Development of a maritime fatigue management programme

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In New Zealand fatigue is largely a problem of small commercial vessels, partially as New Zealand has few large vessels. “Asleep on watch” accidents occur predominantly with fishing vessels, which typically have 2-3 crew, long hours are worked and there is little evidence of a considered approach to managing fatigue. Data on injury accidents is poor and investigation of fatigue is a contributing factor is lacking. Industry representatives and Maritime New Zealand (MNZ) identified fatigue as a priority area for improvement, with the focus to be on the small ship sector. A survey of industry was conducted that indicated that fatigue was an issue for a significant minority of seafarers. Examination of existing fatigue management programmes, together with the health and safety compliance literature, concluded that few programmes have their primary focus on small operators, and that small operators, as a group, are not willing to absorb large amounts of information presented formally (a frequent feature of fatigue management programmes). Supportive and firm leadership from MNZ would also be required. The path chosen is to: formally include an assessment of the need for fatigue management in the normal vessel risk management programme; the development of a vessel-specific response if needed; provide a range of simple information materials to vessel operators and their crew; and to train those people who vessel operators and their crew naturally turn to for advice, to be able to provide encouragement and advice, as and when required.

Problem

Vessel accidents

Small vessels, particularly fishing vessels, regularly hit the New Zealand coast, with the watchkeeper firmly asleep at the time. While this has not resulted in any fatalities (as recorded in the Maritime New Zealand (MNZ) accident database), this situation is of concern to MNZ, industry and the public. This concern is most obvious after a spate of such accidents.

Twenty accidents recorded in the MNZ accident database were analyzed, where the watchkeeper of a fishing vessel was asleep at the time of the accident. All but one were groundings (one collision). The vessels were mostly between 12 – 20 metre long (14/20), had 2-3 crew (12/18), and in most cases the other crewmembers were also asleep (15/17). Eight vessels were leaving port, and 9 were approaching the coast. Almost without exception, alarm systems were not installed or not activated. Two that did activate were so quiet as to not wake the watchkeeper. Sleep histories indicated long periods of work, and short and disturbed sleep. In three instances the skipper did not trust new crew to take a turn at watchkeeping and was working longer than usual. There was little evidence of systematic planning of voyages and watchkeeping schedules or practices. In nearly all accidents, the watchkeeper fell asleep in the (comfortable) wheelhouse chair.

New Zealand fleet and programme focus

New Zealand regulates three classes of commercial vessels. As at 21 August 2006 there were:

- 13 international vessels. These are larger non-fishing vessels that voyage internationally.

\footnote{Not all categories add to 20, as data was not always recorded.}
• 3131 vessels in safe ship management (SSM). These are all other vessels that are over 6 metres in length or any that carry passengers, including vessels under 6 metres.
• 739 vessels registered under safety operational plans (SOPs). These are vessels under 6 metres in length, except passenger vessels.

Given the small size of the international vessel fleet and the number of accidents with vessels in SSM, particularly fishing vessels, the first phase of the New Zealand maritime fatigue programme focuses exclusively on vessels in SSM. Once this phase has been implemented, consideration will be given to a second phase, focusing on international vessels and stevedoring operations, another area of concern.

Available programmes
While fatigue has always been a feature of life at sea, there is very little in the way of programmes available to assist seafarers manage fatigue effectively. The International Maritime Organization (IMO) published guidelines in 2002 which focus on international vessels (IMO, 2002). Smith (2005) observed that the guidelines read more like a general information document than a set of specific guidelines. He also observed that the IMO guidelines focus far more on what individuals can do to mitigate the effects of fatigue, rather than what the company can do. He concluded that:

“The focus of responsibility for fatigue management needs to shift from the personal to the operational. Industry wide, cultural change is needed in order to empower individuals to manage their own fatigue”

Gander (2005) noted that the IMO guidelines “would be of limited usefulness for sectors such as fishing and adventure tourism, for whom they are not adapted.”

The United States Coast Guard has developed a Crew Endurance Management (CEM) programme (Comperatore and Rivera, 2003). This programme is research based (e.g. Miller, Smith and McCauley, 1999) and oriented toward vessels with a structured routine (to the extent that this is achievable in any maritime operation). CEMS is a generic maritime fatigue management programme.

Implementation of CEMS requires the training of fatigue experts within industry, and the use of onboard fatigue management coaches is highly recommended. Originally developed with a focus on larger Coast Guard vessels, CEMS has been applied in the US towing vessel industry. A demonstration project in the towing industry showed improvement on a number of measures over a six-month period (United States Coast Guard, 2005). Gander (2005) concluded that the CEMS programme requires considerable investment of resources and this would restrict its use to larger vessels and companies.

Transport Canada sponsored research into fatigue with Canadian marine pilots and the development of material to be used in workshops with marine pilots (Transport Canada, 2002). Assessment of a trial workshop identified that some of the marine pilots wanted the information presented in a manner relevant to their specific situation (Rhodes and Donne, 2003), rather than being oriented to ship piloting in general.

With the exception of the attempt by the US Coast guard to involve large companies that operate small vessels, no fatigue management programme has been identified that has as its focus, small maritime vessels. The CEMS programme has some useful aspects, but is too complicated for the small companies that dominate the New Zealand SSM industry.

Regulatory environment
Within New Zealand, the maritime industry differs from other transport sectors, in that it does not have prescribed maximum hours of work or minimum hours of rest (with the exception of watchkeepers on international vessels). There are general requirements for owners and masters to ensure that all crew are fit for duty when keeping a watch. Fitness includes consideration of fatigue. This has significant implications for how fatigue management programmes are developed for the maritime industry, particularly for small vessels. In the aviation and road transport industries, companies are given permission to develop company specific fatigue
management programmes, as an alternative to being regulated under a prescribed hours regime. In this situation, companies must be willing to undertake the necessary investment of time and resources to develop a fatigue management plan. In the maritime industry, in theory, all vessel operators should develop and implement vessel specific fatigue management plans. In practice, this has been a relatively neglected part of the New Zealand maritime regulatory programme.

A number of countries do prescribe maximum hours of work and/or minimum hours of rest for seafarers. A number of these regimes (e.g. European Union Directive 2000/34/EC) either exempt some seafarers from their effects (often fishermen) or they are seen as being widely ignored in practice (e.g. Maritime Accident Investigation Board, 2004).

**Framework for the fatigue programme**

Companies operating vessels under SSM do so under two Acts; the Health and Safety in Employment (HSE) Act 1992 and the Maritime Transport Act (MTA) 1994. Both these acts take a hazard identification and risk management approach to regulating safety. Given this, together with the difficulty all nations have in applying prescriptive hours regimes to the maritime industry, a decision was made early on to not attempt to introduce a prescriptive hours of work and/or rest regime for managing fatigue in the maritime industry. Instead, a decision was made to develop fatigue management guidelines for the SSM sector, based on risk management principles.

The HSE Act establishes general duties of employers and employees to identify all hazards and take all practicable steps to ensure risks are managed. The definition of ‘hazards’ includes physical or mental fatigue. The HSE Act does not establish any kind of regulatory process where a safety programme must be approved, but it does contain severe penalties, in comparison to penalties under the MTA. In contrast, rules established under the MTA do require operators of vessel in SSM to submit safety management plans to MNZ for approval, and the operation of vessels is subject to on-going audit.

At present MNZ does not place any substantive emphasis on vessel operators developing fatigue management plans. This recognises that operators have not been provided with guidance material. Once MNZ has developed fatigue management resources for vessels in SSM, the development and auditing of vessel specific fatigue management plans will be required, as part of the normal SSM process.

**Informing the development of the fatigue programme**

**Surveys**

Following public consultation in 1998, MNZ commissioned two surveys in 2003 to improve its understanding of fatigue in the maritime industry; a qualitative interview-based study of 30 seafarers and 11 stakeholders, such as company owners and union representatives, and a questionnaire survey of vessel owners and seafarers. The qualitative survey was used to inform the development of the questionnaire survey.

For the questionnaire survey, vessel owners were contacted by phone and those who agreed to participate (90%) were sent a vessel owners questionnaire and questionnaires to distribute to their staff. All questionnaires were returned to a market research company to protect the confidentiality of replies. An incentive prize was balloted. Response rates were low (42% for vessel owners (n=194) and 23% for seafarers (n=164)). Consequently, complex statistical analysis was regarded as not appropriate.

Seafarers were asked about their last five trips. Key results on the extent and effects of fatigue are in Table 1.
Table 1: Key results from the questionnaire survey, last five trips for seafarers

<table>
<thead>
<tr>
<th>Question</th>
<th>Seafarers</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of fatigue (base: 164)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fatigued on 5 trips</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>fatigued on 3-4 trips</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>fatigued on 1-2 trips</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>not fatigued on any trip</td>
<td></td>
<td>52</td>
</tr>
<tr>
<td>Recovered from fatigue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(base:79)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>always/usually</td>
<td></td>
<td>62</td>
</tr>
<tr>
<td>occasionally</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>never</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Effects of fatigue on (base: 79)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lacked energy</td>
<td></td>
<td>87</td>
</tr>
<tr>
<td>made little mistakes</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>made poor decisions</td>
<td></td>
<td>29</td>
</tr>
</tbody>
</table>

The impression obtained from these results is that, while fatigue is not a significant safety issue for most seafarers, it is for a substantial minority.

Of those who worked on vessels, 63% of skippers and 35% of other positions reported never seeing others fatigued. In contrast, when vessel owners were asked to identify which type of position were likely to result in significant fatigue, 41% nominated none, 40% the skipper, and only 5% nominated the deckhands. An explanation for these disparate data may be that fatigue is a phenomenon that is not reliably detected in others, especially when interaction is brief. In the maritime industry it is highly likely that vessel owners will spend more time with skippers than other crewmembers, and that skippers (who are often isolated in the wheelhouse) spend less time with crew, than do other crewmembers. Perceptions of the extent of fatigue on a vessel are likely to have an effect on the willingness of owners to put effort into fatigue management.

As a group, seafarers reported working long hours (average of 10.2 hours per day on their last five trips). Seafarers who regarded themselves as fatigued worked an average of 12.1 hours per day, compared to 8.6 hours for those who were not fatigued. Not unexpectedly, seafarers solely on salary or wages worked less (median 9 hours per day) than those who were on a percentage of the catch/profits or were self-employed (median 12 hours per day).

**Literature review**

MNZ commissioned the second author to review the literature it had gathered about fatigue in the maritime industry (Gander, 2005). The review emphasized the diverse nature of the causes of fatigue in the maritime industry and the benefits of engaging with the different industry sectors, if practical fatigue management strategies were to be developed.

**Developing an approach to fatigue management for the SSM sector**

There was considerable pressure to develop fatigue management guidelines in a hurry. As with many projects that come into existence to make rapid progress on a complicated issue, a number of false or not particularly productive trails were pursued. The initial decision was to develop a set of generic fatigue management guidelines for the entire maritime industry, supplemented by specific advice for particular classes of vessels. The end result of this process was the development of two generic draft documents, one focused on the science of fatigue and fatigue management strategies and the other on writing a risk management plan.

It became increasingly clear, that though the content of the material developed to date was well received, the amount of it and its form would act as barriers for many of the vessel operators, who would be asked to use it. At around the same time one of us (Perkins) was reading the literature on compliance within a health and safety context, particularly as it
applied to small and medium enterprises (SMEs). A number of conclusions were taken from this literature:

- perceptions of the amount and type of resources required and their effects on costs leads to inaction by SMEs
- there is often a lack of fundamental re-examination of old routines and practices
- reliance on others to inform them of requirements, particularly the field staff of regulators
- external advice is sought from those they trust, such as business advisors
- off-the-shelf health and safety plans do not work as well as those that are workplace specific
- professional trade schemes are useful in encouraging higher standards
- SMEs tend to be driven by external interventions, while larger companies have internal control processes that can keep them focused with a smaller external input
- health and safety processes work best when integrated into broader management systems
- in high hazard industries, external pressure from the regulator was the important factor in gaining compliance
- advice and persuade approaches are not particularly effective in reducing workplace accidents
- business friendly approaches (like improvement notices) work better than harsh enforcement

Programme framework

SSM is administered by private sector companies on behalf of MNZ. At the time the fatigue management programme began, the future of SSM as a private sector business was in doubt. In practice, SSM operated more as a vessel inspection programme, rather than one that focused on safety systems. A year or so later, there was increasing acceptance by SSM companies that they would focus on safety systems. This made it realistic to bring the fatigue management programme under the umbrella of SSM.

Implementing the fatigue programme through SSM means that, for those vessels on which fatigue is an issue, there would have to be an approval sign-off process. In practice, SSM companies provide advice, assist with writing vessel manuals, and approve the manuals. This is subject to auditing by MNZ. MNZ field staff also provide advice to industry. Training SSM company staff and MNZ field staff to a good standard then becomes critical to the success of the programme.

As the SSM process requires interaction between the SSM company and vessel operators, it was decided that the more detailed information about fatigue and its management could be passed onto vessel operators verbally, rather than in a document. The role of advisors is seen as a critical component of the fatigue programme. Trained advisors will also include industry mentors (a separate safety programme) and in-company management staff, for the larger companies.

The two generic documents developed earlier have been adapted to act as resource material for advisors.

Both MNZ operational staff and industry representatives wanted material for vessel operators to be short and simple, but also of direct relevance to the work of vessel operators. This task was simplified somewhat by assuming that the more detailed information in the advisors’ guides would be passed on verbally.

Material for vessel operators and seafarers

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Three types of information were seen as important to provide to vessel operators, their crew and shore staff:

- basic information about the nature of sleep, fatigue and strategies to manage both
- the nature of the fatigue problems that are likely to be found on different types of vessels
- support for vessel operators on to how to manage the development and operation of a fatigue management plan.

It was considered that everyone involved in a vessel and its management would require some exposure to basic information about the nature of sleep, fatigue and strategies to manage both. In addition, it would be beneficial if this information was shared with the families of seafarers. The focus would be on personal fatigue management strategies. The information would be need to be attractive to all those it was intended for, including those who had poor reading skills. As a result, a cartoon format was decided on. There is a model available, focused on fatigue management on larger vessels (The American Club, undated). The current intention is to publish sufficient cartoon booklets to provide one to everyone in the SSM industry.

For vessel operators, the key document highlights the main drivers of fatigue and possible responses to them for specific types of vessels. Guides to fatigue hazards and their management are planned for charter boats, harbour ferries and water taxis, work boats, and for various types of fishing (trawling, seining, long lining, trolling, dredging, pot and trap fishing, set netting, diving, jigging). These documents begin with an example or two of a company, its fatigue management plan and how it went about developing it. There is a list of ‘fatigue hazards’ typical for that type of vessel operation, what makes them a hazard, the safety problem that results, and options to manage the hazard. The document concludes with a list of management milestones, which the operator is encouraged to sign off as he or she proceeds through the process.

To support the vessel operator, two further documents have been written. A questions and answers booklet takes the operator through the sequence for programme development; educating/setting expectations, identifying hazards/developing control plans, training/implementing the programme, and monitoring/review/revising. MNZ recognises that, especially for new vessels, it will not be possible to ‘get the fatigue management plan for a vessel right’ at the first attempt. A trial of up to three months is encouraged, after which the programme can be approved.

A fatigue tools booklet provides a range of additional resources that may be of use to some operators. Three methods of obtaining information about fatigue as experienced by the crew are given; discussion, the Karolinska sleepiness scale, and a scale for rating common drivers of fatigue in maritime operations. Strategies for five areas of fatigue management are also provided. It is expected that the tools provide in this booklet are most likely to be used following discussion with an advisor.

It is anticipated that advisors will run discussion/training sessions with vessel operators and their crews. Resources to assist the advisors are being developed. Three posters have been developed as teaching aids and it is likely that a DVD/video will be developed over the next year.

Programme implementation
Two significant pieces of work will need to be done in 2007 before the programme is ready to be implemented. The first is to take the draft written material through editing and publishing, the second is to train the advisors. It is anticipated that this will be complete by the middle of 2007.
References


