Managing Fatigue in Transport

Causes of, and contributing factors, to fatigue.

Whilst the GUILD does not purport to be an expert in this area we would like to offer the following observations.

The history of Air Transport goes from the extremely frail post World War 1 converted DH-9A and Bristol Tourer types, which carried the rather well off and adventurous to to-day's mass transit aircraft in which the majority of passengers are neither particularly well off or adventuresome and who demand a totally safe system no matter who provides it.

The inter-war period, which has been called the Golden Age of air transport, saw the use of aircraft such as the "Empire" flying boats which with their spacious cabins, leisurely cruising speeds and night stops in exotic locations gave rise to the romance of airline travel which the airlines still use in their advertising campaigns today. These aircraft were also multi-engined and multi-crewed which provided the safety and reliability which the passengers and postal authorities (main customer) were starting to demand. Apart from the cabin crew, a typical flight crew consisted of Captain and Co-pilot, Navigator, Flight Engineer and Radio Operator.

The onset of the Second World War saw the demise of this form of air travel to be replaced by necessary civilian travel only. This period saw the introduction of massed daylight and nightime bombing over Europe, long range oceanic reconnaissance and Australia's first ultra-long haul route from Perth (WA) to Lake Koggala (Sri Lanka) and return. (order of the Double Sunrise) After the war, with the construction of longer runways and the introduction of such capable aircraft as the Lockheed Constellation and Douglas DC6 the flying boats were soon abandoned.

In the austere years after the war, economies were sought and demanded, commercial reality over national prestige became a necessity. Governments both here and in Great Britain nationalised airlines and strictly controlled entry, something which has only been reversed in the last decade or so. The Berlin Airlift helped to streamline our air traffic control systems and more passenger seats were installed in fuselage areas which once would have held "smoking rooms" and the like. In the cockpit with improved radio communication, the radio operator was the first crew member to be made redundant. The first step towards our two crew flight decks of today had begun.

With the advent of the turbine engine the writing was on the wall for the great piston engined airliners and with the introduction of jet aircraft in the late fifties and early sixties their fate was sealed. Jet aircraft brought not only vastly increased speeds and consequent decreases in block times but concurrent improvements in air navigation and air traffic control systems. The next crew member to be dispensed with then, was the navigator.

With their cruising speeds of around 500 knots (925 km/h) and long range it was now possible to fly to London from Sydney in a little over twenty-four hours. For the first time, crews and passengers alike learnt about "jet lag" and something called "Circadian rhythms". This rapid transit of a number of time zones is a major cause of fatigue for the long haul flight crew.

At this time Boeing 727 and Douglas DC 9 aircraft were introduced to Australia's Domestic Airlines and world wide saw the explosion of Tourist Class Travel required to fill these expensive aircraft. The ultimate tourist class aircraft was the Boeing 747 and to a lesser extent, but not used in this country, the Douglas DC 10 and Lockheed TriStar. All these aircraft with the exception of the DC 9 still carried a flight engineer.

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In the early eighties, the Boeing 767 and Airbus A300 aircraft entered service. Both aircraft were originally designed as three cockpit crew aircraft and were quickly redesigned as two crew aircraft without the flight engineer. The age of the digital cockpit and extensive automation had arrived. When Boeing applied this technology to its flagship to create the B 747 - 400 the world finally had an aircraft which could fly London - Singapore or Sydney - Los Angeles non-stop. A boon for the passenger, but with seventeen hours of duty time and multiple time zones, an aircraft which has presented a real challenge for the management of fatigue in flight crews.

In the last fifty years airliners have progressed from 320 km/h with five crew to 925 km/h, two crew aircraft flying in a more congested airspace, operating vastly more complex aircraft for longer duty times whilst carrying ten times the number of passengers.

The catch-cry of modern business has been to do more with less and aviation is no different. Whilst the top end of the aviation industry is well organised for negotiations between flight crews and employers the same cannot be said for General Aviation. There are many aviation enterprises which run on a shoe string budget and many young pilots are eager for a start in the business to advance them towards their goal of a seat in a major airline. These pilots invariably fly very long and fatiguing days but are unwilling to complain as they know that there is always another young hopeful ready to take their place. Whilst recent events have done much to clean up the low capacity RPT operators, aerial work has been left by the wayside. This will continue to happen until General Aviation is recognised as the foundation for much of the aviation activity in this country. Allowing poor practices to flourish in one area of professional aviation does not convey the correct message to our would be airline captains.

In spite of all aviation's advances, the human flight crews still remain central to safe aviation operations. Fatigue, sleep loss, and circadian disruption caused by flight operations can degrade performance, alertness and safety. The circadian clock, referred to earlier, is a powerful modulator of human performance and alertness and it can be disrupted in aviation through night flying, time zone changes and day / night duty shifts.

Due to legislative, commercial and consumer pressures, the optimum departure and arrival times at many of the world's airports are not conducive to the optimal sleep patterns for the flight crews operating those services. However, the following points (not exhaustive) need to be considered when scheduling these crews;

- The need for an appropriate quantity and quality of sleep prior to duty. Current scientific data is clear that the "average" human physiological requirement is for eight hours of sleep to maintain performance and alertness. Therefore there is a basic requirement to allow for an eight hour sleep opportunity every twenty-four hours. This does not equate to a flight crew member finishing a period of duty, having an eight hour rest period and then commencing duty immediately.

- Length of continuous wakefulness;

    1. This complements rest time and is equated to operational Duty Time. OH & S studies have identified decreases in performance and alertness and increases in errors and injuries when working shifts are extended beyond twelve hours.

    2. For ultra long haul flights with extended tours of duty and flight time, onboard crew rest facilities are required along with an augmented crew.

- Circadian factors and the time of day. For aviation operations this involves the following;

    1. Night Flying. Twelve hours of night duty with a circadian low occurring between 3 am to 5 am is more onerous and fatiguing than a twelve hour daylight tour of duty.

    2. Time zone changes can significantly disrupt internal circadian physiology. Longer time spent in a new time zone may facilitate adaptation to the local time zone, which may or may not be advantageous to the operational requirement. In some cases, a quick turnaround and minimal adjustment to a new time zone may be more desirable than a longer layover. In this case allowance should be made on the return to the

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base station for the full recovery and readaptation of the crew. Direction of travel through the time zones is also of importance. Studies have shown that recovery from long eastward flights takes longer than on westward flights and this is of particular importance given that the UK and USA make up the bulk of Australia's long haul destinations.

3. Circadian disruption also occurs when changing between day and night flying over a short time frame. The body's clock cannot adjust to rapid day to night (or night to day) rostering changes.

- Minimising cumulative effects;

  Early starts which require individuals to wake and work during their circadian low can lead to acute fatigue from partial sleep loss. If sleep periods are not scheduled, protected or of sufficient length, then this "acute fatigue" will lead to chronic fatigue. Optimal sleep every twenty-four hours with two good nights sleep every seven days to clear the accumulated "sleep debt" should be allowed.

  In cases where operations are conducted from remote sites with extensions of normal flight and duty time limits then an extended period away from all duty is required. Typically, these remote site operations allow equal time off for time worked and therefore mitigate against cumulative fatigue.

  Minimising fatigue in day / night operations, especially those which cross several time zones is particularly complicated. It has been suggested that a minimum of three days and up to seven days is required depending on the time that has been spent on a night tour which may have been spent in a different time zone to the home station. Current work indicates that a seven day rest period will deal with most changes in circadian shifts.

Consequences of fatigue in Air Transport

The consequences of fatigue in air transport can range from minor parking incidents to major accidents causing total hull loss and large loss of life, or to anything in between.

The following extract from "Flight Safety Australia" April 1999 illustrates well the effects of fatigue;
"Regardless of how a pilot may feel, NASA research shows clearly that fatigue caused by no rests and long hours of work steadily reduces a pilot's performance. Fatigue makes a pilot less vigilant, more willing to accept below par performance and begin showing signs of poor judgement. The pilot may find it increasingly difficult to make decisions and may have to re-check information several times because of impaired memory or inability to process information. Alertness is decreased and reaction times are increased. Irritability and mood swings easily block communication and hamper Cockpit Resource Management (CRM) principles. Additionally, fatigue leads to slower physical and mental reaction times, increased errors despite increased effort, variability and unpredictability in performance, preoccupation with a single task or fixation on a single source of information, and perseverance with ineffective solutions, all with the potential to create sloppy flying."

In today's competitive marketplace companies exist who would like to work their crews unreasonably. Even companies with sound and legal flight and duty schemes schedule crews to tours of duty which many participants feel are unsafe and which in their opinion would prevent them from acting immediately and correctly in emergencies, particularly at the end of final sectors.

This is hardly a desirable situation for our flight or cabin crews to be in, especially in a busy terminal area at night in poor weather.

The safety of passengers and persons on the ground is not solely the responsibility of flight and cabin crews, but also includes such personnel as Air Traffic Controllers, Maintenance Engineers, Ground Handling and Scheduling personnel. All these people must be free of the effects of fatigue for the safe completion of any flight.

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The economic loss both directly and indirectly caused by incidents and accidents is an area in which we are unable to offer any statistical evidence. However any incident or accident which lowers the public's perception of air safety damages not only the airline industry, but consequently, the tourism industry which is of course, the major client group.

Initiatives in transport addressing the causes and effects of fatigue

There are many research institutes carrying out studies in these areas. Some, such as the Centre of Sleep Research, University of South Australia under Associate Professor Drew Dawson, have carried out research into fatigue which is relevant to all modes of transport and is interesting because they have suggested a way in which to quantify fatigue. Following is an abstract of their work;

"Equating the Performance Impairment associated with Sustained Wakefulness and Alcohol Intoxication"

This study equated cognitive psychomotor performance impairment associated with alcohol intoxication and sustained wakefulness. By doing this it was possible to quantify the impairment associated with sustained wakefulness and express it in a blood alcohol equivalent.

Forty subjects participated in each of two counterbalanced experiments. In one, participants were kept awake for twenty-eight hours and in the second group, participants were given 10 grams of alcohol every thirty minutes.

The results suggest that even relatively short periods of sustained wakefulness produce performance impairment equivalent to, or greater than is currently acceptable for alcohol intoxication. The researchers claim that after seventeen hours of sustained wakefulness your cognitive psychomotor performance loss is the same as if you had a blood alcohol concentration of 0.05 per cent. After twenty-four hours of sustained wakefulness, performance at a hand-eye co-ordination task is on par with someone with a blood alcohol concentration of 0.1 per cent.

A fatigue model reflecting this work has been produced by the University and is available to interested parties

Overseas many noted Institutes have carried out research into this area for a number of years. NASA Ames Research Centre along with the United States Navy Medical Service Corps and University of Pennsylvania School of Medicine have produced many papers which were the basis of the US Governments attempts to change flight and duty time regulations in that country. This particular group has also carried out much important work with the long haul crews of Air New Zealand and the New Zealand CAA. The National Business Aircraft Association (NBAA) of the USA has conducted workshops for corporate aircraft operators with particular emphasis on the emerging ultra long haul aircraft types such as the Gulfstream GV and Bombardier Global Express. Professor David Dinges from the University of Pennsylvania will be in this country speaking at the "Sleep Deprivation & Disasters" public education symposium which is to be held on the Gold Coast on the 31 st of July this year.

In the United Kingdom the Defence Evaluation and Research Agency (DERA) along with the UK Civil Aviation Authority Safety Regulation Group have worked together to produce various computer models for measuring aircrew fatigue. They have a particular interest in and have long term studies on the UK to Australia flights as they have found that the greatest disruption of sleep - wake patterns of all the long haul crews they studied were found on this sector.

In general the research bodies have identified five broad initiatives to address the management of fatigue in the aviation environment. The work being carried out in this area is by no means limited to the representative examples which we have shown below;

1. Education - fatigue and alertness management in flight operations;

2. Strategies - a thirty minute NASA nap for long haul crews;

3. Technology - predictive models and algorithms, such as the Drew Dawson model;

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4. Design - onboard rest facilities for augmented long haul operations;

5. Research - continuing the financing of fatigue study centres.

For the last nine years the Australian Civil Aviation Safety Authority (CASA) have been considering proposals to overhaul the Civil Aviation Order, CAO 48 which regulates the flight and duty time limits for professional aircrew in this country. As of April this year ten percent, or around 460 of all concessions against aviation regulations had been granted against this order, demonstrating among other things that the order was both inflexible and inadequate. As the system of granting concessions against this and other regulations was not vested in any central body , Flight Operations Inspectors (FOIs), who were not trained in human fatigue management were able to grant concessions against the order. Invariable some concessions were granted which, when investigated by State Occupational Health and Safety Departments cast doubt on their acceptability from a "work safe" viewpoint.

CASA has responded to this situation by proposing "Operator Flight and Duty Time Limitation Schemes" for commercial air transport operations using both fixed and rotary winged aircraft. Two discussion papers, DP9904RP and DP9906RP respectively are presently in the public forum for comment. The regulatory framework proposed, is based on the current British CAP 371 and Hong Kong CAD 371. The papers specifically address passenger carrying operations, while posing the question;

To what extent, if any, should CASA prescribe Flight Time Limitations for commercial operations other than air transport?

As the closing date for responses has not yet passed and the actual legislation is some time in the future we have enclosed the GUILD's response to these papers and the questions posed within for your consideration. In summary the GUILD supports CASA's proposal but has suggested changes to improve the document. We also believe that CASA should prescribe an FTL framework for all commercial operations and should consider corporate aviation which is presently classified as a "Private Operation" and is therefore not subject to any flight and duty time limitations.

Ways of achieving greater responsibility by individuals, companies, and governments to reduce the problems related to fatigue in transport.

The GUILD recommends the partnership of sleep research units, such as the one at the University of South Australia with a specialised Flight and Duty Time office in CASA . This, along with links to recognised institutes overseas, such as the US NASA Ames research centre and the DERA Centre for Human Sciences in the UK would enable the latest knowledge and practices to reach industry and government quickly.

Flight and Duty Time Limitation Schemes which are devised by companies to ensure operational safety should be equally applicable to ensure the health and occupational safety of the flight crew. The formulisation of fatigue limits and rest provisions within these schemes must be free from commercial pressures.

With the growing global demand for aviation services, the safety and productivity issue of managing fatigue will remain and potentially worsen as human resources are generally remaining the same. Attempts to deny, minimise or distract from fatigue as an operational issue will only delay effective action while the risk continues or increases.

Of course the individual has a responsibility to manage fatigue both within his personal life and in the workplace. Whilst "all work and no play, may make Jack a dull boy" , the flight crew member needs to balance adequate rest with leisure time pursuits and moderate consumption of substances such as coffee and alcohol. That being said, the crew member does have a right to a private life, which if fulfilled does help to alleviate stress and therefore fatigue. Flight crew who spend their whole time away from duty periods trying to recover from fatigue before going back to duty invariably bring problems and discontent into the cockpit which does not engender safety.

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CASA must continue to provide a framework for flight and duty time schemes for all commercial operations in this country and ensure that they are adhered to. For General Aviation a flexible framework will have to be devised to allow for the many varied operations performed.

Education at a community level is required to increase the acceptance of fatigue management, as pushing on when you are tired to get a job done is seen as a very worthwhile attribute. Whilst not belittling the individual who is goal oriented, there is no point in being "Dead Tired" whilst on the job. All too often others suffer permanently when this occurs.

Unfortunately a pilot is unable to stop for a "Driver Reviver" in a nearby rest area, so individuals, companies and governments need to foster a responsible attitude towards fatigue. Over the years the aviation community has successfully recognised and overcome many major safety issues to achieve what is now an admirably low accident rate within the transport industry. However if we wish to maintain at least this level, and the GUILD wishes for better, then now is the time to address fatigue in aviation and manage it.

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