Parallel Session
Current State of Mitigation:
Flight Operations

The easyJet Fatigue Risk Management System (FRMS)

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&
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Clockwork Research

8:35 - 9:00
June 18, 2008
Captain Simon Stewart

Biography

Simon Stewart is currently the Head of Strategic Safety Development at easyJet. Prior to that role he was the easyJet Flight Operations Safety and Quality Manager for 3 years. He is responsible for the development and implementation of easyJet SMS systems, of which, the Fatigue Risk Management System (FRMS) is an integral component. He is currently documenting the FRMS as part of his postgraduate studies at London City University with Dr Alex Holmes & Dr Steve Bond.

Alexandra Holmes, Ph.D.

Biography

Alexandra Holmes is Research Director at Clockwork Research, a London-based company providing fatigue risk management services to airlines, the road transport industry and emergency services. She has worked closely with easyJet for the past 5 years and assisted the company in becoming the first European airline to implement a fatigue risk management system (FRMS). Alex is a sleep, fatigue and shiftwork specialist and completed a PhD with the Centre for Sleep Research in Australia.

Alex primarily works with commercial airlines, both short-haul and long-haul, to enhance the extent to which their safety management systems consider fatigue risk. Alex has developed a range of operational processes for managing fatigue including fatigue reporting systems, incident investigation tools and roster quality indices. She is an experienced workshop host and develops training for management, scheduling staff and crew. Alex regularly runs Line Operations Safety Audit (LOSA) programmes and conducts research to explore the causes and consequences of fatigue and the level of fatigue risk to which an operation is exposed.
The problem with assuming that compliant is equivalent to safe…
1995

1 base
3 airports
2 routes
2 leased aircraft
Virtual airline!

2008

20 bases
103 airports
26 countries
400 routes
170 aircraft
39 million pax
7000 employees
Operational risk

“...in line with increased crew utilisation, the overall operating environment has become significantly more complex, leading to an increase in levels of operational risk.”

UK Civil Aviation Authority 2007
Fatigue hazards and risks

- Work-related causes of fatigue
  - Duration
  - Timing
  - Rotation
  - Shift system
  - Breaks within
  - Breaks between

- Work Factors
  - Workload
  - Workplace
  - Job design

- Job Factors
  - Individual Factors

- Human Performance
  - Vigilance
  - Tracking
  - Decision Making
  - Memory
  - Awareness
  - Reaction time
  - Accidents
  - Absenteeism
  - Costs

- Operational Performance

- Health

- Medications
  - Sleep disorders
  - Sleep rigidity
  - Chronotype

- Home situation
  - Stress
  - Health

- Lifestyle
  - Recreation

Adapted from Sutton et al. (2003)

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008
Fatigue Risk Management System

- A fatigue risk management policy;
- A crew fatigue reporting mechanism with associated feedback;
- Procedures and measures for assessing and monitoring fatigue levels;
- Procedures for investigating, and recording incidents that are attributable wholly or in part to fatigue;
- Processes for evaluating information on fatigue levels and fatigue-related incidents, undertaking interventions, and evaluating the effects of those interventions.
- Competency based education and awareness training programmes (organisational learning);
- A performance audit plan (internal and regulatory).
How do you measure fatigue?
easyJet will maintain an evidence-based Safety Management System that proactively and continuously delivers safety effectiveness and operational integrity within a risk controlled environment.

- Effective **reactive** response to incidents;
- **Proactive** risk analysis to maintain system integrity;
- **Risk trending** that evaluates control strategies;
- **Explore** system risks for future business strategy;
- **Real time** knowledge of System Dynamic Risk;
- Communicate dynamic risk state in ***standardised*** format;
- All management levels have **clear** understanding of system risk.

This requires the establishment of an open framework of linked databases.
# FATIGUE REPORT FORM 1

**ALL INFORMATION PROVIDED REMAINS STRICTLY CONFIDENTIAL WITHIN THE SAFETY DEPARTMENT**

<table>
<thead>
<tr>
<th>NAME:</th>
<th>RANK:</th>
<th>DATE OF BIRTH (DD/MM/YY):</th>
<th>HOME BASE:</th>
<th>TODAY'S DATE:</th>
</tr>
</thead>
</table>

**THIS FORM IS BEING COMPLETED IN RELATION TO FATIGUE ASSOCIATED WITH:** (TICK ONE)

- □ A lodged ASR
- □ An FDM event
- □ A non-reported safety event
- □ A general concern regarding fatigue

When did the event occur?

<table>
<thead>
<tr>
<th>Date (DD/MM/YY):</th>
<th>Time (LOCAL/UTC):</th>
<th>How long had you been on duty?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>/</strong>/__</td>
<td>:/:</td>
<td>___________HOURS _______MINS</td>
</tr>
</tbody>
</table>

What were you doing at the time of the event?

- □ In flight
- □ Driving to work
- □ Driving home
- □ Positioning
- □ Other ________

If relevant, on what flight did the event occur?

<table>
<thead>
<tr>
<th>Flight number:</th>
<th>Route:</th>
<th>Aircraft type:</th>
<th>Event sector:</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____________</td>
<td>_______</td>
<td>_____________</td>
<td>____________</td>
</tr>
</tbody>
</table>

Duty details:

- □ Early
- □ Late

| Early Duty: | Duty Day: | Rostered start time | Rostered finish time |
| ___________ | _________ | :/: | :/: |
| ___/__/___ | __________ | LOCAL/UTC | LOCAL/UTC |

| Actual start time | Actual finish time |
| :/ | :/ |
| LOCAL/UTC | LOCAL/UTC |

Duration of commute to & from duty

- To _______HRS _______MIN
- From _______HRS _______MIN

Tick all factors that you feel contributed to the event/your general concern

- □ Hotel rest
- □ Home rest
- □ Insufficient rostered rest time
- □ Roster disruption
- □ Early to late transition
- □ Early start time
- □ Late finish time
- □ Long duty day
- □ Delay(s)
- □ Positioning
- □ Commute
- □ Health
- □ Long-term fatigue
- □ Home issues
- □ Don’t know
- □ Other (please add details in the space provided)

Use this space to provide further detail or to record factors not listed:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
### Physical Signs

- [ ] No physical signs were noted
- [ ] Fidgeting
- [ ] Rubbing eyes
- [ ] Yawning
- [ ] Frequent blinking
- [ ] Staring blankly
- [ ] Long blinks
- [ ] Difficulty keeping eyes open
- [ ] Head nodding
- [ ] Other: ____________________________

### Cognitive Signs

- [ ] No cognitive signs were noted
- [ ] Increase in slips
- [ ] Increase in lapses
- [ ] Impaired attention
- [ ] Impaired memory
- [ ] Negative mood
- [ ] Reduced communication
- [ ] Impaired problem solving
- [ ] Increased risk taking
- [ ] Impaired situational awareness
- [ ] Other: ____________________________

---

**How alert did you feel immediately prior to the event (tick one):**

- [ ] 1. Fully alert, wide awake
- [ ] 2. Very lively, somewhat 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

---

**NOTE:** If you wish to record additional information not covered by this form, including any suggestions for corrective actions, please use the reverse or attach additional sheets. **Tick here if attaching additional sheets  □  Number of sheets attached _____**
Example FRF investigation data

- Check details of duty for which fatigued
- Check previous duties
- Check duty/flying hrs
- Check night stops away from base
- Check commute times
- Check sickness records
- Run data through predictive model
- Consider hassle factors
### Example fatigue report form data representation

<table>
<thead>
<tr>
<th>Fatigue Indicators</th>
<th>12 month chart</th>
<th>April</th>
<th>Prev month</th>
<th>3 month</th>
<th>12 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commute</td>
<td></td>
<td>8%</td>
<td>7%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>Delay(s)</td>
<td></td>
<td>31%</td>
<td>21%</td>
<td>24%</td>
<td>27%</td>
</tr>
<tr>
<td>Early Start Time</td>
<td></td>
<td>8%</td>
<td>38%</td>
<td>22%</td>
<td>28%</td>
</tr>
<tr>
<td>Early to Late Transition</td>
<td></td>
<td>8%</td>
<td>21%</td>
<td>14%</td>
<td>10%</td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td>8%</td>
<td>10%</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Home Issues</td>
<td></td>
<td>8%</td>
<td>10%</td>
<td>12%</td>
<td>17%</td>
</tr>
<tr>
<td>Home Rest</td>
<td></td>
<td>31%</td>
<td>14%</td>
<td>23%</td>
<td>24%</td>
</tr>
<tr>
<td>Hotel Rest</td>
<td></td>
<td>38%</td>
<td>17%</td>
<td>20%</td>
<td>12%</td>
</tr>
<tr>
<td>Insufficient Rostered Rest Time</td>
<td></td>
<td>31%</td>
<td>24%</td>
<td>28%</td>
<td>26%</td>
</tr>
<tr>
<td>Late Finish</td>
<td></td>
<td>38%</td>
<td>28%</td>
<td>32%</td>
<td>29%</td>
</tr>
<tr>
<td>Late to Early Transition</td>
<td></td>
<td>8%</td>
<td>0%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Long Duty Day</td>
<td></td>
<td>54%</td>
<td>55%</td>
<td>59%</td>
<td>54%</td>
</tr>
<tr>
<td>Long-Term Fatigue</td>
<td></td>
<td>23%</td>
<td>31%</td>
<td>20%</td>
<td>16%</td>
</tr>
<tr>
<td>Positioning</td>
<td></td>
<td>8%</td>
<td>21%</td>
<td>16%</td>
<td>9%</td>
</tr>
<tr>
<td>Roster Disruption</td>
<td></td>
<td>38%</td>
<td>24%</td>
<td>26%</td>
<td>23%</td>
</tr>
</tbody>
</table>

Crew cited contributors to fatigue

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008
Sleep and error management

![Graph showing the percentage of effectively managed errors across different sleep durations. The graph compares early duties (blue bars) and late duties (red bars) for sleep durations of less than 5 hours, 5 to 6 hours, 6 to 7 hours, 7 to 8 hours, and 8 to 9 hours. The error bars indicate variability.]

easyJet HFMP study 2008

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008
How do you assess fatigue risk?
Incidents & Safety Performance information

Risk Threshold Events

Investigation

Risk Assessment
identified hazards from investigations and adverse trends

Risk Mgt
Stakeholder decisions against risk treatment options

Implementation Actions
Monitor, track & evaluate actions

Organisational learning

Feedback to individual and organisation

Data Analysis
(Including sample data extrapolation and frequency consideration)

Risk Mgt
Stakeholder decisions against risk treatment options

Risk Performance Reporting
(Historical trends and predictions)
Day to day and strategic risk trends

HAZID/OP Analysis

Proactive assessment of Significant changes to system or operations

Undesirable indications

reactive

Risk Mgt
Stakeholder decisions against risk treatment options

Implementation Actions
Monitor, track & evaluate actions

Organisational learning

Feedback to individual and organisation

easyJet SIRA©-ECAST safety cycle 2008

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008
EVENTS will be investigated, systemic causal factors analysed

SIRA© Investigation process

1. Event detection
   Sensory network

2. Classification risk grading & notification

3. Define scope, context & investigation team;
   Document risk keywords/event

4. Secure information:
   Data gathering, tabulation against scope
   Event & conditional factor analysis

5. Review AQD investigations & actions for risk keywords per event category

6. Is safety report accurate?
   Y

7. Case based reasoning:
   Reuse (in context) similar event investigation findings in AQD?

8. Select investigation tools for investigation context & apply

9. Document & rank systematic causal factors & recommendations from investigation

10. SIRA Strategic & tactical decision process against risk treatment options (cost and impact)

   Allocate, communicate, implement, evaluate

11. Toolbox directory
   Tool
   Context
   People
   Task
   Output

TU Delft, Lund University 2008
Bowtie Model: Barriers and controls of fatigue risks are examined

Identify

 Threat 1
   Threat Barrier
   Threat Barrier

 Threat 2
   Threat Barrier
   Threat Barrier

 Threat 3
   Threat Barrier
   Threat Barrier

 Escalation Factor
   Escalation Factor Control

Control

Hazard

Hazard or Top Event

Assess

 Consequence 1
   Recovery Preparedness Measure
   Recovery Preparedness Measure

 Consequence 2
   Recovery Preparedness Measure
   Recovery Preparedness Measure

 Consequence 3
   Recovery Preparedness Measure
   Recovery Preparedness Measure
   Escalation Factor Control

Recover

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008
Team will allow management to assess options and rank risks for continuous improvement

<table>
<thead>
<tr>
<th>Severity</th>
<th>People</th>
<th>Environment</th>
<th>Assets</th>
<th>Reputation</th>
<th>Consequence</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No injury</td>
<td>No effect</td>
<td>No damage</td>
<td>No impact</td>
<td>Never heard of in industry</td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>Slight Injury</td>
<td>Slight effect</td>
<td>Slight damage</td>
<td>Slight impact</td>
<td>Has occurred in industry</td>
<td>B</td>
</tr>
<tr>
<td>2</td>
<td>Minor injury</td>
<td>Minor effect</td>
<td>Minor damage</td>
<td>Limited impact</td>
<td>Has occurred in company</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>Major injury</td>
<td>Localised effect</td>
<td>Localised damage</td>
<td>Considerable impact</td>
<td>Occurs several times per year in company</td>
<td>D</td>
</tr>
<tr>
<td>4</td>
<td>1-3 fatalities</td>
<td>Major effect</td>
<td>Major damage</td>
<td>National Impact</td>
<td>Occurs frequently in company</td>
<td>E</td>
</tr>
<tr>
<td>5</td>
<td>multiple fatalities</td>
<td>Massive effect</td>
<td>Extensive damage</td>
<td>International impact</td>
<td>Intolerable</td>
<td></td>
</tr>
</tbody>
</table>

Manage for continuous improvement

Incorporate risk reduction measures

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008
How do you manage fatigue risk?
Fatigue Awareness and Countermeasures Training (FACT)

- c.1800 pilots have completed the online FACT programme
- Competency tested online and records kept for audit purposes
- FACT continuously updated to reflect research and operational risks
- Adapted to suit managers, rostering staff, cabin crew, engineering etc
Safety is our number 1 priority
<table>
<thead>
<tr>
<th>Risk Name</th>
<th>Risk Summary</th>
<th>Risk Owner</th>
<th>Identified (date)</th>
<th>Estimated Closure</th>
<th>Risk Grade</th>
</tr>
</thead>
</table>

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008
The risk evaluation team that ensures safety & quality oversight criteria are met and standardised

Ensures Regulatory Compliance – current and future

Evaluate risk identified from FRMS investigations and regulation against system operation (impact & cost, efficiency, safety & performance criteria)

Is compatible and capable with the business model (operational readiness)

Facilitates evidence-based decision making

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008
easyJet’s system for managing fatigue

LEVEL 2 GEAR
DATA COLLECTION PROCESS
- Information collected from network:
  - including fatigue surrogate variables, fatigue-related behaviours, errors and incidents

LEVEL 3 GEAR
MONTHLY REPORTING PROCESS
- Data analysed and results reported

LEVEL 1 GEAR
STRATEGIC DEVELOPMENT
- Company Culture
- Company Values
- Organisational Learning
- Trend Analysis

Results used to deliver evidence-based change driving forward strategic development

Feedback improves information gathering processes
Achieving commercial objectives

Operational Performance Criteria

Safety Performance Criteria

Operational Performance Criteria

Presented at the FAA Fatigue Management Symposium: Partnerships for Solutions; Vienna, VA: June 17-19, 2008
Minimising loss through risk management

We will have our risks mapped out

Makes us more efficient and safer

Creating added value through optimised rostering solutions based on improved crew resource utilisation supported by evidenced safety criteria
Biographies

Captain Simon Stewart
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Head of Strategic Safety Development, easyJet Operations Risk Group

Simon is currently the Head of Strategic Safety Development at easyJet. Prior to that role he was the easyJet Flight Operations and Safety Manager for three years. He is responsible for the development and implementation of easyJet SMS systems, of which the FRMS is an integral component.

Alexandra Holmes Ph.D.
alex@clockworkresearch.com
Research Director, Clockwork Research Ltd

Alex is a fatigue specialist and Research Director at Clockwork Research, a London-based company providing fatigue risk management services to the aviation industry. She assists short-haul and long-haul airlines and business operators to introduce operational processes for managing fatigue inclusive of FACT (fatigue awareness and countermeasures training), fatigue reporting systems, fatigue risk assessment and monitoring techniques.