FATIGUE – Can we measure?

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ABSTRACT

The world maritime transportation sector has grown rapidly due, *inter alia*, but in particular to the accelerated growth in the international trade industry as it did over the past several decades. The resurgence in world trade activities fuels the need for maritime activities including shipping, sea-transport, sea forwarding and port operations. This examination focuses on examination of the factors that cause fatigue among navigation officers and its consequence for their performance.

For the purpose a representative sample of seafarers were questioned. Then graphical methods and some statistical tools were used for the purpose of analysis. The result shows that the potential for physical and mental fatigue amongst seafarers are high due primarily to their exposure to a large number of recognisable risk factors including operational, organisational, technological and environmental factors. The result shows, however, that it is the combined effect of these risk factors that is most strongly associated with mental and physical fatigue and renders both short and long term consequences for the seafarers.

INTRODUCTION

Over the years, despite the fact that, on the one hand, the technology and techniques of navigation of the sea-faring commercial vessels has developed and, on the other, the training of the navigation officers has improved, the number of accidents, mishaps, collisions caused due to human error has increased to quite tangibly.

Therefore the main aim of this study is to discuss the factors affecting physical and mental fatigue that affect the performances of the navigation officers. Despite the technological equipment whose purpose has been to help the tasks needed to be performed by the navigation officers by automating their tasks and/or helping the navigation officers identify hazards at sea well in advance of time thus helping them to avoid them. The technology has helped the navigation officers navigate their vessels with relative easiness without succumbing to serious difficulties when confronted by adverse weather and sailing conditions at sea.

METHOD

An in-depth verification of existing documentation is carried out in order to avoid the errors committed in previous researches and avoid duplication of information from past researches. The existing strategies that are recommended by previous researchers are evaluated on the basis of its implementability, viability and cost effectiveness. The first step to Primary Research was to define the objective followed by construction of the questionnaire that was used to carry out the
research. This included a sample research which was carried out within a group of randomly selected seafarers. This was initially done to ensure that the questionnaire to be designed is in line with the objectives of the research.

Having decided on the questionnaire, the target sample was identified and it consisted of 351 seafarers who are presently employed, as the source for feedback i.e. Specified Sampling was done as the means to access data. It was decided to freeze on the means of carrying out the research, and decided upon Direct Interviews, Focused Group Interviews and Telephone interviews. The direct, focused group and telephone interviews were carried out with the Maritime Education Institutes, Maritime Administrative officers, retired seafarers, and ship owners. Secondary Data was sourced from related internet sites, journals, online newspapers, periodicals, books and other academic publications. Graphical method and some statistical tools were used for the purpose of analysis.

Questionnaires consisted of 57 questions, and were broken down into 4 categories: personal information and perception of personal effort, perception of personal job performance, perception of training and development, and perception of job satisfaction. Participants ranked, as per their level of agreement for each statement listed on the survey.

FINDINGS

Duration of the sea service of navigation officers ranges from one year to more than sixteen years. The highest percentage, which is 36% of navigation officers represent the least number of years of service which has been categorized as 1-5. While 22% of them have served for more than sixteen years, navigation officers who have got the service of 6-10 years and 11-15 years represent the equal percentage of 21.

The officers were grouped according to their age and the majority of them belong to the age group between 25-30 years which is 29% of the sample, while 21% of the sample represent the age between 36-40 numbering 16 officers, 18% represent the age group below 25 years. Navigation officers above 40 years make up 17% of the sample whereas the least percentage which is 16 are between 31-35 years of age.

Duration of the contract on board ship (months)

The Graph 1 shows the fluctuations in durations of contracts offered or accepted by the seafarers to work on board ships. As per the below graph majority has signed for three to six months contract periods which accounted for 49% as per the sample data and the second highest was 29% of the sample who had signed for six to nine months period of contracts. It seems that the shortest and longest periods of 1 - 3 months and 9 – 12 months respectively were not that common among the officers as their percentages were not that high. They were around 13% and 10% respectively.
Working hours per day

The Graph 2 revealed that findings relating to the number of working hours of the navigation officers have been grouped under two categories as 1-8 hours and more than 8 hours. The below data clearly shows that 94% of the sample has worked more than 8 hours whereas the rest have worked between 1-8 hours per day. It is a very common feature in ships that most of the time the crew over-work beyond the standard number of hours specified by the International Labour Organization (ILO) but it is a fact that the actual number of hours are greater than the number of hours recorded or documented, in order to avoid ILO and other international regulations.
**Port stay for cargo operations**

The Graph 3 shows a port stay of ships for cargo operations and it has been divided into three categories as less than a day, between one to two days and more than two days. According to the below graph more than half of the samples revealed that they have spent less than a day at a port for cargo operations. While 36% of the samples have been grouped under 1-2 days duration and 14% of the sample falls under more than two days category.

**Graph 3. Port stay for cargo operations**

![Graph showing port stay distribution](image)

Source: Survey data (Jayakody, 2008)

The time at each port-of-call ranges from few hours to several days and varies by ship to ship and often quick turnaround of many modern ships, spending only a matter of hours in port, limits a seafarer's free-time ashore. Such restrictions on shore leave coupled with reduced time in port by many ships translate into longer periods at sea. Mariners report that extended periods at sea living and working with shipmates who for the most part are strangers, takes getting used to. At the same time, there is an opportunity to meet people from a wide range of ethnic and cultural backgrounds.

It must be recognized that the seafarer is a captive of the work environment. Firstly, 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. 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 passage, port-rotation, and length of time a ship remains in port. All these aspects present a unique combination of potential 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 as per the survey carried out.

• Crew-Specific Factors
• Management Factors (ashore and aboard ship)
• Ship-specific Factors
• Environmental Factors

The Crew-Specific Factors are related to lifestyle behaviour, 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 Sleep and Rest, Quality/Quantity and Duration of Sleep, Sleep Disorders/Disturbances, Rest Breaks, Fear, Monotony and Boredom, Diet, Illness, Skill, knowledge and training as it relates to the job, Personal problems, Interpersonal relationships.

Only sleep can maintain or restore performance level of the crew. When the crew does not get enough sleep, fatigue will set in and alertness will be impaired. Poor quality of sleep also may cause fatigue. Apart from sleep, rest (taking a break) between works periods can contribute to restoring performance levels. Insufficient rest periods or postponing assigned rest times (to finish the job early) can cause fatigue.

Disturbances while resting such as being woken up unexpectedly, on call (during port operations), or unpredictable work hours (when arriving in port) can cause fatigue. Stress can be caused by personal problems (family), problems with other shipmates, long work hours, work in general, etc. A build up of stress will cause or increase fatigue. Boredom can cause fatigue. You may become bored to the point of fatigue when your work is repetitive and monotonous and/or bodily movement is restricted.

To work with an international crew who belongs to various nationalities, speaking in different languages is a difficult task to deal with, when it comes to a situation where you find a communication barrier to make others to understand what your requirements and needs are. Sometimes the crew has to deal with uneducated and inexperienced staff where one may find it stressful to carry out day today operations, in giving instructions and making them to understand what one really require out of a staff member.

It is unbearable for a crew member when he realizes that his family needs his presence to help the family members in difficult situations. Being away from the loved ones and the family for a long period is very stressful. It is very unfortunate to note that most of the senior officers are compelled to manipulate the ILO regulations with regard to the rest hours for the crew.

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. These factors include: Organizational Factors such as Staffing policies and Retention, Role of riders and Shore personnel, Paperwork requirements, Schedules-shift, Overtime, Breaks, Company culture and Management style, Rules and Regulations, Upkeep of vessel, Training and Selection of crew.

Seafarers are compelled to work more than the specified number of hours, sometimes in excess of 20 hours due to various reasons, such as scarcity of man power, long pilotage and during long manoeuvring hours in canals, fairways, transits etc. which affect the physical and mental stability and efficiency of the crew. Nowadays, for most of the ships, port stays are very short especially in Japanese, Chinese and European ports. Most of the times vessels shift from port to another within a very short period and as a result short spells of loading/unloading, frequent arrival/departure and continuous ship operations cause lot of stress and fatigue to crew members on board ship. Voyage and scheduling factors such as frequency of port calls, time between ports, routing, weather and sea condition on route, traffic density en route and nature of duties/workload while in port cause stress and fatigue.

It is being reported that it is very stressful for the crew when the Port State Control (PSC) officers and other Inspectors visit the ship for inspections such as wetting and safety inspections, when the crew is busy with the cargo operations and the administrational work/paper work simultaneously. Most of the ship Masters are autocratic and very demanding. In some instances when you analyze some of the Masters’ behaviour is questionable and unacceptable. Due to this fact the crew has to go through lot of hardships during their contract on board.

There are some ship design features that can affect/cause stress and fatigue. Some ship design features such as automation, equipment reliability affect work load. 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 details ship-specific factors: ship design, Level of Automation, Level of Redundancy, Equipment reliability, Inspection and Maintenance, Age of vessel and Physical comfort in work spaces, Location of quarters, ship motion and Physical comfort of accommodation spaces.

Noise or vibration can affect one’s ability to sleep/rest, and it can affect the level of physical stress thus causing fatigue. The ship’s movement affects the ability to maintain physical balance. Maintaining balance requires extra energy, which can then cause fatigue. A ship’s pitching and rolling motions would need 15-20% extra effort to maintain the balance.

Environmental factors can also be divided into factors external and internal to the ship. Within the ship, the crew is faced with elements such as noise, vibration and temperature (heat, cold, and humidity) and social life among the crew members. External factors include port condition and weather condition and vessel traffic.

Exposure to excess levels of environmental factors, e.g. temperature, humidity, excessive noise levels, can cause or affect stress and fatigue. Long-term exposure may even cause harm to a person’s health. Furthermore, considering that environmental factors may produce physical discomfort as the temperatures at the northern edge can be totally different to that on the southern edge, same time it defers from continent to continent and country to country. Extremes of temperature
are experienced between very short periods by the seafarers if a ship sails from Africa to Europe, the warmest usually ranging from 30°C to 35°C and the coldest usually ranging from -17°C to -25°C respectively. Therefore, every seafarer will find it difficult to acclimatize to these extreme conditions.

Excessive noise levels can also cause or contribute to the disruption of sleep. Ship motion is also considered an environmental factor. Motion affects a person’s ability to maintain physical balance. This is due to the extra energy expended to maintain balance while moving, especially during harsh sea conditions. There is a direct relationship between a ship’s motion and a person’s ability to work. Excessive ship movement can also cause motion sickness.

According to survey, most often the ship crew consists of multinationals. Due to this fact food for the crew is always an issue on board ship as most of the Chefs fail to cater to different types of tastes. It is being reported that most of the Masters try to minimize meal costs for the crew in order to make money for himself or to cut down costs for the company. Most food related issues are due to inexperienced catering staff, non availability of fresh food during voyage, frozen meat, and due to non availability of a special menu for vegetarians who sail on board ships.

CONCLUSIONS

The results show that the potential for fatigue at sea is high due to seafarers’ exposure to a large number of recognizable risk factors: operational (e.g. port frequency), organizational (e.g. job support), technological and environmental (e.g. physical hazards). However, that it is the combined effect of these risk factors that is most strongly associated with fatigue and its both short and long term consequences (fatigue symptoms, personal risk and reduced health and well-being).

Although seafarer fatigue is not a new concept, there has been little research to date examining work and rest schedules in the maritime industry. Seafaring is a dangerous occupation because it includes a number of workplace dangers in combination, something rare in other industries. Seafarers are exposed to extreme weather conditions: rough seas and storms result in the rolling and pitching of the ship, leading to an unstable environment that makes physical work difficult. Increasingly, shipping regulators, owners and trade unions alike are becoming aware that such conditions, along with ship type, minimal Manning, rapid turnaround, short sea passages and traffic conditions, may find seafarers working long hours without sufficient rest. These factors will undoubtedly result in fatigue, which has potentially disastrous consequences both for the individual in terms of reduced performance and poor health (for example, ulcers, hypertension and hearing loss as a result of excessively noisy machinery and vibration) and as for the environment, if accidents occur as a result of lowered alertness.

However, Fatigue was consistently associated with poor quality sleep, negative environmental factors, high job demands and high stress. Other important factors included frequent port turn-around, physical work hazards, working more than 12 hours a day, low job support and finding the switch to port work fatiguing. Sailors on board merchant vessels remain on the high seas for six months at a stretch. Also, there is a dearth of effective co-ordination and communication among the crew as they come from various ethnic backgrounds, Overwork due to shortage of man power, paper work and long pilotage, irregular working hours including
night work and lack of sleep are some of the contributory factors for fatigue on board ship.

REFERENCES


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