DEAD TIRED

How you can win the war against fatigue.

ON 14 JUNE 2001, just north of Albury on the Hume Highway, a convoy of six semitrailers was involved in an accident that scattered wreckage over 200 metres and closed the highway for hours.

The convoy was "slipstreaming", a common practice in motor racing and trucking, which involves the lead vehicle effectively towing those behind in its wake. The Transport Workers Union claimed the practice was used to save fuel, and even to keep the vehicles going if the driver fell asleep. It was just one example, they said, of the measures drivers must take to meet unrealistic deadlines.

Extraordinarily, no one was killed, but the message is clear: the commercial pressures on drivers often outstrip their all-too-human limitations, and the resulting fatigue presents an enormous threat to safety.

For the aviation industry, the threat of fatigue is just as real, but the consequences of fatigue-induced errors are far greater.

Regulations: Originally drafted in 1953, Civil Aviation Order (CAO) 48 was designed to provide limitations on flight and duty times in an effort to minimise fatigue.

However, many operators argued CAO 48 placed unfair restrictions on their businesses and did not reflect changes to the aviation industry including longer flight sectors and increased numbers of transmeridian flights. Through industry consultation, a set of standard exemptions were provided on a trial basis. Some continued to argue these were insufficient, and over time non-standard exemptions were approved, allowing duty times to be lengthened.

As CASA continues to reform its regulations, and as new research on the dangers of fatigue comes to light, significant changes have been made to the way CAO 48 is administered. An operator who wants to work outside the limits of CAO 48 must now introduce a fatigue management system and demonstrate that the safety of their operation will not suffer.

Obviously, the long hours associated with aviation cannot be completely eliminated, particularly with flight and cabin crews facing the introduction of ultra-long-haul routes in the near future. A shortage of skilled labour and the move to permanent night shifts place maintenance personnel under similar pressures, increasing the chance that human error in the hangar could cause an accident.

Preventing fatigue from affecting safety is the responsibility of both the employer and employees under Occupational Health and Safety (OH&S) legislation, and can be readily achieved through the use of an effective fatigue management system.

Administered correctly, such a system can improve productivity, morale, absenteeism, safety, and the bottom line.

Fatigue management: A fatigue management system is a comprehensive set of procedures and work practices designed to reduce fatigue and mitigate its effects on safety and performance.

CASA can be contacted for assistance in drafting your fatigue management system, but as a guide here are some of the points you will need to consider.

Seven major domains should be addressed in an integrated program to manage fatigue in operational settings:

- Management commitment.
- Hazard identification and defences.
- Rosters.
- Education.
- Fatigue measurement and consultation.
- Review.
- Contingency plans.

Management commitment: In many organisations excessive fatigue is regarded as a badge of honour. Staff are rewarded for "putting in extra hours" and punished for admitting to being tired.

The first step in implementing any fatigue management system is reversing this culture. This change must come from senior management.

If staff perceive that senior managers are not serious about fatigue management this will filter down through the organisation very quickly. If a fatigue management system is introduced simply to gain an exemption from CAO 48 it will fail.

There are numerous reasons for management to embrace a fatigue management system. Fatigue reduces vigilance, and impairs judgement and communication. It therefore reduces productivity and increases the probability of errors that could lead to incidents or accidents. For these reasons alone fatigue management systems offer significant benefits to shareholders and management.

Staff must be encouraged to report events where fatigue has adversely affected performance.

Also, it should be made clear that deliberate breaches of the company's fatigue policy will be treated in the same way as any other deliberate violation.

Hazard identification and defences: It is important to identify and address those areas of your operations where fatigue is most likely to have a negative impact on safety. Things to

consider are:

• The type of task and the probability and consequences of it being performed incorrectly.

• The controls and procedures in place to reduce the possibility and/or consequences of human error.

• The time of day the task is performed.

• The overall fatigue of the person(s) performing the task.

• Whether the task is performed at the beginning or end of the shift.

Once a task has been identified as fatigue sensitive, the organisation will usually have two options: reschedule the task to a period of higher alertness, say day shift; and/or strengthen the defences around the task to reduce the likelihood and impact of fatigue-induced errors.

In a maintenance environment, defences may include increased staff numbers during high-risk tasks, mandatory use of written checklists, and/or additional requirements for independent checks.

Similarly, on flights where a fatigue risk is identified, say one that includes a landing during a circadian low period, defences may include: the carriage of extra crew members to allow extended in-flight rest periods; in-flight napping (in multi-crew environments); and/or changing in-flight procedures to increase the margin of safety.

Rosters: It is impossible to eliminate fatigue. The challenge is to develop rosters that allow management and staff to accurately predict fatigue peaks and defend against them.

For example, a peak fatigue period between 3:30am and 4:30am may be of little consequence if the company ensures safety-critical tasks are not performed at that time.

Software programs which calculate fatigue scores over the duration of a seven-day roster are available and are extremely useful in highlighting the strengths and weaknesses of a particular roster (see "What's Your Fatigue Score?"). The programs allow for a number of factors including circadian considerations and recent shiftwork history.

When designing a roster four elements must be considered: time continuously awake, time of day, fatigue prior to duty and sleep debt.

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Time continuously awake: It's ironic that the practise of extending a duty day can increase productivity when used sparingly but can result in a decrease in productivity if used excessively.

In one study by Professor Drew Dawson and colleagues at Adelaide's Centre For Sleep Research it was found that performance impairment after 17 hours awake was equivalent to a blood alcohol concentration of 0.05 per cent.

However, this study does not suggest people are unable to complete *any* tasks successfully when they have been awake for an extended period. Simple over-learned tasks are relatively unaffected by fatigue. This is not the case however with tasks requiring reasoning or judgement. Performance on these tasks will be impaired and additional fatigue proofing may be necessary if this performance decrement is to be managed safely.

Time of day: The consistency and effectiveness with which a task is completed during a day is higher than during a night shift. In addition fatigue recovery during a night off-duty period is considerably more efficient than recovery during a day off-duty period.

These differences occur because the body's internal clock follows a 24-hour cycle and controls many functions including temperature regulation, performance capability and mood (see box on page 25). This cycle includes two periods during the day when alertness is at a maximum (roughly 0800-1100 and 2000-2300 and two periods during the day when sleepiness is the greatest (0300-0600 and 1500-1700).

As is the case with length of time continuously awake, additional defences may be required if tasks undertaken during circadian low periods (especially between 0300 and 0600) are to be completed to the required standard. Similarly, allowances must be made if off-duty time coincides with a period of maximum alertness.

Fatigue prior to duty: Individuals need about seven to eight hours sleep in order to cope with ordinary demands of everyday life. To the extent that this need has not been met (perhaps as a result of early morning starts, out of phase attempts to sleep, poor sleeping conditions, administrative requirements or poor sleep discipline) individuals will be suffering from

acute fatigue.

Consequently their performance, especially on tasks requiring reasoning and judgement, will deteriorate as their on-duty time increases. While it's true there are individual variations and some tasks can be successfully completed by individuals who have had less than their required sleep, these are exceptions and special cases.

Policies should address the normal requirements rather than relying on extra effort to cope with the effects of sleep loss. Following a day duty individuals should be provided with enough time off to allow for eight hours sleep. Following a night duty individuals will require extra time off-duty because of the relative inefficiency of sleeping during the day, In addition these individuals should not be required to attend meetings or complete administrative activities during their off-duty time.

Sleep Debt or Cumulative Fatigue: Although the loss of a small amount of sleep on a single night may not have a significant effect on performance, sleep loss is cumulative and should it continue for several nights, it will build into a sleep debt.

For example, the loss of one hours sleep for a single night will be undetectable, after the loss of a second hour on the second night the individual will feel its effects, after the third night the effects of sleep loss on performance will be noticeable to an external observer. To manage the fact that it is not always possible for individuals to get all the sleep they need every night, they must be offered periodic opportunities to recover this sleep loss.

Research has established that two nights of unrestricted sleep are usually sufficient to recover from even a relatively severe sleep debt.

Circadian rhythms

CIRCADIAN rhythms refer to a collection of biochemical systems built into the human body that have cyclical patterns recurring approximately every 24 hours.

Examples include temperature regulation, digestion, hormonal releases and most visibly our sleep/wake patterns. Circadian rhythms evolved in animal and plant life alike, indicating our synchrony with the cyclical rotation of the Earth.

Generally we are programmed for daytime activity and night time sleep. In fact, the brain physiologically induces two maximal opportunities for sleep each day: from approximately 0300-0600 and 1500 to 1700. Western culture is one of the few not to acknowledge this with a customary siesta.

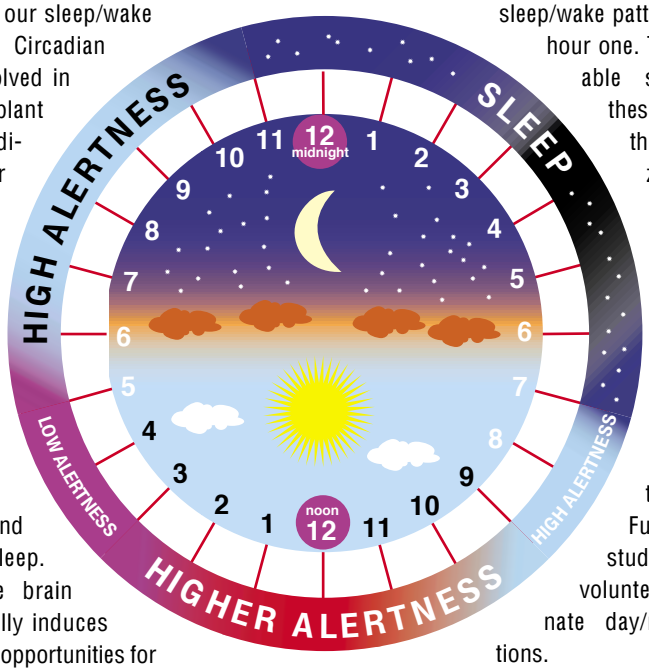
A series of "time-isolation" studies were conducted earlier this century, in which volunteers subjected themselves to environments devoid of 'zeitgebers', or time-givers, such as sunlight, social cues and other factors from which clues about the time of day could be guessed.

The most vivid of results concerned the tendency of time-isolated individuals to lengthen their normal 24-hour sleep/wake pattern to a 25-hour one. The remarkable stability of these rhythms in the absence of zeitgebers eventually led to the identification of a 'circadian clock' located in the hypothalamus.

Further studies exposed volunteers to alternate day/night rotations.

Researchers found that under laboratory conditions their sleeping patterns and other circadian rhythms gradually adapted to the new environmental conditions.

This demonstrates that environmental cues act to pull or "entrain" circadian rhythms into alignment with the day/night cycle.



Therefore to prevent the accumulation of excessive sleep debt, everyone should be provided with the opportunity for recovery sleep, ideally after every five days on duty.

Education: A syllabus of training on fatigue and fatigue management should be developed. It should include:

- The company's fatigue management system.
- Management's responsibilities with regard to the fatigue management system, occupational health and safety legislation, and civil aviation legislation.
- Employees' responsibilities with regard to the fatigue management system and related legislation.
- How to recognise signs of fatigue.
- How to assess the effects of fatigue on performance.
- How to obtain optimal rest when off duty.
- The risks associated with shiftwork and extended hours.
- How to adjust to shift changes.
- The relationship between fatigue and drugs like caffeine, alcohol, prescription and non-prescription medicines, marijuana, and amphetamines.
- The processes available to report hazards relating to fatigue.

Training should include exams and refresher courses should be conducted at regular intervals. Courses should be tailored to meet the needs of staff, management, schedulers and families.

Fatigue measurement and consultation: Systems must be established which help the organisation measure fatigue and its effects on performance on an ongoing basis. This should include regular analysis of actual hours worked.

Importantly there should be avenues for staff to report fatigue issues, and an appropriate feedback loop should be established to ensure staff know reports are being investigated.

Staff should have access to confidential and non-confidential reporting systems. Findings resulting from safety reports and meetings should be distributed to all staff.

Operators must consult with employees about fatigue at regular, defined and documented intervals.

Review: While CASA conducts its own audits of operators' fatigue management systems, these should be supplemented by regular internal reviews, at least on an annual basis. This will ensure operators respond to issues of concern, and that the system is continually updated and improved.

Contingency plans: What happens if crew members are not fit to fly, or if urgent maintenance is required at strange hours? Ideally, passengers should not be inconvenienced and regular operations should not be delayed, but in these situations operators need to allow for continued compliance with the fatigue management system.

If calling in off-duty staff, attention should be paid to recent work patterns when choosing who to call. Unpredictable work routines increase the extent of circadian disruption, so – when these arrangements are used – on site facilities for rest and adequate diet should be provided. Transport should be provided if required.

The last word: Drafted and implemented correctly, your system can have multiple benefits, and ultimately save both money and lives.

CASA's Aviation Safety Compliance Division has developed an example that illustrates how airlines should document a fatigue management system. For more information contact Tara Callaghan at callaghan_t@casa.gov.au

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Article includes extracts from the RAAF AVMED paper: "Maintaining the Maintainers: Alertness management for ADF personnel".

What's your fatigue score?

THE FATIGUE AUDIT INTERDYNE SOFTWARE (FAID) was developed in a collaborative process between the Centre for Sleep Research of the University of South Australia and the software developer InterDynamics. It is designed to calculate levels of fatigue based on proposed or operational rosters.

The software calculates work-related fatigue scores on the basis of: (i) one-week prior work history; (ii) the timing of work periods; (iii) the duration of work periods; and (iv) the biological limitations on the body's ability to recover.

To provide a basis on which to interpret fatigue scores FAID requires a risk level to be assigned to each shift of the roster. This represents the inherent risk of the tasks to be undertaken.

For example, a non-precision approach would be assigned a higher risk level than a precision approach. In maintenance, a task involving maintenance on a system that has built-in redundancies would be assigned a lower risk than one that did not.

Assigning a risk-level to a particular shift tells FAID whether a fatigue score is acceptable, given the inherent risk associated with the tasks involved. Thus, shifts assigned a lower level of risk will not be highlighted as a potential hazard until a relatively high fatigue score is reached. A high-risk shift will be highlighted as a potential danger much earlier.

FAID does take time to learn and monitor. Untrained use will not provide an accurate reflection of fatigue levels, and in reality the use of such software is only a small part of an overall approach to fatigue management.

Additional information can be found on the Centre for Sleep Research website (www.unisa.edu.au/sleep) or the InterDynamics website (www.interdynamics.com/faid).

Information concerning risk management and a limited license version of the software are also available on the InterDynamics website.