Australian Government

Australian Transport Safety Bureau

ATSB RESEARCH AND ANALYSIS REPORT

Aviation Safety Research Grant – B2004/0048

Final

Fatigue Management in the New Zealand Aviation Industry

Leigh Signal, Denise Ratieta & Philippa Gander

Sleep/Wake Research Centre, Research School of Public Health, Massey University

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Aviation Safety Research Grants Program

This report arose from work funded through a grant under the Australian Transport Safety Bureau's Aviation Safety Research Grants Program. The ATSB is an operationally independent bureau within the Australian Government Department of Transport and Regional Services. The program funds a number of one-off research projects selected on a competitive basis. The program aims to encourage researchers from a broad range of related disciplines to consider or to progress their own ideas in aviation safety research.

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CONTENTS

DOCUMENT RETRIEVAL INFORMATION

Report No.	Date	No. of pages	ISBN
B2004/0048	April 2006	51	1 921092 41 6

Title of report

Fatigue management in the New Zealand aviation industry

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Funded by

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PO Box 967, Civic Square ACT 2608 Australia
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Acknowledgements

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Abstract

The aim of the study was to determine how New Zealand aviation organisations are managing fatigue. Three questionnaires (one each for management, rostering, and line pilots) were sent to each organisation holding a Part 119 air operator certificate. One hundred and fifty-three questionnaires (out of 480) were returned from 55% of the companies study packs were sent to. Ten of the responding companies were large aircraft operators (Part 121 operators), 10 were medium aircraft operators (Part 125 operators), and the remaining 77 were general aviation or helicopter operators (Part 135 operators).

Most Part 125 and Part 135 organisations reported adhering to the prescriptive flight and duty time limits, while Part 121 organisations had either a Fatigue Management Scheme (FMS) or another company-specific accredited scheme in place. Comparisons between organisations that complied with the prescriptive limits and those that indicated their company had a FMS or other accredited scheme, showed no differences in ratings of how well fatigue was managed, the number of fatigue management strategies in place, and their frequency of use.

Part 121 and Part 125 organisations reported using more fatigue management strategies compared with Part 135 operators. Monitoring the flight and duty times of pilots, and monitoring pilot workload were the most frequently used strategies while fewer organisations report educating their rostering staff or reviewing company processes for managing fatigue.

Comparisons between management and line pilots in the same organisation showed that significantly more management staff considered that their company educated their pilots and management staff compared with line pilots. Management personnel were also more likely to indicate that their organisation monitored pilot workload, identified and managed fatigued personnel, and reviewed company processes for managing fatigue.

The findings of this study indicate that there are air transport operators in New Zealand who are taking a comprehensive approach to fatigue management. However, for many operators the findings suggest that fatigue is not particularly well understood or managed. The findings of this study strongly suggest that there is a need to raise industry awareness of the causes and consequences of fatigue, and processes for its management. This may also be relevant to the Australian aviation industry.

ACKNOWLEDGEMENTS

We would like to gratefully acknowledge the involvement of the many air transport operators in New Zealand, who took the time to respond to the questionnaire. Many thanks also to representatives from the New Zealand Airline Pilots Association, the Aviation Industry Association, the New Zealand Civil Aviation Authority and the Civil Aviation Safety Authority who contributed to the design and development of the study.

We would also like to acknowledge the funding support from the Australian Government through the Australian Transport Safety Bureau's Aviation Safety Research Grants Program.

ABBREVIATIONS

AIA	Aviation Industry Association
ATSB	Australian Transport Safety Bureau
CAO	Civil Aviation Order
CAA	Civil Aviation Authority (NZ)
CASA	Civil Aviation Safety Authority (Australia)
CRM	Crew resource management
FMS	Fatigue management scheme
ICAO	International Civil Aviation Organization
IFR	Instrument flight rules
MCTOW	Maximum Certified Take Off Weight
NZALPA	New Zealand Airline Pilots' Association
NZCAA	New Zealand Civil Aviation Authority
OSH	Occupational safety and health
ULR	Ultra long range
VFR	Visual flight rules

EXECUTIVE SUMMARY

We presently know very little about how fatigue is being managed in the New Zealand aviation industry. The present study aimed to gather information on how New Zealand aviation organisations are managing fatigue, the different strategies being used, the advantages and disadvantages of different approaches, the barriers companies are facing in managing fatigue, and the resources used or required to help organisations better manage fatigue.

Methods

All New Zealand-based aviation companies holding a Part 119 air operator certificate were invited to participate in the study (a Part 119 certificate is required to conduct air operations that involve carrying passengers or goods for hire or reward). Three questionnaires were sent to each organisation: one to an individual in a management position; another to a person in a rostering position; and the third to a line pilot.

With assistance from industry representatives a questionnaire was designed that included questions on: the structure of an organisation and the type of operations conducted; the use of fatigue management strategies in the organisation; how flight and duty time limits were met within the organisation; how well the organisation was managing fatigue; and how issues around fatigue management worked in the organisation.

Results

Responses from organisations were categorised according to the rule they operated under (Part 121 large aircraft operators; Part 125 medium aircraft operators; and Part 135 helicopter and small aircraft operators). One hundred and fifty three questionnaires were returned (out of 480), which included responses from 10 Part 121, 10 Part 125 organisations and 77 Part 135 organisations. This represents 55% of the companies questionnaires were sent to. The distribution of company responses is considered representative of the makeup of the New Zealand industry.

As expected, organisations operating under Part 121 were, on average, large organisations, operating similar aircraft in a relatively controlled environment. At the other end of the continuum, and also as expected, organisations operating under Part 135 were generally small, and operated single piston-engine aircraft and helicopters. These organisations were far more diverse in the type of work conducted and the conditions under which this work was done (e.g. all types of airspace and from all types of aerodromes). Part 125 organisations fell very much in the middle of the other two categories.

When asked about the use of 10 different fatigue management strategies in their organisation, 60% of both Part 121 and Part 125 organisations reported having 8 or more fatigue management strategies in place, while only 28% of Part 135 operators reported this number. Monitoring the flight and duty times of pilots, and monitoring pilot workload were the most frequently used strategies. Fewer organisations report educating their rostering staff or reviewing company processes for managing fatigue.

Examples of how these strategies were implemented in companies varied widely. Some companies had excellent ideas, such as including education on fatigue in Crew Resource Management courses. On the other hand, although many Part 135 respondents indicated that they educated their pilots, management and rostering staff,

they stated this was done by detailing what the flight and duty time limits or company policies were and/or that these were to be followed. These discrepancies existed in the examples given for most fatigue management strategies.

There was a wide range of additional fatigue management strategies reported by organisations, including promoting an environment in which pilots could easily indicate when they were fatigued, raising awareness of fatigue within the company, and the use of internal communication.

The majority of Part 125 and Part 135 organisations adhere to the flight and duty time limits specified in AC 119-2 (Advisory Circular 'Air Operations – Fatigue of Flight Crew'), with 10% having some minor dispensation to these limits. In contrast, most Part 121 organisations stated they had either a Fatigue Management Scheme or another company-specific accredited scheme.

Where two or more questionnaires were received from a company, and where one participant identified as a line pilot, and a second participant identified as having a management role, responses were compared (34 companies). Significantly more management staff than line pilots considered that their company educated their pilots and management staff. Management personnel were also more likely to indicate that their organisation: monitored pilot workload; identified and managed fatigued personnel and; reviewed company processes for managing fatigue.

Ratings by line pilots and management personnel of how well their organisation managed fatigued pilots were also compared. Line pilots from Part 121 or 125 organisations rated their organisation's management of fatigue as below average, and tended to give lower ratings than line pilots from Part 135 organisations, or management personnel from Part 121 and 125 organisations, who all rated fatigue as being moderately well managed.

Comparisons were also made between organisations that complied with the prescriptive limits specified in AC 119-2 and those that indicated their company had a Fatigue Management Scheme or some other flight and duty time scheme accredited by the New Zealand Civil Aviation Authority. Ratings of how well fatigue was managed, the number of fatigue management strategies an organisation had in place, and the frequency of use of each of the ten different fatigue management strategies did not differ between these two groups.

Replies to open-ended questions indicated that most respondents did not think that seeking information on fatigue management was necessary, or that they needed further help, advice or resources on better managing fatigue. Those respondents who did report seeking information on fatigue primarily indicated industry sources (industry publications, regulatory authority, and other industry groups). Further information was also commonly mentioned as a resource which would assist in fatigue management.

Safety, and improved staff performance, productivity and mood were seen as the primary advantages of an organisation's approach to fatigue management. Reduced flexibility was seen as a negative outcome, and the financial cost and staffing were the main barriers to fatigue management.

Discussion

There are certainly air transport operators in New Zealand who are taking a comprehensive approach to fatigue management, with some companies having systems in place that make them international industry leaders in this area. However,

in general, findings suggest that fatigue is not particularly well understood or managed by many operators. What is somewhat concerning is that many management individuals seem to believe they are managing fatigue well, but when asked specifically how this is being done, a large proportion of the examples indicate otherwise. This possibly signifies not only a lack of understanding of fatigue, but also what is involved in its management. This is further supported by the number of operators who indicate for various reasons that fatigue is not an issue for them, or that the use of 'common sense' is all that is required for managing fatigue.

The findings of this study strongly suggest that there is a need to raise industry awareness of the causes and consequences of fatigue, and processes for its management. It is suggested that the regulatory authority, industry bodies, and Occupational Safety and Health (OSH) representatives consider who is responsible for doing this, and what educational material and supporting resources need to be developed and made available to operators.

It is also suggested that the regulator carefully considers what supporting information it provides to operators and the fatigue management processes it requires operators to have in place. This is considered of particular importance for those organisations which have approval to operate under company-specific or accredited flight and duty time schemes where greater flexibility is possible.

The findings of this work may also have relevance to the Australian aviation industry.

1 INTRODUCTION

An Australian inquiry in 2000 into managing fatigue in transportation stated that 'fatigue is widely recognised as a core safety issue in the transport industry' (House of Representatives Standing Committee on Communication, Transport and the Arts 2000). Serious accidents or incidents, poorer workforce health and higher worker attrition rates are potential outcomes of not managing fatigue (Mitler et al. 2000). For high-risk occupations such as transportation and medicine, decreased safety margins not only have implications for the safety of the workforce but also for the general public.

Despite recognition of the role of fatigue in reducing safety, accurate information on the contribution of fatigue to aviation accidents or incidents is often difficult to obtain. Rates vary depending on the reporting system, timing and nature of questions asked, and the skill and knowledge of investigators. In the United States, fatigue has been identified as a factor in approximately 21% of the aviation incidents reported through the NASA Aviation Safety Reporting System (Rosekind et al. 1995). The New Zealand Civil Aviation Authority (NZCAA) reports that 0.2% of New Zealand incidents have fatigue as a contributing factor while in Australia the level is reportedly 7%. The NZCAA recognises that the New Zealand estimates are unrealistically low and believes the real rate is closer to 25% (Civil Aviation Authority of New Zealand 2000).

1.1 The inevitability of fatigue

Traditionally, fatigue has been managed in the aviation industry solely through the prescriptive regulation of hours of work. Historically, this approach has had limited success, largely because it addresses only one part of the problem, that is, fatigue related to work duration. More recently it has been recognised that, to appropriately manage fatigue in this work environment, other fatigue-inducing factors must also be considered. These include sleep-related factors, which relate to the physiological requirement for an optimal daily amount of good quality sleep and circadian factors, which refer to the underlying physiological processes that effectively programme individuals to be asleep during the night and awake during the day. The contribution of intrinsic sleep- and circadian-related factors to fatigue means that fatigue is inevitable in any occupation where individuals are required to work when they would normally be asleep (Gander 2001). Thus, fatigue management will always entail the minimisation, rather than elimination, of fatigue.

1.2 The internal drive for sleep

The amount of prior sleep obtained is one factor that will influence the duration and quality of sleep an individual obtains. This is known as the 'sleep homeostat' (Dijk and Czeisler 1995). It can be thought of as an internal drive for sleep, which increases across a normal day of wakefulness and contributes to maintaining sleep at night. It also increases when sleep has been prevented, shortened, or is of poor quality, and decreases when sufficient sleep has been obtained.

1.3 The circadian biological clock

The second factor that influences sleep duration and quality is the circadian biological clock. The clock is a group of cells located in the brain that controls the peaks and

troughs in daily functioning across a range of physiological and behavioural variables, including the temperature, hormone levels, the sleep-wake cycle, and performance (Dijk 1997).

The circadian contribution to sleep is maximal in the early hours of the morning (3 to 5 am) with another, smaller peak in sleepiness in the middle of the afternoon (Czeisler and Khalsa 2000). The circadian system also helps maintain wakefulness during the day, with sleep rarely being initiated, and difficult to maintain, during the late morning and again a few hours before normal bed time. These are often referred to as 'wake-maintenance' zones (Dijk and Czeisler 1995). The circadian clock, therefore, effectively 'programmes' us for wakefulness during the day and sleep at night (also known as being diurnal).

The circadian clock has a natural tendency to run slightly slow (longer than 24-hours) but is kept in time with the 24-hour day-night cycle by environmental cues, particularly exposure to light (Pittendrigh 1981). The pattern of work and rest, physical activity (Van Cauter et al. 1993) and social interaction (Aschoff et al. 1971) are additional, weaker cues that help keep the clock in time with the day-night cycle.

1.4 Jet lag

After rapid travel to another time zone, an individual's circadian clock will be out of step with the local day-night cycle. However, the circadian clock can adapt the timing of the physiological and behavioural variables that are under its control, albeit relatively slowly. Depending on the number of time zones crossed, the different physiological rhythms will shift over a number of days, becoming aligned with the local day-night cycle. Another key property of the circadian clock is its ability to ensure each physiological system is in time with all the others (Comperatore and Krueger 1990).

Often, after travelling to a new time zone, people complain of symptoms such as daytime sleepiness, difficulty sleeping, impaired performance, and gastrointestinal complaints. These symptoms are known as jet lag and are thought to be largely due to the body's rhythms being 'desynchronised' or out of step with the environment. A further factor thought to contribute to jet lag is the various physiological and behavioural rhythms being out of step with each other (Arendt et al. 2000), as each system adjusts to the new time zone at a slightly different rate from the others.

1.5 Shift work

Shift work in its broadest sense is work that is scheduled outside normal daytime working hours and therefore requires sleep to be displaced from its normal night time location. Because of the above-mentioned characteristics of the circadian and sleep-wake system, particular problems are created for shift workers.

Shift workers often report similar symptoms to those seen with jet lag and for similar reasons. When a shift worker changes to a new shift schedule, such as working at night and sleeping during the day, many of the cues that keep the circadian clock in time with the day-night cycle encourage the circadian pacemaker to shift to the new pattern of work and rest. As a consequence, the body's systems get out of step with the day-night cycle and each other, like after travel to a new time zone.

For a shift worker there is a further complication. The change in the pattern of work and rest creates conflicting cues for the circadian clock, which attempts to adapt to the

new pattern of activity and sleep, but is constantly drawn back to its diurnal orientation by exposure to daylight. The result is incomplete adaptation to the new work pattern. Gander et al. (1998a) demonstrated this in pilots flying overnight cargo on domestic routes. The pilots crossed no more than one time zone in 24 hours and normally worked either three or five night shifts in a row. It would be expected that if the pilots completely adapted to their night schedules, then their circadian rhythm of body temperature would shift by 12 hours. However, the study findings indicated that on average the rhythm of body temperature only changed by 2.8 hours.

In addition, frequent changes in the pattern of work and rest may have the potential to result in the circadian clock being almost constantly out of step with the 24 hour light-dark cycle, resulting in the shift worker constantly experiencing jet lag like symptoms (Gander et al. 1998a).

The circadian clock also acts to shorten the sleep of the shift worker, particularly the night worker, who would normally attempt their main sleep episode after finishing work (Åkerstedt 1991). The high drive for sleep (after being awake all night) should help falling asleep, but the circadian system makes staying asleep difficult. Irrespective of the amount of sleep obtained, the circadian clock produces a wake-up signal mid to late morning (the morning wake maintenance zone) resulting in reduced sleep duration (Gander et al. 1998b). In the study of overnight cargo pilots (Gander et al. 1998a), it was shown that regardless of the time of sleep onset after the night shift, the pilots consistently woke in the wake maintenance zone. Other disturbances such as noise (Knauth and Rutenfranz 1972), lighting levels, social and domestic commitments may also play a role in reducing daytime sleep. The consequence is that the duration of sleep after a night shift is approximately two thirds of a normal night's sleep (Åkerstedt 1998).

It is not only night work that affects sleep duration. Due to our circadian system we find it difficult to go to sleep earlier than normal, thus a shift requiring an early morning start will result in truncated sleep. Late evening shifts can also delay bedtimes resulting in a reduced amount of sleep.

1.6 Acute and chronic sleep loss

Sleep loss can be acute, or chronic (accumulate over days and weeks), and does not necessarily mean going completely without sleep. If the amount of sleep obtained each day is shortened, for example, over a number of days of early starts, the effects will accumulate and an individual develops a 'sleep debt'. Sleepiness, performance, and mood become progressively worse. Operating with a sleep debt reduces alertness and performance at all times in the circadian cycle.

1.7 The consequences of fatigue

The precise nature of fatigue is diverse and insidious. As fatigue increases, accuracy and timing degrades, lower standards of performance are unconsciously accepted, the ability to integrate information into a meaningful overall pattern is degraded and a narrowing of attention occurs that leads to forgetting or ignoring important aspects of tasks (Perry 1974). Generally, as sleepiness increases, performance becomes less consistent, especially during the night hours (Dinges and Kribbs 1991). Problem solving and reasoning are slower than normal, psychomotor skills are degraded and the rate of false responding is increased (Caldwell 1997). There is some evidence to suggest that the ability to assess risk degrades with increasing sleep loss, and that

individuals become less concerned with negative consequences (Harrison and Horne 1998). In addition, the fatigued individual tends to withdraw from social interaction with others, especially in a highly automated environment, and the ability to effectively divide resources between tasks is lost (Harrison and Horne 2000). All these aspects of performance are integral to the effective functioning of individuals performing complex tasks, such as operating aircraft.

It has been reported for many years that mood changes also occur with sleep deprivation. The reduced ability to control mood and behaviour is reflected in the reports of increased irritability, impatience, reduced social inhibitions, inappropriate interpersonal behaviour and childlike humour (Horne 1993). It has been shown that mood is more negatively affected when the tasks being performed are more demanding and complex (Angus et al. 1995).

It has been well demonstrated that the biological limits imposed by fatigue will impair the performance of even the most highly skilled and motivated individuals (Dinges 1991). The effects of fatigue cannot be overcome by training or experience. In addition, the impact of fatigue cannot be negated by monetary or other incentives.

1.8 Fatigue management schemes

To better manage fatigue in the operational environment, multi-faceted approaches that incorporate recent scientific findings are being considered. Such approaches are often referred to as Fatigue Management Programmes, Schemes, or Systems. In this document they will be referred to as Fatigue Management Schemes (FMSs).

FMSs take a more 'holistic' approach to managing fatigue, and often form an integral part of an organisation's approach to occupational health and safety. They are generally composed of a number of elements including: clear workplace policies and procedures; good rostering practices; an informed work group; active management involvement; and effective monitoring of safety-related outcomes. They have been introduced on the basis that '…better results (both in terms of safety and productivity) might be obtained from approaches that are more comprehensive, more flexible, and better tuned to current scientific understanding of key factors in fatigue prevention' (Fatigue Expert Group 2001).

It should be noted, however, that FMSs represent a relatively recent approach, and the implementation, acceptance, and benefit of such systems is yet to be scientifically validated.

1.9 Regulatory background

The International Civil Aviation Organization (ICAO), which sets standards and recommended practices that member States should follow, specifies that regulatory authorities should 'establish regulations specifying the limitations applicable to the flight and duty time periods for flight crewmembers.'

In Australia, this is specified for flight crew in Civil Aviation Order (CAO) 48. These limits are effectively arbitrary and based on industrial practices that existed 50 years ago. CAO 48 has been criticised for its complexity, its inappropriateness for some industry sectors, and its lack of scientific basis (Civil Aviation Safety Authority: Australian Government 2004). For these reasons, many Australian air operators have sought and been granted exemptions to these limits. The Australian Civil Aviation Safety Authority (CASA) is now considering alternatives to the existing prescriptive

limits, in an effort to more effectively manage fatigue in the industry. In fact in 2003, an assessment was made of the perceptions of 16 general aviation operators who implemented a trial FMS (Centre for Sleep Research 2002). Findings indicated that operators supported the concept of FMSs, but found the implementation process difficult. This was reportedly largely due to a lack of assistance and resources from the regulator.

New Zealand has taken a similar, prescriptive approach to flight and duty time limits. However, in 1995, the regulations were altered so that air operators could meet the flight and duty time limits by either complying with a standard prescriptive scheme or by applying to the NZCAA to have an alternative, company-specific scheme approved. In the alternative scheme, operators must consider additional factors that may result in fatigue, such as: rest periods prior to and in flight; effects of time zone changes and night operations; crew composition; type and amount of workload; and the cumulative effects of work. However, in essence, the alternative schemes are still based around prescriptive limits as the sole method of managing fatigue.

1.10 The present study

Despite the regulatory changes in New Zealand, we still know very little about how fatigue is being managed in the New Zealand aviation industry. The present study aimed to gather information on how New Zealand aviation organisations are managing fatigue, the different strategies being used, the advantages and disadvantages of different approaches, the barriers companies are facing in managing fatigue, and the resources used or required to help organisations better manage fatigue.

2 METHOD

2.1 Participants

All New Zealand-based aviation companies holding a Part 119 air operator certificate were invited to participate in the study. A Part 119 air operator certificate effectively allows an organisation to conduct air operations that involve carrying passengers or goods for hire or reward[1]. An organisation holding a Part 119 air operators certificate will, depending on the weight of the aircraft operated and the number of passenger seats, also work under one of three categories of rules:

- Large aircraft operators work in accordance with the rules specified in Part 121[2].
- Medium aircraft operators work in accordance with the rules specified in Part 125[3].
- Helicopter and small aircraft operators work in accordance with the rules specified in Part 135[4].

In October 2004, there were 160 organisations listed as holding a Part 119 air operator certificate in the NZCAA database. Three questionnaires were sent to each organisation. One was addressed to an individual in a management position, another to a person in a rostering position, and the third to a line pilot.

2.2 Measures

Originally, the intention was for the questionnaire to focus almost solely on how FMSs were being implemented in the New Zealand aviation industry. However, after consultation with the industry working group, it was recognised that very few organisations were truly utilising a non-prescriptive approach to managing fatigue. As a result, the questionnaire was redesigned so that questions were more applicable to all organisations and addressed issues around the general management of fatigue, including, but not limited to, the implementation of an FMS.

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1 Air operations are divided into two categories: Air Transport Operations (ATOs) and Commercial Transport Operations (CTOs). ATOs refer to the carriage of passengers for hire or reward (with some exceptions). CTOs also refer to the carriage of passengers for hire or reward but where the passengers are performing a task, or undergoing training to perform a task, or the passengers or goods are carried to or from a remote aerodrome (a remote aerodrome is an aerodrome where access is limited or an aerodrome that does not meet the normal standards for an aerodrome).

2 A Part 121 operator uses an aeroplane with passenger seating for more than 30 people (excluding any required crew member seat), or an aeroplane that has a payload capacity of more than 3410 kg.

3 A Part 125 operator uses an aeroplane with passenger seating for between 10 to 30 people (excluding any required crewmember seat), or an aeroplane that has a payload capacity of 3410 kg or less and a Maximum Certified Take Off Weight (MCTOW) of greater than 5700 kg. A single-engine aircraft operating under instrument flight rules (SEIFR) is also required to operate in accordance with the rules specified in Part 125.

4 A Part 135 operator uses an aeroplane with passenger seating for less than 10 people (excluding any required crewmember seat), or an aeroplane that has a MCTOW of less than 5700 kg, or uses a helicopter.

The final questionnaire comprised three main sections (see Appendix A for further details):

- Description of the organisation, including questions on: the participant's role in their organisation, the size of the organisation, the rules the organisation operates under, the type of aircraft operated, and the type of operations conducted.
- Fatigue management strategies in the organisation, including questions on: different fatigue management strategies and specific examples (education, monitoring flight and duty times, monitoring workload, occurrence reporting, identification and management of fatigued personnel, review of fatigue management processes, provision of a feedback system, and the use of rostering software). This section also included a question on how flight and duty time limits were met within the organisation and a question on how well the organisation was managing fatigue. Responses to the latter question were made on a 10 cm visual analogue scale anchored with 'not at all well' and 'extremely well'.
- How fatigue management works in the organisation, including questions on: who is responsible for fatigue management, where the organisation obtains information on fatigue management, the positive and negative effects of fatigue management, the problems of and barriers to managing fatigue, and resources or help that would assist with managing fatigue.

2.3 Procedure

The study received ethical approval from the Massey University Human Ethics Committee – Wellington, protocol number 04/37.

At the commencement of the study, an industry working group was established. This included researchers from the Sleep/Wake Research Centre (SWRC), representatives from the New Zealand Civil Aviation Authority (NZCAA), the New Zealand Airline Pilots' Association (NZALPA), the Aviation Industry Association (AIA) and the Civil Aviation Safety Authority (CASA) in Australia. The working group provided input into the design of the study and the content of the questionnaire.

In order to understand how individuals with different roles in an organisation perceived the management of fatigue, three questionnaires were sent to the Chief Pilot of each organisation. One questionnaire was to be completed by a person in a management position, another by a person in a rostering position, and the third by a line pilot. It was possible for participants to indicate if they had multiple roles, a situation which was expected to occur frequently in smaller organisations. A return pre-paid addressed envelope was provided with each questionnaire.

To ensure the highest possible response rate, several steps were taken. These included providing concise and clear instructions on the purpose of the questionnaire and the use of the information (e.g. provision of feedback to participating organisations, ensuring anonymity, confidentiality, and independence of the study from both the NZCAA and NZALPA), keeping the questionnaire brief, and ensuring it was sent to an appropriate person in the organisation. Support from NZCAA, NZALPA and the AIA was also made apparent in the accompanying cover letter. Finally, three separate mail outs were conducted followed by a phone call.

The first mail out of questionnaires occurred in October 2004. Reminder post-cards were sent to non-responders in mid-November 2004, and completely new questionnaire packs were then sent to remaining non-responders in early December 2004. In January 2005, follow up phone calls were made to the Chief Pilot of each organisation from which there was no response or only a partial response. The project was also publicised in the November/December Issue of the NZCAA News magazine and received media coverage on New Zealand National Radio in November 2004.

Data were entered into an SPSS (Statistical Package for the Social Sciences – version 12.0.1) database. To ensure accurate data entry all questionnaires were double-entered and cross checked with the original entry. Late questionnaires were accepted up to the middle of February 2005.

3 RESULTS

3.1 Respondents

Of the 480 questionnaires sent to the 160 organisations holding a Part 119 air operator certificate, 153 completed questionnaires were returned. Of those, 56% of responses were from individuals indicating that they had more than one primary role within their organisation. The break down of the roles of participants is given in Table 1.

The large number of participants indicating multiple roles effectively changed the number of potential responses (since we could not expect to receive multiple questionnaires from small organisations in which one or two individuals filled a number of roles). The final response rate of 52% was calculated using the roles for which responses were received[5].

Table 1: Roles of participants

Role	Questionnaires received (%)
Line pilot only	27
Rostering only	6
Management only	12
Line pilot/rostering/management	37
Management/line pilot, or management/rostering	14
Line pilot/rostering	4

3.2 Participating organisations

Of the 88 organisations from which a response was received, a single questionnaire was received from 40 organisations (29 of which reported filling all 3 roles: line pilot; rostering; and management), and 3 questionnaires were received from 15 organisations.

To provide an overview of the organisations that participated in the study, one response from each company was selected. Where available, a response from a person in a management role was selected (82 organisations) since it was thought they would have the most comprehensive view of company operations. If there was no response from a person in management, a line pilot response was selected (5 organisations), followed by a response from a person in rostering (1 organisation).

Each response was considered by the category of rule under which the organisation operated (Part 121, 125 or 135). Where a respondent indicated that the organisation operated under multiple rule categories, their response was included in each of the

5 For example, a single response indicating that the individual worked in a line pilot, rostering and management role resulted in all three roles being filled and a 100% response rate for that organisation. Similarly, two responses from one organisation, one indicating the individual worked as a line pilot only, and the other individual in a rostering and management role, also resulted in all three roles being filled for that organisation.

categories indicated. The number of companies operating under the different rule categories is indicated in Table 2.

Table 2: Rules under which organisations operated

Rule category	Number of companies	Rule category	Number of companies
Part 121	10	Part 121, 125 and 135	1
Part 125	10	Part 121 and 125	2
Part 135	77	Part 125 and 135	6

3.3 Size of the organisation

Table 3 details the number of people and pilots participating organisations reported employing. Not surprisingly, Part 121 operators have on average a greater number of employees and pilots than Part 125 and 135 operators. There is, however, in each rule category a very wide range in the number of people and pilots employed.

Table 3: Number of people and pilots employed by participating organisations*

	Part 121		Part 125		Part 135	
	Median	Range	Median	Range	Median	Range
Number of employees	220	5-10,000	37	3-250	7	0-80
Number of pilots	55	4-650	21	1-126	4	1-40

* This table uses only one participant's response from each company; the reasons for selecting a specific respondent are detailed in section 3.2, paragraph 2. Where a company indicated that they operated under more than one rule (for example both Part 121 and Part 125), information on that company was included in the results for each rule category.

3.4 Aircraft operated

The types of aircraft organisations reported operating are detailed in Table 4. Ideally, each section in Table 4 should add up to 100% (i.e. the proportion of Part 135 organisations operating jet aircraft, turbo-prop aircraft, piston-engine aircraft and a mixed fleet should equal 100%). The reason for sections not totalling 100% was that the question required respondents to tick multiple boxes, which many people did not do.

Part 121 operators reported primarily operating jet or turbo-prop aircraft, while Part 125 operators reported operating a mix of turbo-prop and piston engine aircraft. Part 135 operators primarily reported operating piston engine aircraft.

Half of the Part 125 and a third of the Part 135 organisations reported operating a mix of multi- and single-engine aircraft. Very few Part 135 organisations operate multi-engine aircraft only. Only a small proportion of helicopter operators operate under Part 125, while almost an equal number of Part 135 organisations operate either rotary or fixed wing aircraft.

Table 4: Proportion of organisations reporting to be operating different aircraft types*

Aircraft type	Part 121 (%)	Part 125 (%)	Part 135 (%)
Jet only	40	0	4
Turbo-prop only	30	20	3
Piston engine only	10	20	49
Mixed	20	50	12
Multi-engine only	30	20	8
Single-engine only	10	10	31
Multi- and single-engine	10	50	29
Rotary only	0	10	38
Fixed wing only	30	50	45
Rotary and fixed wing	0	10	5

* This table uses only one participant's response from each company; the reasons for selecting a specific respondent are detailed in section 3.2, paragraph 2. Where a company indicated that they operated under more than one rule (for example both Part 121 and Part 125), information on that company was included in the results for each rule category.

3.5 Type of operations conducted

As expected, Part 121 organisations largely reported conducting scheduled operations, both internationally and domestically (see Table 5 and Table 6). Half of Part 121 organisations also reported conducting some type of non-scheduled operation. Part 125 organisations reported conducting scheduled and non-scheduled operations that are either domestic passenger services, or a mix of domestic passenger services and freight. The majority of Part 135 organisations reported conducting non-scheduled operations that are also a mix of domestic passenger services and freight. This is the largest group to report conducting 'other' types of operations, which included aerobatics, agricultural operations, air ambulance work, charter flights, helicopter work, company transport, flight training, lifting, scenic flights and bush flying.

Table 5: Proportion of organisations reporting to be operating scheduled and non-scheduled operations*

Operation type	Part 121 (%)	Part 125 (%)	Part 135 (%)
Scheduled only	50	10	3
Non-scheduled only	10	40	86
Scheduled and non-scheduled	40	50	11

* This table uses only one participant's response from each company; the reasons for selecting a specific respondent are detailed in section 3.2, paragraph 2. Where a company indicated that they operated under more than one rule (for example both Part 121 and Part 125), information on that company was included in the results for each rule category.

Most Part 121 organisations operate under instrument flight rules (IFR), in controlled airspace, and from certificated aerodromes (see Table 7 and Table 8). Part 125 organisations are mixed, in that equal numbers operate under IFR or visual flight rules

(VFR), and they all largely operate in both controlled and uncontrolled airspace, and from both certificated and uncertificated aerodromes. Part 135 organisations primarily operate under VFR rules, in both controlled and uncontrolled airspace, and from all types of aerodromes (certificated, uncertificated and remote). Almost all Part 121 and Part 125 organisations reported operating outside daylight hours, while fewer than 60% of Part 135 organisations reported doing so.

Table 6: Type of scheduled and non-scheduled operation reported*

Operation type	Part 121 (%)	Part 125 (%)	Part 135 (%)
Scheduled			
Domestic only	30	20	1
International only	20	0	0
Freight only	0	0	1
Mixed	40	40	14
Other	0	0	3
Non-scheduled			
Domestic only	30	30	13
International only	0	0	0
Freight only	0	0	3
Mixed	10	40	45
Other	10	20	34

* This table uses only one participant's response from each company; the reasons for selecting a specific respondent are detailed in section 3.2, paragraph 2. Where a company indicated that they operated under more than one rule (for example both Part 121 and Part 125), information on that company was included in the results for each rule category.

Table 7: Type of flight rule, class of airspace and timing of operations reported by organisations*

Rule/airspace	Part 121 (%)	Part 125 (%)	Part 135 (%)
IFR	90	40	13
VFR	10	40	79
IFR and VFR	0	20	8
Controlled airspace	80	20	7
Uncontrolled airspace	0	0	21
Controlled and uncontrolled airspace	20	80	71
Outside daylight hours	90	90	58

* This table uses only one participant's response from each company; the reasons for selecting a specific respondent are detailed in section 3.2, paragraph 2. Where a company indicated that they operated under more than one rule (for example both Part 121 and Part 125), information on that company was included in the results for each rule category.

Table 8: Type of aerodrome organisations reported operating from*

Aerodrome	Part 121 (%)	Part 125 (%)	Part 135 (%)
Certificated	100	100	88
Uncertificated	30	80	79
Remote	40	60	77

* This table uses only one participant's response from each company; the reasons for selecting a specific respondent are detailed in section 3.2, paragraph 2. Where a company indicated that they operated under more than one rule (for example both Part 121 and Part 125), information on that company was included in the results for each rule category.

3.6 Fatigue management strategies

Using data from one respondent in each company, the number of fatigue management strategies reported to be in place in each organisation was calculated. Figure 1 indicates the proportion of Part 121, 125 and 135 operators reporting that their organisation has between 1 and 10 fatigue management strategies (no respondent indicated their organisation had zero fatigue management strategies). Sixty percent of both Part 121 and Part 125 organisations reported having 8 or more fatigue management strategies in place, while only 28% of Part 135 operators reported this number.

Figure 1: Number of fatigue management strategies reported by organisations

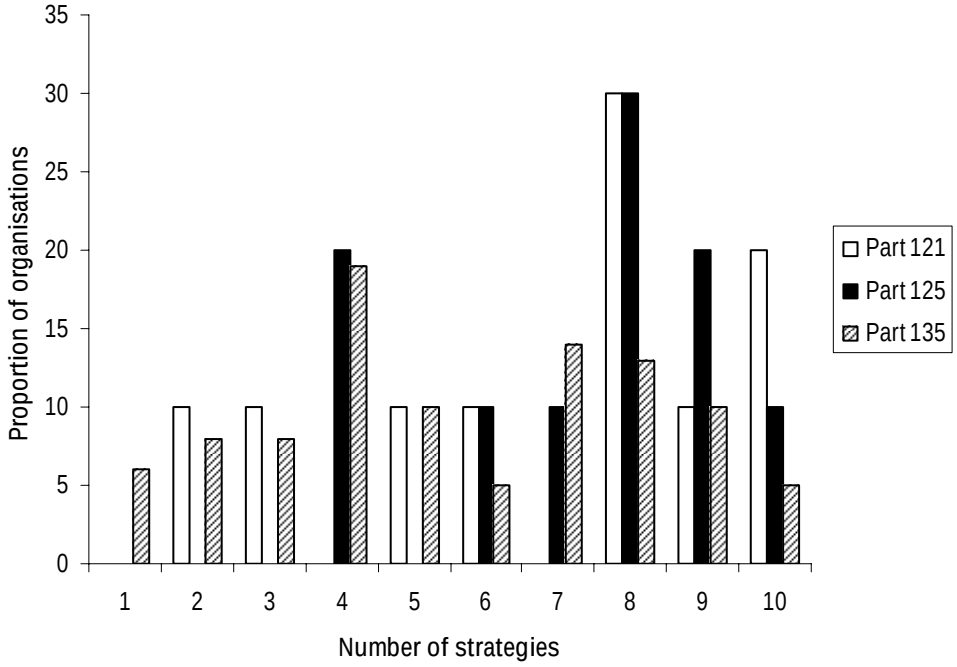

Table 9 indicates the proportion of Part 121, 125, and 135 organisations that reported using each of the different fatigue management strategies (using one response from each company). Nearly all respondents reported that their organisation monitored the flight and duty times of pilots, and a large proportion also reported monitoring pilot

workload. Most Part 121 and 125 organisations report educating their flight crew, having an occurrence reporting system in which fatigue can be indicated as a causal factor, and having a system in place that allows feedback from pilots on fatigue-related issues. Fewer organisations reported educating their rostering staff or reviewing company processes for managing fatigue. Generally, a smaller proportion of Part 135 organisations reported having each of the different fatigue management strategies in place, compared with Part 121 and 125 organisations.

Table 9: Fatigue management strategies reported*

Strategy	Part 121 (%)	Part 125 (%)	Part 135 (%)
Pilot education	70	70	53
Management education	50	70	43
Rostering staff education	50	50	36
Monitoring flight and duty times	90	90	99
Monitoring workload	70	90	84
Reporting system that includes fatigue	80	70	44
Identification and management of fatigued personnel	60	100	68
Review of processes for managing fatigue	60	60	39
Feedback system	90	80	66
Rostering software	70	50	23

* This table uses only one participant's response from each company; the reasons for selecting a specific respondent are detailed in section 3.2, paragraph 2. Where a company indicated that they operated under more than one rule (for example both Part 121 and Part 125), information on that company was included in the results for each rule category.

There was a large number and wide range of fatigue management strategies reported by organisations, in addition to those listed in Table 9. These included promoting an environment in which pilots could easily indicate when they were fatigued (e.g. '*Any employee is empowered to stop operations if they feel fatigue{d}…*', '*…encouragement of pilots to advise when they are fatigued; "no questions asked policy" when pilot goes fatigued.*') . Related to this, several respondents indicated raising awareness of fatigue within the company (e.g. '*A culture which promotes pilot awareness…*'), and the use of internal communication (e.g. '*Verbally ask pilots if they are fit to fly…*'). One organisation indicated they had rest facilities – '*We have facilities for "horizontal rest" on premises*'.

Changes to the roster and time off were also mentioned, as were safety meetings, general monitoring, strict compliance with the flight and duty time limits, plans to include fatigue management in annual training, alertness studies, and the use of I'M SAFE (an acronym for checking fitness to fly: Illness, Medication, Stress, Alcohol and drugs, Fatigue and Eating).

Several participants mentioned that the management of fatigue was done at multiple levels (by pilots, operations staff, and management), or alternatively only by pilots or management. A number of Part 135 organisations indicated that the small size of their company allowed fatigue to be more easily monitored and managed (e.g. '*Small company. Communication with staff, knowing your limits. Knowing other staff limits*', '*As a relatively small company with only a few line pilots we are able to easily note, record and deal with situations of fatigue if and when they arise*') or that the number

of flight hours was low so that fatigue was not considered a problem (e.g. '*The two of us do about 250 hours per year. Fatigue from flight ops is not a problem….*', '*We don't do many hours…*'). Common sense was also mentioned by several respondents as a strategy for managing fatigue.

Many respondents who indicated their organisation used a particular fatigue management strategy also gave an example of how that strategy was implemented in their company, and, in some instances where a strategy was not used, comments were made about this. Detail of responses is included in Appendix B. Because there were too few responses from Part 121 and 125 organisations for them to be considered separately, responses from all organisations were grouped together. Where possible, patterns of responses are described, and the examples are listed by the frequency with which they were reported (most frequent first).

3.6.1 Education

Most organisations reported using internal or external courses, or providing discussion sessions or meetings to educate their pilots. Several Part 121 and 125 organisations reported including education on fatigue management as part of their CRM training. Some companies provide written articles or literature, and a few stated they use an outside expert. Somewhat surprisingly, many Part 135 organisations indicated that pilot education involves either following procedures outlined in company manuals or adhering to the flight and duty time limits (presumably education involves informing pilots of what these procedures or limits are).

Similar examples were given for how management and rostering staff receive education on fatigue management. Several respondents from Part 121 organisations stated that they thought management education was either not taken seriously or needed to occur. As with pilot education, examples of rostering staff education largely included following company policies or compliance with flight and duty time limits (again it is assumed that education involves informing staff what these procedures or limits are).

3.6.2 Monitoring flight and duty times

Most examples provided for the monitoring of flight and duty times included either a computer- or paper-based system. A number of respondents did not state exactly how flight and duty times were monitored, but referred to processes in company manuals, or that this was done 'continuously'. Several companies indicated that flight and duty times were monitored by complying with their company's schedule or limits.

3.6.3 Workload monitoring

There was a diverse range of processes mentioned for monitoring the workload of pilots. These primarily included using roster or duty records, or regular communication or discussion. Many respondents identified the person responsible for monitoring workload, which was normally a management person, but on some occasions it was the responsibility of pilots. A number of Part 135 respondents indicated that, due to the size of their company, it was possible to be aware of workload issues, or take into account what occurred outside of work.

3.6.4 Incident reporting

When providing examples of the occurrence reporting system that asks about fatigue, only two companies mentioned that fatigue was listed as a potential hazard on their reporting form, or that there was a specific form for reporting fatigue-related issues. The large majority of organisations referred to a general reporting system, with comments including: *'We have an excellent reporting system but it does not include fatigue as a possible contributing factor'* and *'Does not specifically ask about fatigue but if it is a factor then it will be included in the report'*. Several respondents referred to company documents rather than providing specific examples.

3.6.5 Identifying and managing fatigued pilots

Many respondents reported that their company culture or size made identifying and managing fatigued pilots easier, as there was regular contact between management and pilots. Examples of responses in this category include: *'Close knit team. Close monitoring by senior staff. A clear culture encouraging pilots to be open and unembarrassed about fatigue'* and *'Small company, easily able to note and deal with situations'*. Other organisations mentioned the person responsible for identifying and managing fatigued pilots, which included management, the pilots themselves, or another person (counsellor, safety coordinator). How fatigued pilots were managed was explained by a number of participants. This was largely through rostering or providing time off.

3.6.6 Review of fatigue management processes

When providing examples of how the processes used for fatigue management are reviewed, the most common response was via the existing quality assurance system. Other examples of review processes included management meetings, or less specifically, company procedures. On a few occasions, a person responsible was named and several other respondents indicated that this did not occur or was not needed.

3.6.7 Pilot feedback

Most participants who provided an example of a system for allowing feedback from pilots on fatigue-related issues mentioned that this was done verbally, while far fewer referred to a specific form or internal reporting process. Several mentioned their quality assurance system, but did not specifically state how this allowed for feedback. A large number of participants mentioned safety or staff meetings as the avenue for feedback.

3.6.8 Rostering software

Organisations that indicated having software to assist with rostering either referred to a named system or mentioned more general computer software.

3.7 Meeting flight and duty time limits

Table 10 details how organisations meet the flight and duty time limits. A large proportion of Part 125 and Part 135 organisations report adhering to the limits specified in NZCAA Advisory Circular AC 119-2, with 10% having some minor dispensation to these limits. Most Part 121 organisations stated they had either a Fatigue Management Scheme or another company-specific accredited scheme. Participants also referred to computer programmes, the rules, a system for recording flight and duty times, rostering systems, or stated that fatigue was not a problem in their organisation.

Table 10: Method for meeting flight and duty time limits*

Flight and duty time limits	Part 121 (%)	Part 125 (%)	Part 135 (%)
AC 119-2	20	50	39
AC 119-2 with dispensations	0	10	10
Accredited scheme or FMS	60	40	17
Other	10	0	23

* This table uses only one participant's response from each company; the reasons for selecting a specific respondent are detailed in section 3.2, paragraph 2. Where a company indicated that they operated under more than one rule (for example both Part 121 and Part 125), information on that company was included in the results for each rule category.

As can be seen in Table 11, on average, participants report that their organisation is currently managing fatigue moderately well, although there was a very wide range of responses. There were no marked differences between Part 121, Part 125, and Part 135 organisations, although Part 121 organisations tended to rate their management of fatigue as slightly poorer than either Part 125 or Part 135 organisations.

Table 11: How well fatigue is being managed in the organisation*

	Part 121	Part 125	Part 135
Median	61	71	68
Range	21-73	36-100	6-100

(0 = not at all well, 100 = extremely well)

* This table uses only one participant's response from each company; the reasons for selecting a specific respondent are detailed in section 3.2, paragraph 2. Where a company indicated that they operated under more than one rule (for example both Part 121 and Part 125), information on that company was included in the results for each rule category.

3.8 Comparing responses of management and line pilots on fatigue management strategies

To determine how different people in the same company perceived their organisation's approach to fatigue management, responses from participants identifying only as line pilots were compared with those of participants who indicated that they had a management role. There were 34 organisations in which two or more questionnaires were received, and where one participant identified as a line pilot (and did not indicate having another role), and a second participant identified as having a management role (they may have also indicated additional roles[6]).

In these analyses all organisations were first considered together. Organisations that operated only under Part 135 were then compared to all other organisations, as there were too few responses from Part 121 and Part 125 organisations for them to be considered separately. Table 12 presents the proportion of line pilots and management people reporting that their organisation uses a particular fatigue management strategy. Chi-square tests were used to determine whether these positions agreed on the use of these strategies in their organisation (responses were categorised as binary: yes versus no/don't know/not applicable, tests were 2-tailed). Significantly more management staff than line pilots considered that their company educated their pilots and management staff. Management personnel were also more likely to indicate that their organisation: monitored pilot workload; identified and managed fatigued personnel and; reviewed company processes for managing fatigue.

The pattern of findings was similar when Part 135 organisations were considered separately from Part 121 and 125 organisations (see Table 13). Participants who worked in a management role in a Part 135 organisation were more likely than line pilots to report that their organisation educated pilots and management, and that the company reviewed their processes for managing fatigue. Participants with a management role from a Part 121 or 125 organisation were also more likely than line pilots to report that their organisation educated management staff on fatigue.

Ratings by line pilots and management personnel of how well their organisation managed fatigue were compared (see Table 14 and Table 15). When all organisations were grouped together, line pilots and management personnel both rated fatigue as moderately well-managed. Independent *t*-tests indicated no significant difference between groups (t=.924, p=.360). Line pilots from Part 121 or 125 organisations rated their organisation's management of fatigue as below average, and tended to give lower ratings than line pilots from Part 135 organisations, or management personnel from Part 121 and 125 organisations. These differences were not, however, statistically significant (Z = -1.221, p= .222, and Z = -1.608, p= .108 respectively).

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6 The job titles given by participants who were categorised for analyses as managers included: CEO (n=1), CFI/Chief Pilot (n=4), Fleet or Flight Operations Manager (n=10), Manager/Management, including Quality Assurance/Safety (n=8) or some combination of the above titles (n=10). One participant did not give a title. Participants could also indicate on their questionnaire whether they had a role in rostering and/or as a line pilot. For participants who were categorised as managers, the following responses were received: management only (n=8), management and rostering (n=8), management and line pilot (n=4), all roles (n=14). These respondents were considered distinctly different from those who indicated having only a line pilot position because their management responsibilities would ensure they were more familiar with company policies. Such individuals may also be responsible for changing and implementing such policies, including those relating to how fatigue was being managed.

Table 12: Proportion of line pilots and management reporting their organisation has a particular fatigue management strategy

Strategy	Line Pilots (%)	Management (%)	*p*
Pilot education	29	65	.004
Management education	9	50	<.001
Rostering staff education	21	38	.093
Monitoring flight and duty times	97	100	*1.00
Monitoring workload	74	91	.024
Reporting system that includes fatigue	38	59	.112
Identification & management of fatigued personnel	53	79	.043
Review of processes for managing fatigue	6	50	<.001
Feedback system	65	74	.302
Rostering software	32	32	.862

* Fisher's exact test used

Table 13 Proportion of line pilots and management reporting their organisation has a particular fatigue management strategy (by organisation type)

Strategy	Part 135 only			Part 121 and 125		
	Pilots (%)	Mgmt (%)	*p*	Pilots (%)	Mgmt (%)	*p*
Pilot education	23	56	.016	57	89	*.262
Management education	12	40	.024	0	78	*.003
Rostering staff education	23	36	.266	14	44	*.308
Monitoring flight & duty times	96	100	*1.00	100	100	**
Monitoring workload	77	92	*.100	57	89	*.262
Reporting system	27	52	.083	71	78	*1.00
Identification & management of personnel	54	76	.136	43	89	*.235
Review of processes	4	44	<.001	14	68	*.060
Feedback system	62	68	.357	71	89	*1.00
Rostering software	31	20	.333	43	67	*.622

* Fisher's exact test used, ** no statistic calculated as responses constant

Table 14: Line pilot and management perception of how well fatigue is being managed in the organisation

	Line Pilots	Management
Mean	61	65
Standard deviation	24	14
Range	3-100	33-100

(0 = not at all well, 100 = extremely well)

Table 15: Line pilot and management perception of how well fatigue is being managed in the organisation (by type of operator)

	Part 135 only			Part 121 and 125		
	Mean	SD	Range	Mean	SD	Range
Pilot perception	65	20	17-100	43	31	3-82
Management perception	67	14	33-100	61	14	36-78

(0 = not at all well, 100 = extremely well)

3.9 Comparing organisations using prescriptive regulations versus an approved scheme

Using data from one respondent in each company, comparisons were made between organisations that complied with the prescriptive limits specified in AC 119-2 (organisations that had minor dispensations to AC 119-2 were also included in this group) and those that indicated their company had a Fatigue Management Scheme or some other NZCAA accredited flight and duty time scheme. Organisations operating only under Part 135 were considered separately from Part 121 and 125 operators (which were combined due to small numbers). There were more Part 135 organisations complying with AC 119-2 (N=35) than there were organisations that had an FMS or other accredited scheme (N=10), while equal numbers of Part 121 and 125 organisations complied either with AC 119-2 (N=7) or had an FMS or other accredited scheme (N=8).

Ratings of how well fatigue was managed, and the number of fatigue management strategies an organisation had in place, did not differ between companies that complied with AC 119-2 and those that had an accredited scheme in place (Table 16). Using chi-square tests, the frequency of use of each of the 10 different fatigue management strategies was also compared between organisations complying with AC 119-2 and those with an FMS or other accredited scheme in place (responses were binary: yes versus no/don't know/not applicable, tests were 2-tailed). There were no differences found in the use of any of the 10 different fatigue management strategies between these two groups (for either Part 135 or Part 121/125 organisations).

Table 16: Comparisons between organisations using different flight and duty time approaches on how well fatigue is managed and the number of fatigue management strategies used

	AC 119-2		FMS or Accredited Scheme	
	Mean	SD	Mean	SD
Part 135 only organisations				
How well fatigue is managed	68	16	68	11
Number of strategies	6	3	6	2
Part 121 and 125 organisations				
How well fatigue is managed	62	23	62	18
Number of strategies	7	2	7	3

3.10 How fatigue management works in an organisation

As in the sections above, data from one respondent in each company was used to indicate how fatigue management worked in an organisation. Responses on open-ended questions were grouped into categories or themes, and details of these can be found in Appendix C.

There was a diverse range of positions indicated as responsible for fatigue management in an organisation. Participants from Part 121 organisations largely indicated that groups of personnel or the Flight Operations Manager were responsible for fatigue management in their organisation. In contrast, Part 125 and 135 listed a broader range of positions, but primarily the Chief Executive Officer, Chief Pilot, Flight Operations Manager or a combination of these positions.

When asked where their organisation obtained information on fatigue management, the most common response was '*We don't*', '*Not applicable*' or '*Common sense*'. One respondent stated '*Wouldn't know where to start – occasionally get something out of CAA mag*…'. Other respondents mentioned different types of publications, industry bodies, NZCAA regulations and associated documentation, and company documents. Less frequently mentioned were other airlines, expert persons or groups, management individuals, personal experience and the Internet.

A large number of participants indicated that safety was a positive benefit of their organisation's fatigue management strategies. Comments included: '*Lower risk of mistakes in all areas of work*', '*Less incidents…*', '*Lowers risk of accident/incident….*' and '*….the overall biggest benefit is safety'*. Just as many comments were made about the positive benefits for pilots' performance, productivity and mood. For example, '*Better pilots, making good judgment calls*', '*Employees have more positive attitude and better able to recognize other hazards*', '*Happier pilots who are more productive*' and '*Staff are motivated to work*'. Further benefits mentioned were improved fatigue awareness, prevention or earlier intervention. Greater flexibility in pilot use was also mentioned. A number of respondents stated that fatigue was not a problem for them, or that this question was not applicable to them.

Most respondents indicated that there were no negative aspects of their organisation's fatigue management strategies. Of those who did mention negative effects, the most common was reduced flexibility ('*…a little inflexible when arranging duties*', '*Can be inflexible in that longer daylight flight could be accommodated*' and '*Lose flexibility when operating on specific rosters when commercial needs change*'). The time or practicalities associated with managing fatigue were also mentioned as a negative aspect, as was insufficient staff, costs, and not picking up when pilots were fatigued.

The majority of participants also stated that there were no problems, barriers or obstacles to managing fatigue in their organisation. Others mentioned operational factors, costs (including the cost of staff), or staffing issues ('*Staffing issues would be the main barrier as they put stress on the remaining staff to cover the workload*'). Aspects of the flight and duty time limits were also given as problems. For example, '*Yes, some days you may need to go over your allowed hours and if you could do it, in some cases would cause less stress and more time off the next day*'.

A number of participants felt that they needed no help, advice or resources. Of those who did, the large majority suggested further information or education ('*Easily digestable* {sic} *and readily available info…*', '*Research information made available to pilots etc. Similar to CRM/pilot decision making etc*.', '*Briefing/lecture to senior management from all divisions of the company by experts on fatigue…*'. Several individuals suggested that having an opportunity to see how other companies managed

fatigue would be useful (‘*Network with other Operator/Knowledge sharing/Experience*’). Other items mentioned were more staff, computer software for rostering, and having a flight and duty time scheme that was more applicable to the operation.

4 DISCUSSION

4.1 Participating organisations

Information on the participating organisations provides an overview of the diverse range of air transport and commercial operations conducted in the New Zealand aviation industry. As expected, organisations operating under Part 121 were, on average, large organisations, operating similar aircraft in a relatively controlled environment. At the other end of the continuum, and also as expected, organisations operating under Part 135 were generally small, and operated single piston-engine aircraft and helicopters. These organisations were far more diverse in the type of work conducted and the conditions under which this work was done (e.g. all types of airspace and from all types of aerodromes). Part 125 organisations fell very much in the middle of the other two categories. The smaller number of Part 121 and Part 125 organisations (10 in each category), compared with the large number of responses from Part 135 organisations is considered representative of the makeup of the New Zealand industry.

4.2 Limitations

The 'true' response rate for this study was difficult to determine, as the number of questionnaires returned represented 32% of those sent out, 52% of the positions from which responses were requested, and 55% of the companies to which questionnaires were sent. Nevertheless, receiving responses from over 50% of New Zealand operators is a reasonable achievement, given the relatively sensitive nature of the issue. The results can also be considered fairly representative of all Part 119 air transport operators in New Zealand.

The lower numbers of Part 121 and 125 operators made it difficult for responses from this group to be broken down in detail, particularly where comparisons were made between the responses from line pilots and individuals in a management role. This is, however, a limitation of the size of the New Zealand industry, as there are relatively few large and medium-size aircraft operators.

Over 60% of responses were from an individual in a management position (often one of their many roles). The consequence of this is that many of the findings are strongly influenced by the views of this group of individuals. The views of management are certainly important, particularly since they are likely to be responsible for influencing and changing the way in which fatigue is managed in an organisation. However, it should also be kept in mind that the perceptions of those in management often differed from those of line pilots.

4.3 Fatigue management strategies

Compared with Part 135 organisations, Part 121 and 125 organisations generally reported using a greater number of the 10 fatigue management strategies they were questioned about. Given that Part 121 and 125 organisations are on average larger companies, it would be expected that they have more resources available to them for managing fatigue. In addition, due to their greater size and the type of aircraft operated, they are likely to have more complex operations, thus necessitating a more comprehensive approach to fatigue management.

Unsurprisingly, nearly all respondents stated their organisations monitored the flight and duty times of crew, irrespective of the type of rules operated under. Since this is a regulatory requirement, what is more surprising is that a few respondents indicated that this was not done in their organisation.

More organisations reported educating their flight crew than reported educating their management or rostering staff, with the exception of Part 125 organisations, who report educating both their pilots and management staff in similar proportions.

More Part 121 organisations reported using software for rostering than Part 125 and 135 organisations, probably due to the greater availability of resources and complexity of operations among Part 121 operators.

Somewhat surprisingly, only 60% of Part 121 operators reported having a process for identifying and managing fatigued personnel. This is lower than for both Part 125 and 135 organisations (100% and 68% respectively). Because of large staff numbers, it may be more difficult for the larger Part 121 operators to have a process for identifying individuals whose performance might be affected by fatigue. However, because of the reduced opportunity for personal contact in larger organisations, a more formal approach may be even more important.

4.3.1 Additional approaches to fatigue management

Additional strategies recorded by respondents for managing fatigue were diverse. Of significance, a number of companies indicated that they promoted an environment or culture that allowed easier reporting of fatigue, or raised awareness of the issue. Such an approach, along with the education of staff, is considered vital if fatigue management is to be effective.

Many respondents from Part 135 organisations noted that their small size made the management of fatigue easier, in that it was possible to monitor staff closely and quickly deal with a developing situation when there were only a few people who knew each other well. Some smaller organisations also stated that the low number of hours flown per annum meant that fatigue would not pose a problem for them.

These perceptions may be justified in some cases. However, it is of some concern that organisations viewed them as making additional fatigue management strategies unnecessary.

Many respondents indicated that ‘common sense’ was a further strategy for managing fatigue. The risk in this belief is that it relies on past experience, and reduces the likelihood that organisations will take advantage of new knowledge, or adapt to changing demands.

4.3.2 Examples of fatigue management strategies

Although on the surface the proportion of organisations that reported using the various fatigue management strategies is encouraging, when the examples of what is actually done in practice are considered, the picture is not so reassuring.

Some companies have excellent ideas, such as including education on fatigue in existing workplace training courses (e.g. CRM courses). On the other hand, although many Part 135 respondents indicated that they educated their pilots, management and rostering staff, they stated this was done by detailing what the flight and duty time limits or company policies were and/or that these were to be followed. Such an

approach does not in any way result in an individual understanding the causes of fatigue, how they might recognise its effects, and how it could affect performance and safety. It is concerning that this is thought to constitute education, and may indicate a lack of understanding of the complexity of the issue. It also implies that many people believe fatigue will not occur if the flight and duty time limits are adhered to.

A common theme was for respondents to indicate a person responsible, or policies and documents, when asked to describe an example of a fatigue management strategy in their organisation. For example, many respondents indicated that their organisation monitored the workload of pilots, and while some companies gave very practical and useful examples (such as using daily duty records and scheduling regular meetings to address the issue), others named the individual responsible for this rather than detailing the process used. It may be that there is indeed a process in place, but it is seen as the responsibility of someone else and the details are not clear to all staff. Given that the largest proportion of responses were from individuals who had a management role, it would be expected that if such a workload monitoring policy was in place, then people in these positions would know what it was.

4.4 Comparisons between line pilots and management

The lack of company policies, or the lack of awareness of these policies, is further supported by the findings from the comparison of responses of line pilots with management staff. Compared with those in management, fewer line pilots reported their company as using each of the 10 different fatigue management strategies. For example, less than 10% of line pilots thought their company educated management staff about fatigue, or that there was ongoing review of the company's processes for managing fatigue. In contrast, half of the individuals in management positions believed that these strategies were being used in their organisations. Similarly, greater numbers of respondents in management roles reported that the company monitored pilot workload and had a process for identifying and managing fatigued personnel.

It is possible that line pilots are not aware of some of the strategies a company has in place, such as the education of management staff, or how review processes are conducted. Nevertheless, it would be expected if fatigue management strategies are to be effective, line pilots should be aware of them.

Similar findings were seen when the responses of line pilots and management individuals from Part 135 organisations were considered separately from Part 121 and 125 organisations. Fewer differences between line pilots and management were statistically significant, but in some instances the differences were even larger than when all organisations were grouped together. For example, no line pilots thought that the management staff in Part 121 and 125 organisations received education on fatigue, while nearly 80% of management staff stated that this occurred.

4.5 How well fatigue is being managed

Despite the differences between the perceptions of line pilots and management about the presence or absence of fatigue management strategies, in Part 135 organisations both these positions rated fatigue as moderately well managed. In contrast, line pilots from Part 121 and 125 organisations thought fatigue was less well managed than did management. In addition, when the management of fatigue was considered by type of operator (using one response from each company), respondents from Part 121 organisations rated fatigue as less well managed compared with respondents from Part

125 and 135 organisations. These findings may also be related to company size and resources. That is, in a larger and presumably better-resourced organisation, there is the expectation that fatigue should be well managed (particularly from those in line flying roles).

4.6 Comparisons between flight and duty time approaches

Interestingly, there was no difference in ratings of how well fatigue was managed between respondents from companies that complied with AC 119-2 compared with those from companies that had an FMS or other accredited scheme in place. Nor were there differences in the total number of fatigue management strategies used, or the proportion of companies using each of the 10 different strategies.

The lack of any difference between these two groups suggests that allowing increased flexibility in flight and duty time limits does not lead to the better management of fatigue, although reassuringly it also does not lead to poorer fatigue management. It also raises the question of what is actually required by a company when they gain regulatory approval for an alternative flight and duty time scheme. It seems the strategies companies were questioned about in the present study are not those that the regulator requires. Thus it could be argued that the regulatory authority should carefully consider what policies and processes it expects companies to have in place in order to operate under alternative schemes.

4.7 How fatigue management works in an organisation

A diverse range of positions was identified as responsible for the management of fatigue within an organisation. The Flight Operations Manager (or similar) was the most commonly identified position, with Part 121 organisations more likely to have a group of individuals oversee fatigue management, while the smaller companies identified single individuals. Comprehensive fatigue management in an organisation is resource and time intensive, as indicated by the approach taken by Part 121 operators, and is possibly best shared between a group of individuals and overseen by someone in an operational role.

Most respondents did not think that seeking information on fatigue management was necessary, or that they needed further help, advice or resources on better managing fatigue. This finding may suggest a poor awareness of fatigue as a major safety issue within the industry.

Those respondents who reported seeking information on fatigue primarily indicated industry sources (industry publications, regulatory authority, and other industry groups). Further information was also commonly mentioned as a resource that would assist in fatigue management.

Safety, and improved staff performance, productivity and mood were seen as the primary advantages of an organisation's approach to fatigue management. Reduced flexibility was seen as a negative outcome, and the financial cost and staffing were the main barriers to fatigue management.

4.8 Suggested actions

The findings of this study strongly suggest that there is a need to raise industry awareness of the causes and consequences of fatigue, and processes for its

management. It is suggested that the regulatory authority, industry bodies, and Occupational Safety and Health (OSH) representatives consider who is responsible for doing this, and what educational material and supporting resources need to be developed and made available to operators.

Possible options might include:

- Comprehensive information for managers on fatigue (information should be easily accessible and/or provided through industry seminars).
- Detailed information on how to develop and implement a Fatigue Management Scheme (see Appendix D and examples from the Australian Civil Aviation Safety Authority <http://www.casa.gov.au/aoc/fatigue/index.htm)>.
- Educational and training packages for staff, which an organisation could tailor to their operation (again also easily accessible).
- On-going publications and articles in industry magazines.
- A dedicated internet site or page where information and examples can be easily accessed (again see examples from the Civil Aviation Safety Authority <http://www.casa.gov.au/aoc/fatigue/index.htm)>.

It is also suggested that the regulator carefully considers what supporting information it provides to operators, and the fatigue management processes it requires operators to have in place, particularly for those organisations operating under company-specific or accredited flight and duty time schemes, where greater flexibility is possible. Recently an industry group addressing issues associated with Ultra-Long-Range operations (including representatives from airlines, regulatory authorities, pilot associations and scientific groups) developed a framework for a Fatigue Management Scheme (see Appendix D). A further example is provided in the draft Advisory Circular 172-01 released by the Civil Aviation Safety Authority.

4.9 Conclusions

It is clear from overseas research that fatigue contributes to approximately 20% of all incidents and accidents. Although the reported rate in New Zealand is lower, this is most likely due to how fatigue is recorded and investigated, not that it is less of a problem. In an industry focused on safety, any other factor that was found to potentially contribute to one-fifth of all aviation accidents and incidents, such as a defective part or inappropriate procedure, would be the focus of attention, and action would be taken immediately to withdraw the part or change the procedure.

There are certainly air transport operators in New Zealand who are taking a comprehensive approach to fatigue management, with some companies having systems in place that make them international industry leaders in this area. However, in general, findings suggest that fatigue is not particularly well understood or managed by many operators. What is somewhat concerning is that many management individuals seem to believe they are managing fatigue well, but when asked specifically how this is being done, a large proportion of the examples indicate otherwise. This possibly signifies not only a lack of understanding of fatigue, but also what is involved in its management. This is further supported by the number of operators who indicate for various reasons that fatigue is not an issue for them, or that the use of ‘common sense’ is all that is required for managing fatigue.

Although the results of this study may portray a relatively negative picture of the management of fatigue in commercial aviation, there are also many encouraging findings. There are certainly operators with excellent ideas and processes for managing fatigue. Mechanisms need to be found through which this experience and knowledge can be shared. The size of the New Zealand industry makes sharing information, and providing training opportunities and educational material possible.

The current regulations provide an opportunity for more innovative and comprehensive approaches to be used. Presently, there seems to be a discrepancy between the regulatory approaches available, one of which implies and encourages a much more 'holistic' approach to managing fatigue, and what is actually occurring in the industry (often the bare minimum).

The intention of this report is not to condemn the current state of fatigue management in the New Zealand aviation industry, but to stimulate debate, encourage serious consideration of this issue at an industry and regulatory level, and to indicate the opportunities available to the industry for improving the overall approach to fatigue and fatigue management. Change can happen quickly in New Zealand, and this is certainly one area where rapid improvements could be made with relative ease and at no great cost.

It is strongly suggested that the New Zealand Civil Aviation Authority in association with industry bodies, carefully consider the information operators have available to them on managing fatigue, the resources that could be provided, and the channels through which information could best be delivered. The findings of this work may also have relevance to the Australian aviation industry.

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APPENDIX A: QUESTIONNAIRE

HOW IS AIRCREW FATIGUE MANAGED IN THE NEW ZEALAND AVIATION INDUSTRY?

Section A: Description of Your Organisation.

1. The title of your position(s) ……

2. What is your role(s) within the organisation you work for?

   ☐ Management ☐ Rostering ☐ Line Pilot *(if you have multiple roles please tick all the boxes that apply)*

3. How many people are employed by your organisation? ……

4. How many pilots are employed by your organisation? ……..

5. What rule does your organisation operate under? ☐ Part 121 ☐ Part 125 ☐ Part 135

6. What type(s) of operation(s) does your organisation conduct? (*please tick appropriate box or boxes*)

☐ Scheduled	☐ Non-scheduled
☐ Domestic passenger services	☐ Domestic passenger service
☐ International passenger services	☐ International passenger service
☐ Freight operations	☐ Freight operations
☐ Other (please specify)	☐ Other (please specify)
……	…….

7. What type of aircraft does your organisation operate? (*please tick appropriate boxes*)

   ☐ Jet aircraft ☐ Turbo-prop aircraft ☐ Piston-engine aircraft

   ☐ Multi-engine aircraft ☐ Single-engine aircraft ☐ Rotary-wing aircraft ☐ Fixed-wing aircraft

8. What flight rules does your organisation predominantly operate under? (*please tick appropriate box*)

   ☐ Instrument flight rules ☐ Visual flight rules

9. What type of airspace does your organisation operate in? (*please tick appropriate box or boxes*)

   ☐ Controlled airspace ☐ Uncontrolled airspace

10. What type of aerodromes does your organisation operate to? (*please tick appropriate box or boxes*)

    ☐ Certificated aerodromes ☐ Uncertificated aerodromes ☐ Remote aerodromes

11. Does your organisation operate outside daylight hours? ☐ Yes ☐ No

Please turn over and continue..

Section B: Fatigue Management Strategies in Your Organisation

12. Which of the following fatigue management strategies does your organisation use? (*If possible, please give an example of how this strategy is carried out or used in your organisation)*

- Ongoing education for pilots on fatigue management ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

- Ongoing education for people in management on fatigue management ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

- Ongoing education for rostering staff on fatigue management ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

- Monitoring of pilots' flight and duty times ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

- Monitoring of pilots' workload (other than flight and duty times) ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

- Occurrence reporting system that asks about fatigue ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

- Identification and management of fatigued pilots ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

- Ongoing review of the processes used for fatigue management ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

- A system for allowing feedback from pilots on fatigue-related issues ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

- Software to assist with rostering ☐ Yes ☐ No ☐ Don't know ☐ Not applicable

  e.g. ……

13. What other fatigue management strategies does your organisation use?

……

……

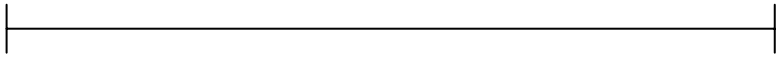
Please continue on the next page..

14. How does your organisation meet the Flight-and-Duty time limits? (*for example: Has adopted AC 119-2, Has adopted AC 119-2 with dispensations, Has an accredited Fatigue Management Scheme, Don't know*).

……..

……..

15. How well do you think your organisation currently manages the fatigue of pilots?
(*Please place a mark on the line*).



not at all well extremely well

Please turn over and continue ..

Section C: How does Fatigue Management Work in Your Organisation?

16. Who is responsible for fatigue management in your organisation? *(titles or group)*

…….

…….

17. Where does your organisation look for and get information on fatigue management?

…….

…….....

18. From your experience, what are the positive benefits of your organisation's fatigue management strategies?

…….

…….

19. From your experience, what are the negative aspects of your organisation's fatigue management strategies?

……

……

20. Are there problems, barriers, obstacles to managing fatigue in your organisation? (e.g.; costs, operational factors, staffing)

…….

…….

21. What help/advice/resources would assist in managing fatigue in your organisation?

……

……

22. Other comments ……..…

……

……

…….

……

Thank you for completing the questionnaire

APPENDIX B: SUMMARY OF RESPONSES – FATIGUE MANAGEMENT STRATEGIES

Strategy	Examples
Pilot education	▪ Courses: external (e.g. CAA safety meetings, industry forums, NZAAA), or internal (e.g. HF/CRM training, annual refresher courses, induction training) ▪ Flight and duty time limits (e.g. adhering to or monitoring limits, recording flight and duty times) ▪ Discussion/meetings (e.g. individual/group discussion, regular or staff meetings, having an open door policy) ▪ Articles or literature (from CAA and AIA, shift worker's manual) ▪ Company manuals (e.g. operations manual, reporting systems) ▪ Expert person (e.g. stress management counsellor)
Management education	▪ Courses (e.g. annual refresher courses, as required) ▪ Articles or literature (from CAA and AIA, handouts, aviation journals) ▪ Discussion/internal meetings ▪ Expert person (e.g. stress management counsellor, safety coordinator) ▪ Company manuals (e.g. office training manual) ▪ Management provides the education ▪ Needs to occur
Rostering staff education	▪ Courses (e.g. annual refresher courses, seminars) ▪ Articles or literature (from CAA and AIA) ▪ Flight and duty time limits (e.g. compliance with, knowledge of flight and duty times) ▪ Company manuals (e.g. following company procedures or guidelines) ▪ Expert person (e.g. stress management counsellor) ▪ Management provides the education
Monitoring flight and duty times	▪ Computerised system (e.g. software, computerised reports, rostering and monitoring system, computer system monitored by management/chief pilot) ▪ Paper based system (e.g. daily flight/duty records, log books) ▪ Flight and duty time limits (e.g. approved flight and duty time scheme, Part 135 regulations) ▪ Company individual responsible (e.g. CEO, chief pilot, QA manager, personal and management responsibility) ▪ Company manuals (ieX system, operations manual) ▪ Regular monitoring (continuously monitored/audited) ▪ If appropriate
Monitoring workload	▪ Via records (e.g. daily duty record, via roster, consideration of additional rostered administrative duties) ▪ Company individual responsible (e.g. operations manager, chief pilot, CEO) ▪ Meetings or discussion (e.g. regular or direct communication/discussions) ▪ Small size (e.g. small staff and can be aware of what is happening, very little workload other than flying duties) ▪ Pilots themselves ▪ General monitoring

Strategy	Examples
	▪ Factors outside of work (e.g. being aware of what pilots do outside of work) ▪ Providing time off
Occurrence reporting system that includes fatigue	▪ General reporting system (e.g. quality safety reporting system, CAA005, can report any problems including fatigue) ▪ Company documents (e.g. as per operations manual, ieX system) ▪ Other (e.g. verbally, monthly safety meetings, common sense)
Identification and management of fatigued personnel	▪ Company size/culture (e.g. pilots are seen, close knit team) ▪ Providing time off (e.g. send home or limit work, rostered time off, managed through roster, gets next day off after working at night) ▪ Company individual responsible (e.g. operations manager and controller, chief pilot) ▪ Pilot responsible (e.g. monitored by pilots, responsibility of pilot to communicate, self regulating) ▪ Monitoring crew (e.g. constant monitoring, case by case, habits) ▪ Flight and duty limits (e.g. monitoring of flight and duty limits and not rostering those who may be fatigued, flight and duty report and forms identify pilots at risk) ▪ Other person identified as responsible (e.g. safety coordinator, counsellor) ▪ Does not happen (e.g. no issues to date, has not happened to date) ▪ Other (e.g. no procedure but are pro-active in dealing with reported fatigue, discussions, common sense)
Review of processes for managing fatigue	▪ Quality assurance system (e.g. quality improvement form, internal audits) ▪ Management meetings (e.g. monthly meetings, standing item at regular management review meetings) ▪ Company manuals (e.g. ieX, annual exposition) ▪ Person identified as responsible (stress management counsellor, safety coordinator report) ▪ Does not occur (e.g. doesn't happen. Not really, current systems sufficient)
Feedback system	▪ Verbal channels (e.g. daily communication, discussions, personal feedback encouraged, talk to chief pilot) ▪ Meetings (e.g. staff meetings, monthly safety meetings, pilot meetings, scheduled discussion) ▪ Quality assurance system (e.g. internal QA, ieX system) ▪ Reporting form (e.g. internal reporting, fatigue form)
Rostering software	▪ Named software ▪ General computing software (e.g. excel spreadsheets, access, computerised database) ▪ Other (e.g. small staff, operations manager rosters staff, white board system sufficient)

APPENDIX C: SUMMARY OF RESPONSES – HOW FATIGUE IS MANAGED IN AN ORGANISATION

Question	Categories or themes in responses
Who is responsible for fatigue management in your organisation?	▪ Chief Executive Officer ▪ Chief Pilot (includes Chief Flying Instructor and Fleet Manager) ▪ Operations Manager ▪ Quality Assurance position (includes Safety Officer) ▪ Combinations of the above mentioned positions (e.g. Chief Pilot/Operations Manager, CEO/Chief Pilot) ▪ Pilots followed by Chief Pilot/Operations Manager ▪ Management (non-specific about position) ▪ Pilots ▪ Another named position (e.g. OSH officer, Club President, Stress Management Counsellor, Roster person)
Where does your organisation look for and get information on fatigue management?	▪ We don't (e.g. haven't needed to, not applicable, not an issue, common sense) ▪ Publications (e.g. magazine articles, *Vector*, industry publications, safety publications, books, library) ▪ Industry bodies (e.g. CAA, AIA, NZAAA, NZALPA) ▪ CAA rules (including advisory circulars, flight and duty time limits) ▪ Company publications (e.g. operations manual, exposition, own policies) ▪ Expert person (e.g. medical doctor, stress management counsellor, other expert person or group) ▪ Other airlines (including peer groups) ▪ Management (e.g. Operations Manager) ▪ Personal experience ▪ Internet (including CAA website) ▪ Seminars
From your experience, what are the positive benefits of your organisation's fatigue management strategies?	▪ Safety (e.g. less incidents, safe work place, less mistakes) ▪ Effects on staff (e.g. improved performance, better judgment, greater productivity, improved mood and morale, more motivated, fresh pilots, not fatigued) ▪ Not a problem or not applicable ▪ Prevention (e.g. early recognition, early intervention) ▪ Flexibility (in use of pilots)
From your experience, what are the negative aspects of your organisation's fatigue management strategies?	▪ None (including not applicable) ▪ Loss of flexibility ▪ Difficult to manage (time wise, practically) ▪ Limited staff numbers ▪ Not detecting pilots are fatigued ▪ Present approach to fatigue management not sufficient ▪ Costs ▪ No education

Question	Categories or themes in responses
Are there problems, barriers, obstacles to managing fatigue in your organisation? (e.g. costs, operational factors, staffing)	▪ None ▪ Operational factors (e.g. weather, workload) ▪ Cost (including the cost of staff) ▪ Staffing ▪ Flight and duty time system (e.g. going over flight and duty limits one day would make next day easier, difficulties with getting an alternative flight and duty scheme approved, the importance of having variations to AC 119-2) ▪ Other (industrial issues mixed with fatigue issues, loss of production, pilot fatigue, no education, outside activities of pilots)
What help/advice/resources would assist in managing fatigue in your organisation?	▪ Not required ▪ Information (e.g. educational material, fatigue manual, guidelines on fatigue management for small companies, more Vector articles, research information, videos, feedback from survey) ▪ Education/training opportunities (e.g. more education, ongoing training opportunities, briefing by experts to management) ▪ Seeing what others do (e.g. network with other operators, see others flight and duty time systems, belong to industry groups) ▪ More staff ▪ Software (for roster building) ▪ More flexible flight and duty time system (specific to operation)

APPENDIX D: FATIGUE RISK MANAGEMENT FRAMEWORK

Framework for a Fatigue Risk Management System[7]

A Fatigue Risk Management System (FRMS) is an integral part of a Safety Management System that provides a means of ensuring that employees' alertness and performance is not degraded to an unacceptable level as a result of fatigue.

The purpose of an FRMS is to reduce the errors, incidents and accidents in which fatigue is a contributory factor. It is expected that an FRMS will lead to improved safety, efficiency, productivity and operational flexibility, while satisfying the company's duty of care to its employees and the public.

Elements of an FRMS

An FRMS should include the following elements:

- a fatigue risk management policy
- education and awareness training programmes
- a crew fatigue reporting mechanism with associated feedback
- procedures and measures for monitoring fatigue levels
- procedures for reporting, investigating, and recording incidents that are attributable wholly or in part to fatigue
- rocesses for evaluating information on fatigue levels and fatigue-related incidents, undertaking interventions, and evaluating the effects of those interventions.

Fatigue Risk Management Policy

The company's Fatigue Risk Management Policy must be an integral part of its Safety Policy. It should be open and transparent, and include the following elements:

- commitment from the highest levels of the organisation
- a specified line of accountability for fatigue risk management in the organisation
- definition of the responsibilities of the company management and the employees
- identification of the work groups covered by the FRMS
- terms of reference for the Fatigue Management Steering Committee (FMSC), including frequency of meetings; identification of fatigue reporting mechanisms
- identification of fatigue reporting mechanisms;
- policies for identifying and managing employees who are fatigued to an extent that represents a safety risk, including considering provision for opting out of an assignment
- commitment to provide training and resources in support of the Fatigue Risk Management Policy
- commitment to act on recommendations regarding fatigue risk management arising from internal audit.

Functions of the Fatigue Management Steering Committee (FMSC)

The FMSC is the focal point for coordinating all fatigue risk management activities within the organisation. Its functions include the following:

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7 Flight Safety Digest, August-September 2005, page 16-19

- monitoring fatigue information sources
- investigating fatigue-related issues
- requesting internal audit of specific issues
- proposing solutions to fatigue-related issues
- making recommendations on priorities for targeting fatigue management resources
- providing transparent and timely feedback to the workforce
- providing transparent and timely feedback to higher management
- cooperating with internal and regulatory audits
- overseeing the quality assurance of fatigue risk management training (initial and on-going) across the organisation.

Representation on the Fatigue Management Steering Committee

The composition of the FMSC should include balanced representation from the company and employees, with scientific/specialist advice available as needed. Company and employee representatives may be drawn from the following areas:

- cabin crew representation
- pilots' representation
- medical staff
- manpower planners/rostering
- commercial/marketing
- training
- technical
- safety
- operations.

Information Sources for the Fatigue Management Steering Committee

Initiated by Others

- voluntary fatigue reports (confidentiality optional)
- other fatigue-related reports from crew (e.g., Captain's Special Reports, Cabin Crew Voyage Reports)
- monitoring of calls reporting 'too fatigued' to take duty
- fatigue-related incident reports
- internal and external audit reports
- external expert review of the FRMS.

Initiated by the FMSC

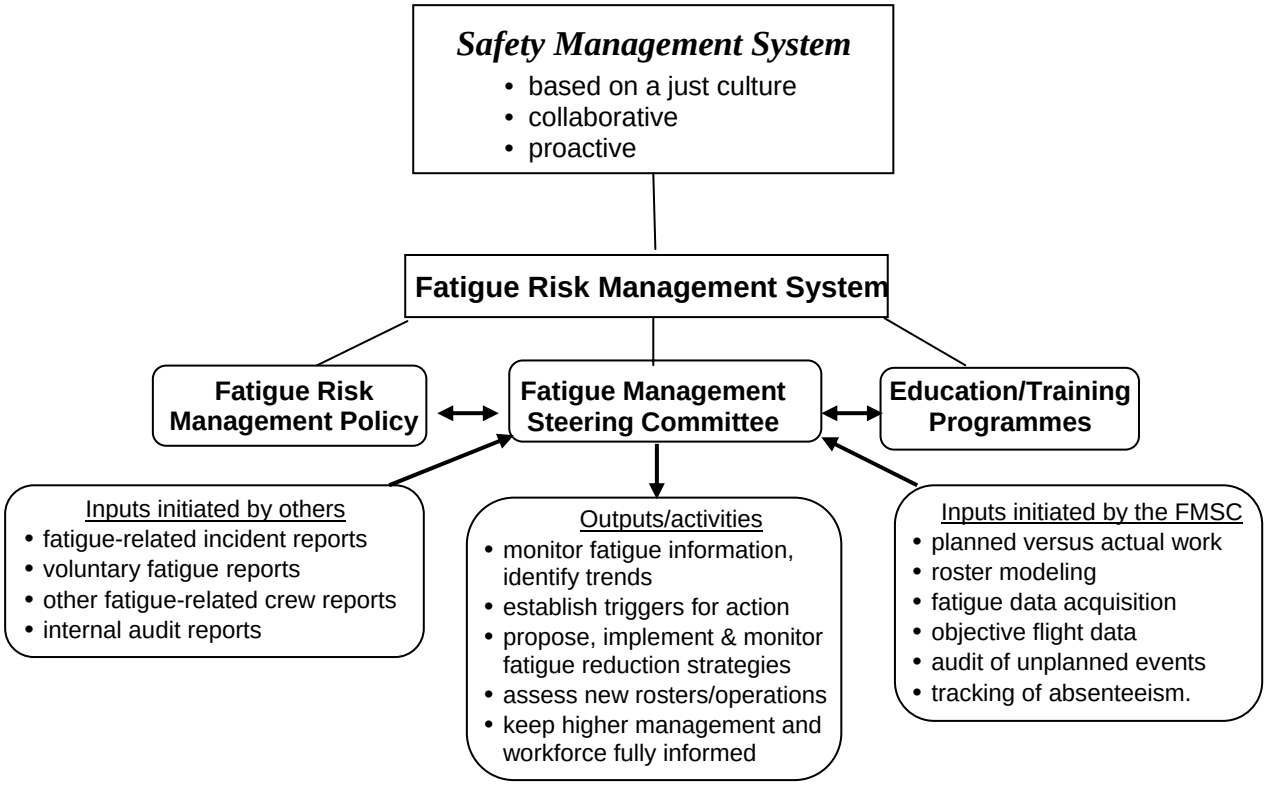
- planned versus actual work (i.e. rostered/scheduled duty versus actual duty, trip swapping, use of reserve and standby)
- roster modeling
- fatigue data acquisition (e.g. questionnaires, diaries, actigraphy, performance testing)
- objective flight data e.g. flight data management (FDM) flight operations quality assurance (FOQA), line oriented safety audit (LOSA)
- audit of unplanned events (delays, diversions, Captain's discretion, etc.)
- tracking of absenteeism.

Activities and Outputs of the Fatigue Management Steering Committee

- monitoring fatigue information and identify trends
- establishing triggers for action

- proposing, implement, and monitor fatigue reduction strategies (e.g., roster changes, layover hotels, crew rest)
- assessing new rosters/operations
- keeping higher management and the workforce fully informed of the activities, findings, and recommendations of the Committee.

Figure 1 summarises the proposed overall structure of an FRMS. The detailed structure of an FRMS might vary for different workforce groups within an organisation, and among different size organisations.



Recommendations

It is recommended that a Fatigue Risk Management System, with appropriate regulatory oversight, be considered as an acceptable alternative to prescriptive flight and duty time limitations and rest requirements. For operators that choose this alternative means of compliance, a Fatigue Risk Management System should then become a required component of the Safety Management System.

A Fatigue Risk Management System is considered essential for ULR operations.

It is also recommended that some components of Fatigue Risk Management Systems, in particular fatigue management education, would be valuable additions to prescriptive regimes.