THE ROLE OF HUMAN FATIGUE FACTOR TOWARDS MARITIME CASUALTIES

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ABSTRACT

The international studies on maritime accidents has shown that fatigue is continuing to be either the main cause or a contributory factor in a considerable number of casualties at sea resulting in the loss of life and damage to the environment and property. In fact, fatigue’s detrimental role toward performance at work is leading to errors being made and consequently resulting in fatalities. In light of these considerations, fatigue issue is of great importance to seafarers, the shipping industry and to the international maritime organizations. Therefore, the purpose of this paper is to analyze the impact of fatigue on seafarers which leads to casualties of human life and property at sea. In this regard, the authors support the idea that indeed fatigue plays a detrimental role on seafarers which in turn may impact the normal operation of ships while at sea resulting thus in accidents.

Keywords: Human factor, Performance onboard ship, Fatigue at sea, Maritime casualties, Maritime disasters.

1. INTRODUCTION

Generally perceived as a major concern in the shipping industry, fatigue has been subject to many studies, books and papers. Reyner and Baulk (1995) studied and examined technical data on fatigue among seafarers particularly on ferry crews, providing thus a proactive approach in fatigue management. Also, Cardiff University (1996) addressed the fatigue issue in terms of identifying important elements for further research and analysing the unresolved components of fatigue itself. More recently in 1997, Parker, Hubinger, Green, Sargent, & Boyed in their study focused on the health and lifestyle behaviours of seafarers leading to an efficient investigation regarding fatigue issues. Furthermore, IMO’s concern toward fatigue at sea, resulted in 2001 in the adoption of the foremost important document regarding fatigue issues “Guidelines on Fatigue”, which directly tackles this significant issue.

Despite many studies and research projects being undertaken by many authors concerning fatigue, the complexity and the difficulties that the fatigue issue represents today in the shipping industry in terms of structural adjustments, technological changes and operational requirements reveal the need for further research to tackle fatigue issues at sea. Considering also the permanent and the potential hazard that fatigue factors are posing towards the personnel in the shipping industry at present it is relevant now for additional studies in this area to be undertaken in order to find more efficient solutions to combat fatigue at sea.

The purpose of this research paper is to define the role of fatigue issues toward maritime casualties by identifying the main components of fatigue and its impacts on the performance at work which in turn leads to errors being made. In order to have a comprehensive analysis of fatigue, relevant information regarding the understanding of fatigue at sea will be first provided in this paper. The second aim is to describe appropriate examples of maritime casualties worldwide when fatigue is reported to be either a primary cause or key contributory element in this matter. In addition, the contributing factors to fatigue followed also by fatigue’s effects upon seafarers will be identified in the paper. Finally, recommendations on how to address fatigue’s threat, suggestions which can probably lead to the impairment of the fatigue factor at sea will be proposed in the last chapter.

2. UNDERSTANDING FATIGUE AT SEA

2.1 Background of fatigue at sea:

Fatigue at sea is extensively perceived as a complex factor within the shipping industry and a comprehensible overview of this matter in terms of historical and current events is important. In the past, characteristics such as behaviour, intellect, education, training, abilities, inspiration, rewards, physical size, strength, attractiveness and professionalism were believed to be barriers against fatigue factor at sea. This misunderstanding was the main reason that fatigue’s impact as a potential cause to human error was underestimated (Fatigue: IMO guidance, 2006). Nevertheless, recent studies have rejected this theory and further research reveals fatigue’s detrimental role on performance as an important factor toward marine casualties (IMO, 2001).

In the meanwhile, a good understanding of fatigue requires the identification of some possible obstacles within human factor which is quite a hard task due to the complex nature of this issue. In this context, studies on fatigue at sea have shown that measuring fatigue in a person’s performance and the under-reporting of fatigue cases to maritime agencies are some of the obstacles in alleviating fatigue effects onboard. Another obstacle observed by Mucsio in 1921 regarding this issue was that, there are no observable criteria for fatigue factor in general (Cardiff University, 1996). Similarly, the identification of the maritime groups most vulnerable to fatigue is an important issue, which provides a complete picture of the real problem. According to Cardiff University Research Workshop on Fatigue, groups such as ferry crews, Masters, Chief Officers and Chief Engineers remain the most vulnerable to fatigue due to their constant workload and the responsibility they carry.
Within the accurate perception of the fatigue issue, the establishment of an appropriate definition is particularly essential in order to prepare the ground for an efficient alleviation of this problematic issue. Traditionally the fatigue issue has been on the agenda of the maritime organizations for more than half century and the efforts for a universally accepted definition has failed. Regardless of the diverse approaches undertaken, common to all definitions worldwide is the term “degradation of human performance at work” (Fatigue: IMO guidance, 2006). With respect to this approach, the Seafarers International Research Centre (SIRC) definition contends that “Fatigue is a consequence of continuously high or prolonged levels of information load which involves subjective feelings of tiredness or a disinclination to work” (Cardiff University, 1996, p. 5)

In other words, a broader view of this definition describes fatigue as acute or chronic tiredness, depression, sleepiness, stress, disturbed circadian rhythm and boredom.

On the other hand, IMO describes fatigue as a “State of feeling tired, weary, or sleepy that results from prolonged mental or physical work, exposure to harsh environment, or loss of sleep which can lead to the impairment of performance and to the reduction of alertness” (IMO, p.1) Furthermore, in the IMO’s MSC/Circ.813/MEPC/Circ.330 fatigue within the human element is described as a “Reduction in physical and 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” (as cited in Fatigue: IMO guidance, 2006, p.7). All the above definitions, despite some differences, are very valuable in terms of understanding fatigue and finding the appropriate approach in the resolution of this problem.

Fatigue is a major concern currently in the transportation industry worldwide, and particularly fatigue’s impact in the shipping industry is more hazardous than elsewhere due to the exclusive aspects that seafaring presents. In light of these considerations, the unique environment of seafaring is characterized by harsh working conditions including permanent noise, vibration, heat and bad weather. In addition, the seafarer is forced to live and work for a period up to six months away from home and family, exposed also to unpredictable environmental factors. In the same way, the working nature of seafaring represents a vague separation between work and leisure leading to a stressful situation for the seafarer. Furthermore, various nationalities and cultural elements represented in the vessel’s environment today indicate another problematic issue for the seafarer (Parker et al, 1997). Finally, the operational aspects of shipping such as variety of ship types, port rotation and the pattern of sea passage are some other elements apparently revealing the unique aspects that seafaring represents today (Fatigue: IMO guidance, 2006).

3. MARITIME DISASTERS RELATED TO FATIGUE

3.1 Importance of fatigue at sea

The investigation reports of most marine accidents occurring worldwide considers fatigue as one of the main contributing factors toward these disasters leading to many fatalities (Time to wake up to consequences of fatigue, 2007). With regard to this issue, the biggest concern currently by the maritime organization is the loss of lives resulted from maritime accidents. Seafarers’ lives are endangered every day and many of them have died due to the maritime disasters caused by fatigue factors onboard ship. Another issue which emphasises the importance of fatigue at sea is that accidents caused by the latter are having a negative impact on the environment. In other words, oil pollution caused by the groundings or collisions of ships due to fatigue factors is damaging the maritime environment and causing a huge financial impact on the coastal countries and companies. Finally, the importance of fatigue at sea stands also in the fact that property is being damaged heavily or lost because of fatigue’s contribution to accidents. Regarding this matter, ships and cargoes in a case of accident are totally lost or useless causing to the shipping companies huge financial impact and sometimes bankruptcy. On the whole, the above concerns indicate that fatigue at sea is of a great importance to all the parties interested in the maritime affairs.

3.2 Statistics of maritime disasters caused by fatigue

Identifying the impact of fatigue toward maritime casualties is quite a difficult task and an overview of statistics regarding maritime casualties caused by fatigue will assist in the efficient perception of this matter. In this framework, a study carried out by the US Coast Guard Research and Development Centre defines fatigue as a primary source contributor to 16% of vessel casualties and to 33% of injuries onboard (Rothblum, 1996). In addition, Great Britain’s Department of Transportation in a study which involved 1,647 collisions, groundings and near collisions occurred between 1994 and 2003 contends that “A third of all the groundings involved a fatigued officer alone on the bridge” (2004, p.4) emphasizing the problematic nature of fatigue regarding accidents.

Furthermore, other sources indicate the fact that fatigue as primary cause is the contributor of 11%-23% of all the collisions reported and according to the same source this percentage might be greater due to under-reporting cases of fatigue (Houtman, 2007). Similarly, fatigue’s detrimental impact on human alertness has proven to be the main cause of many accidents involving Coast Guard ships in USA when “70% of CG personnel studied exhibited signs of compromised alertness” (Comperatore, 2001, p. 5). Emphasizing the importance of fatigue’s impact toward maritime accidents the Japanese Maritime Research Institute takes the view that the lack of alertness within fatigue element accounted for approximately 53% of the marine casualties in the category of collisions and stranding (as cited in Cardiff University, p.10).

In order to have a comprehensive understanding of maritime accidents caused by fatigue the investigation of the periods of time when the most accidents occur is of a
great significance. In light of these considerations, studies regarding this issue have shown that the time between 00:00 and 00:06 hours is the most dangerous period for accidents (Great Britain, Department of Transportation, 2004). This statement is reinforced also by the US Coast Guard Research and Development Centre which maintains the fact that “Inevitably, fatigue-induced performance degradation occurs mostly during night time hours” (Comperatore, 2001, p. 3-18). The same period of time is suggested as the most dangerous for marine accidents due to biological clock within the human organism which makes a person subject to heavy sleep at that period of time (Fatigue: IMO guidance, 2006).

3.3 Maritime disasters related to fatigue

Traditionally, fatigue has been perceived as possible factor in maritime accidents but it was the Exxon Valde case that triggered the outmost attention of the maritime organizations regarding this hot issue. The US tanker Exxon Valdez during its navigation near Alaska’s coast got stranded on Bligh Reef, on March 24th 1989 (Cardiff University, 1996). The investigation conducted by US National Transportation Safety board revealed the fact that fatigue was identified as the major contributor to this accident citing also that “there were no rested officer to stand the navigation watch during the voyage” (WMU, 2006). The financial impact caused by this accident was huge and was estimated around 8 billion dollars in claims and clean up operations (Cardiff University, 1996).

Another maritime accident demonstrating the negative effect of fatigue’s implication in the chain of events of the casualty was the Cittas case in the English Channel. The German-owned container ship in 1997 ran aground off the coast of the Channel leading to the damage of the ship and to the environment. Similarly, in the Exxon Valdez accident, fatigue was found to be the primary cause of the grounding. In brief, the investigation revealed that the watch keeper was short of sleep as a result of the shipboard organization, leading thus to the accident (Ryner & Baulk, 1998).

The most recent in a series of extraordinary accidents caused by fatigue factor, are the cases of the vessel Jambo off the coast of Scotland in 2003, and the sinking of the tug Thomas Herbert off the New York coast in 2004. Both of these cases had as a common feature a fatigued officer on watch operation. While in the Jambo case the watch keeping officer missed course alteration as a result of his impaired performance caused by fatigue, in Thomas Herbert case the watch keeping seafarer fell asleep due to the workload and tiredness, leading to the death of five seafarers. The consequences in both accidents were devastating, causing environmental damage and loss of property in Jambo accident and in the loss of innocent lives in the second casualty (Great Britain, Department for Transportation, 2004; Gulf Coast Mariners Association, 2004). As a result, all the above cases indicate the important role that fatigue factor plays in maritime casualties worldwide.

4. CONTRIBUTING ELEMENTS TO FATIGUE AT SEA

4.1 Human factor

The most crucial element which poses a great danger toward human performance at work is obviously sleep and rest. Regarding this element many studies have confirmed the fact that features such as quality, quantity and duration of sleep can play a significant role in a good sleep. In order to have a good performance at work a normal seafarer should have a deep and uninterrupted sleep during rest hours (IMO, 2001). According to US Coast Guard Research and Development Centre energy is produced during uninterrupted sleep putting also emphasis on the fact that people need 7-8 hours of sleep per 24-hour to perform their best. In addition, sleep disorders such as insomnia and apnea, which is a condition when breathing stops during the sleep are major concerns regarding sleep, leading thus to the impairment of alertness of the seafarer (Fatigue: IMO guidance, 2006). Furthermore, rest breaks during work, particularly aboard ship should be sufficient and strictly complied by seafarers and management of the vessel due to the importance of this element which can also impair the performance and alertness of seafarers. As a result, the implementation of all the factors above is difficult onboard ship due to the harsh environment that vessel represents.

Another important factor within the human element which contributes to fatigue is the biological clock/circadian rhythm. The biological clock within human’s body makes a person sleepy or alert on normal schedule whether they are working or not (Cardiff University, 1996). Similarly, circadian rhythm represents various processes and states in our body within 24 hours such as sleeping/waking, hormone levels and body temperature. In light of these considerations, the biological clock heavily conflicts with the working patterns of the seafarers due to the irregular schedules aboard ship caused mainly by crossing time zones while the vessel is en route and shifting rotations (IMO, 2001). Consequently, the circadian rhythm of the seafarer will be out of synchronization leading to sleep disorders and tiredness which are contributing factors to the impairment of the seafarer’s performance at work (Fatigue: IMO guidance, 2006).

The unique aspect that seafaring symbolizes today in the international industry leads to the enhancement of stress factors among mariners. Stress represents a complex issue currently because it thwarts mariners from achieving a good sleep and causes the release of energy reducing alertness (Comperatore, 2001). Naturally, the inability of the seafarer to cope with an environment that poses demand or threat which is quite often aboard ship will definitely initiate the development of stress. Consequently, this can result in diminished work performance and health trouble among seafarers. Features such as noise, vibration, temperature, personal problems and interpersonal relationships are the most known contributors to stress onboard ship (IMO, 2001).

To efficiently analyze the human element as a contributing factor of fatigue it should be taken under
consideration also the identification of many other secondary factors which are part of this issue. Some of the factors within human element which can potentially cause fatigue are as follows:

- Mental and emotional factors such as fear, monotony and boredom, which are characteristics of seafaring in general. (IMO, 2001);
- Physical conditions such as diet (fat, fried food, sugar content food) and illness as common problem aboard ship due to harsh environment. (Comperatore, 2001; IMO, 2001);
- Ingested chemicals such as alcohol, drugs and caffeine used very often among seafarers to overcome sleep and boredom (Fatigue: IMO guidance, 2006);
- Workload aboard ship and in ports,
- Age of seafarer;
- The “Can do” attitude of seafarers, a sensitive problem traditionally due to the nature of seafaring which promotes a culture of self reliance (Patraiko, 2006);
- The increased volume of workload at ports today (Patraiko, 2006).

4.2 Management factor

The management of the vessels can potentially cause stress problems toward the seafarer and the organizational aspect within the management factor plays a key role concerning this issue. A comprehensive evaluation of the organizational aspects proves the fact that inefficient employment policies and insufficient training by the management of the ship are affecting depressingly the operations onboard causing stress and fatigue in the crew. In addition, tasks such as paperwork requirement, schedule shifts and overtime can have big impact on seafarer’s fatigue onboard leading to errors being made. Without a doubt, the management style that shipping companies implement on ships are of great significance in terms of fatigue’s impact among seafarers. In this context, the company management style sometimes does not respect the needs and the requirements of the seafarers, imposing harsh rules generating thus conflicts and stress among the personnel. Furthermore, considering the harsh conditions onboard ship and multi-task environment of the seafaring, it is very difficult for the mariners to comply with all the existing regulations leading to a high level of stress. As a result, the compliance of the national/ international rules and regulation by the seafarers is another source of fatigue which can lead to the impairment of alertness. Finally, the regular maintenance of the ship which is difficult work can prove to be another heavy burden for the mariners (IMO, 2001; Fatigue: IMO guidance, 2006).

Besides the organizational aspect, another essential component within management factors is the voyage and scheduling aspect. Regarding this matter, the scheduled time between ports arranged by the shipping management can be very frustrating for the seafarers, who must work overtime and under pressure to be on time. Also, required to follow the schedule, the seafarers are exposed many times to harsh weather and dangerous sea conditions, factors which can result in stress, fear and extreme fatigue levels. Likewise, the traffic density encountered by the vessel during the navigation at sea is another aggravating factor leading to many problematic issues such as diminished alertness and impaired performance at work (Fatigue: IMO guidance, 2006).

4.3 Vessel factor

Another important feature that can cause or affect fatigue upon seafarers is ship design. Many ship design features can impact the workload onboard while others affect the crew’s ability to sleep and the level of stress. Understanding the basic operations of the ship a professional seafarer will lead to the conclusion that the level of automation is very important in terms of reduced workload, low stress level and less fatigue. The high level of automation is important because it facilitates the work of the seafarers due to less time required to accomplish a task and effortless operation of equipment aboard ship. Moreover, spending up to six months aboard ship, subject to harsh weather, the life of the seafarers is heavily dependent on the ship’s equipment reliability which has proven to be a crucial factor leading to fatigue.

Certainly, it is widely perceived among seafarers that old ships are usually more difficult to operate, less safe and more uncomfortable in terms of living conditions in comparison with new vessels. Consequently, the age of the ship is an important element which can lead to the enhancement of the mariner’s stress aboard ship. Considering also that sleep and rest are among essential components of good performance, the physical comfort in work and quarters are important features of the ship design vital in alleviating fatigue factor. Finally, the ship motion (instability) caused mainly by poor design of the vessel influences also upon seafarers, increasing the level of tiredness and fatigue (IMO, 2001).

4.4 Environmental factor

The excessive exposure of the seafarers to the internal environmental factors can cause not only fatigue but also health problems. Features like noise within the ship have been defined to be an important cause of fatigue at sea. Noise is caused mainly by the engine operation, ventilation and ship motion during harsh weather. Another internal feature contributing to fatigue is vibration caused by the engine and ship motion leading to the tiredness of the seafarer. Naturally, working aboard ship a mariner is subject to harsh environmental conditions including internal features such as heat caused by the engine and the ship’s structure material and cold mainly attributed to weather conditions and humidity from sea water. All the above internal features are directly influencing the fatigue impact toward the seafarers (Fatigue: IMO guidance, 2006).

The second element within the environmental aspect is the external factor which has the same impact on the enhancement of the fatigue level onboard. Some of the main external features contributing to fatigue are port conditions, weather conditions and vessel traffic.
The last two components are already explained in the previous sections and are identified as important elements contributing to fatigue. In light of these considerations, the port conditions are becoming a problematic issue of the ships and seafarers at present time due to the huge workload, additional burden of safety, a large number of inspections and pressures for turnarounds leading thus to immense stress on the seafarers (Pataiko, 2006).

5. EFFECTS OF FATIGUE ON SEAFARERS

5.1 Fatigue’s impact on alertness

Considering the global concern toward maritime disasters, studies and research regarding this issue have proven the fact that fatigue has a tremendous impact on seafarer’s alertness. In a maritime study concerning fatigue conducted by Chalmers University of Technology, Sweden, in 1995, was concluded that 30% of the officers onboard declared that they worked under extensive fatigue which indicates a reduced alertness during work hours (as cited in Cardiff University, 1996).

Research has revealed that fatigue has a confirmed destructive effect on alertness which is considered to be the best state of the brain leading to conscious decision-making (IMO, 2001). In other words, with a diminished alertness a seafarer will take a longer time to react or respond to signals, difficult situations and other tasks aboard ship. Furthermore, “a decline in alertness will lead to reallocation of attention to central features rather than peripheral ones” (Cardiff University, 1996, p.34). In light of this consideration, the concentration and sustainable attention of the seafarer will be drastically impaired leading to poor performance. As a result, the alertness negatively impacted by fatigue can cause a significantly reduced performance at work in terms of physical, psychological and mental aspects (IMO, 2001).

5.2 Fatigue’s detrimental role on performance

Fatigue factor has been classified a hazardous element not only because it impairs the performance at work but also because it is very difficult to be understood by the people, who often can not distinguish their level of exhaustion (Fatigue: IMO guidance, 2006). The most important of fatigue’s effects toward performance at work have been identified by many studies and research, leading thus to a clear picture of this matter. The first effect is the individual’s errors of awareness and memory resulting in the loss of information, data and steps in a sequence. The second effect is the high degree of risk undertaken by the seafarer in difficult tasks performed during the navigation. With respect to this issue, a fatigued seafarer always strives to find an easy way to the resolution of critical situations and puts less effort needed to accomplish this task, subsequently leading to wrong decisions being made.

Another effect is fatigue’s impact on individual’s skills to react, recognize and interpret stimuli (driving force) in the work environment. In addition, fatigue encourages the apathy status and reduces motivation at work contributing consequently toward seafarer’s poor performance at work. The last effect is the detrimental impact that fatigue has in problem-solving and decision-making which are integral and essential components of the seafaring task (IMO, 2001). On the whole, fatigue’s effects toward performance at work are very important to perceive and understand, because they pose a potential threat to seafarer’s life and ship’s safety.

6. RECOMMENDATIONS TOWARDS THE ALLEVIATION OF FATIGUE AT SEA

6.1 Main recommendations on fatigue’s mitigation

The unique aspects of operational regime onboard that shipping industry represents today, based mainly in prolonged working hours is an important element in generating fatigue and especially stress among seafarers. Regarding this issue it is important by the maritime organizations to undertake a complete review of the working schedules and the duration of the rest breaks with the purpose to find new working strategies to reduce the impact of fatigue factors toward seafarers (Parker et al, 1997). In addition, many studies conducted by maritime institutions suggest that a good monitoring of working hours will assist the seafarers to make a clear separation between work and rest leading to the relief of fatigue at sea (IMO, 2001). Furthermore, the verification of the working hour procedures by external authorities will definitely assist the seafarers to respect rest hours which in turn will mitigate fatigue onboard (Parker et al, 1997).

Another important recommendation toward alleviation of fatigue at sea is a “thorough examination of sleep patterns and their effects on work performance” (Parker et al, 1997, p. 10; IMO, 2001). This assessment can be achieved by a regular review of the procedures of rest periods at sea stated in the international conventions followed by a strict verification that these regulations are implemented aboard ship. In addition, the analysis of sleep data and the assessment of sleeping quality in general will reveal essential information within the examination of sleep patterns (Parker et al, 1997, p. 10).

In any case, a strong support to assist seafarers to cope with the changes that shipping industry has undergone recently in terms of technical and emotional aid is another crucial recommendation regarding fatigue’s mitigation. In light of these considerations “appropriate training/retraining in terms of manning level, skills, managing issues both on managerial staff and onboard personnel” are of a great significance in combating fatigue (Parker et al, 1997, p. 11; IMO, 2001). In addition, appropriate training of the port personnel which can facilitate the work of the seafarers at peak periods while at port and the publication of the support systems regarding industry improvements are also important to assists seafarers to adjust with the new changes (Parker et al, 1997, p. 10).

Next suggestion recommends the improvements that should be made in order to minimize the negative effects of environmental hardships upon seafarers. The studies regarding fatigue has shown that continuing exposure to excessive levels of environmental sufferings...
is potentially hazardous to mariner’s health and work performance (Fatigue: IMO guidance, 2006). In this framework, it is very important that steps are taken to reduce the effects of noise, heat, cold and humidity aboard ship as harmful factors contributing to fatigue of the seafarers. Other positive factors improving the environmental hardships onboard are good illumination and music on the working places of the mariners (IMO, 2001). Finally, compliance with the respective international regulations and the use of protective equipment are important to minimize the negative effects of environmental hardships onboard (Parker et al, 1997, p. 10).

The last main recommendation emphasizes the need of establishing safety culture among the personnel aboard ship (Bhatt, 2006). This approach underlines the fact that more efforts should be undertaken to convince the seafarers that compliance with the international maritime regulations regarding safety should be made consciously. In addition, the philosophy, prevention better than cure concerning fatigue problem, highlights the need of a systematic report of fatigue cases by the seafarers which can assist in a comprehensive assessment of the problem (Bhatt, 2006).

6.2 Other recommendations on fatigue’s mitigation

Besides the main recommendations, other approaches within lifestyle behaviors need to be considered to alleviate fatigue at sea (Parker et al, 1997, p. 10). Traditionally, it is well known that physical exercise is an important technique to relieve stress and the development of exercise models onboard as well as a good motivation for seafarers to participate in exercises are some of the solutions regarding this issue. In the same way, the improved time for relaxation and appropriate programs offered by the management concerning this matter is an excellent approach in managing fatigue issues. Furthermore, in a study conducted by the US Coast Guard Research and Development Centre, Comperatore claims that nutrition onboard is crucial factor contributing to fatigue. The same author comments that the reductions of fat and fried food as well as the consumption of regular meals are important in diminishing fatigue. Finally, the review of alcohol policy and the establishment of cessation programs for smoking in the seafaring community are some other recommendations regarding fatigue’s alleviation issue aboard ship (2001).

7. CONCLUSIONS

In conclusion, analyzing all the main components of fatigue issue and its impact on the human performance at work is an efficient approach in defining the role of fatigue toward maritime casualties. In light of these indications, a comprehensive understanding of fatigue by identifying fatigue’s background, possible obstacles, its definition and the exclusive aspects of shipping industry is achieved, leading to the conclusion that fatigue factor is a complicated issue which poses a potential hazard in shipping industry. Naturally, the examination of maritime disasters related to fatigue can reveal valuable information regarding fatigue’s role toward accidents. With regard to this issue, the importance of fatigue, relevant statistical data and the examination of accident cases related to fatigue indicate a determinant role that fatigue factor plays toward maritime casualties and their consequences.

Furthermore, the fundamental elements contributing toward fatigue issue are proven in this paper to be as follows; human, management, vessel and environmental factors. These essential elements are of a great importance in analyzing fatigue issue with the final purpose to identify the role of fatigue in accidents. Another essential point is that fatigue’s effect on seafarers plays a detrimental role in the impairment of performance at work and in diminishing the human alertness leading to errors being made which in turn results in maritime casualties. In other words the impacts of fatigue on performance at work such as errors of awareness and memory, high degree of risk undertaken, negative effect on stimuli, detrimentally effect on problem-solving and decision-making as well as other problems of this kind are the key factor in identifying the role of fatigue in accidents and leading to the resolution of this issue.

With respect to possible mitigation of fatigue, some of the recommendations are considering a comprehensive review by international regulatory bodies of working schedule and sleeping issues, supporting seafarers to adjust to industrial changes, reducing the environmental hardships and establishing safety culture aboard ship. On the whole, the detrimental role of fatigue on person’s performance and its negative effects toward effectiveness, productivity and standards at work are the main concerns which can lead to fatal errors. In light of these considerations fatigue is a very important issue at present time to the whole maritime community due to the crucial role that plays toward maritime casualties posing thus a dangerous risk to human life, environmental damage and economic impact.

8. REFERENCES