices provided by the arisen KPIs, it would be very interesting to study how should or how do, the oil companies,

already, really implement the TMSA, as far as the new-born need, of manipulating the human factor in the elements of the TMSA that plays a significant role.

1st Element – Leadership and the safety management system

The Alpha and the Omega of a shipping company is the way in which it chooses to synchronize and manage the Safety management system documents which it sends and informs throughout its fleet and in which each sailor must have access to keep up properly with the company's regulations. A platform for communication between ship and company is the basis for the creation of the appropriate management system. Leadership can establish and share critical policy documents across a maritime organization with the ability to produce clearly defined roles and responsibilities, ensure roles within the shore organization and fleet are altered and have easy access to policies, and assign mandatory readership and acknowledgments ensuring all personnel is kept up-to-date. Leadership and management evolve through the correct communication of ship and office through annual management reviews and fleet circulars and Safety campaigns on board. A very effective method to achieve such a goal is to make employees regardless their position, to comply with the responsibilities that employees of even higher or lower level in the managing hierarchy, account for, and the way they would behave in order to succeed the goal. Role-play scenarios during company’s insight seminars could provide such an achievement

2nd Element – Recruitment and management of shore-based personnel

The company must pronounce to its employees the appropriate and correct job description in order to achieve the desired result of work and loyalty by its employees. Correct promotion, training needs and proper task management must be offered by the company. So, the worker stays faithful to it, tries for the common good and forms a positive image for the company outward. Happy employee equates to positive advertising.

3rd Element – Recruitment, management, and wellbeing of vessel personnel

Defined rank wise processes in the recruitment module. The document requirement matrix which is defined within company's platform, enabling documents to be checked when personnel is planned/signed on to a vessel, providing alerts when gaps are recognized. The provision to enter the manning scale is important too. If the crew complement goes below the safe manning requirement, alerts are generated. Appraisals that can be configured (as per requirements) with their workflows should be defined in the system. The provision for recording the attendance of the seafarers to seminars conducted by the company or need to be contacted.

4th Element – Vessel reliability and maintenance including critical equipment

For this element companies can provide a work planning module. This is a useful tool because a company will be able to complete overview of all tasks and enables a fleet to be kept up-to-date on all planned or unscheduled maintenance work. Through this, each company will be able to built-in dashboards and reports provide a real-time overview of KPIs by monitoring overdue maintenance, critical equipment and work procedures, the status of essential spares, and to keep track of targets. The interactive dashboards not only provide a visualization of data but enable users to open relevant records and act directly. Other tools could be the following:

-Smart Data:

Capture structural integrity data such as tank inspections or crankshaft deflection along with planned maintenance work orders with automatic trending in the system using dashboards.

-Inventory

Critical Spares inventory must be maintained in order to manage the spares needed in case of need or expiration. Keep your critical spares list up to date with a mobility platform, which lets you perform inventory audits, and scanning on the go with the future planning module built into the system, plan for critical jobs, and order spares in time using the integrated procurement system.

-Keep Improving

Keep improving the planned maintenance system through a formal change request process for monitoring and implementation of changes and correction to maintenance information within the platform.

Element 5: Navigational Safety

Senior officers receive appropriate ship-handling. Training before promotion to Master or assignment to a new vessel type. TMSA attaches great importance to the navigation part, due to the significance of human factor. The naval personnel involved in this piece, must have adequate training. Both the machines and the naval personnel must adhere to, and follow all regulations, regarding the company's cyber security.

Element 6-Cargo, Ballast, Tank Cleaning, Bunkering and Mooring operations

In this area, human element plays a very key role. The sailor must be able to cope with all reported events of the element. Again, proper training and crisis management seminars are necessary for the individual to function properly and calmly.

Element 9: Safety Management-Shore based Monitoring

The Office must follow all basic safety rules such as emergency exits, hazard plans, signals, fire extinguishers and flashlights at easy-to-reach points. All personnel must be aware of and hear the company's safety manual. Misses must be reported and basic regulations safety should be known to all. Drills for crisis management must take part at least once a year.

5.2. Tools to implement resilience

What is to be further noticed, is that objectives should be listed for those, who work at every level in every company. Staff should be given specific aims and targets and above all else, management should be willing to listen and learn.

KPIs should be established, which could take in the numbers of pollution incidents, accidents, audit findings resolved, near miss reports, inspection results, customer complaints, the time taken from completion of an audit until its issuance and distribution and the number of audits performed against audits planned.

But then, tanker shipping seems to be all about compliance. Everybody must comply with the requirements of regulations, rules, standards, codes and directives. Along comes TMSA3 and all of a sudden, tanker shipping won't be a compliance industry. It won’t be only regulation driven. It will be proactive, continuously improving, self-regulating, self-assessing and self-assessed; because what occurs from the human nature, and the multidimensional meaning of the term human factor, returns back to human.

The aforementioned, captures the philosophy, of all the agreed actions many companies use to give answers to questions such as:

- What are the personal behaviors and values that contribute to good safety performance?
- What should be done to have a zero-incident industry?
- How to make a person and moreover a system, resilient?

Research from other industries, similar to the maritime transport industry, such as oil & gas industry and aviation industry has shown that leadership visits, reflective learning and learning engagement tool are significant factors to access the ability to bounce back and learn from adversity.

Shell as an Oil Major Company, supports that it is of a big importance to build resilience and the ability to remain focused even in the most stressful situations. This is crucial for both individuals and teams. Shell is the first company to demonstrate a complete program implementing resilience. The company's resilience program is team-based; it is based on a series of modules which focus on specific resilience techniques. The program lets participants learn together. Strengthening and supporting each other. Resilience techniques are practiced using scenarios and the participants share insights on how to apply resilience to their lives and to safety critical situations. Working proactively on resilience as a team benefits from others interpretation. It is the only way to keep ourselves, our teams, our assets and the environment safe.

Shell, as the first to invent the theme of resilience in maritime affairs, has set a framework of five core modules in order to cope with, each taking between 30 minutes and 1 hour, which can be delivered by a volunteer facilitator in any order. Each module focuses on a different area that makes up our natural capacity to deal with life's challenges. The five modules are:

- What is Resilience?
- Take Decisive Action
- Keep Things in Perspective
- Change is a Part of Living
- Take Care of Yourself

The resilience package includes everything that is needed for a vessel's staff to successfully deliver the modules on board. No additional specialist expertise is required. To help in running the sessions the package is built using the facilitator guide and the participant guide and has the required materials for each session. As the participants guide will be kept by the participants they can make personal notes which can be referred to at a later date for their own use.

Shell fully applies this program to its own vessels, and compels the shipowners and the management companies to follow the program in order to charter their vessels.

Greek shipowners and companies are in great efforts to cope with the program using Shell's modules. Greek companies, such as Almi Tankers S.A, Ionic Shipping (MGT) Inc., Neda Maritime Agency Co Ltd., Thenamaris Ship Management Inc. and Minerva

Marine Inc. have already started implementing the program according to newsletters and magazines, in collaboration with Venlys.

5.3 Getting into deeper thoughts

On January 15, 2009, Sullenberger was the captain of US Airways Flight 1549, an Airbus A320 taking off from LaGuardia Airport in New York City. Shortly after takeoff, the plane struck a flock of Canada geese and lost power in both engines. Quickly determining he would be unable to reach either LaGuardia or Teterboro airport, Sullenberger piloted the plane to a water landing on the Hudson River. All 155 people on board survived and were rescued by nearby boats.

Sullenberger said later: "*It was very quiet as we worked, my copilot Jeff Skiles and I. We were a team. But to have zero thrust coming out of those engines was shocking"*. Sullenberger was the last to leave the aircraft, after twice making sweeps through the cabin to make sure all passengers and crew had evacuated.

Sullenberger, described was noted for his poise and calm during the crisis; nonetheless, Sullenberger suffered symptoms of post-traumatic stress disorder in subsequent weeks, including sleeplessness and flashbacks. He said that the moments before the ditching were "*the worst sickening, pit-of-your-stomach, falling-through-the-floor feeling*" that he had ever experienced. He also said: "*One way of looking at this might be that for 42 years, I've been making small, regular deposits in this bank of experience, education and training. And on January 15, the balance was sufficient so that I could make a very large withdrawal"*.

The National Transportation Safety Board ruled that Sullenberger made the correct decision in landing on the river instead of attempting a return to LaGuardia because the normal procedures for engine loss are designed for cruising altitudes, not immediately after takeoff. Simulations performed at the Airbus Training Centre Europe in Toulouse showed that Flight 1549 could have made it back to LaGuardia had that maneuver begun immediately after the bird strike. However, such scenarios both neglected the

time necessary for the pilots to understand and assess the situation, and risked the possibility of a crash within a densely populated area.

This aviation's industry, incident, triggers thoughts such as: Is resilience measurable? And if yes, does a seafarer's resilience change over the years in case of the maritime industry? What about measuring human performance? And if we take into account that human performance is measurable in the aviation sector, when and how will it be measured in the maritime industry? Are psychometric assessments enough to measure human performance in maritime industry?

What is more, the example of Sullenberger, proves that although human factor's issues could and may have affected him, he succeeded great human performance, excellent resilience, and finally took the perfect decision judging from the result. So if once needed, was a success, there must be great effort to make it happen ever needed time whatever it may takes.

5.3 Proposals

The keys to success:

- Leadership engagement
- Be humble and encourage participation
- Campaign in office and on vessels
- Build on positives and successes

The way to achieve the above goals is by implementing valuable habits to the employees of a company. Moreover, leading and lagging indicators and their importance must be distinguished.

For example, if talking about the personnel on board:

- Get connected.

The most important factor in order a crew member to be resilient is to stay in contact with his loved ones while onboard. Each company must give all the necessary tools (telephone, internet) to its crew in order to be able its crew to building strong, positive relationships with loved ones and friends while he travels. This can provide crew with needed support and acceptance in both good times and bad.

- Learn from experience.

Company must train its crew to recognize difficult times and learn from the past incidents. Company must teach its crew to consider the skills and strategies that helped them through rough times. A discussion presents a difficult experience onboard of every crew member may help and guide their future behavior.

- Remain hopeful.

You can't change the past, but you can always look toward the future. Accepting and even anticipating change makes it easier to adapt and view new challenges with less anxiety. This can be the continuation of the discussion we mentioned above.

- Take care of yourself.

Everyone must tend to his self his own needs and feelings. Participate in activities and hobbies they enjoy. Include physical activity in their daily routine. Get plenty of sleep. Eat a healthy diet. Practice stress management and relaxation techniques, such as yoga, meditation, guided imagery, deep breathing or prayer. Sometimes all these are difficult to take place onboard. But a Company can create programs like yoga and meditation in its premises for crew ashore in order to have the right attitude when onboard and be able to relax in stressful times.

- Be proactive.

Crew must now that Company’s personnel doesn’t ignore their problems, and same they must be done for their selves. Instead, figure out what needs to be done, each crew member must make a plan, and take action. Although it can take time to recover from a major setback, traumatic event or loss, they must know that their situation can

improve if they work at it. Crew department of a Company must be able to communicate everything and every time the needs of their crew.

- Attend a resilience training program

Employees with high levels of personal and professional resiliency foster confidence, productivity and profit. More and more shipping organizations turn to such training programs with the aim to provide managers and teams with the necessary skills. These programs help to understand how mind works and the difference between pressure and stress, provide strategies enabling to improve personal resilience and performance and equip people with the resources to design their own plan to get physically and mentally healthier and develop their resilience.

- Resilience virtual drills

As the world go faster and accidents onboard may happen every day the old fashion drills can't stand alone anymore. A proposal may be crew and superintendents to participate in a simulation of an accident. Virtual reality may help this "drill" to take place in places outside the office and vessel. Crew will have the opportunity to experience feelings and situation and try to find solution in an incident.

For example, in case of a collision, in a virtual reality drill the Captain and the rest of the crew may follow some specific actions in order to report the incident to port authorities, their companies and to all parties concerned. But what about their feelings and their reactions in that moment?

Through a virtual drill, crew members will be able to feel their emotions and handle them as wrong and as good as they can. They will be able to face their feelings and in case a real problem occurred they will know how to manage themselves in order to avoid panic and act.

- Resilience starts from the Office

In order to have a healthy crew who will be able to act in a resilient way, the company must also focus to how this can be happened. Specifically, what is the thing that office personnel and superintendents are doing in order to give the correct example to the crew and protect them for unpleasant feelings.

While on board vessels do technical superintendents get involved in any kind of risk management processes? Genuine safety communicating, getting involved and showing the importance of risk management will stimulate crew understanding of its importance and feel comfortable to do same.

After a job requiring a Permit to Work does technical vessel management get involved in the debriefing process? Since technical vessel management manage a number of vessel debriefings could help pass on important learnings from other vessels.

To what degree does the operation department coordinate activities with other departments to avoid crew fatigue? Ship crews have many activities and an important objective is to avoid doing too much at one time. Operations departments have a large influence on the timing of activities.

While in the process of purchasing new safety shoes, to what degree will the purchase department investigate the quality of the shoes? Since slips, trips and falls are the most common cause of personal injuries it is worth investigating prior to buying hundreds of pairs of shoes how ‘slip resistant’ they are through simple testing on board.

There are many things that Companies must have in mind in order to be able to learn to their crew to be resilient. First of all, personnel in the office must learn to be resilient in order to be able to explain and help the crew in the most correct way.

To succeed in all possible ways, implementing the “human factor’ as a KPI should entail, the honesty of every answer and response, everybody gives at first to himself about his doings.

6. Conclusion

The maritime and, in particular, the international shipping industry have undergone a major change in attitude over the last decades. A focus on quality, safety and, ultimately, the environment has developed in this industry driven by serious incidents, both involving humans and the environment. The development of tanker vetting schemes, the increasing employment of Quality Management Systems which were set up by the International Standardization Organization and the establishment of an international mandatory quality standard for the shipping industry, the International Safety Management Code, reflect this change in attitude. These developments have stretched out for over more than two decades. At first, the main focus was on the safe operation of vessels, but within the last years, it has swung to contributing to the sustainable use of the world's resources and, therefore, to environmental management systems.

The introduction of non-financial performance measurements was necessary due to the new quality awareness resulting in the practice of continual improvement. The TSMA also has to be seen, in many respects, as a Performance Measurement System, especially due to its background as an assessment of a tanker operator's compliance to the ISM Code and its performance under the ISM Code. What is more to be noticed is, that the anthropocentric theorisis of safety (safety II) brought up TMSA's third version need, to enhance the parameter of human factor. By analyzing all the aspects of the human factor and the way it affects all the maritime areas we understand the necessity of self-assessing, so that we develop ourselves as in order to think and act proactively.

There come the ideas of human error, human reliability, leadership and resilience. The findings, how should they be implemented as KPIs along with the writer' s proposals are the main contribution of this thesis.

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