Dying for a rest:
how much of a problem is fatigue?

By Anne Isaac

Just after midnight on 24 March 1989, the single-hulled Exxon Valdez struck Bligh Reef off Alaska's southern coast. The tanker spilt 11 million US gallons of crude oil into the sea. The slick eventually covered 11 million square miles of ocean; hundreds of thousands of sea creatures died. Within two years, the local marine population and fishing industry had all but collapsed. Several residents, including a former mayor, committed suicide and the Alaska Native Corporation went bankrupt. Billions of dollars were paid in damages and fines. At the time of the accident, there were two crew members on the bridge. The third mate, then aged 25, was in charge of the wheelhouse and an able seaman was at the helm. Neither had been given their mandatory six hours off duty before their 12-hour duty began. Amongst its main findings, the US National Transportation Safety Bureau's (NTSB) accident investigators concluded that the Exxon Shipping Company's manning policies "did not adequately consider the increase in workload caused by reduced manning". The widely-shared belief that fatigue played a significant part in marine incidents had been made official. Yet, despite that unambiguous finding more than 20 years ago, the issues of reduced manning, increased workload and resulting fatigue have continued to play a major role in many transport accidents to the present day.

This event is not unique in the history of accidents involving loss of life. The Bhopal disaster, the Herald of Free Enterprise, the Challenger accident and the runway catastrophes at Tenerife and Linate all have strong factual evidence of fatigue, indicating the presence of poor decision-making leading to impaired operator activity with disastrous consequences. However, the issues of fatigue, shift work and sleep deprivation are poorly understood and a social phenomenon that is 'unpopular' at best and 'ignored' at worst by investigators and safety specialists since, in all these professional environments, the operational staff are considered highly trained, extremely competent and have a well developed sense of 'duty of care' towards their safety responsibilities.

Are there similar issues in the ATM environment? The short answer is yes. So what important points should we consider in the debate regarding fatigue? The main factors are concerned with the nature of fatigue, the issues of shift work and the inevitable consequences of sleep deprivation for specialists who work in a 24/7 environment.

What causes fatigue?

People get tired when they have been awake too long. Humans naturally tend to fall asleep or suffer from extreme fatigue between 2am - 3am. But how long is 'too long'? The harder people work, the sooner

Dying for a rest!: how much of a problem is fatigue? (cont'd)

they need time to recover. Workload itself is influenced by the design of the work, the equipment and procedures people must use and the expertise they have acquired through training and experience. In fact, the problem of workload and its measurement is a little more complicated than it appears at first sight. This is because it is the result of a mix of external and subjective factors. So why is workload a tricky problem? The main issue is associated with its definition, since there is little agreement on what workload actually is. Some researchers focus on the external demands of a working situation, whilst others concentrate on the person's experience of workload. Additionally, no clear relationships have been found between measures of external demand, subjective assessment and physiological indications of workload. The weight of demand a person can cope with is one focus for workload but another focus has to do with the pattern of demands. For example, talking on a mobile phone while driving a car is not generally considered to be a weighty workload task, but all the evidence points to the greatly increased risk of an accident; but being distracted or having to switch tasks occupies more of our attention and memory and increases the risk of making a mistake. The introduction of technology into both the flight-deck and the ATM environment will have inevitable consequences on the stress and fatigue experienced, particularly in training.

Being distracted or having to switch tasks occupies more of our attention and memory and increases the risk of making a mistake.

There is also the issue at the other end of the spectrum, namely having too little to do which can equally put safety at risk since boredom and monotony are as fatiguing as heavy workload. The bottom line is that a person's experience of workload is a combination of both the actual external demands of the job and the individual characteristics and expertise of the person doing the work.

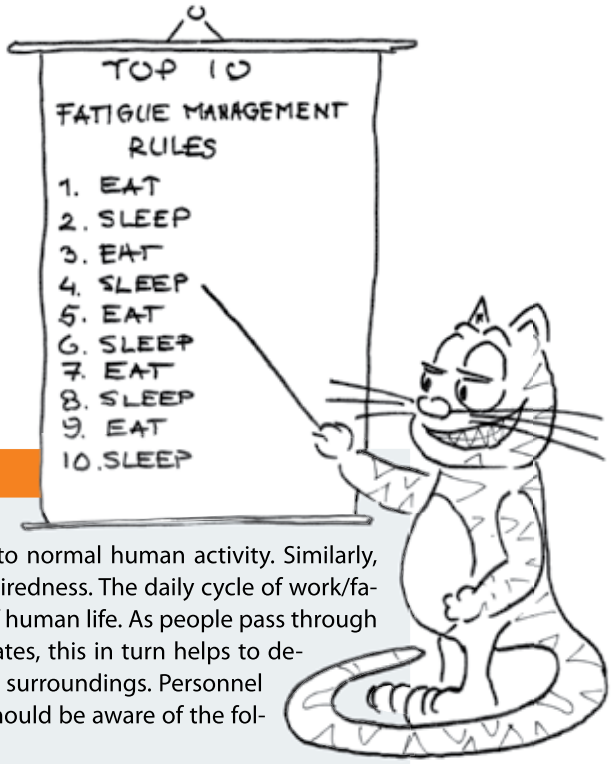
What are the effects of fatigue in the operational environment?

The main effects of fatigue on people at work are psychological. Accident records show that the mental effects of fatigue on the individual can readily translate into catastrophic physical events, affecting individuals, their teams and the wider organisation. The most potentially damaging effects of fatigue are inattention, and the fact that fatigued people often fail to acknowledge that their performance – both their own and that of others – is being degraded.

Key skills and behaviours affected by fatigue:

- **Slower information processing and degraded mental performance:** taking increasingly longer to transform data or process information; including confusion, poor concentration, narrowed perception and forgetfulness which leads to degraded vigilance and poor response to changing situations.
- **Faulty memory recall of recent events:** for example, the content of a radio message may be immediately forgotten or recalled incorrectly.
- **Omissions and carelessness:** people increasingly skip steps, miss checks and make mistakes.

Anne Isaac leads the Human Performance development work in the pilot/controller interface in NATS, UK. She gained her PhD in Cognitive Neuropsychology at Otago University in New Zealand. Her previous work has been in the development of incident investigation tools and techniques in European ATM, the introduction of TRM into the ATC environment and the introduction of Day to Day Safety Surveys techniques into NATS. She has written several book chapters, academic papers and the book Air Traffic Control: the human performance factors.



- **Slower comprehension and learning:** it takes longer and longer to understand any written or spoken information, or display patterns, e.g. a map or charts.
- **Worsening team performance:** this includes decreased interaction with crew/team members and degraded communication due to lower sensitivity to other people's needs and aims. People may become moody, irritable, argumentative or socially withdrawn, all of which can badly affect team relations.
- **Diminished personal safety:** reduced self- and situation awareness leading to apathy, neglect of normal safety precautions, and more risk taking.
- **Impaired leadership:** some people take longer to make decisions while others make poorer ones; the people themselves are often unaware of the decline.

Fatigue management

Fatigue is a normal human response to normal human activity. Similarly, sleep is a normal human response to tiredness. The daily cycle of work/fatigue/sleep is a normal, healthy part of human life. As people pass through this cycle, their level of arousal fluctuates, this in turn helps to determine how alert they can be to their surroundings. Personnel working in an aviation environment should be aware of the following fatigue management issues:

- **Perceived risk or interest: I**f people are stimulated by their sense of risk or interest in what they are doing, they can stay awake and alert for longer. However, the time they then need to recover from sustained activity will also get longer. If people are engaged on tedious or boring tasks, they will feel tired sooner.
- **Environment:** People become more fatigued in environments with bad levels of light, noise, vibration, temperature and motion.
- **Time of day:** People live by a natural daily rhythm, which means that they feel least alert in the small hours of the morning and most alert in the period before midday.
- **Fitness and exercise:** People who are overweight and/or lacking in exercise will tend to feel fatigued earlier than their leaner, fitter or more active colleagues.
- **Food and diet:** Inadequate levels of nutrition accelerate the onset of fatigue. Different foods also affect alertness. For example, heavier meals dominated by carbohydrates encourage sleepiness, while lighter, protein-based meals encourage wakeful alertness.

  Food is a powerful fatigue management tool. Fatigue levels may be partly controlled by what you eat and when. Here are some key tips:

  - Meals made up largely of carbohydrates facilitate better sleep
  - Meals made up largely of protein assist wakefulness and activity
  - Regular meal timings help to regulate the human 24-hour cycle
  - On night duty, main meals should be eaten before 01.00 hrs
  - After night duty, a light snack of carbohydrates should be taken no later than two hours before expected sleep time
  - Drinking alcohol before sleep is a bad idea – it may help you to 'drop off', but shortens the deep sleep you really need
  - Taking caffeine within 4 hours of sleep is likely to disrupt the sleep you get. But it can assist nap recovery.

- **Length and quality of sleep:** People need adequate time to sleep and good recovery demands that the sleep itself is of good quality. 'Sleep debt' is an insidious product of disrupted and poor quality rest and is often identified as a contextual factor in occurrences.