Managing fatigue

in a large mixed fleet operation

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PACDEFF 2 Aug 2012
Flying

Real Flying
Outline

1. Background, previous work
2. Method
3. Results
4. Possible applications
5. Where to now?
Background – ICAO Guidance

1. FRMS policy and documentation
2. FRMS risk management
   Identify fatigue hazards
     - Reactive, Proactive, Predictive
   Assess fatigue risks
   Interventions to control fatigue risks
3. FRMS assurance processes
   including measures of effectiveness
4. FRMS promotion processes – training, education
Background – ICAO Guidance

1. FRMS policy and documentation

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   - Identify fatigue hazards
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   - including measures of effectiveness

4. FRMS promotion processes – training, education
Background - studies

- Typically 20-30 pilots over six weeks
- Studies conducted without an experimenter on board
  - crews are briefed prior to the first departure
- Participants wear a wrist actigraph throughout the study
  - provides an indication of the timing of their sleep periods
- In-flight information obtained using a Palm Pilot computer
  - subjective assessments of fatigue, sleepiness and mood
  - a choice reaction time test
Traditional studies

Christchurch-Brisbane-Christchurch 2-pilot overnight

Subjective fatigue

Performance (choice reaction time)

Powell DMC, Spencer MB, Petrie KJ. Fatigue in airline pilots after an additional day’s layover period. Aviat Space Environ Med 2010; 81:1-5
## Routes studied with PDA/actiwatch

<table>
<thead>
<tr>
<th>Pilots</th>
<th>Cabin Crew</th>
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<tbody>
<tr>
<td>AKL-LAX-LHR-LAX-SYD</td>
<td>AKL-NAN-RAR-PPT-RAR-NAN-AKL*</td>
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<tr>
<td>SYD-KIX-BNE-SYD (Ansett)</td>
<td>AKL-KIX-CHC-AKL</td>
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<tr>
<td>SYD-LAX-AKL* 3 vs 4 pilot</td>
<td>AKL-PER-AKL</td>
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<td>AKL-LAX-AKL* 1 vs 2 nights</td>
<td>AKL-TBU-HNL-AKL*</td>
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<td>AKL-LAX-LHR-LAX-AKL  1 vs 2 night</td>
<td>AKL-LAX-APW-AKL</td>
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<td>AKL-LAX-AKL</td>
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<td>AKL-HKG-LHR-HKG-AKL x2</td>
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<tr>
<td>AKL-ADL-AKL</td>
<td>AKL-PPT-AKL*</td>
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</table>

* - Changes made
Another way

- More flights
- Brief measure
- Critical phase:
  - Probability of brain impairment
  - Demands of task and environment
  - Impact of failure

= Top of Descent
Top of Descent Survey

Last descent of duty day
Self rated fatigue (SP, VAS)
Three months
>9000 responses
Three parts of operation

PILOT ALERTNESS REPORT FORM
Forms to be completed immediately prior to Top of Descent on last leg of duty period.

Report Time (UTC)

Time (UTC) at Top of Descent
Name the Sectors operated this duty period.

Please circle “How you feel” at Top of Descent
1. Fully alert, wide awake
2. Very lively, responsive, but not at peak
3. OK, somewhat fresh
4. A little tired, less than fresh
5. Moderately tired, let down
6. Extremely tired, very difficult to concentrate
7. Completely exhausted

Please mark on the line below
Alert Drowsy

Please place in brown envelope
Top of descent survey results (Longhaul)
Fatigue (7-pt Samn-Perelli) vs.
- Top of descent (h)
- Duration (h)
- Number of sectors
Why not try to do it routinely?
Top of Descent Alertness Evaluation (ToDAE)

A new tool for monitoring fatigue in commercial airline operations
1. Fully Alert, wide awake
2. Very lively, responsive, but not at peak
3. OK, somewhat fresh
4. A little tired, less than fresh
5. Moderately tired, let down
6. Extremely tired, very difficult to concentrate
7. Completely exhausted, unable to function effectively
0. Not Applicable
Participants

- All pilots on the 777-200 fleet were invited to participate
  - anonymous
- Mixture of operations
  - long-haul international (almost all overnight)
  - out-and-back duties (daytime)
- Between Jun 09 and May 10
  4629 ratings were obtained
  - from over 50% of flights
  - approx. 38% of pilots
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<tr>
<th>From</th>
<th>To</th>
<th>Take-off (approx LT)</th>
<th>Flight durn (h)</th>
<th>No. of pilots</th>
<th>Type of flight</th>
<th>Prior nights layover</th>
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</table>
Samn-Perelli scores by sector

Short<Long  (p<0.001)

Out and back daylight duties

- Scores on return were considerably higher than on the outward flight $p<0.001$
- The Fiji flights were less fatiguing than the others $p<0.05$
- The Brisbane flights were less fatiguing than the Melbourne flights $p<0.01$
Effect of time of day

- Comparison between an overnight flight (AKL-HKG) and a daytime flight (AKL-NRT)
- Flights of similar duration
- $p<0.001$
Effect of an additional pilot

- Comparison between:
  - AKL-HKG (3 pilot)
    - start 00:00; duration 11.5h
  - AKL-PEK (4 pilot)
    - start 23:00; duration 13.5h
  - AKL-YVR (4 pilot)
    - start 20:00; duration 13.2h

- Scores were higher at the end of AKL-HKG than AKL-YVR

- No difference between AKL-HKG and AKL-PEK

* p<0.05
Comparison with previous two-crew results

- The two-crew flights were in very close agreement
- The scores on the augmented flights were lower than predictions based on previous two-crew results
  - except for the two daytime flights
Comparison with predictive model (SAFE)
Comparison with SAFE predictions

![Graph showing the relationship between SAFE predictions and mean scores with a Pearson correlation coefficient of r=0.88.](image)
A320

0917 TOP OF DESCENT 1/4
ALERTNESS EVALUATION

PILOT A  NOTES
1 - 3 >

PILOT B
4 - 6 >

PILOT C
7 & 0 >

ENTER CODE FOR EACH PILOT. 0 = NOT APPLICABLE

<RETURN  CLEAR>

0917 TOP OF DESCENT 2/4
ALERTNESS EVALUATION

1 FULLY ALERT, WIDE AWAKE

2 VERY LIVELY, RESPONSIVE BUT NOT AT PEAK

3 OK, SOMewhat FRESH

<RETURN

0917 TOP OF DESCENT 3/4
ALERTNESS EVALUATION

4 A LITTLE TIRED, LESS THAN FRESH

5 MODERATELY TIRED, LET DOWN

6 EXTREMELY TIRED, VERY DIFFICULT TO CONCENTRATE

<RETURN

0917 TOP OF DESCENT 4/4
ALERTNESS EVALUATION

7 COMPLETELY EXHAUSTED, UNABLE TO FUNCTION EFFECTIVELY

0 NOT APPLICABLE

<RETURN
Potential applications

- Monitoring operation
  - New routes
  - Other changes
- Avoiding formal studies
- Integrating with safety monitoring – FOQA
- What else?

Feel free to copy it!
Potential problems
FRMS Elements – ICAO Draft Guidance

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   Identify fatigue hazards
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   including measures of effectiveness

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Significant fatigue from the job - changes since 1993

- Once a week or more
- Once every two weeks or less

- 1993
- 2001
- 2004
- 2006
- 2010
What about safety?

• How much fatigue = how much effect on safety?
• What are the validated measures of safety performance?
• What has been studied so far in this regard?
Studies to date

- easyJet – LOSA
- Qantas – Simulator study
- Thomas – LOSA compared to prior sleep
- French regional airlines – FOQA
- Moore-Ede – unstable approaches

More work is required…. 
Where to now?

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david.powell@airnz.co.nz
Questions?


- Fatigue in airline pilots after an additional day’s layover period. Powell DMC, Spencer MB, Petrie KJ. Aviat Space Environ Med 2010; 81:1-5
