

## **THE PREVENTION AND MANAGEMENT OF SEAFARERS' FATIGUE: A REVIEW**

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### **ABSTRACT**

Global concern about the extent of seafarer fatigue is widely evident across the shipping industry. This paper provides an evaluation of the extent to which fatigue can be prevented and managed. Given the diversity of activities undertaken in the maritime sector, and the different profiles of fatigue risk factors in different work groups, it is clear that a range of strategies will need to be implemented.

One conclusion from the review is that current legislation and guidance on fatigue has not had the desired effect. 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. Manning levels need to be addressed in a realistic way that prevents economic advantage accruing to those operating at bare minimum and the issue of false record-keeping requires urgent attention. This must be supplemented with appropriate training and guidance regarding avoidance of fatigue and the creation of optimum working conditions. Lessons can be learned from other transport industries and it is important to seek examples of best practice and apply these in an effective way to the maritime sector. Methods of addressing issues specific to seafaring are now well developed and a holistic approach to the problem of fatigue can lead to a culture that benefits the industry as a whole.

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## INTRODUCTION

A number of recent publications show that seafarers' fatigue is common and widespread [1] [2] [3]. In an extremely competitive 24hr industry, where shift work and long hours are the norm, the potential for fatigue at sea is great. A broad range of fatigue risk factors have been identified which cover all areas from company organisation to environmental conditions, personal characteristics and legislation. Where studies are starting to draw together compelling evidence that fatigue is a serious health and safety issue [4], attention naturally turns to ways in which this problem can be addressed. The present paper reviews approaches to the prevention and management of fatigue. The first section considers major issues that influence this process.

### *(a) Economics*

International shipping is driven by market forces and therefore to gain a perspective on fatigue the role of economics needs to be understood. Bloor, Thomas and Lane [5] chart the roots of globalisation in modern shipping and point to excessively competitive market conditions as critical in terms of understanding the current state of the industry. The introduction of flags of convenience, increased reliance on technology, reduced crewing and internationally sourced labour have led to a climate where profit concerns can eclipse all others. In such a climate it is interesting to note that fatigue has now drawn the attention of insurance underwriters in other industrial sectors with inclusion as part of general risk assessments [6]. When aiming to address seafarers' fatigue such an insurance model would appear to hold certain promise, using an economic incentive to address an economically evolved problem [See also 7].

### *(b) Legislation*

Before exploring new fatigue management approaches, the success of current fatigue related measures needs to be assessed. The most pertinent issue in this regard is the way in which working hours are currently recorded. In order to assess compliance with working hours regulations seafarers are currently required to keep records detailing their of hours of work and rest which are open to viewing by port or flag state control. A survey by Allen, Wadsworth and Smith [8] found, however, that 40% of a sample of predominately British officers reported at least occasionally under-recording their working hours in order to comply with legislation. In addition it was found that those seafarers who reported at least occasionally under-recording their working hours were found to be significantly more fatigued and less healthy than their non under-recording counterparts.

At an international level legislation is dictated by two UN (United Nations) bodies: the International Labour Organization (ILO) and the IMO. In 2002 the IMO issued a publication addressing fatigue entitled 'Guidelines on fatigue' which breaks the subject of fatigue down into separate chapters for the different areas of responsibility onboard ship e.g. fatigue and the rating, fatigue and the ship's officer.. In an appraisal of the IMO fatigue guidelines, however, McNamara, Allen, Wellens, and Smith [9] suggest that over-emphasis is placed on the personal responsibility of crew to manage fatigue without due recognition of operational factors over which seafarers have little or no control. Advising a seafarer that 'Boredom can cause fatigue', for example, (p.24) may be of little use when schedules dictate that a seafarer stands on watch for 8 hours with little to do beyond monitoring radar and correcting charts. Where Gander [10] discusses the concept of 'shared responsibility' in relation to fatigue, guidance packages such as that provided by IMO would appear to represent only single-level intervention.

(c) Working Hours

It is impossible to address the issue of fatigue without looking at how many hours seafarers are working. As highlighted by Allen et.al [8], regulating working hours in the maritime sector is a distinct challenge with a work place that exists largely beyond auditable range. An International Transport Federation (ITF) report entitled 'Seafarer fatigue: Wake up to the dangers' [11] describes a survey in which 2,500 seafarers from 60 different nationalities were surveyed showing hours of work to be very high. A quarter of the ITF sample reported working on average more than 80 hours a week. Smith et.al [12] similarly found 36.8% of a sample of UK offshore oil support ship workers to work more than 85 hours a week. Whilst it should be acknowledged that some excessive working hours are found on short tours of duty where cumulative fatigue is less of a concern, the fact that over half of the ITF sample considered their working hours to present a danger to personal health and safety re-raises the problem previously stated.

If working hours are used as a yard stick by which fatigue is measured then logic would suggest working hours to be the focus of action in this area. Jones, Dorrian, Rajaratnam, & Dawson [13] argue, however, that such a prescriptive approach should not be adopted without due consideration. As an alternative to using specific work characteristics to measure and audit fatigue, Jones et.al describe an 'outcomes' based approach which aligns with current discussion around 'goal based standards' (for an example see De Bievre [14]). Rather than prescribing specific rules and regulations aimed at preventing a target problem, an outcomes approach simply involves stating a standard and leaving the means of achieving this at operator discretion, as outlined by Efthimios Mitropoulos, Secretary-General of the IMO (Interviewed in Tallack, [15]):

In simple terms, a goal-based standard may be something like: ‘People shall be prevented from falling over the edge of a cliff’. By contrast, in prescriptive regulation, the specific means of achieving compliance is mandated, for example: ‘A one-metre high rail shall be installed at the edge of the cliff’ (p.13).

Whilst a prescriptive approach to fatigue might therefore stipulate specific hours of work, an outcomes based approach would focus only on managing fatigue, a goal which might be achieved in very different ways by different companies or sectors of the industry. From an outcomes perspective, therefore, using any one specific measure to control fatigue will always result in an approximative system which fails to account for the complexity of the work situation [16]. If an officer stands on watch for 6 hours during dense fog then a prescriptive system, using working hours to assess fatigue, would consider this equivalent to a 6 hour period spent holding anchor. Whilst the flexibility inherent in an outcome, or non-prescriptive system sounds promising, however, the practical reality is that prescriptive legislation is arguably a more efficient way of regulating an industry which calls for universal standards and official routes in apportioning blame. Certainly where evidence has shown that working hours are an extremely good indicator of fatigue risk [17], the inevitable fact that all variables can not be considered appears a compromise currently accepted. Furthermore, moving away from the prescriptive use of working hours as a first line in managing fatigue would perhaps appear premature in light of evidence that such a system is still to be reliably enforced and therefore essentially tested (e.g. [8]).

*(d) Caffeine*

Studying a sample of U.S Navy Seals, Lieberman et.al [18] investigated the mitigative qualities of caffeine following a stress intense sleep deprivation exercise. In line with general research in this field (e.g. [19]), Lieberman et.al found caffeine to successfully counter many sleep deprivation effects, a result of clear relevance to fatigue at sea. Supporting Lieberman et.al’s findings, Marsden and Leach [20] found caffeine to aid performance in a visual search task which further demonstrates the enhancement this stimulant can provide. Whilst reliance on a pharmacological solution is clearly not acceptable as a long-term strategy, evidence suggests that caffeine should nevertheless be recognised as a means of combating fatigue when systems have failed and danger might be inevitable without intervention.

*(e) Technology*

With rapid technological advances in the shipping industry, it is inevitable that solutions to the problem of fatigue will be sought in this area. Evidence suggests, however, that if human agency is removed through increased reliance on technology, a paradoxical increase in fatigue may occur. Bielic and Zec [21] argue that an automation-dominated environment leaves seafarers as passive operators, denied the opportunity for

creative input. Such monotonous conditions, the authors conclude, are conducive to fatigue. Sauer et.al [22] conducted a study looking at the benefits of an integrated bridge interface design and found, in support of Bellic et.al, that slight operational benefits might be outweighed if fatigue is found to increase.

Whilst limits might exist on how far technology, through automation, can reduce fatigue, other research has concentrated upon the issue of detection. Johns, Tucker and Chapman [23] describe a new method of monitoring drowsiness which involves monitoring eye and eyelid movement using infrared reflectance. Whilst not conducted on seafarers, research demonstrating objective sleep detection holds promise in terms of producing an emergency fail safe system for maritime workers.

*(f) Considering multiple factors*

When addressing seafarers' fatigue McNamara and Smith [24] (see also [25, 26]) suggest that potential stressors should be considered in combination rather than alone, as experienced in the real world setting. Comparing seafarers and installation personnel working in the UK offshore oil industry, McNamara et.al found a linear association between additive numbers of physical and psychosocial stressors and negative fatigue and health outcomes as measured by a survey questionnaire. Support for using such a 'combined effects' strategy comes from Comperatore, Rivera, and Kingsley [27] who have investigated the onboard environment using a unique systems based approach. In line with McNamara et.al, Comperatore et.al suggest that "stressors rarely act independently because most occur concurrently, simultaneously taxing physical and mental resources" (p.B108).

Where a fatigued state can be induced by any constellation of different factors a range of solutions arguably need to be employed [10]. Such a conclusion is also suggested by Maritime New Zealand [28] who divide their maritime worker fatigue programme up into 'new initiatives' and 'business as usual'. Such a practical division reflects how fatigue interventions need not always be 'new' with the update of existing systems of equal importance.

Evaluating a number of strategies for addressing fatigue in the Dutch sector, Houtman et.al [29] used standard criteria including cost, training and general effectiveness in a pragmatically focused overview. Proper implementation of the ISM (International Safety Management) code, optimum organisation of onboard work patterns, lengthening of rest periods and a reduction of administrative tasks are all highlighted by Houtman et.al as essential to reducing fatigue in the Netherlands, although current manning regulation is assigned a peripheral concern. Where Houtman et.al therefore consider multiple factors in their study, a focus upon company-based strategic solutions arguably overlooks the responsibility held by both legislator and seafarer who form critical layers in any fatigue management structure [10]. If the

problem of fatigue is to be truly conceived in multi-faceted terms then all layers of responsibility need to be transparently involved and sufficiently empowered to act [1].

In summary, seafarers' fatigue is an occupational health and safety issue that reaches across the industry. Evidence of mis-recorded working hours suggests even good operators face problems, however where combinations of negative factors are present together it is clear that accidents are all but inevitable [4]. Small bulkers working unpredictable schedules with only two watchkeepers and frequent port turn-arounds is a scenario in particular that has drawn significant concern [4, 30].

The next question is what can be done to help.

#### *The way forward*

##### **(a) Treat fatigue as a serious health and safety issue**

Walters [31] has argued that a large proportion of the toll of work-related death, injury and ill-health amongst seafarers arises from failure to manage health and safety effectively. Seafarers' fatigue should be tackled using standard approaches (e.g. regulation; appropriate training; audits) with any increased risk dealt with in a similar way to other breaches of health and safety. Industry wide, cultural change is needed. There are serious consequences associated with fatigue at sea including loss of life, environmental damage, economic cost and the compromised health and well being of seafarers themselves. The first stage in terms of dealing with fatigue is to establish a consensus that there is indeed a problem to address. The evidence base for such a view is strong and has been developed through multi-disciplinary research studying a wide variety of ships in different countries. A wider perspective on the consequences of fatigue is required as our knowledge of the impact of fatigue on health shows that it reduces quality of life by increasing the risk of physical and mental health problems. Such effects are likely to be apparent in all sectors and ranks, which in some cases may lead to an increased risk of premature death.

##### **(b) A more robust and realistic approach to regulation and manning**

A starting point for improving the current situation is to establish a more robust and realistic approach to regulation. Whilst many vessels may already operate with more crew than demanded by their flag state, an issue frequently overlooked is that of operational mode. A vessel may have sufficient crew for a passage of open sailing, however the same vessel may be considerably under-staffed when maintenance, recovery, port turn-arounds and security requirements are factored into the equation [4, 30].

Regulation therefore needs to be realistic, but it also needs to be robust. Companies will only man their vessels with a level of redundancy if other vessels are forced to do

the same. Manning levels need to be addressed in a way that prevents economic advantage accruing to those who operate with bare minimums.

**(c) Enforcement of legislation, elimination of false record-keeping, and better training and guidance**

Another essential requirement is to enforce existing guidelines with mandatory provisions and take serious measures to overcome the problem of false record-keeping. This must be supplemented with appropriate training and guidance regarding avoidance of fatigue and optimum working conditions. Lessons can be learned from other transport industries and it is important to seek examples of best practice and apply these in an effective way to the maritime sector. Methods of addressing issues specific to seafaring are now well developed and a holistic approach to the issue of fatigue can lead to a culture that benefits the industry as a whole. Fatigue awareness training and the development of measures to identify fatigue and counter it are becoming common place in other transport sectors and may be a useful part in any package developed to prevent and manage fatigue at sea. However, their efficacy needs to be evaluated and the use of such approaches should not be seen as a reason for breaching regulations nor for the adoption of minimal levels of manning. Future research should, therefore, not be restricted to demonstrating that fatigue exists but be concerned with the evaluation of methods for preventing and managing seafarers' fatigue (implementation and effectiveness research rather than fundamental research on the science of fatigue).

**(d) Learn from best practice in the maritime sector and in other comparable industries**

Research [1] has attempted to examine fatigue within different sectors of the maritime industry and also make comparisons with other transport sectors. Much of the research has been concerned with identification of risk factors for fatigue, the prevalence of fatigue and the consequences of it. This process has also identified the best methods of preventing and managing fatigue and it is apparent that principles of "best practice" have been identified and operationalised in some contexts. For example, concerns amongst oil majors over the consequences of tanker accidents resulted in masters no longer standing a routine watch. Where similar concerns are now being aired in relation to small coasters and two man 6-on/6-off watches [4], similar steps might in the future be taken here. It is important to learn from such examples and adopt those strategies that will lead to a culture of "best practice" and eliminate "worst case scenarios". This approach will require the collaborative efforts of all stakeholders and good models of such teams (the work force, owners, regulators, and academics) have been developed in other areas of transport.

## CONCLUSION

It is readily apparent that current legislation and guidance on fatigue has not had the desired effect in the seafaring industry. Hours of work are likely to be under-recorded, either by management, or individual seafarers wary of jeopardising their current or future employment by bringing their company under legislative scrutiny. Similarly, guidance too often involves suggestions that are beyond the control of the individual and which cannot compete with economic pressures. One approach would be to improve on current measures addressing fatigue (e.g. improved guidance; enforcement of working time directives). Another would be to focus on specific aspects of the problem and deal with those using standard health and safety approaches. Looking at manning levels from a wider perspective, there may be reasons other than fatigue that would suggest that increases are needed (e.g. safety in emergencies). Other possible organisational changes, such as changes in shift patterns need to be evaluated, since knowledge about shift work onshore may not be directly applicable to circumstances offshore.

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. Manning levels need to be addressed in a realistic way that prevents economic advantage accruing to those who operate with bare minimums. Such an approach must consider more than the minimum levels necessary to operate a vessel; rather it must address the need for maintenance, recovery time, redundancy, and the additional burden of the paperwork and drills associated with security and environmental issues. Another essential requirement is to enforce existing guidelines with mandatory provisions and take serious measures to overcome the problem of false record-keeping. This must be supplemented with appropriate training and guidance regarding avoidance of fatigue and the creation of optimum working conditions. Lessons can be learned from other transport industries and it is important to seek examples of best practice and apply these in an effective way to the maritime sector. Methods of addressing issues specific to seafaring are now well developed and a holistic approach to the problem of fatigue can lead to a culture that benefits the industry as a whole.



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