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Maritime sector has always been influencing the global economy. Shipping facilitates the bulk transportation of raw material, oil and gas products, food and manufactured goods across international borders. Shipping is truly global in nature and it can easily be said that without shipping, the intercontinental trade of commodities would come to a standstill.

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SEAFARER FATIGUE: ARE WE RECEPTIVE TOWARDS ITS CONSEQUENCES

Dr. Aprajita Bhardwaj

Abstract
Seafarers’ fatigue has been identified as a contributing factor in a number of maritime accidents. While regulatory authorities have proposed certain minimum guidelines to manage fatigue, the expectation of the stakeholders is that the seafarers are responsible to manage and tolerate fatigue as part of their working life at sea. The current demands of the shipping, with no or little support from the shore based personnel, makes a seafarer highly fatigued, compromising the safety of the ship. Recent researches on seafarers highlight the fatigue-related problems peculiar to the shipping industry. Through this paper an attempt is made to sensitize the stakeholders to seafarer fatigue, with the aim of finding suitable solutions.

Key words: Maritime Fatigue Safety; Maritime; Fatigue; Seafarer; Shipping; Fatigue Risk Management.

1. INTRODUCTION:

Human fatigue is recognized as being one of the primary causes of accidents in industry today. The costs of fatigue are a major human and financial burden to companies, workers, and their families.

Shipping, like other transport industries (rail, aviation, commercial road transport) works a twenty-four-hour continuous operation. Ship owners and operators are obliged to seek economic efficiencies, as a result, reduce the number of shipboard crew, which implies more demanding working conditions for seafarers. Seafarers have to work long and irregular hours for long periods of time and are frequently subjected to restricted and interrupted sleep, high workload, poor eating habits, poor sleeping conditions, social isolation and no clear separation between work and recreation.

Fatigue has become a key concern within shipping because the operational aspects associated with the industry are more complex than those associated with other industries. For example, variety of ship types, the pattern and length of sea passage, the number of port visits and the non-standardized port stay, all present unique combinations of potential causes of fatigue.
**Regulations, Compliance and Safety:**

Seafarers currently engaged in international trade generally have their hours of work and rest governed by the provisions of the STCW Convention 2010, Manila Amendments, as interpreted by the Flag State of the vessel on which they are serving.

Prescriptive hours of work and rest limits set out in the International Maritime Organization (IMO) and the International Labour Organization (ILO) Conventions are considered to be the primary fatigue risk management requirements, setting minimum standards of compliance in international shipping (Grech 2016).

Despite efforts directed at mitigating the risk of fatigue through the adoption of hours of work and rest regulations and development of codes and guidelines, fatigue still remains a concern in shipping. Lack of fatigue management has been identified as a contributory factor in a number of recent accidents. These approaches mainly focus on prescriptive hours of work and rest and include an individualistic approach to managing fatigue. The expectation is that seafarers are responsible to manage and tolerate fatigue as part of their working life at sea.

Ships’ crews are under increasing pressure from competitive voyage schedules and have to handle their tasks with fewer crew members. The rules imposed by the company management may be stressful to the seafarers. Additionally, it is very difficult for seafarers to comply with all the existing regulations due to the harsh conditions on board ships. Consequently, the effort for compliance with national/international rules and regulations becomes a source of stress, leading to fatigue, subsequent impairment of alertness and affecting maritime safety.

Fatigue has been linked to a substantial share of groundings, and may also be linked to collisions. An analysis of accident investigation reports of groundings, reveals that irregular working hours, inadequate task allocation and high demands are common antecedents of fatigue-related groundings, and that fatigue is a factor in 41 per cent of groundings (Phillip 2014). There has been very little evidence based research concerning fatigue at sea prompting the significant studies in this area.
Seafarer Fatigue: Significant Researches and their Findings:

A study into seafarer fatigue was undertaken by Cardiff University’s Centre for Occupational and Health Psychology (COHP, 2006), supported by several UK-based shipping bodies, mostly on UK flagged vessels. The findings of that study concluded that:

- Seafarers commonly worked excessive hours, falsifying of records was common, frequent port calls led to greater fatigue, Mini-bulkers suffered worst. Poor sleep quality increased fatigue as did negative environmental factors, high job demands and high stress.

In 2012, ‘Project Horizon’ a European Commission part funded multi-partner research initiative was set up to scientifically investigate seafaring watch keeper fatigue. The results of the project confirmed several high-risk situations:

- Watch keepers were found to be most tired at night and, to lesser extent, in afternoon.
- End of watch was the worst time for sleepiness, especially at night. Their slowest reaction times at end of night watches.
- 6 on 6 off was found to be more tiring than 4 on 8 off. Watch keepers had markedly less sleep than those seafarers on 4 on 8 off. Onset of tiredness occurred over shorter timeframe.
- Passages through difficult waters was found to be particularly high risk.

Project MARTHA was set up in 2014 and the final report was published in February 2017. The research and surveys in Project MARTHA were carried out by a number of educational institutions from China, Denmark, Sweden and the UK. It differentiated between sleepiness and the other effects of fatigue.

The results from the MARTHA project have indicated that

- Fatigue and stress increase for most crew as the voyage length increases, and motivation decreases.
- Captains suffer more than their colleagues from both fatigue and stress.
Port work was found to be particularly demanding.

No one on board gets adequate sleep, with the night watch keepers being particularly at risk of falling asleep.

High sleepiness levels can occur at any stage of the voyage but the quantity and quality of sleep deteriorates over long voyages.

Merely ensuring that a crew member receives the minimum legal amount of rest under STCW and MLC is not a guarantee of avoiding fatigue.

**Fatigue Management: Ground Reality:**

While the shipping industry is now mindful of the importance of managing fatigue, both in terms of sleepiness and also in its longer term psycho-social effects, not much is being done to reduce its impact. Records are regularly falsified in order to appear to be in compliance. Rest hour regulations cannot be met, and schedules remain unchanged, further additional crew are not provided where ever required. The master is not empowered and supported by shore management to actively enforce hours of rest regulations, including stopping the ship if necessary.

There are systems that can be employed to minimise the risks of fatigue. These include addressing fatigue from a regulatory (record-keeping) point of view and the adoption of fatigue risk management. Fatigue Management Systems have been implemented in the aviation and road transport industries where it has been realised that fatigue is a hazard that can be effectively managed like any other risk. However, in the shipping industry there have been many cases where non-conformances have been raised because ships’ crews have made errors in their record-keeping, due to commercial pressures and other factors beyond their control.

The implementation of a Fatigue Management Plan for the seafaring industry will only be effective if there is commitment shown by all stakeholders, from senior shore management downwards throughout the organisation. The chances of failure for the plan would be high if the over-riding culture, one which embraces the traditional maritime attitude, and ignores the fact that fatigue is dangerous to personnel, ships, cargo and company. While the policy makers
and the seafarer may be aware of the consequences of fatigue, there seems to be a void as far as the ashore personnel are concerned about its sensitive implications towards all the players. The need of the hour is to bring about the awareness about the consequences of seafarers’ fatigue to all concerned.

2. FATIGUE: AN OVERVIEW:

Given below is a general overview of fatigue, its causes and consequence and potential effects on maritime personnel.

Definition of Fatigue and IMO Guidelines:

The International Maritime Organization (IMO) has defined fatigue as the diminution in the physical or mental capacity as a result of physical, mental or psychological exertion, which has weakened the physical abilities, including strength, speed, response time, hand-eye coordination and decision-making. (MSC, 2001)

In another definition by the ICAO has defined fatigue as a physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a crew member’s alertness and ability to safely operate an aircraft or perform safety related duties. (International Civil Aviation Organization)

Both the definition focus on the reduced physical, mental and psychological functions due to increased exertion and reduced sleep.

IMO Guidelines (2001) have categorized seafarer fatigue into four general factors.

(a) Crew-specific factors: sleep and rest, working hours, skills and experience
(b) Management factors (ashore and on board):
   1. Organizational Factors – Staffing Policies and requirement, Company culture and management style, rules and regulations, economics, training and selection of the crew
2. Voyage and scheduling factors: level of manning, frequency of port calls, paperwork requirements, time between ports, traffic density on route, nature of duties and workload while on ports, weather and sea conditions on route.

(c) Ship-specific factors: level of automation, age of ship, equipment reliability, inspection and maintenance accommodation environment, physical comfort in work spaces,

(d) Environmental factors: noise, vibration temperature, weather and sea conditions, traffic density, and interpersonal relationships.

**Distinguishing Sleepiness and Fatigue:**

Sleepiness and Fatigue are separate but related phenomenon and it is essential to distinguish between the two.

Sleepiness is a short-term phenomenon experienced by healthy individuals. It has a rapid onset, is of a short duration, may be due to a single cause and impacts a short-term effect on daily activities.

Fatigue, on the other hand, is long term consequence of physical, mental and psychosocial exertions, may cause health disorders (physical and mental). It has an insidious onset which persists overtime. It is due to multiple factors and can significantly affects behaviour and wellbeing.

**Fatigue, Alcohol and Performance Impairment:**

The performance impairment caused by fatigue was compared with that due to alcohol intoxication, and results indicated that relatively moderate levels of fatigue impair performance equal to or greater than what is currently acceptable for alcohol intoxication (mean blood alcohol concentration 0.10%) (Dawson, Reid, 1997). Performance decreased significantly in both conditions especially, hand-eye coordination.

This implies that a moderately fatigued seafarer may not be the best person to be given ship related responsibilities as his performance may be compromised. Sadly, this is not the case as a seafarer has to shoulder multiple responsibilities due to the reduced staffing policies at sea.
3. CONSEQUENCES OF FATIGUE:

Fatigue degrades performance and mental abilities. Fatigue has been associated more with skill-based errors, knowledge based errors or violations. Fatigue due to monotony has been associated with less frequent checking behaviour and increased effort. As fatigue increases errors of omission and commission to increase, leading to micro sleep. Fatigue can cause uncontrolled and involuntary shutdown of the brain regardless of the how hard one tries, irrespective of the level of competence, or the training of the person.

- A fatigued worker may seem sleepy, irritable, sad or giddy
- Fatigue can reduce mental and physical abilities and may increase risk-taking
- Fatigue can cause workers to fall asleep unintentionally
- Extended work hours can contribute to worker fatigue

Cognitive Processes Slow Down: alertness declines, the brain shuts down to conserve energy, involuntary lapses into sleep increase over time; attention, perception and decision making abilities are impaired.

Attention Span Narrows: Inattention to minor, but potentially important details occur; lapses of attention increase; greater time lapses occur as fatigue increases.

Memory Problems: The ability to integrate, store, and retrieve information declines when the worker is fatigued.

Reaction Time: slows down and becomes irregular relevant cues are missed as a result. Cross checking declines, taking too much mental effort and time.

Flawed Decision Making: Decisions are made on missed, flawed, or based on incomplete information. Thought processes suffer, as the ability to logically reason is impaired. The person experiences difficulty concentrating and thinking clearly. Mental skills decline and everything becomes more difficult to perform, even simple tasks.

Mental Tasks Harder to Perform: Tasks involving Mental arithmetic, programming, entering data, remembering are compromised.

- Short-term recall and working memory performance decline.
- Performance requiring divergent thinking deteriorates.
- Performance deteriorates as task duration increases.
- Increased likelihood of finding ineffective solutions.

**Perceptual Changes:** Channelling of attention, Tunnel Vision, Tunnel Hearing are commonly observed.

**Attitude Problems:** Attitude and mood deteriorate. “It’s good enough” attitude prevails, psychological depression, poor morale is observed. Person experiences increased irritability about little things and becomes more moody.

**Teamwork Problems:** Communications between the team members’ breakdown leading to a decline in social interactions. It impairs cooperation, and team coordination.

**Performance Problems:** Performances lowers as accuracy and timing degrade critical actions.

- Inadequate crosschecking of relevant cues leads to poor and careless performance, and increased errors.
- Lower standards of performance become acceptable and the person may develop greater tolerance for error.

**Physical Symptoms Increase:** Increased dizziness, headaches, and stomach aches are experienced.

**Long term consequences of fatigue:**

Greater psychological distress, poorer general health and more frequent visits to the doctors have all associated with both fatigue risk factors (such as work stress and job demand) and fatigue. Worsening work characteristics have been associated with increased fatigue over time, and consequently increases in fatigue have been found to deteriorate psychological and general health. Recovery from fatigue after a tour of duty on average does not occur until the second week of leave. The impact of fatigue in the industry may, therefore, be much greater and more widespread than watch-keeping and accident statistics imply.
FATIGUE: its Consequences and Impact:

<table>
<thead>
<tr>
<th>Consequences</th>
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<tr>
<td>• Slowed reaction time</td>
<td>• Long term health issues (obesity, cardiovascular, gastrointestinal, diabetes)</td>
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<tr>
<td>• Reduced vigilance</td>
<td>• Psychological Distress</td>
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<tr>
<td>• Memory lapses</td>
<td>• Low Morale, absenteeism and turn-over</td>
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<tr>
<td>• Inattention to tasks</td>
<td>• Health-injuries, sleep disorders</td>
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<td>• Complacency</td>
<td>• Lost productivity</td>
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<td>• Lack of awareness, communication and Judgment</td>
<td>• Equipment and property damage</td>
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<td>• Decline in motivation</td>
<td>• Work cover claims</td>
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<td>• Micro-sleep</td>
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4. FACTORS CONTRIBUTING TO FATIGUE:

Sleep Loss and Sleep Debt: Sleep restriction severely degrades performance. When sleep is less than 6 hours per night, fatigue becomes a problem almost immediately. When sleep is cut to less than 4 hours per night, uncontrolled micro sleep attacks occur. When sleep loss becomes cumulative it results in sleep debt. Research shows 10 days of restrictive sleep leads to progressively worsening performance and eventually lead to a zone of impairment of abilities.

Jet Lag or Shift Work: is an abrupt change in environmental time. It leads to disturbed sleep, increased drowsiness, decreased physical or mental performance, increased reports of fatigue, more negative moods, and gastrointestinal problems.

Circadian Rhythm Disruption: are caused mainly due to Jet Lag and Shift Work. Symptoms are manifested as Disturbed Sleep Patterns, Decreased Performance, and Gastrointestinal Problems.

Boring / Repetitious Work: Research has demonstrated that monotonous vigilance tasks decreased alertness by 80% in one hour and is referred to a “Boredom Fatigue”. Boredom and monotony are widely recognized as undesirable side effects of repetitive work.
**Prolonged Work:** usually leads to fatigue because of cumulative sleep loss leading to sleep debt.

The seafarer travels across time zones, mostly joining the vessel on arrival. He gets into shift work immediately leading to Circadian Rhythm Disruption, sleep loss and sleep debt. Fatigue increases most significantly during the first week of voyage has been reported by the Cardiff University Project on Fatigue (2006).

The potential for fatigue at sea is high due to seafarers’ exposure to a large number of recognisable risk factors, both operational (e.g. port frequency), organisational (e.g. job support), and environmental (e.g. physical hazards).

5. **COMMON MISCONCEPTIONS ABOUT FATIGUE:**

“*I know how tired I am*” or “*I can tell when I’m going to fall asleep*”: The more tired one becomes, the less able he is to make a good judgement about his ability to remain awake, or recognise that his performance is deteriorating. We are all bad judges of how fatigued we actually are.

“I’ve lost sleep before and done just fine” or “I’m motivated enough to push through it” or I’m really experienced, I can fight off any feelings of fatigue: One cannot simply “decide” to feel less tired. Although intense concentration may help for a short period, fatigue cannot be overcome by willpower, experience or motivation. The only remedy for fatigue is sleep.

Fatigue can be managed by addressing working time arrangements: Fatigue isn’t just about managing working time. Fatigue can also be made worse by workplace conditions. High-pressure demands, poor lighting, constant noise, heat, cold, vibration and even poor weather can make the seafarer feel more tired.

*Our bodies get used to working shifts:* If one is working when he should normally be sleeping, or sleeping when one should normally be awake, one will be fighting against his natural instincts to work during the day and sleep at night.
*Exercises is a safe guard against Fatigue:* Physical Fitness is not a safeguard against mental fatigue. Organizations have historically tried to decrease fatigue susceptibility by improving physical fitness. This strategy works well in jobs which require physical labour.

*My Crew Will Tell Me When They’re Tired:* Individuals can’t accurately gauge their own level of impairment, due to sleep loss. Senior officers and team members must learn to look for the symptoms of sleep loss in others.

*You can’t tell if someone is fatigued:* There are symptoms that may indicate a worker is fatigued, such as short term memory problems, an inability to concentrate, impaired decision-making, slow reflexes and withdrawal from interpersonal communication.

6. **PREVENTIVE MEASURES TO COMBAT FATIGUE AT SEA:**

Jet Lag: After travel across time zones, physical and mental resources lag behind while adjusting to the rapid change at the destination, light/dark cycle and the new sleep and work schedule. 1-day recovery is recommended for every time zone crossed to restore normalcy.

Develop Proper Shift Schedules: Schedule teams in ways that ensure enough daily sleep.

Good Sleep Habits: Use sufficiently bright lights in the work environment during the night shift in order to resynchronize the circadian timing system to the nocturnal schedule. Maintain complete darkness in daytime sleeping. Follow a consistent sleep-and meal-timing schedule from day to day. Emphasize Sufficient Sleep on a Daily Basis. 7 hours per night is the minimum requirement.

Napping: Controlled Napping can maintain or restore performance when sleep is shortened, disrupted, or missed altogether. When napping, it is best to either get up after 30 minutes or sleep through a full sleep cycle which is an hour and a half. When possible, allow time for sleep inertia to dissipate which is usually from 30 - 45 minutes after waking up.

Lifestyle: Exercise regularly, avoid alcohol and caffeine at bedtime and eat a balanced diet.
7. MANAGEMENT OF FATIGUE: Long Term Perspective

The potential for fatigue at sea is high due to a range of factors, many unique to the marine environment. Fatigue has been consistently associated with poor quality sleep, negative environmental factors, high job demands and high stress. Other important factors contributing to fatigue included frequent port turn-around, physical work hazards, working more than 12 hours a day, low job support and the switch to port work.

Fatigue at sea would appear to be more prevalent than the seafaring community is currently able to gauge. In an industry where market competition can result in compromised standards, this concern needs to be addressed as fatigue, due to its crucial role in maritime casualties, pose a great risk to human life and property, as well as to the marine environment.

Fatigue can be addressed at three levels: legislation, company policy and personal awareness/management. Success will only be achieved if all three are co-operatively involved. The way forward is to treat seafarers’ fatigue as a serious health and safety issue. A starting point must be to take a more robust approach to regulation.

Ship owners could provide sufficient support to vessels with a sufficient number of crew members suitable to the nature of work on board. Manning levels need to be addressed in a realistic way. This must be supplemented with appropriate training and guidance regarding avoidance of fatigue and the creation of optimum working conditions. This approach will only be effective if crew are empowered to act on their training in terms of actively intervening with operations when required.

The introduction of Fatigue Risk Management Systems, as already used in other safety-critical transport systems, presents an integrated systems approach to managing the risk of fatigue. It requires ownership by all in the company, provide changes in culture and can be introduced in a gradual process as the company develops its own approach. (Project Martha, 2017)

Activating the role of educational institutions responsible for training seafarers to raise awareness among trainees about the dimensions of fatigue, its symptoms and it’s the short term and long term impact, as well as possible prevention precautions, are some of the ways to manage fatigue at sea.
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