Fatigue in a regional aircraft operator: the effect of multi-segment operations in alertness

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**ICAO definition of Fatigue**

A physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a crew member’s alertness and ability to safely operate an aircraft or perform safety-related duties.
What is the impact in alertness of flying short multiple sectors during a single duty day in a potentially challenging environment?

- To identify the preeminence of the need to manage fatigue in air crew members

- To integrate fatigue hazards and its risk management in the framework of an existing SMS according to the new ICAO and European regulations

- To infer real risk already present in the airline through subjective fatigue queries

- To validate the chosen methods and processes so as to lead sustainable fatigue management implementation and maintenance
Research Context

- Regional Airline

- Island connections:
  - Short: 00h15
  - Long: 02h00
Methodology

• Literature review
  – Online scientific databases

• Questionnaire
  – Google forms
  – Based on Nasa’s fatigue study in regional operators
  – Goals:
    • analyze demographics, personal and social habits
    • Evaluate fatigue and safety gaps
Methodology

• Diary:
  – Start and end times for the duty day;
  – Samn-Perelli Fatigue Scale (Samn & Perelli, 1982) and the Karolinska Sleepiness scale (Akerstedt & Gillberg, 1990);
  – NASA’s TLX measurement, on a simplified version adapted to this study;
  – Assessment of further disruptions during the day.

• Questionnaire and diaries:
  – Available for one month;
  – Approved by the Airline’s management and the Safety Department
• 52 individuals – all male

• Average age 39.2 (±9,539)
  – 27 Captains:
    • mean age 44.2 (± 10,059)
    • Youngest: 30 years old
    • Oldest: 63 years old
  – 25 First Officers:
    • mean age 33.8
    • Youngest: 26 years old
    • Oldest: 44 years old
Results

Questionnaires

• 26 responses:
  • Representative sample (age and total flying hours)
  • Average age: 37 years old, [26;55], 50% below average
  • 70% married
  • More than 50% have up to 3 dependants
  • 50% have high school education (only 1 post-graduated)
  • 30% smokers
  • 85% practice exercise
  • 76.9% ingest caffeine daily
  • Diet is typical Portuguese/Mediterranean
Results

Analysis of planned schedules
## Results

### Analyses of planned schedules

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Weight in total Operation</th>
<th>Sector count</th>
<th>Duty length</th>
<th>Rest time</th>
<th>Previous day start time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 06:00</td>
<td>10 %</td>
<td>6</td>
<td>08:00</td>
<td>17:15</td>
<td>07:30 to 09:00</td>
</tr>
<tr>
<td>06:01 to 07:30</td>
<td>13.1 %</td>
<td>4</td>
<td>06:45</td>
<td>18:00</td>
<td>06:00 to 07:30</td>
</tr>
<tr>
<td>07:31 to 09:00</td>
<td>24.2 %</td>
<td>4</td>
<td>06:30</td>
<td>18:05</td>
<td>07:30 to 09:00</td>
</tr>
<tr>
<td>09:01 to 12:00</td>
<td>21.3 %</td>
<td>4</td>
<td>07:00</td>
<td>17:00</td>
<td>09:00 to 12:00</td>
</tr>
<tr>
<td>12:01 to 15:00</td>
<td>21 %</td>
<td>5</td>
<td><strong>06:00</strong></td>
<td>18:40</td>
<td>12:00 to 15:00</td>
</tr>
<tr>
<td>After 15:00</td>
<td>10.4 %</td>
<td>2</td>
<td>04:00</td>
<td>22:45</td>
<td>12:00 to 15:00</td>
</tr>
</tbody>
</table>
Results

Live trial

1 - Identify total times for the period and their distributions

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duty</td>
<td>88:35 (+- 28:57)</td>
<td>88:00</td>
<td>27:09</td>
<td>159:31</td>
</tr>
<tr>
<td>Block</td>
<td>20:40 (+- 10:32)</td>
<td>22:00</td>
<td>02:05</td>
<td>42:03</td>
</tr>
</tbody>
</table>
Results

*Live trial*

Segment the flights by reporting time
Results

Live trial
Conclusions

• Fatigue has a big impact in human performance and consequently in flight operations

• Early start time of the duty day has a negative influence in alertness

• Number of sectors flown further aggravates sleepiness and consequently reduces alertness
Limitations

• Study performed in the winter months – operational discrepancy with year round reality

• Limited amount of time to collect data and infer more significant results

• Lack of fatigue studies with regional aircraft operators
Future directions

• Overview and control groups with higher block and duty hours

• Monitor early hour starts due to the potential risks associated with circadian disruption and sleep debt

• Further validate and monitor the impact of high workload in flight operations

• Perform a year round study to encompass the different variations in the operational context
The End