Athens University of Economics and Business

**MSc in International Shipping, Finance and Management**

# Fatigue and Loss Prevention, The P & I Clubs perspective

**by**

**Bouris Evangelos & Xenos Alexandros**

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## CERTIFICATION OF THESIS PREPARATION

"We hereby declare that this particular thesis has been written by us, in order to obtain the Postgraduate Degree (MSc) in International Shipping, Finance and Management, and has not been submitted to or approved by any other postgraduate or undergraduate program in Greece or abroad. This thesis presents our personal views on the subject. All the sources we have used for the preparation of this particular thesis are mentioned explicitly with references being made either to their authors, or to the URL's (if found on the internet)."

Bouris Evangelos

Xenos Alexandros

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**List of Abbreviations**

| | |
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| FRMP | Fatigue risk Management Plan |
| ILO | International Labor Organization |
| IMO | International Maritime Organization |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MLC | Maritime Labor Convention |
| PEME | Pre-employment Medical Examination |
| P&I Clubs | Protection & Indemnity Clubs |
| SOLAS | International Convention for the Safety of Life at Sea |
| STCW | Standards of Training, Certification and Watchkeeping |

**Abstract**

*"A ship in harbor is safe, but that is not what ships are built for"* had quoted John A. Shedd in 1928 in his collection of sayings ″Salt from My Attic″ and we couldn't agree more that this is a true statement. Ships are built however not to stay at ports but to travel all over the world through harsh conditions in the oceans. As their main purpose of construction is the international trade and the transport of people, they play an extremely significant factor in world's economy. Considering the high percentage of seaborne transportation in our days that reaches almost ninety percent, the safety in maritime industry is of great importance. The improvement of safety onboard is not only important for the vessel's crew, but also for the shipping industry itself. Eliminating the risk of fatigue for seafarers and its consequences requires the incorporation and establishment of strict rules and guidelines.

Our dissertation addresses how fatigue affects the maritime sector and can lead even to losses from the perspective of Protection and Indemnity Clubs towards fatigue.

In order to minimize the number of accidents and losses that occur from the human factor in shipping, the International Maritime Organization has enacted regulations. These regulations have been established in an effort to reduce fatigue levels of seafarers and extend the minimum hours of rest. Although these regulations are imposed by IMO they are difficult to enforce, increasing as a result maritime safety.

Contrary to other studies that just report the factors which cause seafarers to be fatigued, our study goes further and through a questionnaire investigates whether these factors do play an important role. The analysis of the data provides us with results that confirm theory and display the most frequent fatigue drivers.

Protection and Indemnity Clubs have introduced measures and resolution for the reduction of claims from seafarers when accidents take place. Through publications the Clubs achieve to inform the involved parties in shipping about loss prevention initiatives. Moreover, the Clubs have launched programs against illness claims or disorders of the crew and also medical examinations for seafarers prior to their employment beginning.

In conclusion, our research presents the analysis of the data collected regarding factors of shipboard fatigue addressing that even though regulations are followed, shipowners

and operators must find additional means to provide seafarers with adequate rest. Suggestions and proposals are also discussed in order to be implemented in future additions from shippers.

# 1. Introduction

Shipping is considered to be the world's most international industry due to the fact that it connects all parts of the world through trade and transports. It is stated that around ninety percent of world trade is performed through ocean going vessels (IMO, 2015) and also that the total volume of seaborne trade has reached almost eleven billion tones up until nowadays (UNCTAD, 2017). Additionally, the maritime environment is known to be one of the harshest in the world (Deacon, 2010). Shipping like any other transport industries works on a continuous twenty-four-hour operation and can be described as a tough job in which small incidents can have devastating consequences both on the environment and human life (Hetherington, 2006). Even though through the years tremendous improvements have been achieved in the manufacturing of vessels there is still a need to increase safety and provide protection to both the environment and crew. Thus, different regulations and guidelines have been established by the International Maritime Organization (IMO) such as Safety of Life at Sea, the International Convention on Standards of Training, Certification and Watchkeeping (STCW), Loadline and others in order to set the requirements for safety on sea.

## 1.1 Motivation and the purpose of our research

We were taken aback when we found out that relatively little research has been done in the field of safety due to fatigue in the maritime industry. Despite the fact that this subject has been a major contributing factor in many marine incidents and accidents in the ocean. Even though shipping companies and operators are making high efforts through imposing safety integrations onboard ships they cannot completely prevent such accidents from happening.

In our research we tried to focus on the issue of maritime fatigue by analyzing all the factors that can cause seafarers to be fatigued during voyages. These causes can affect the limits of human beings which if crossed can result in human errors that may end up in significant accidents.

After the analysis of the factors related to fatigue there is an introduction on the guidelines and rules set by the IMO and its conventions that have been established on the topic of seafarer's fatigue.

Further on the industry of P & I Clubs is mentioned so as to become familiar with third party liability claims that are related to personal injuries, illnesses and death which sum up to millions of costs per year in the shipping industry. The fact that every year these claims increase, concerned our research and we presented the solution that Clubs have established in order to retain claims in low levels. This approach involves examination of seafarers prior to voyages through the Pre-Employment Medical Examination programs.

## 1.2 Research objective and definition

Our research study attempts to confirm the influence of that fatigue causes to seafarers who operate for long term periods on board vessels. Our target is to identify that all the factors have an effect on the performance and alertness of mariners.

At the same time, we also want to clarify that even though ship-owners and operators are following guidelines and regulation set internationally, they have not managed to limit fatigue which is still present and imposes a threat. Thus, this subject should be addressed in a more detailed method in order to be gradually solved.

To investigate the issue of third-party claims, someone needs at first understand the role of P & I Clubs. After that liabilities claims can be introduced and we can explore how claims can be reduced. The main problem rises from seafarers who must be verified as healthy and fit to go in order to begin a journey. So, we had a small journey ourselves into the pre-employment medical programs which cover a great deal of preventive examinations to certificate healthy seafarers.

## 1.3 Research methodology approach and data

Our research focuses on the issue of seafarers' fatigue presenting in detail the factors that cause fatigue, lack of sleep and also the healthy lifestyle of mariners while on voyages.

In order to develop our subject in detail we explored through recent bibliography and International Maritime Organization (IMO) publications the factors that cause fatigue and its effects on seafarers. In addition, the International Conventions that have been established by IMO are presented and their aspects towards maritime fatigue are mentioned. The importance and the role of P & I Clubs is also analyzed along with the

training tools and guidance that clubs provide so as to ensure safety and health of the personnel on board vessels.

The next part of our assignment includes an analytical questionnaire which reveals whether or not seafarers feel fatigued during voyages and the importance of sleep in their daily life onboard. Furthermore, there are some questions regarding the healthy lifestyle including exercise while on the ship.

Last but not least there is an introduction through an interview on the implementation of Pre-employment Medical Examination programs by the P & I Clubs. These programs have been established to ensure that the highest safety regulations are promoted for ship-owners, ship operators and seafarers.

### 1.4 Contribution and relevance of research

The issue of maritime safety is of high importance in our era in which most of the trade and transportation is performed by sea. The lack of investigation on how P & I Clubs try to tackle fatigue and how they face its causes was an opportunity to investigate further on this subject.

With the help of literature and our research method we managed to identify multiple results and reach to different conclusions. First of all, we identified and confirmed the main factors of fatigue. To confront these factors, we contributed by providing some significant suggestions that if pursued can be very valuable to shipping companies and ship operators.

On the other hand, research on the topic of Pre-employment Medical Examination programs also guided us to perform some recommendations for these examination in order to cover more medical aspects. The increase in thoroughness of the programs can cause serious decrease in claims which incur high costs for shippers annually.

Reduction in claims can play a very important role because ship-owners will be benefited from the incurrence of high costs. For example, an unexpected incident such as the deviation of a ship's voyage due to fatigued crew can cause economic damage the ship-owners or operator with high running and operating costs.

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## 2. Literature Review

### 2.1 A general introduction on the term of fatigue and its relation to seafarers

***What is Fatigue?***

Fatigue is the state of feeling very tired, usually resulting from insufficient sleep, prolonged mental or physical work, or extended periods of stress or anxiety. Boring or repetitive tasks can intensify such feelings (IMO, MSC, Circ. 2014) Fatigue can be described either as an acute or chronic condition. Acute fatigue, often resulting from short term sleep loss or intense short periods of heavy workload, can easily be reversed by sleep and relaxation. Chronic fatigue syndrome is a more severe state of tiredness that is not immediately relieved by rest.

***'One of the fundamental challenges associated with fatigue and stress is that they are not easy to identify, quantify or monitor'***

Signs of fatigue and stress can include irritability, depression, loss of appetite and an increased susceptibility to illness. Awareness therefore of the symptoms and effects of fatigue becomes critical in managing the related workplace risks.

The understood effects of fatigue include reduced decision-making ability, reduced communication skills, reduced attention and vigilance, dulled reactions, increased tendency for risk taking and increased errors in judgment. It is not difficult therefore to correlate such effects with risks in the workplace, especially where individuals are working with machinery, moving parts and mobile equipment.

***The appropriate rest for facing fatigue issues***

So how much sleep does one need? Each individual differs, but studies suggest on average somewhere between 7.5 and 8.5 hours of sleep per a twenty-hour period are needed. Typically, a night shift worker will get 5 to 7 hours less sleep per week than a day worker. Humans naturally follow a biological clock, a cycle of sleep, wakefulness and alertness that are generally aligned with the hours of daylight.

***The impact of fatigue through a study***

A recent study sought to monitor personnel driving mobile equipment through the deployment of sophisticated camera technology installed in the vehicles. The equipment was mounted in the driving cab of the vehicles and monitored the behavior and responsiveness of the operator. The associated software detected events such as when the eyes of the operator unwittingly closed for any prolonged period during their working hours.

So, the study started with an information campaign to the workers explaining the effects of fatigue, followed by two stages of monitoring. In the first stage the equipment was installed and only recorded fatigue events without alerting the driver, building a significant amount of information over a period. The second phase of the study introduced an audible warning if an ″event″, related to prolonged eye closure, thus highlighting the issue to the operator.

For many years, fatigue was discounted as a potential cause of or contributor to human error. One reason for this misunderstanding was the old myth that fatigue could be prevented by various characteristics: personality, intelligence, education, training, skills, compensation, motivation, physical size, strength, attractiveness, or professionalism. However, recent accident data and research point to fatigue as a cause of and/or contributor to human error precisely because of its impact on performance. Human error resulting from fatigue is now widely perceived as the cause of numerous marine casualties, including one of the worst maritime environmental disasters in the last century, the ″Exxon Valdez″ (National Transportation Safety Board, NTSB, 1990). The negative effects of fatigue present a disastrous risk to the safety of human life, damage to the environment, and property. Because shipping is a very technical and specialized industry, these negative effects are exponentially increased, thereby requiring seafarers' constant alertness and intense concentration. The key issue addressed is that fatigue is a fundamental problem for the maritime industry as it detrimentally affects performance at work.

## 2.2 Definition Fatigue by IMO

There is no universally accepted technical definition for fatigue. However, common to all the definitions is the degradation of human performance.

According to IMO's MSC/Circ.813/MEPC/Circ.330, found in the List of Human Element Common terms, fatigue can be defined as: *'A reduction in physical and/or mental capability as the result of physical, mental or emotional exertion which may impair nearly all physical abilities including: strength; speed; reaction time; coordination; decision making; or balance.' (IMO: Guidance on fatigue, 2001).*

## 2.3 Fatigue and life on a Seagoing Ship

Fatigue is a problem for all twenty-hour a day transportation modes and industries, the marine industry included. However, there are unique aspects in seafaring that separate the marine industry from the others. It must be recognized that a seafarer is captive to his working environment. First of all, the average seafarer spends between three to six months working and living away from home, on a moving vessel that is subject to unpredictable environmental factors (i.e. weather conditions). Secondly, while serving on board the vessel, there is no clear separation between work and recreation. Thirdly, today's crew is composed of seafarers from various nationalities and backgrounds who are expected to work and live together for long periods of time. The operational aspects associated with shipping become more complex compared with standard industries, for reasons such as: variety of ship-types, pattern and length of sea passages, port-rotation, and length of time a ship remains in port. All these aspects present a unique combination of potential factors that can cause fatigue.

## 2.4 Causes of Fatigue

The most common causes of fatigue known to seafarers are lack of sleep, poor quality of rest, stress and excessive workload. There are many other contributors as well, and each will vary depending on the circumstance (i.e. operational, environmental). There are many ways to categorize the causes of fatigue. To ensure thoroughness and to provide good coverage of most causes, they have been categorized into 4 general factors.

- Crew-specific Factors;
- Management Factors (onshore and onboard ship);
- Ship-specific Factors;
- Environmental Factors.

### 2.4.1 *Crew-specific Factors*

The crew-specific factors are related to lifestyle behavior, personal habits and individual attributes. However, fatigue varies from one person to another and its effects are often dependent on the particular activity being performed.

The Crew-specific factors include the following in detail:

- Sleep and Rest - Quality, Quantity and Duration of Sleep - Sleep Disorders/Disturbances - Rest Breaks;
- Biological Clock / Circadian Rhythms;
- Psychological and Emotional Factors, including stress - Fear - Monotony and Boredom - Health - Diet – Illness - Stress - Skill, knowledge and training as it relates to the job - Personal problems - Interpersonal relationships;
- Ingested Chemicals - Alcohol - Drugs (prescription and non-prescription) – Caffeine;
- Age;
- Shift work and Work Schedules;
- Workload (mental / physical);
- Jet Lag

### 2.4.2 *Management Factors*

The Management Factors relate to how ships are managed and operated. These factors can potentially cause stress and an increased workload, ultimately resulting in fatigue.

The Management factors include the following in detail:

*1) Organizational Factors*

Staffing policies and Retention - Role of riders and shore personnel - Paperwork requirements – Economics - Schedules-shift, Overtime, Breaks - Company culture and Management style - Rules and Regulations – Resources - Upkeep of vessel - Training and Selection of crew

*2) Voyage and Scheduling Factors*

Frequency of port calls - Time between ports – Routing - Weather and Sea condition on route - Traffic density on route - Nature of duties/workload while in port

### 2.4.3 *Ship-specific Factors*

These factors include ship design features that can affect/cause fatigue. Some ship design features affect workload (i.e. automation, equipment reliability), some affect the crew's ability to sleep, and others affect the level of physical stress on the crew (i.e. noise, vibration, accommodation spaces, etc.).

The following list presents in more detail ship-specific factors:

Ship design - Level of Automation - Level of Redundancy - Equipment reliability - Inspection and Maintenance - Age of vessel - Location of quarters - Ship motion - Physical comfort of accommodation spaces

### 2.4.4 *Environmental Factors*

Exposure to excess levels of environmental factors, e.g. temperature, humidity, excessive noise levels, can cause or affect fatigue. Long-term exposure may even cause harm to a person's health. Furthermore, not only can environmental factors produce physical discomfort, but they can also cause or contribute disruption of sleep. Ship motion is also considered as an environmental factor. Motion affects a person's ability

to maintain physical balance. That is due to the extra energy expended to maintain balance while moving, especially during harsh sea conditions. There is a direct relation between a ship's motion and a person's ability to work. Excessive ship movement can also cause nausea and motion sickness. Environmental factors can also be divided into factors external to the ship and those internal to the ship. Within the ship, the crew is faced with elements such as noise, vibration and temperature (heat, cold, and humidity). External factors include port and weather condition and vessel traffic. There are a number of things that can be done to address these causes. Some factors are more manageable than others. Opportunities for implementing countermeasures vary from one factor to another (noise can be better addressed during the vessel design stage, breaks can be addressed by the individuals of the crew member, training and selection of the crew can be addressed during the hiring process, etc.).

## 2.5 Basic concepts in understanding fatigue

This section highlights some of the basic concepts that provide an overall understanding about fatigue.

***2.5.1 Sleep is an active process;*** when people sleep they are actually in an altered state of consciousness. All types of sleep do not have the same quality and do not provide the same recuperative benefits. In order to satisfy the needs of the human body, sleep must have three characteristics to be most effective:

- Duration: Everyone's sleep needs are unique; however, it is generally recommended that a person should obtain, on average, 7 to 8 hours of sleep per a twenty-hour period. A person needs the amount of sleep that produces the feeling of being refreshed and alert. Alertness and performance are directly related to sleep. Insufficient sleep over several consecutive days will impair alertness. Only sleep can maintain or restore performance levels.

- Continuity: The sleep should be uninterrupted. Six one-hour naps do not have the same benefit as one six-hour period of sleep

- Quality: People need deep sleep. Just being tired is not enough to ensure a good sleep. An individual must begin sleep in synch with his/her biological clock to ensure quality sleep. If the time of sleep is out of synchronization with his/her biological clock, it is difficult to sleep properly. Many factors contribute to sleep disruption, some are within somebody's control while others are not: - environmental factors (e.g. ship's violent movement, weather, heavy vibration, noise or poor accommodation) - food and consumption of chemicals (e.g. alcohol intake, coffee, medication, etc.) - psychological factors (e.g. stress, family worries, on-duty responsibilities) - sleep disorders (e.g. one, insomnia–prolonged inability to obtain adequate sleep or e.g. two, sleep apnea–a condition where breathing stops when sleep occurs due to a collapse of the upper airway or the diaphragm not moving causing the person to wake up) - operational factors (e.g. disruptions caused by drills, loading and unloading).

***2.5.2 Biological Clock and Circadian Rhythm;*** Each individual has a biological clock, and this clock regulates the body's circadian rhythm. To best understand both of these features, it is first necessary to understand how the circadian rhythm functions. Our bodies move through various physical processes and states within a twenty-hour period, such as sleeping/waking and cyclical changes in body temperature, hormone levels, sensitivity to drugs, etc. This cycle represents the circadian rhythm. The biological clock regulates the circadian rhythm. The biological clock is perfectly synchronized to the traditional pattern of daytime wakefulness and night-time sleep. The biological clock makes a person sleepy or alert on a regular schedule whether they are working or not. In normal conditions, the sleep/wake cycle follows a twenty-hour rhythm; however, the cycle isn't the same for everyone. Although individual rhythms vary, each person's cycle has two distinctive peaks and dips. Independent of other sleep-related factors that cause sleepiness, there are two times of low alertness (low-points or dips) in each twenty-hour period. These commonly occur between 3-5am and 3-5pm. Preceding these lowest alertness periods, are maximum alertness periods (peaks). The states of sleep/wakefulness and circadian rhythms interact in several ways: - The two can work against one another and thereby weaken or negate each other's effect. For example, a well-rested person is still affected by a circadian low-point; conversely, a person who is sleeping deprived may feel a momentary increase in

alertness due to a peak in circadian rhythm. - The two can also work in the same direction, thereby intensifying the effect they each have on a person's level of alertness. For example, when someone is sleep deprived, a circadian low point will further exacerbate the feeling of sleepiness. For many seafarers, working patterns conflict with their biological clock. Irregular schedules caused by shifting rotations, crossing time zones can cause the circadian rhythms to be out of synchronization. Furthermore, the internal clock can only adjust by an hour or two each day. Sometimes, depending on a new schedule, it takes several days to adjust. As a result, the internal clock wakes a person up when they need to sleep and puts them to sleep when they need to be awake.

***2.5.3 Stress;*** occurs when a person is confronted with an environment that poses a threat or demand, and the individual becomes aware of his/her inability or difficulty in coping with this environment (a feeling of being overwhelmed). This can result in reduced work performance and health problems. Stress can be caused by a number of things, including:

- Environmental hardships (noise, vibration, exposure to high and low temperatures, etc.);
- Weather (i.e. ice conditions);
- Personal problems (such as family issues, etc.);
- Broken rest;
- Long working hours;
- On-board interpersonal relationships.

**2.6 Effects of Fatigue**

Alertness is the optimum state of the brain that enables us to make conscious decisions. Fatigue has a proven detrimental effect on alertness–this can be seen when a person is required to maintain a period of concentrated and sustained attention, such as looking out for the unexpected (e.g. night watch). When a person's alertness is affected by fatigue, his or her performance on the job can be significantly impaired. Impairment will occur in every aspect of human performance (physically, emotionally, and

mentally) such as in decision-making, response time, judgment, hand-eye coordination, and countless other skills. Fatigue is dangerous due to the fact that people are poor judges of their own level of fatigue. The following present a sample of fatigue's known effects on performance.

- Fatigued individuals become more susceptible to errors of attention and memory (for example, it is not uncommon for fatigued individuals to omit steps in a sequence);
- Chronically fatigued individuals will often select strategies that have a high degree of risk on the basis that they require less effort to execute;
- Fatigue can affect an individual's ability to respond to stimuli, perceive stimuli, interpret or understand stimuli, and it can take longer to react to them once they have been identified;
- Fatigue also affects problem solving which is an integral part of handling new or novel tasks;
- Fatigue is known to detrimentally affect a person's performance and may reduce individual or crew's effectiveness and efficiency; decrease productivity; lower standards of work and may cause errors to happen.

Unless steps are taken to alleviate the fatigue, it will remain long after the period of sustained attention, posing a hazard to ship safety.

To sum up, the most important contributing factors of shipboard fatigue are mentioned below:

a. Stress;

b. Personal problems;

c. Fitness;

d. Fear;

e. Shift work;

f. Excessive work noise;

g. Alcohol;

h. Poor diet;

i. Excessive workload;

j. Ship movement.

## 2.7 Pillars of Quality Shipping

The most significant pillars of quality shipping are mentioned below:

A) SOLAS

B) MARPOL

C) STCW

D) MLC 2006

**STCW Convention (2010) Standard watch keeping personnel – hours of rest**

A. 10 hours rest per 24-hour period divided into no more than two periods

B. One daily rest period must be at least 6 hours in length

C. 10-hour rest and 6-hour consecutive rest period may be reduced but not beyond a two (2) day period

D. No less than 70 hours of rest in a seven (7) day period

**STCW Convention (2010) Personnel with safety and security duties – hours of rest**

A. 10 hours rest per 24-hour period divided into no more than two periods

B. One daily rest period must be at least 6 hours in length

C. 10-hour rest and 6-hour consecutive rest period may be reduced but not exceed 14 hours between rest periods

D. No less than 77 hours of rest in a seven (7) day period that can be extended to two (2) weeks with restrictions

**Maritime Labor Convention (2006) Harmonized with STCW Convention regarding rest hours**

A. Maximum number of work hours: 14 hours for any 24-hour period; and 72 hours in any seven (7) day period

B. Minimum number of rest hours: 10 hours for any 24-hour period; and 77 hours in any seven (7) day period

C. At least one rest periods must be at least 6 hours in length, no more than 14 hours between rest intervals A

**SOLAS & MARPOL**

The maritime industry's most important concerns are safety of personnel and prevention of marine pollution for a smooth cargo transportation and marine operation at open seas. International Maritime Organization (IMO) introduced SOLAS – Safety of life at sea & MARPOL - The International Convention for Prevention of Marine Pollution from Ships, for safeguarding human life and preventing marine environment from all kinds of pollutions.

SOLAS 74, the last adopted revised convention of 1974, includes a number of chapters which deal with safety precautions and safety procedures starting from the construction of a ship to real emergency situation like – ″Abandon Ship″. The convention is updated so as to meet the safety norms in the modern shipping industry.

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## 3. Research Methodology

The primary issues that this report is going over are fatigue and loss prevention factors in the shipping industry and how seafarers are affected. This part of the report covers two aspects. The first is a questionnaire, designed to capture and investigate factors related to fatigue in the maritime industry. Research illustrates that there are potentially disastrous outcomes that can be caused from fatigue in terms of good health and diminished performance (Josten, Ng-A-Tham, & Thiery, 2003). Shipping is considered to be an occupation with a high rate of fatal injuries which are caused by organizational accidents and maritime disasters (Hansen, Nielsen & Frydenberg, 2002), however accidents can happen due to chronic or unaware illnesses. Furthermore, the second part presents a short interview-questionnaire about Pre-employment Medical Examination programs (PEME programs) that seafarers must undergo in order to comply with the requirements of P & I Clubs. These tests provide information in advance, regarding the health behaviors of the members of the crew and can indicate future outcomes that can have impact on the health and performance of seafarers.

### 3.1 Study of factors that cause fatigue

#### 3.1.1 *Sample of Study*

In order to identify and understand the factors that cause fatigue among seafarers within the shipping industry, a custom-designed questionnaire was used that was answered by a diverse range of marine personnel. The questionnaire was sent to two local shipping companies and then was forwarded to a number of ships from each company. The participants in this study were of different positions in the hierarchy of a ship. In particular, they were deck watch officers (DWOs, chief mate, second mate and third mate) and engineers (chief, second and third engineers).

The main responsibilities and role of each seafarer varies in the hierarchy of a ship's management. The master (also known as captain), the chief mate, the second mate and finally the third mate, compile the deck personnel, which is in charge mostly for the vessel navigation and watch keeping, among other duties. The master is the general manager of the ship, responsible for the operation and safety navigation of the ship, the economic transactions and the documentation of the ship. Unlike the rest of the deck

personnel he does not have a scheduled watch, but shall be present during loading/unloading, sailing in pilotage waters and in navigation under severe weather.

The chief mate is the first deck officer and head of the deck department; he focuses in charging and discharging operations, watch duties and assignment of watches to the rest of the deck officers. He is usually assigned with the 4-8 watches (04.00-08.00 and 16.00 to 20.00). The second mate holds the ships navigation and creates the ship's passages, apart from these he might fulfill the rank of safety or medical officer. His watches are most of time, the 12-4 (00.00 to 04.00 and 12.00 to 16.00). Finally, the third mate stands the 8-12 watches (08.00 to 12.00 and 20.00 to 24.00) and his responsibilities involve the assistance of first and second mate. Sometimes the third mate is in charge of the lifesaving and the firefighting equipment of the ship and must ensure its good functionality.

On the other hand, the engine department is responsible for the operation and maintenance of the ship's machinery. This department consists of the chief engineer, the second, third and in some cases a fourth engineer too. The chief engineer is a qualified mechanic that manages and oversees all operations of engine maintenance and service; he holds an equivalent to the captain position for the engine department. The second engineer holds probably the busiest position on board, as he is in charge of the daily maintenance and operation of the engineering systems, reporting directly to the chief engineer. The third and fourth engineers are juniors who are responsible for the rest of the duties in the engine room.

In our survey took part a total of 18 participants from almost all of the above-mentioned positions in a ship. The table below shows the participants and their organizational position in detail.

| Position | # of participants |
|---|---|
| **Chief mate** | 2 |
| **Second mate** | 4 |
| **Third mate** | 4 |
| **Chief engineer** | 3 |
| **Second engineer** | 3 |
| **Third engineer** | 2 |
| *Total* | ***18*** |

**Table 3.1.1 - Participants & Positions**

### 3.1.2 *Analysis of the Study*

The instrument that helped the research to be performed was a 9-part questionnaire, with an aim to provide answers on causes of fatigue, sleep patterns and track of health lifestyle during a seafarer's voyage. The questionnaire was divided into three parts, as presented below extensively with questions that addressed all of the above-mentioned issues.

#### 3.1.2.1 *Causes and occurrence of Fatigue*

The three questions presented below in Figure 3.1.2.1 are related to seafarer's fatigue that may result in the impact of their performance while on watch throughout the journey. Extensive hours of watched can be experienced while on board and lead seafarers on long term fatigues issues. For watch keepers, the IMO states in STCW Section A-VIII/1 that to be fit for duty each crew member shall be provided with a rest period of not less than a minimum of 10 hours of rest in any 24-hour period; and 77 hours in any 7-day period. At the same time ILO MLC states on work/rest that maximum hours of work shall not exceed (i) 14 hours in any 24-hour period and (ii) 72 hours in a 7-day period and also that minimum hours of rest shall not be less than (i) 10 hours in any 24-hour period; and (ii) 77 hours in any 7-day period. As far as the department of the engine staff, the work periods and rest hours can vary due to possible engine failures or unexpected complications. The second question captures the appearance of fatigue while on watch duty which can be caused due to a variety of reasons identified in the next question. Prior researched have provided as risk factors that affect performance and safety, the lack of sleep, stress, temperature, motion of the

ship, not regular work periods, noise on board the ship and time zone difference (NSF, 2004; Lal & Craig,2004; Comperatore & Rivera,2003).

| | | | | | |
|---|---|---|---|---|---|
| **1)** | **How many hours do you work per day onboard?** | | | | |
| a) 6-7 | b) 7-8 | c) 8-9 | d) 10+ | e) Other | |
| **2)** | **Do you feel fatigued while you are on watch?** | | | | |
| a) Never | b) Sometimes | c) Often | d) Usually | e) All the time | |
| **3)** | **From the below mentioned causes, please identify the ones you believe cause fatigue (more than one answers)** | | | | |
| a) Lack of sleep | b) Excessive work load | c) Stress | d) Motion of ship | e) Noise on board | |
| f) Time zones | g) Temperature | h) Other | | | |

**Figure 3.1.2.1 Questions related to Fatigue**

### 3.1.2.2 *Sleep habits and patterns*

Research has illustrated that disastrous outcomes may occur due to poor sleep habits and fatigue (Josten, Ng-A-Tham & Thierry, 2003). One of the most environmental catastrophic incidents, the Exxon Valdez in 1989, was caused by the ship's watch keeper lack of sleep. The watch keeper had only 5 to 6 hours of sleep in the twenty-hour period prior to the grounding, so he performed poorly during his watch, causing the ship to ground. In order to optimize their performance in the field of work, most adults have to sleep between seven to nine hours to keep their body in physical health (NSF, 2004). Guidelines and theoretical methods have been introduced by the IMO, but still there are occasions where individuals have to work more than 12 hours with a break less than 6 hours. For example, while on port, at discharging operations, the chief officer must be present at all times (Catherine Hetherington, Rhona Flin & Kathryn Mearns, 2006). The questions below in Figure 3.1.2.2 were asked to determine the hours of sleep each adult gets and whether they are enough.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **4)** | **How many hours in your opinion, is a suitable rest period?** | | | | | | | | |
| a) | 4-5 | b) | 5-6 | c) | 6-7 | d) | 7-8 | e) | 8+ |
| **5)** | **How many hours is your rest period?** | | | | | | | | |
| a) | 4-5 | b) | 5-6 | c) | 6-7 | d) | 7-8 | e) | 8+ |
| **6)** | **Have you ever been woken up during your rest period? (e.g. accidents, emergencies)** | | | | | | | | |
| a) | Never | b) | Sometimes | c) | Often | d) | Usually | e) | Many times |

**Figure 3.1.2.2 Questions related to Sleep habits and Patterns**

### 3.1.2.3 *Health and Lifestyle on board*

Fatigue causes are not limited to sleep, rest and stress, they can also be based on the health of the crew on board. A particular diet, an illness, the abuse in ingested chemicals, such as alcohol, drugs (either on prescription or not), caffeine, or an unbalanced nutrition, may have an impact on seafarer's health. An unbalanced diet with refined sugars can cause high blood pressure, which on the one hand offers a short-term energy boost but on the other hand leads to a similar rapid drop in blood sugar. The low blood sugar levels can cause weaknesses, difficulty in concentration and extreme unconsciousness (IMO, Guidance on Fatigue mitigation and management, 2014). Moreover, the ingestion of chemicals, as mentioned above, has certain side effects as sleep disruption, headaches and hypertension. Finally, chronic illnesses and medical conditions affect human body strongly with outcomes, such as slow response time in difficult situations and serious hand-eye coordination. The below questions, in Figure 3.1.2.3, were asked for our research, in order to examine some factors on the health issues and lifestyle of the crew.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **7)** | **Do you follow a healthy nutrition diet? minimizing the use of alcohol/nicotine/sugar, etc.** | | | | | | | | |
| a) | Never | b) | Sometimes | c) | Often | d) | Usually | e) | All the time |
| **8)** | **In your free time, do you exercise?** | | | | | | | | |
| a) | Never | b) | Sometimes | c) | Often | d) | Usually | e) | All the time |
| **9)** | **Have you had a medical examination program before going on a voyage?** | | | | | | | | |
| a) | Never before | b) | Sometimes before | c) | Everytime before | | | | |

**Figure 3.1.2.3 Questions related to Health & Lifestyle onboard**

### 3.2 A research on the Pre-employment Medical Examination (PEME) programs

The P & I Clubs have established since the 1990's medical programs, called Pre-employment Medical Examination (PEME), in order to protect ship-owners from claims that arise from medical conditions of the crew, prior to its employment and voyage. Moreover, the PEME programs provide seafarers who are ready to travel with a high-quality health examination check, so as to prove that they are ready before going to sea.

Due to the fact that the increase in illness claims from seafarers is not a new problem of the present decades, the claims rise more and more each year. In the past ten years there is a high increase in frequency of illnesses, thus this is a warning sign that illnesses must be closely monitored as there is also a high rise in their cost too.

The most common illnesses for crew on board vessels are cardiovascular/heart diseases, which are also the most expensive one to heal. This type of diseases is usually caused by:

- Obesity;
- Poor diet;
- Smoking;
- Physical inactivity;

The crew on board vessels can do little to prevent such illnesses from striking and the only available options available are to focus on the prevention of such conditions. Healthy lifestyle, regular exercise and limitation on the use of cigarettes, alcohol and sugar should be promoted in order to address this type of diseases.

Thus P & I Clubs have teamed up with clinics all over the world and especially in key recruitment places of the world, such as the Philippines, India, Indonesia, Singapore and Thailand, to provide high quality medical examinations, to prospective seafarers. Shipping companies offer PEME examinations in replacement of the standard medical examinations in local countries, which are insufficient and usually don't properly cover pre-existing medical conditions of the crew.

### 3.2.1 *Sample of the Study*

For the purpose of this assignment and the research on the topic of PEME programs, a short interview took place with an employee of the crew department of a local shipping company. The crew department handles the recruitment processes of new seafarers and tracks down the results of the medical examinations as well. In communication with the PEME teams of P & I Clubs, shipping companies are provided with useful reports and insights into the quality of recruited seafarers. A high percentage of shipping companies that run internationally are obliged to have their future employees pass a medical examination. As far as ship-owners are concerned the PEME examinations, improve their crew risk management, comprise their ships with fitter and healthier crew, establishing safes ships and last but not least reduce the claims that originate from illnesses.

### 3.2.2 *Analysis of the Interview*

#### 3.2.2.1 *What's a PEME and is it universally accepted?*

Each P & I Club has designed its own universally accepted medical form, in order to be completed upon the medical examination of each participant in the approved clinic. The Clubs have proceeded with an autonomous form due to the fact that is approved by its stuff and doesn't exclude important physical details that the forms of local authorities and clinics do. After the medical examinations each clinic sends back to the club the medical report which verifies the health record of the applicant. Each report is cross-checked in order to avoid any deception and is held at each Club's database.

#### 3.2.2.2 ***What is the medical examination content of a PEME?***

PEME's include a previous declaration of pre-existing health conditions that should be reported. Moreover, a medical history questionnaire is covered, in order to complete a background check of the person examined. As far as the examination is concerned, the below list covers the most important checks that are carried out:

- Physical Examination (Body Index Mass BMI);
- Blood pressure check – Blood counts (Cholesterol etc.);
- Dental examination;
- Psychological tests;

- Visual tests – Color vision;
- Audiometry tests;
- Chest X-rays;
- Cardiograms;
- Hepatitis tests;
- HIV tests;
- Stress tests;
- Diabetes;
- Alcohol and Drug test.

#### 3.2.2.3 ***To whom the PEME's are addressed?***

The PEME programs are addresses to seafarers who are about to be employed and embark on a voyage to sea. Seafarers are provided with a high-quality medical examination, a free check on their health and can also be instructed on valuable advices and guidelines for a healthy lifestyle and life. On the other hand, ship-owners are provided with a fitter and healthier crew. For that they can depend on the accountability of the clinics that have performed the examinations and enjoy safer ships when the crew is in good health.

#### 3.2.2.4 ***What happens if someone doesn't take part in a PEME?***

The PEME programs are mandatory for seafarers before going on the sea and shall not be overridden. Bypassing a PEME program or counterfeiting one can lead to serious issues. If a future seafarer has an important health issue, complications in his health can cause problems to the ship that can lead even to loss or grounding, depending on his position. Furthermore, the ship-owner or ship operator has the fundamental liability towards the employee of his crew illness claims which may sum up to thousands of US dollars for healing.

## 4. Research Findings / Results

In the previous part of this assignment (part 3), and particularly in subsection 3.1.2, the description of our research instrument was introduced. The aim of the data collection that will be further on analyzed was to test the causes and occurrence of fatigue while on board, check on the sleeping habits of the crew and also their health and nutrition lifestyle. The data analysis from the questionnaires was performed with the use of Microsoft Office Excel program, version 2016.

### 4.1 Analyzing the General Information

The first part of the questionnaire involved the completion of some information, regarding general data and different per person details.

The questionnaire was filled out by a total of 18 crew members, with positions on board the ship, from that of chief mate to that of the third engineer, as seen in the table below.

| Position | # of participants |
|---|---|
| **Chief mate** | 2 |
| **Second mate** | 4 |
| **Third mate** | 4 |
| **Chief engineer** | 3 |
| **Second engineer** | 3 |
| **Third engineer** | 2 |
| ***Total*** | ***18*** |

**Table 4.1.1 - Participants**

The participants were of different age's categories, depending also on their position in the ship, as seen in the pie chart on the right. The highest percentage was between 30-36 years old, and crew in this category compiled of first and second mates and engineers.

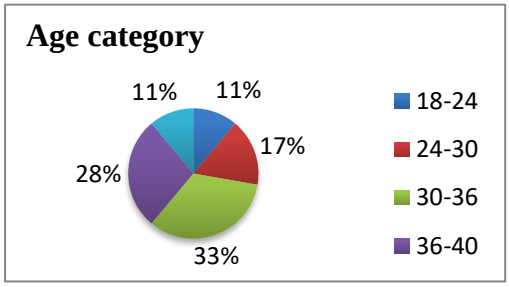


**Chart 4.1.2 - Age categories**

The next table provides an analysis of the number of years that participants in the study have in shipping and the average duration of their

trips. Third mates and engineers were the younger to complete the survey and thus had fewer years in the industry. Chief and second mates and engineers had an older background in shipping, from 10 to 15+ years of work.

| Number of years in industry | Percentage | Number of participants |
|---|---|---|
| **0-1** | 22% | 4 |
| **1-5** | 22% | 4 |
| **5-10** | 17% | 3 |
| **10-15** | 28% | 5 |
| **15+** | 11% | 2 |
| ***Sum*** | ***100%*** | ***18*** |

**Table 4.1.3 - Distribution of participants in relation to number of years in the industry**

### 4.2 Analyzing the causes and occurrence of Fatigue

Despite the various efforts towards fatigue mitigation, by incorporation from companies of international rest regulations and the adoption of different codes and guidelines, the risk of fatigue is still very important for seafarers and the shipping industry in general.

The first three questions, on our study, regarding fatigue, assessed the number of hours that crew spend on their shifts, whether or not they felt fatigued during their watch and finally a hand-picked selection of the most famous causes of fatigue. Recent studies have exhibited that compliance to international requirements in the maritime industry is generally poor, and thus huge differences are observed in the actual and recorded hours of work and rest (Allen, Wellens, McNamara, Smith, 2005 / Oldenburg, Hogan & Jensen, 2013).

The responses in the first question on the topic of fatigue described the amount or hours each crew member works per day. As seen in Table 4.2.1, the most selected answer was d & e. Although regulations and guidelines suggest a certain number of working hours per day, there are certain occasions when these requirements cannot be achieved. For

example, when ships are at ports for loading or unloading the chief mate has to be present at all time, until the operations are completed.

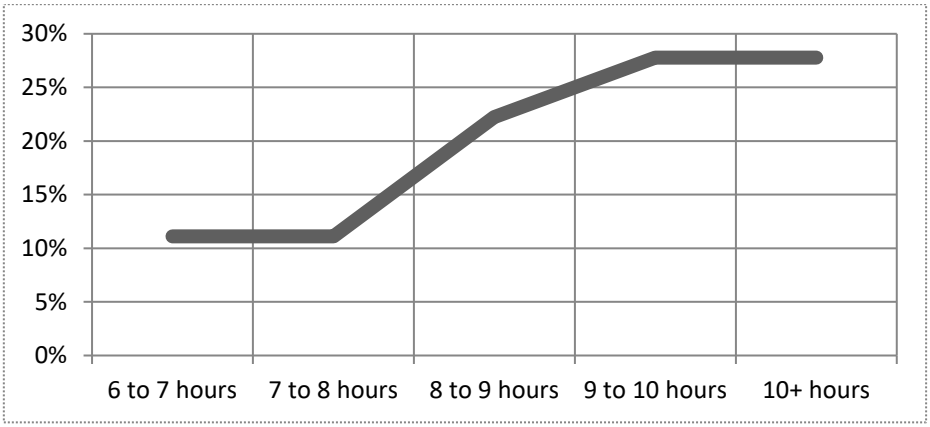


**Table 4.2.1 - Hours of work per day**

Because shipping companies function in highly competitive markets, both shipowners and operators are obliged to perform reductions in the shipboard crews (Akhtar & Utne, 2014), thus seafarers are consequently exposed to more hours of demanding work conditions. Under these demanding conditions and intensive nature of shipping operations, seafarers are subjected to less and less rest hours. The answers on the second question proves this relationship and the results are presented below, in Table 4.2.2. Almost 40% answered that they sometimes feel fatigued during their watch, while on the other hand a 33% replied that they often feel fatigued. 28% stated that they usually feel fatigued and none of the participants replied to have never feel fatigued or all of the time, during their watch.

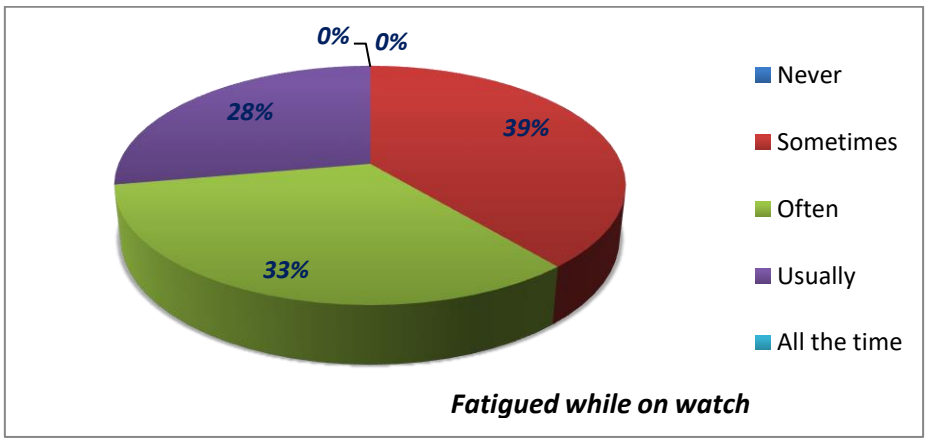


**Table 4.2.2 - Distribution of fatigue while on watch**

Regarding the third and last question on the topic of fatigue, participants were asked to pick up to 4 answers, on which reasons generate higher fatigue. The major cause of fatigue as selected by the participants was found to be lack of sleep, with a high percent, close to 50%. It is monitored in the results of other surveys too, that due to long and irregular work hours, seafarers enjoy restricted and interrupted sleep (Arendt, Middleton, Williams & Luke, 2006). Second most popular answer, was the excessive work load that seafarers, despite their position in the ship, have to confront. Almost 15% of the participants described stress as their main cause of fatigue, with the rest of the choices completing the answers with lower percentages. Stress has been identified as a contributory factor to productivity and also to personal health and welfare of an organization (Cooper, Dewe & O' Driskoll, 2001). High exposure to stress levels for an extended period of time can cause negative mental and physical outcomes in adults (Quick, Quick, Nelson & Harell, 1997). The Table 4.2.3 reveals the answers from the seafarers for our study.

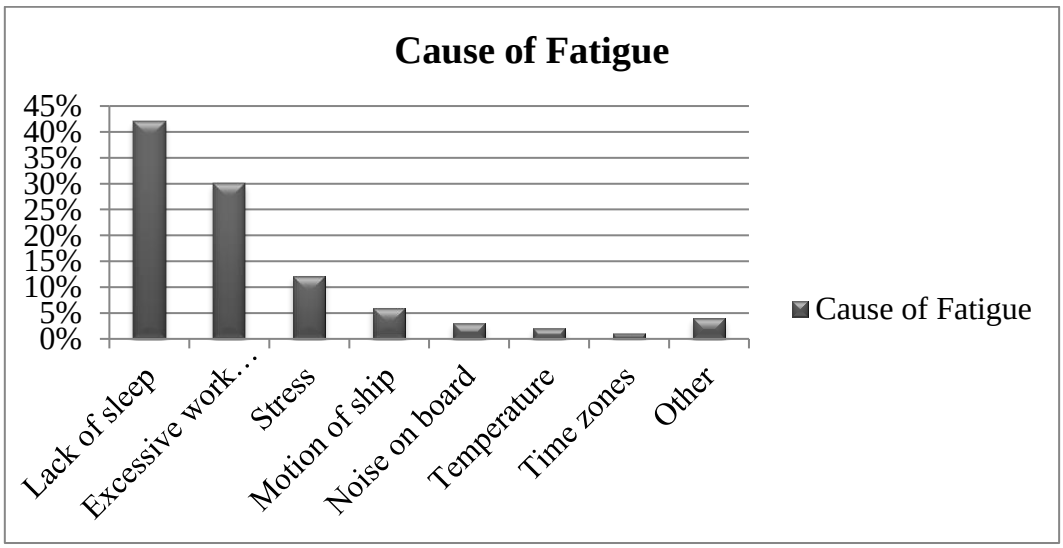


**Table 4.2.3 - Most common causes of fatigue**

### 4.3 Analyzing the sleeping habits and patterns

As mentioned before, seafarers are responsible to manage on their own, shipboard fatigue which is not an easy thing to achieve. Rotating shifts, excessive workload, crossing of different time zones and other factors oblige seafarers to have restricted and interrupted sleeping times. While most adults require on average 7-9 hours of sleep each night in order to optimize their performance (US National Science Foundation,

2004), seafarers cannot achieve these numbers of continuous sleeping time. When asked at question 4, how many hours believe that are suitable for them to relax they confirmed the above-mentioned findings. A total of 56% answered that sleeping between 6-8 hours can revive their body and mind so as to maximize their performance afterwards. Among the participants that picked 8+ hours of sleep were 6 out of 8 engineers who took part in the survey and less deck watch officers.

| Sleep / rest hours | Percentage |
|---|---|
| **5-6** | 11% |
| **6-7** | 22% |
| **7-8** | 28% |
| **8-9** | 28% |
| **9+** | 11% |
| ***Sum*** | ***100%*** |

**Table 4.3.1 –Sleep / rest hours for performance optimization**

Poor sleeping conditions can also have a tremendous impact on seafarers' alertness, leading to possible maritime disasters. Research has pointed out that fatigue along with poor sleeping conditions has a destructive effect on alertness. In other words, the brain takes a longer period of time to react to signals or respond to difficult situations and tasks on board the ship (IMO, 2001). Efficient sleep conditions, deep and continuous sleep can relax the physical and mental aspects of an adult so as to be alert whenever it is needed. In our research, almost 75% of the participants replied that they manage to get only up to 7 hours of rest / sleep time, which is not enough. At the same time, most of the crew members admitted that they have been woken up during their sleep time, due to emergencies or similar situations. The higher percentage that granted to have been woken up was crew

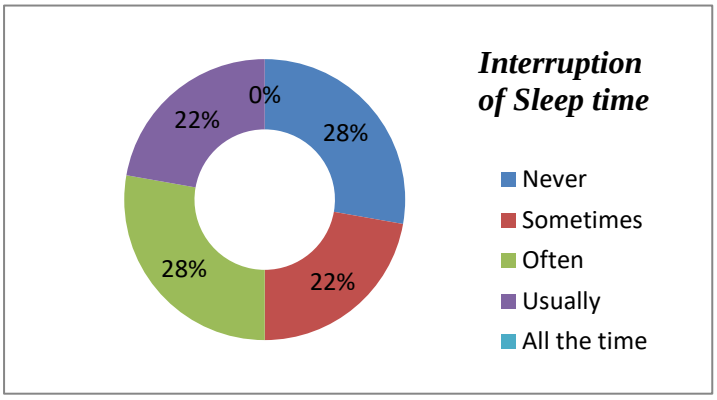


**Table 4.3.2 - Sleep/rest time Interruption**

members of the engine department, due to different complications in the normal running of the engine room.

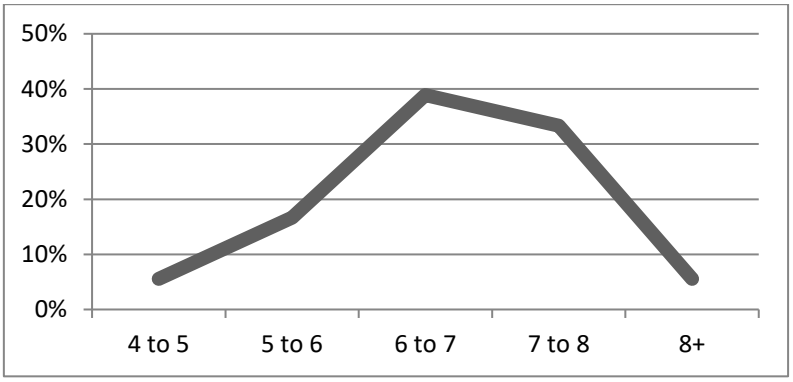


**Table 4.3.3 - Rest period per day**

In the third and last question regarding the number of hours that participants achieve to rest the answers can be shown on the Table 4.3.3 above. Almost 40% achieved 6-7 hours of rest each day while another more than 30% managed to rest for 7 to 8 hours. Although the number of hours may seem high they aren't enough, because the conditions under which seafarers rest aren't ideal. High or low temperatures, the constant noise from the sea or the engines, the motion of the ship affect the quality of rest that crew members join at a significant level.

## 4.4 Analyzing the Health and Lifestyle options on board

Research from other industries has indicated that there is a positive relationship between health management and safety performance (Mearns, Whittaker & Flin, 2003). General health issues and chronic diseases can have an effect on adults towards their ability to work and to recover from an illness. A healthy lifestyle that keeps an adult fit will generate less fatigue to the body, instead of an adult who is overweight or don't get enough exercise. Not only general health of an adult plays an important role but also the nutrition which a person follows is important. A balanced diet will maintain one's good health and will secure his/her immune system from fatigue and illnesses.

The first question of this part of our research focused on whether or not seafarers who participated follow a healthy nutrition / diet and if they limit the use of alcohol, cigarettes (nicotine), sugar, etc. while onboard. The majority, almost 30% of the participants, try often to follow a healthy nutrition and limit abuses on chemical

substances. A slightly lower percentage of around 20%, manages to follow a healthy lifestyle, sometimes or usually. Finally, there is a high percentage of around 20% that never even tries a healthy and balanced nutrition and another 10% who are constantly struggling to remain fit and lean. The results are shown in Table 4.4.1 below.

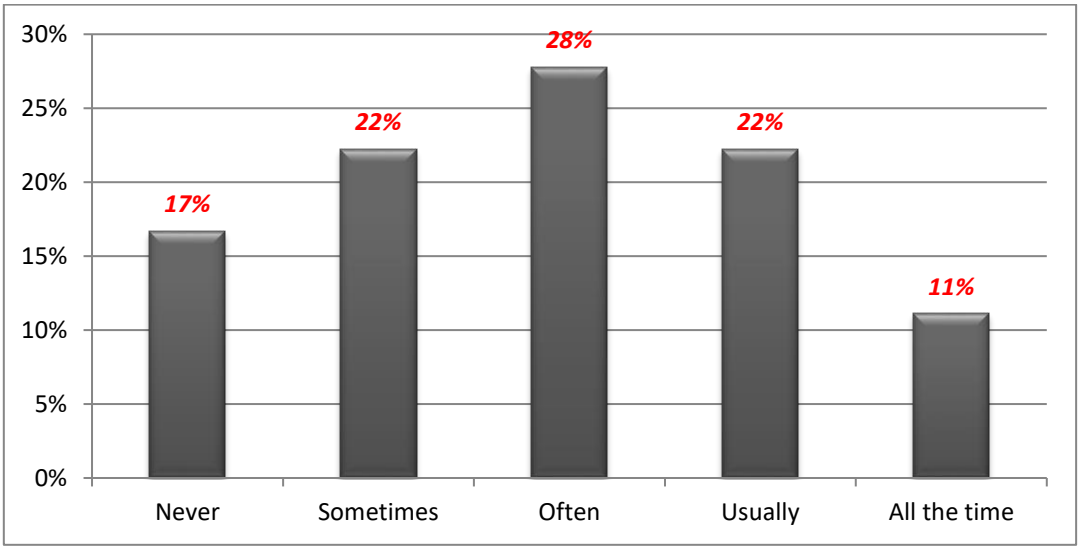


**Table 4.4.1 - Health Nutrition/Diet frequency**

The second question of the study monitored the choice of whether seafarers choose to exercise while on board the ship. Ships are equipped with gym equipment in order to provide seafarers the ability to exercise while on a voyage. Exercising is essential not only for the body but also for the mind and can help seafarers keep their mental and physical health at high levels. Adults who exercise and simultaneously attend a balanced diet, with light protein-based meals, can maximize their alertness and minimize response time in complex situations. At the same time, heavy meals with lots of carbohydrates can generate sleepiness when needed so as to better and easier relax crew stuff.

Regular exercise can also increase the levels of alertness of an adult, both on duty and of duty alertness, so ship-owners or managers should promote the culture of exercise for their employees while on board. In the next table, Table 4.4.2, results from the second question regarding if the participants in their free time exercise are presented.

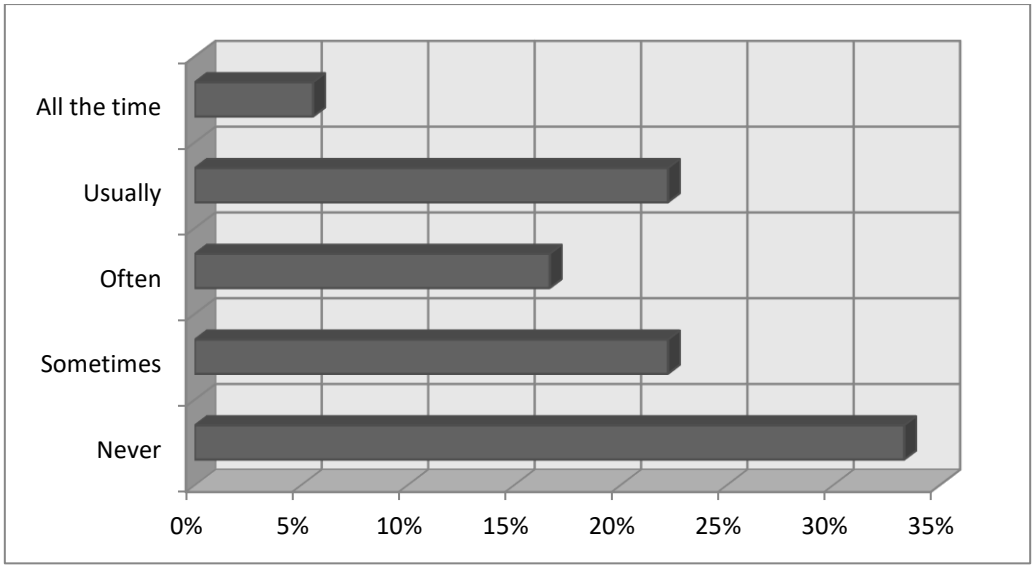


**Table 4.4.2 – Frequency of exercise on board the ship**

As it can be seen from the data above, a great percentage, almost 35%, of participants answered that they never exercise while on board. A total sum of up to 60% replied that sometimes, often or usually try to get some exercise. The percentages are not low, but seafarers should be encouraged with a different attitude towards exercise on board.

Last but not least, participants were asked in the final question of our research to answer whether or not they have taken a medical examination program and at what frequency prior to a voyage it was. The results can be seen in the following table, Table 4.4.3. Almost 50% of the seafarers pointed out that had a medical examination before their first voyage, while a 20% answered never before and the rest 30 every time before voyages.

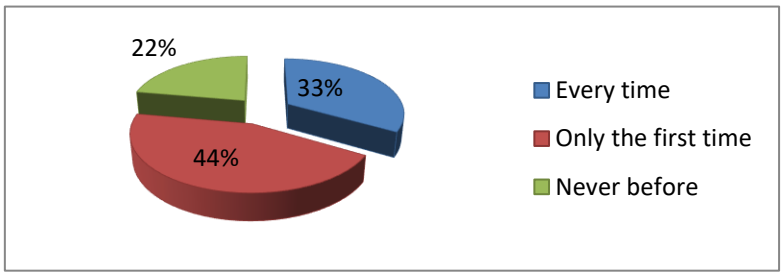


**Table 4.3.3 - Medical examination frequency**

### 4.5 Analyzing the Pre-Employment Medical Examination programs

The P&I Clubs have released a series of comic pamphlets, for their members, dealing with matters of safety, protection towards the marine environment and maritime security.

**The American P & I Club**

The American P&I Club require seafarers originating from Bulgaria, India, Indonesia, Latvia, Philippines, Poland, Romania, the Russian Federation and Ukraine that they must comply with the requirements of its PEME Program as follows:

i) Seafarers must be subject to a medical examination at a P&I Club approved clinic as listed on the Club's website. The costs of the P&I Club PEMEs are periodically updated and the prices are summarized on the Price List for the American Club PEMEs.
ii) The shipboard employees must obtain a P&I Club approved medical examination by the clinic prior to their voyage. The Club-approved clinics have been instructed to retain a copy of the PEME medical forms should there be questions about the validity of a particular PEME. The seafarer must retain the original copy with the security hologram validated sticker printed. The requirements of the PEME will not be considered fulfilled until the P&I Club's Pre-Employment Medical Examination Form is completed fully by the Club-approved clinic.
iii) P&I Clubs PEMEs will be valid for two (2) years in harmony with regulation of which seafarers' medical certificates issued under the Convention will be valid for a maximum of two years.

The P&I Club understands the importance to ensure the highest quality and ethics in the interest of both ship-owner and seafarers alike. In that spirit, the P&I Club's PEME program adheres to the standards as set forth by the majority of P & I Clubs.

Seafaring is generally recognized as a hazardous occupation. The number of crew who fall ill on-board vessels, sometimes fatally, because they are unable to receive prompt treatment due to undiagnosed illnesses is alarming.

In addition to the personal distress and worry caused to crew members, one single serious crew illness claim can force a vessel to deviate from its planned route and lose time, with all the escorting commercial consequences and expenses. The efficient hospitalization, medical treatment and related expenses could cost hundreds of

thousands of dollars. For ship-owners and ship operators around the world, dealing with and resolving crew illness claims continues to be a substantial on-going cost.

Many of these types of claims could be avoided if seafarers had a comprehensive pre-employment medical examination (PEME) by a reliable medical facility or clinic. This is a requirement under the Maritime Labor Convention 2006.


**The North P & I Club**

For example, the North P & I Club has been running an enhanced pre-employment medical program since 2002, initially starting in the Philippines and extending to Odessa in 2007. PEMEs were introduced in both areas following evidence of a high number of Filipino and Ukrainian seafarers falling ill on-board vessels, with illnesses which could have easily been detected and treated prior to their boarding on the vessel. Detection and treatment can keep away seafarers from jeopardizing their health and harming those around them. Thorough medical examination programs is an effective tool in preventing high value claims for ship-owners and operators.

The PEMEs of North P&I Club have continue to grow year by year, with both existing members and new members joining, realizing the importance of having a healthy crew on board their vessels.

With the assistance of the UK based Your Excellent Health Service and Dr. Charlie Easmon; the North P&I Club ensures that clinics are suitably qualified and equipped for carrying out the examinations required for future seafarers. Ensuring this way that the doctors are willing to follow strict guidelines to secure the best quality of examination for future crew members. The P&I Club performs frequent visits with a qualified consultant doctor in order to ensure that clinics in these areas keep up with medical equipment of high standards and that they continue to follow the Club's program rigorously.

In the Philippines, the Club recommends four clinics in Manila and two in Cebu, while recently has introduced a new clinic in Iloilo. The number of clinics in Philippines is high due to the fact that the country is a large crew supplier for the international shipping industry. The additional facility will benefit members who employ crew from Iloilo as it will save time and costs of the crew travelling to either Manila or Cebu to carry out their medical examinations prior to employment. In Ukraine, the club recommends three clinics in Odessa with which it cooperates since the inception of the program there in 2007 and have proved to provide services of high standards.

North's statistics, can confirm that participating members in its PEME programs will benefit from significantly fewer illness claims and overall a healthier workforce on board. In addition, individual seafarers have seen an improvement in their own personal health thanks to a thorough examination prior to their employment at sea.

Furthermore, any illness or injury claim on board is immediately made more serious by the vessel's distance from port. As well as the increased risk to health for the seafarer, the medical treatment, potential hospitalization, sick pay and possible claims may end up being very costly.

Also, the club has developed and supported several initiatives over the years to provide high quality care for the seafarer, mitigate claims, reduce costs and improve service to its members. Information on these initiatives, which include our Pre-Employment Medical Programs, a Post Repatriation Medical Program for Filipino Seafarers, First Call and EHIC Cards, is available below:

### 4.5.1 *Pre-Employment Medical Programs*

Crew illness claims continue to be a substantial cost for the ship-owner who are members of North P&I. One single serious illness claim can force a vessel to deviate and lose time with all the attendant commercial consequences. The resultant hospitalization, medical treatment and related expenses may potentially cost hundreds of thousands of dollars.

Many of these claims could have been avoided if the seafarer had a comprehensive pre-employment medical examination by a reliable medical facility or clinic. These guidelines have been prepared to provide Members with advice on effective pre-employment medical screening and the selection of suitable clinics in their crew supply areas worldwide.

- Clinic Selection Worldwide;
- PEM Philippines;
- PEM Ukraine;
- International Group of P&I Clubs (PEME) Programs – Guidance for Clubs.

### 4.5.2 *People Claims – Controlling the Cost*

The P & I Clubs have developed and supported several initiatives over the years to provide high quality care for the seafarers, mitigate claims, reduce costs and improve services.

### 4.5.3 *Post Repatriation Medical Program (PRM) for Filipino Seafarers*

The Post Repatriation Medical Program (PRM) was introduced in February 2013 by North P&I Clubs. Its prime goal is to help seafarers who have been repatriated to the Philippines as a result of injury or illness on board. This is achieved with the assistance of the Ship to Shore Medical Assist and Shiphealth Inc. which operates Post Repatriation Medical facilities in Manila.

The aim is to provide efficient, high-quality treatment for Filipino seafarers whilst at the same time avoiding excessive costs, in particular by avoiding unnecessary treatment for additional medical conditions for which members were not legally or contractually responsible.

#### 4.5.4 *First Call*

The Club has also developed the First Call service in conjunction with Hudson Tactix and Shuman Consulting Services for its members who are disembarking crew for medical treatment in the USA only.

#### 4.5.5 *The European Health Insurance Card (EHIC)*

The European Health Insurance Card (or EHIC) is issued free of charge and allows anyone who is insured by, or covered by, a statutory social security scheme of the European Economic Area (EEA) countries, including Iceland, Lichtenstein, Norway and Switzerland, to receive medical treatment in another member state for free or at a reduced cost, if that treatment becomes necessary during their visit (for example, due to illness or an accident).

### 4.6 Case studies

#### 4.6.1 *Case study of smoking abuse*

A crew member had smoked for around 40 years and had a valid health certificate while he was working on board he suffered a heart attack and was rushed to hospital. In the days prior to this he had experienced shortness of breath and a rapid heart rate. At the hospital he was found to have respiratory failure and required mechanical ventilation, he had little if any respiratory reserve. The cause was diagnosed to be Chronic Obstructive Pulmonary Disease (COPD). This means that the airways become narrowed, limiting the flow of air from the lungs. The most common cause is from smoking. After a couple of weeks, he was finally allowed to leave hospital and fly home to his native country to rest and receive further treatment. Unfortunately, he was found dead in his home a couple of weeks later.

The particular seafarer was a heavy smoker for several years. The health certificate that he provided did not state any concerns thus questions must be raised as to whether a normal health certificate is sufficient for determining a crewmember's health. If health certificates are not treated seriously by doctors, they could lead to severe consequences, as in this case.

### 4.6.2 *Case study of alcohol abuse*

Within two weeks of going on a voyage, a seafarer was hospitalized in the United States, for an infected injury to his elbow. However, he then developed respiratory problems requiring a tracheotomy and stayed in the US hospital for a number of weeks as he was too ill to risk repatriation to Europe. It was then discovered that he was diabetic and had a recent history of alcohol abuse – neither of which had been detected during the conventional crew medical examination. When finally repatriated to Sweden, the total net costs amounted to $307,000.

At this point we would like to highlight the importance of PEME programs. If the particular crew member had been thoroughly examined by doctors of P & I Clubs approved clinics or had taken a PEME there are many possibilities that this incident would have been avoided. Therefore, we can conclude that PEME programs should examine each crew member prior to disembarking on the vessel in order to be ensured the safety of the personnel as well as the safety of the vessel.

## 5. Conclusion / Results / Suggestions

After the completion and analysis of our research data in chapters three and four we have monitored a few data regarding the fatigue of seafarers while on board. The study focuses on factors that contribute to shipboard fatigue and also how sleeping habits and the keep up with a healthy lifestyle affects seafarers on voyage. Furthermore, the demonstration of PEME examination programs has been presented, which are thorough medical examinations for seafarers. Their role is to reduce claims from illnesses and losses and have been established by P & I Clubs so as to equip ships with a fit and healthy crew that can accomplish successful voyages.

Seafarers work longer and harder in contrast with onshore employees. Work hours cannot easily be arranged and even though mariners may feel tired and fatigued, they are willing to work because they believe that it is a ″professional″ thing to do. (Grech, Dawson, Ferguson, Robers, Meuleners, Brook & Sargent, 2016). Our research revealed that crew members do not receive the rest and sleep times they should, even though the international regulations are followed by shipping companies. Interruption of sleep seems to be a common interference in their rest time resulting in future fatigue as well. In addition, seafarers don't find it easy to manage their onboard health and lifestyle options (nutrition for example), which leaves a gap that ship-owners or operators should come to fill.

Further on in this part, we are providing some suggestions and methods that can be adopted either by ship operators or owners which can have critical effects on the long-term health and general well-being of their seafarers. Finally, in the second part of our conclusion, some propositions on PEME examinations programs are displayed.

### 5.1 Suggestions on the topic of maritime fatigue

As it has been stated many times previously, fatigue has been identified as a very important topic in the maritime industry, which can be a contributing factor causing accidents and even ship losses.

Regulations in international shipping propose that written individual records must be fulfilled and kept on board by seafarers for the purposes of future auditing and inspections. Most of the times these records aren't properly reported due to the fact that crew members work longer hours than those completed in the reports.

### 5.1.1 *Fatigue Risk Management Framework*

In order to reduce the risks of fatigue at sea, shipowners and operators should consider initiating the use of fatigue risk management plans. A Fatigue Risk Management Plan (FRMP) is a risk-based plan or system of controls that identifies monitors and manages fatigue risk. Its aim is to ensure that employees perform at an adequate level of alertness (FRPM, Energy Institute London, 2014). An effective FRMP should be based on four pillars:

1. Customized to the operation for which it is developed;
2. Based on assessed risk and evidence;
3. Built on the principle of shared responsibility;
4. Integrated into existing management systems.

Thus, a FRMP focused on shipping should provide effective support to seafarers through training and awareness campaigns in order to control and manage fatigue risks. Shipping companies must monitor sleep which is the most common factor that causes high levels of fatigue. Through monitoring sleep hours and habits, companies should work on providing adequate sleep opportunities in duration and quality that are important factors for the alertness of their crew. Moreover, a healthy shipboard environment must be a top priority as an amenity to seafarers. Last but not least through frequent assessment plans companies can establish whether someone is fit for duty or not.

A Fatigue Risk Management Plan enhances safety and prevention of fatigue related incidents transforming ships in safer options of transportation while at the same time minimizing accidents and ship losses. FRMP plans are also considered as a systematic and documented approach to fatigue management that evaluates different possible causes of fatigue. Their benefits extend to sea employees as well including improvements in their health, their well-being and the satisfaction that is related to work (FRPM, Energy Institute London, 2014).

### 5.1.2 *Automation in Maritime Industry*

As shipping operates in a highly competitive market, ship-owners and operators must achieve economic efficiencies while simultaneously cutting costs to the lowest levels. This paradox attempt navigates them many times to reductions in shipboard crew

(Akhtar & Utne, 2014). Due to this reduction in manning levels there has been a cultural shift towards increasing the levels of automation in different tasks, particularly in navigation systems (Hetherington, Flin & Mearns, 2006). This decrease in manning levels and increase in automation can create new attention demands and change the role of the seafarer (Grech & Horberry, 2002).

Mariners have been transformed to system managers due to automation, with current responsibilities the coordination and monitor of automatic systems. Automation has impacted both the deck and engineering department in ships, reducing manning requirement for each vessel (Ding, Han & Zhang, 2012). As far as the deck department is concerned, radars, electronic information systems, GPS and other information systems are broadly used so as to promote an almost fully automated bridge. On the other hand, automation has resulted in a remotely monitored engine department with minimal personnel that doesn't have to be on a 24-hour watch.

Thus, it is considered that automation can reduce seafarers' workload during a voyage and also minimize the appearance of human error. As a result, we could say that automation may lower fatigue levels, stress and work pressure for seafarers. But is this really true?

According to Sarter & Woods (1995), automation can create new demands that can be described with the term ″mode awareness″. Particularly, the system operator may have to permanently keep track of how all systems operate and whether they malfunction, increasing his / her levels of tiredness.

Another opinion is that seafarers will monitor operations less effectively as they will rely on automation as a safe and efficient method, resulting in possible accidents at sea (Lutzhoft & Dekker, 2002).

Bearing in mind all the previously mentioned views, we cannot propose for certain that automation can have positive results on seafarers' fatigue. Systems that can provide seafarers with a 100% guarantee on automation have not yet been invented, making the presence of human factor essential in ships, now more than ever.

### 5.1.3 *Wearable technology*

For the past twenty years technology is rapidly growing providing us with a great number of gadgets and stuff that seem to be helping us in different aspects of our lives. Wearable technology has been growing for a couple of years with usages both on the industrial and private sector of our lives.

Wearable technology for industrial usage may sound like a science fiction story but it's not at all one. Companies are using this kind of technology in order to improve their businesses by monitoring safety issues and ensuring that their employees are productive. Through this technology they can also track health and physical accuracy of their employees.

Especially in shipping where seafarers work under harsh conditions for many months at sea and also don't enjoy proper sleep and rest, wearable technology might seem the perfect industry for application. Tracking and monitoring seafarers fatigue status and also safeguarding their well-being can prevent accidents based on human error. Moreover, shipowners and operators whose crews use this technology will be provided with real time data and can instantly change their employees' schedules so as to prevent exhaustion.

Although today wearable technology is still at an very early stage of implementation in shipping its adoption by the industry must be very careful. Companies should not only use this equipment to track their seafarers down on their performance only but also enhance the capability of its assets (ships) to take advantage of the maximum capabilities they can get.

Opponents to the use of this technology would say that seafarers might experience higher levels of stress due to the fact that they will be tracked all the time. They might think of working longer and harder against the fear of displaying lower statistics regarding their performance. Thus, this pressure can lead to the exact opposite results than those desirable.

Whether the infusion of this kind of technology is correct or wrong is still under debate. There are people who vote towards it, presenting the advantages and there is the opposition which is completely negative. On the other hand, there is a great number of seafarers that have already been using smart technology and wearable gadgets for

private use who may be willing to participate in the promotion of wearable technology in the shipping industry.

### 5.1.4 *Pets and animals on board ships*

P & I Clubs publish regularly guidelines and information on the topic of fatigue for seafarers. In the case of human fatigue, the clubs try to provide practical assistance for seafarers in order to support fatigue and tiredness prevention.

In a recent publish the American P & I Club suggested the use of pets and especially dogs on board, to help seafarers manage fatigue. A dog can be very well trained and also stand as a loyal friend to a man. Thus, certain training can help dogs realize when a human may be fatigued and prevent him from causing incidents.

Dogs or other pets on board can also be used a stress repellent for seafarers or helpful companions. Many years before, pets and especially dogs were used for hunting at ports of call or other purposes. Furthermore, pets have played an important emotional role on the long and monotonous voyages at sea and are considered to be great de-stressors for seafarers.

## 5.2 Suggestions on the topic of PEME programs

The introduction of the Pre-Employment Medical Examination (PEME) program prior to seafarer recruitment has had a considerably positive impact in the shipping industry. The scope of the program is to protect seafarers by ensuring their medical fitness towards performance routines and their alertness in emergency situations and duties. By completing a PEME examination before leaving shore for a journey one can assure that he / she is not suffering from any medical condition that will worsen while servicing at sea and also to protect himself and his co-workers onboard.

### 5.2.1 *Complexity and further additions of checks to PEMEs*

The PEME programs include medical checks on future seafarers which exceed the minimum standards that are adopted by national and international regulations. Normal medical examinations in clinics are inadequate to ensure illnesses that PEMEs can distinguish. This states that PEMEs include the regulations of the 2006 ILO Maritime Labor Convention but also include more detailed and comprehensive standards.

The P & I Clubs have tested certain clinics throughout the world on rules and regulations and have established lists with the approved clinics for seafarers. These clinics undergo thorough audits in order to maintain the Clubs high standards and comply with the guidelines and regulations given at first place.

Unhealthy living may lead to serious illnesses which can take many years to be obvious for a human being. While a typical medical examination may not identify all these signs a PEME may do so, preventing a lot of suffering and even premature death.

Each P & I Clubs has developed its very own PEME examination in order to provide for seafarers the most comprehensive medical examination it can, to detect illnesses and reduce the claims caused by them. In an attempt to reverse the increase in illnesses shipping companies must give emphasis that their employees successfully pass thorough PEMEs before disembarkation.

Pre-employment medical examination programs cover as much as more than double what illnesses are covered by typical examination. Below is presented a comparison between a PEME from the UK P & I Club and a standard medical examination in a Philippine clinic.

| PEME vs. Typical Examination | | |
|---|---|---|
| **Illness screened** | **P&I PEME** | **Standard examination** |
| **Physical appearance** | Yes | Yes |
| **Eyesight** | Yes | Yes |
| **Colour blindness** | Yes | Yes |
| **Audiometry** | Yes | Yes |
| **Heart function** | Yes | Yes |
| **Dental examination** | Yes | Yes |
| **Urinalysis** | Yes | Yes |
| **Blood count and type** | Yes | Yes |
| **Chest x-ray** | Yes | Yes |
| **Sexual health** | Yes | Yes |
| **Fecalysis for food handlers** | Yes | Yes |
| **Pregnancy test** | No | Yes |
| **Hepatitis A / B / C** | Yes | No |
| **HIV test** | Yes | No |
| **Psychological examination** | Yes | No |
| **Drug and alcohol presence** | Yes | No |
| **Lung function** | Yes | No |
| **Major organ function** | Yes | No |
| **Diabetes** | Yes | No |
| **Cholesterol / triglycerides** | Yes | No |
| **Liver / Kidney function** | Yes | No |
| **Kidney disease** | Yes | No |
| **Liver dicease** | Yes | No |

**PEME examination vs. typical examination (with data from UK P&I Club)**

### 5.2.2 *Advantages of PEMEs for ship-owners and seafarers*

The introduction of PEME examinations has had a positive impact on seafarers and ship-owners / operators. The quality controls have reduced the number of adults who are found to be unfit for sea and have identified many more who suffered from illnesses and chronic diseases. Below are summarized in bullets the advantages that PEME examinations provide towards ship-owners/operators and seafarers.

*Advantages for shipowners*

- Improved crew risk management;
- Fewer claims;
- Safer ships;
- Minimal disruption;
- Fitter and healthier crew;
- Control on costs;
- Accountability of clinics;
- Crew claims analysis.

*Advantages for seafarers*

- Quality medical examination;
- Free health check / lifestyle advice;
- Improved awareness of health issues;
- Increased personal safety onboard.

### 5.2.3 *Frequency of examinations*

As P & I Clubs have as their main scope through PEMEs the prevention of illnesses and also claims from illnesses, the clubs should impose higher frequency for the examination checks to seafarers.

Higher frequency in examination could lead to high savings from illness claims that arise. Seafarers ought to be examined every time before going on a voyage in order to track their current health status. Mariners who are on 6-on 6-off periods onboard can

easily lost track of their health while on shore. For those who are not cautious and take examinations in advance the PEME can step right in and save from the worst.

### 5.2.4 *Example of PEME results*

The examination is handled by certain PEME teams that provide shipping companies with useful reports and insights into the quality of seafarer recruitment. The use of this scheme currently ranges crew onboard tankers and dry bulk to major cruise lines.

The program provides extensive money-saving opportunities and reduces the volume and frequency of crew illness claims. These claims may be either above or below the Member's deductibles thus providing a saving for both the Member and Club. Other features include:

- More clinics in more countries than any other scheme;
- 78 clinics in 26 different countries;
- 22 successful years and 380,000 examinations;
- Club Crew Health Team handle all administrative duties including accreditation of new clinics, audit of existing facilities, and review of clinic performance;
- Independent medical audits of participating clinics;
- Efficient, top-quality medical examinations;
- Clinics are fully accountable to the Club, and must uphold high standards;
- Screening of crew before employment insuring best/healthiest crewmen onboard;
- Medical examination online authentication process;
- Reduced risk to other crew members and passengers onboard a vessel;
- Reduction in claims above and below the deductible;
- Most extensive and sophisticated medical screening program in the industry.

Therefore, we can conclude that contribution of PEME programs is highly important, as they can prevent and protect P&I Clubs from several claims, which means costs saving as well as both shipowners and seafarers from many unexpected incidents.

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## **Appendix A** - Questionnaire

**General information** *(please circle the answer)*

Position in the ship: Mate: Chief Second Third

Engineer: First Second Third

Number of years in the shipping industry:

a) 0-1 b) 1-5 c) 5-10 d) 10-15 e) 15+

Age of participant:

a) 18-24 b) 24-30 c) 30-36 d) 36-40 e) 40+

Number of months on board:

a) 1-2 b) 2-4 c) 4-6 d) 6+

**Questions** *(please circle the answer)*

1. How many hours do you work per day onboard?

   a) 6-7 hours b) 7-8 hours c) 8-9 hours d) 10+ hours e) other

2. Do you feel fatigued when you are on a watch?

   a) Never b) Sometimes c) Often d) Usually e) All the time

3. From the following mentioned causes, which in your opinion generates more fatigue (up to 4 answers)

   a) Lack of sleep b) Excessive work load c) Stress

   d) Motion of the ship e) Noise on board f) Temperature

   g) Time zones h) other

4. How many hours in your opinion, is a suitable rest period?

   a) 4-5 hours b) 5-6 hours c) 6-7 hours d) 7-8 hours e) 8+ hours

5. How many hours is typically your rest period?

   a) 4-5 hours b) 5-6 hours c) 6-7 hours d) 7-8 hours e) 8+ hours

6. Have you ever been woken up during your sleep period (due to emergency)?

   a) Never b) Sometimes c) Often d) Usually e) All the time

7. Do you follow a healthy nutrition-diet, minimizing the use of alcohol, cigarettes, sugar etc.?

   a) Never b) Sometimes c) Often d) Usually e) All the time

8. In your free time, do you exercise?

   a) Never b) Sometimes c) Often d) Usually e) All the time

9. Have you had a medical examination check prior to your departure for a journey? (not PEME)

   a) Every time b) Only first time (PEME) c) Never before a journey