

**DAVID W SMITH\***  
**REPORTS ON THE  
 LATEST RESEARCH  
 INTO SEAFARER  
 FATIGUE AND THE  
 IMPORTANCE OF  
 SAFETY CULTURE IN  
 MARINE CASUALTIES**

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# THE HUMAN FACTOR

**T**he widely acclaimed book *The Human Element: a Guide to Human Behaviour in the Shipping Industry*, published by the UK's MCA, comments that issues of reduced manning, increased workload and resulting fatigue have continued to play a major role in many maritime accidents to the present day.

While groundings and collisions are often the types of accidents in which fatigue is identified as one of the causal factors – usually within the navigation watch there have also been incidents where fatigue within the engineering staff has been cited, but perhaps with less spectacular consequences, such as *Safe Concordia* (2005), *River Embley* (2010) and *Ever Excel* (2010). Furthermore, while fatigue is relatively easy to identify as a causal factor in a major casualty, when for example, work records might establish that the officer-of-the-watch held responsible for the casualty had had little sleep in the previous 24h, it is less likely to come to light if, for example, an engineer suffering from fatigue had made an error during machinery overhaul which subsequently lead to a much later significant failure or loss of life.

The most recent research into fatigue of seafarers was the Horizon Project which looked into the effects that watchkeeping patterns have on the performance of deck and engineering officers. The research, carried out under controlled conditions using bridge and engine-room simulators at Warsash Maritime Academy (UK) and Chalmers

University of Technology (Sweden) simulated a one-week voyage in the North Sea under six on and six off and four on and eight off watch systems. Experienced deck and engineer officers participated in the study during which subjective and objective performance measures were monitored during a range of real-life, real-time scenarios of voyage, workload and off-watch interruptions.

As well as providing further evidence of degraded performance on six on/six off watch systems and a better understanding of sleepiness under both watchkeeping regimes, the study findings were used to generate data to enable the development of a mathematical model that predicts sleepiness at sea which is a critical predictor of fatigue. This culminated in the development of a prototype tool – MARTHA an acronym derived from a Maritime Alertness Regulation Tool based on hours of work. While the report on the research project (available at [www.project-horizon.eu](http://www.project-horizon.eu)) recognises the need for further research on the impact on fatigue of parameters such as weather conditions, onboard noise and the effects of long periods at sea – and prototype testing of the tool at sea has revealed some problems with user-friendliness which are currently being addressed – the work is nevertheless significant. The outcome of the project was presented by the UK to IMO's sub-committee on Standards of Training and Watchkeeping (STW) in April 2013 and following from the discussions of the work there was general recognition that IMO should look afresh at fatigue issues.

At the beginning of this year the revised IMO sub-committee structure came into effect, which resulted in the former STW sub-committee taking on the earlier role of the Human Element Working Group to become the sub-committee on Human Element, Training and Watchkeeping (HTW). At its first meeting, held in April this year, Australia contributed to the debate with a paper setting out its proposals for the development and adoption of a holistic Fatigue Risk Management System (FRMS).

According to this paper, FRMS is seen by the Australian Maritime Safety Authority (AMSA) as a practical approach to the management of fatigue

“ The human element is a complex multi-dimensional issue that affects maritime safety, security and marine environmental protection. It involves the entire spectrum of human activities performed by ships' crews, shore-based management, regulatory bodies, recognised organisations, shipyards, legislators, and other relevant parties, all of whom need to co-operate to address human element issues effectively. ”

– IMO Res. A.947(23)

and includes risk assessments, mitigation and control strategies, training and education programmes, monitoring systems and continual adaptation processes for reflecting changing circumstances through feedback. AMSA envisages a system based on development and implementation of five key elements:

- ▲ Fatigue risk management guidelines;
- ▲ Fatigue risk management education and training;
- ▲ Optimising work and rest schedules at sea;
- ▲ Fatigue assessment, monitoring and feedback;
- ▲ Appropriate work and living environment.

In a second paper submitted to the same meeting, AMSA recognises that a successful FRMS needs the presence of an effective safety culture permitting, without prejudice, the open communicating and reporting of fatigue-related issues together with a shared responsibility between owners/operators and shipboard crew.

The paper reports that in 2013 AMSA commenced a three-year research study to assess the determinants of safety culture in shipping. For the purpose of this study, safety culture was taken to mean an employee's perceptions of organizational policies, procedures and practices that may be used to inform safety policies, regulations, training and practice considerations. The findings of an initial pilot study suggested that senior officers onboard ships consider factors at the 'individual' level to be the main causes of accidents and injuries (i.e. a lack of knowledge, skill or motivation on the part of the crew). According to the paper there appeared to be relatively little awareness of the role of organisational factors in accidents and injuries onboard ships and although the sample size was relatively small, the results seemed to reflect a common global understanding of how the maritime industry views 'human error', that is, to tend to ignore systematic, organisational aspects that influ-

*“ A sustainable maritime transportation system must promote a safety culture, fostered through global standards and their rigorous enforcement. These global standards should ensure a “level playing field”, but the safety culture should go beyond mere regulatory compliance and deliver added value for the system through the promotion of safety. ”*

– IMO, World Maritime Day 2013

ence shipboard behaviour. Commercial pressure, in particular, emerged strongly in the study. Due to the need for economy and efficiency, the report considered that seafarers may sometimes be forced to operate at or beyond the limits of safety. These issues will be explored further in the Australian study. It remains to be seen how this will be taken up at IMO.

While increased knowledge of the science of fatigue and the development of bi-mathematical tools such as MARTHA will provide us with tools that provide an indicative level of fatigue at sea, the view from the 'coal face' indicates that some immediate improvements could be realised if industry partners addressed known issues.

John Lillie, in his Notes from the Duty Mess column in the February 2014 edition highlighted the administrative burden imposed on ships officers by many ports. This is particularly relevant in the short sea trades due to the high number of port visits coupled with the lean manning level of these vessels. Last year IMO started a public consultation on administrative burdens in maritime regulations. The consultation ended in October and the analysis of responses by an ad-hoc steering group has now begun.

The aim is to develop recommenda-

tions on how to alleviate administrative burdens that have become unnecessary, disproportionate or obsolete. The recommendations will be presented to the Council in the course of 2014. While the outcome of the IMO consultation may result in some alleviation of onboard safety management systems – related paperwork, reduction in port-driven bureaucracy will require the understanding and good will of the port states – and that needs to be encouraged.

Within the engineroom, introduction of the 'unmanned machinery space' supposedly freed-up watchkeepers to undertake day-time maintenance but, in parallel, engineroom crew levels were reduced; the industry forgetting perhaps that in the days when it was normal for two engineers to be on watch at least one would spend most of the watch progressing routine maintenance tasks. Furthermore, with increasingly complex integrated control and alarm systems it is becoming increasingly challenging for the assigned duty engineer to get a quiet night yet still have to 'turn-to' the following day, which might well involve a port arrival at which time the engineers will need to be particularly vigilant.

In 2010 the coal-fired *River Embley* endured a serious engineroom fire followed by an explosion. The event was the result of a coal transfer compressor malfunction shortly after start-up. One of the findings was that the compressor was not inspected to ensure that it was operating satisfactorily after it was started. While not specifically assigning fatigue as a contributory factor, the casualty investigator commented in the report: 'At 0330 in the morning, the (duty engineer) was probably tired, following a night of broken sleep attending to engine room call outs. As a result, he may not have been as focused on the task at hand as he would have been had he been adequately rested.'

'While many of the effects associated with fatigue, like slowed reaction time, decreased work efficiency and increased errors or omissions only appear after substantial levels of sleep deprivation, even the loss of sleep for one night can have negative effects on human performance. Therefore, it is possible that because the second engineer was tired, he may have lacked the motivation required to go to the compressor deck to check the compressor after it had been started.'

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\*David W Smith is the chairman of the IMAEST Human Element Working Group, a body set up to act as a forum for the dissemination of current knowledge and best practice in human element issues and as a focal point for human element research

### Seafarer fatigue could have contributed to the *River Embley* casualty in 2010

