

Crew Utilisation Project

**Aircrew Fatigue, Scheduling and
Performance**

AAME Conference April 09th '05

easyJet

Project Blue

A Human Engineering study into fatigue levels of flight crew under the easyJet roster pattern.

Aim:

To investigate performance of rostered operations under CAP 371, as to whether a relationship exists between rostering practice, pilot fatigue and human error.

easyJet Operational Risk Management

- Perception: Low cost = Low Standards
New aircraft, comprehensive crew training, etc... but it is public perception which is important
- easyJet exists in a competitive market, multi-sector shifts, intensive ops, high fuel costs, reducing yields.
- Result: The company works its' assets hard causing operational risk.
- High intensive LCC operations induces crew fatigue which must be mitigated to control operational risk.

Operational Context

- 20 000+ flights per month, Crews flying 90+ hours per month, European wide Ops, complex airspace
- 6 and 3 roster pattern: 3 'earlies' then 3 'lates'

6 days work

3 days off

6 days work

- Fully compliant with CAA CAP 371 FTL guidelines
 - but this was written 40 years ago, no low cost operations
- Operations reasonably stable.
 - Is this at the sacrifice of safety?
 - Day 1, backward phase shift crew start 0500 hrs
 - Day 4, forward phase shift crew start 1300 hrs
 - Day 6, end work at 2300-2400 hrs, may extend to 0300 hrs

Risk Management – two year study

- In response to a high-risk incident, for which fatigue was cited as a causal factor, easyJet commissioned this project to investigate the relationship between flight-deck crew fatigue levels, rostering practices and crew performance.
- The 6/3 roster worked by easyJet flight-deck crew was associated with significant decrements in performance.
- In response, the company were granted a temporary alleviation from flight time legislation (FTL) to trial a slow wave shift pattern 5/2/5/4 roster (5 'earlies', 2 days off, 5 'lates' and 4 days off).

'Slow wave' shift pattern 5254 – circadian stability

→ 5254 trial pattern – 2 Bases

5 early flights

2 DO

5 late flights

4 days off

→ Balance circadian stability and recovery time from acute fatigue

→ 5 early duties start 0500-0700 hrs

→ Finish day 5 at 1400 hrs, 2 days off

→ 5 late duties start 1200 hrs, finish day 5 at 2300 hrs

→ Max 55 hr rolling week

Project Blue Methodology

- ➔ Employs an Operational Risk Management Approach (ORMA©), utilising a Human Factors Monitoring Program (HFMP©) for data mining from the following sources:
 - Safety culture and fatigue trial Surveys;
 - Flight Data Monitoring (FDM); Air Safety Reports (ASRs);
 - Sickness rates, roster stability and duty hours;
 - Threat and Error Management LOSA taxonomy;
 - Behavioural marker assessment; Performance Shaping Factors
 - Cognitive Performance tests; sleep diaries; activity watch; and
 - Subjective fatigue / alertness indexes.

- ➔ Predictive modelling ('*FAID*'®) applied to rostering pattern to be compared with collected data.

Archive Data

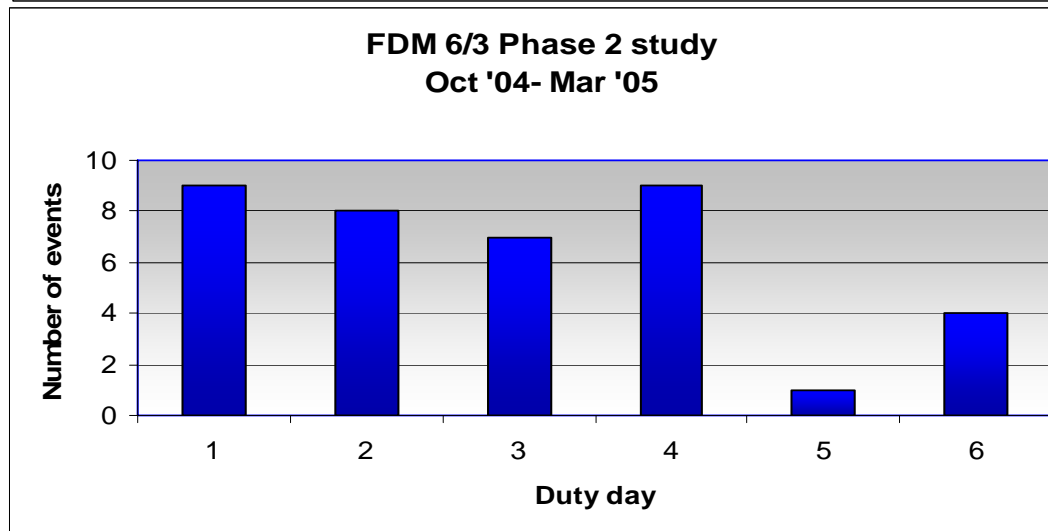
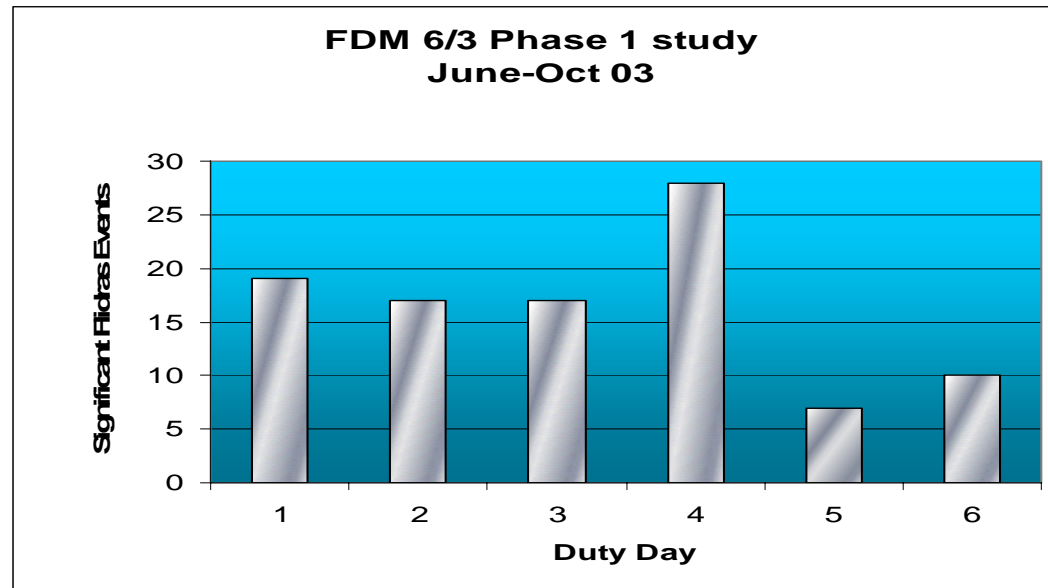
- ASRs: reviewed for 6 month period of LOSA audit. Correlation b/n duty days and no. of ASRs?
- FDM: Class III exceedance events reviewed for 6 month period. No. of significant events set against duty day.
- Sickness rates: averaged on a monthly basis and reviewed for a 12-month period as a fatigue indicator.
- Duty Hours: Crew Duty hours accessed for the previous 24-month period to ascertain whether crew fatigue could be attributed to an increase in duty hours worked.

Project Blue – Pattern comparison

Independent variables:

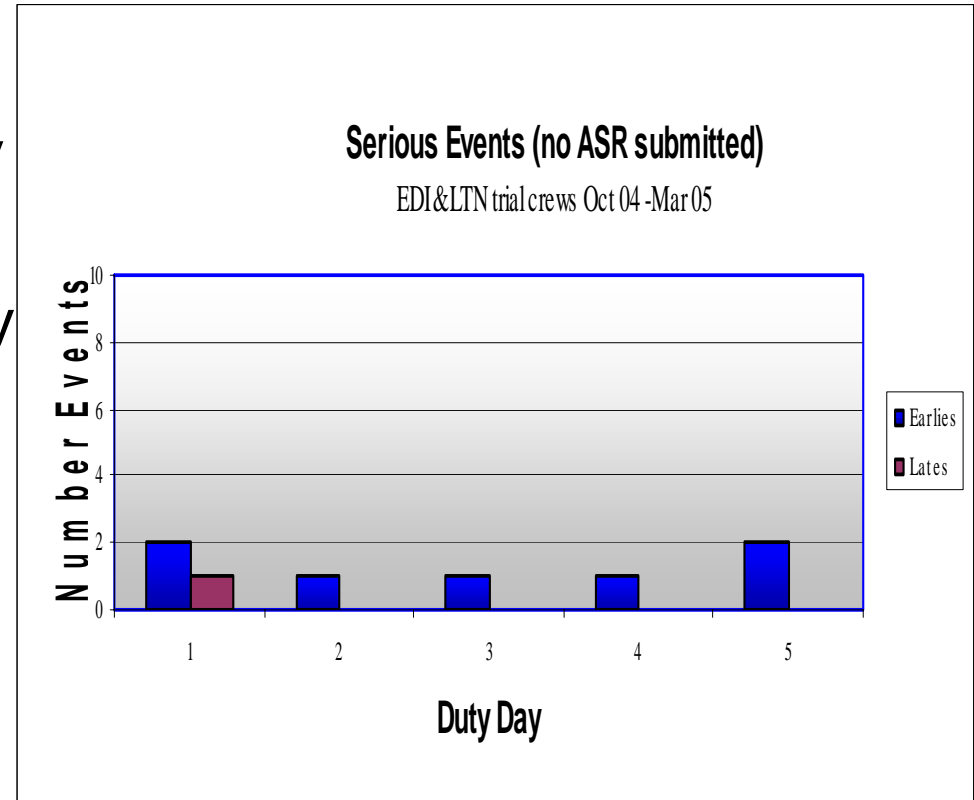
- Priority independent variable (IV): Roster duty day - audited on days 1-5 early duties and 1-5 late duties of the 5254 roster. Duty days 1,3,4,6 of the 6&3 roster
- Secondary IV: comparison of performance of early vs late duties
- Tertiary IV: number of sectors audited per duty day.

FDM Serious Class 3 events - 6/3



FDM Serious events - 5254 Roster Pattern

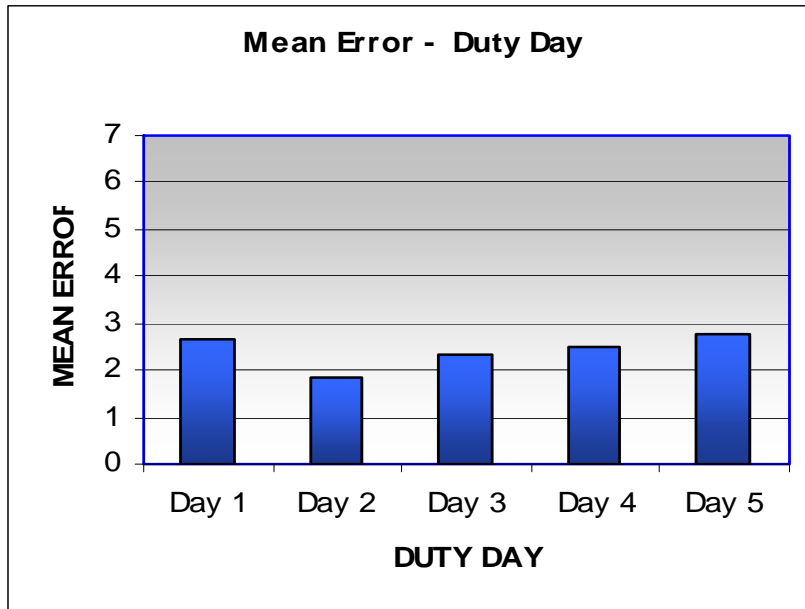
- Number of events recorded not statistically significant
- No events recorded duty days 2-5 on lates
- Performance shows a significant improvement over 6/3 pattern



Mean Error Rate – Duty Day

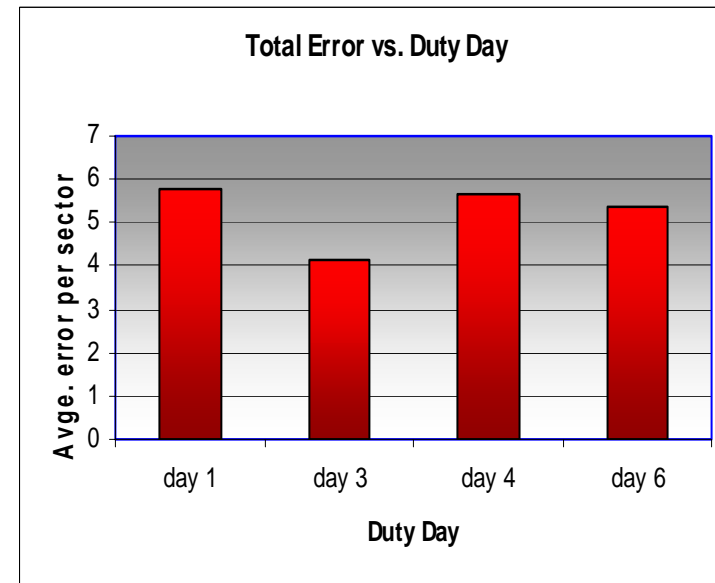
5/2/5/4

6 / 3



Mean error per sector = 2.4

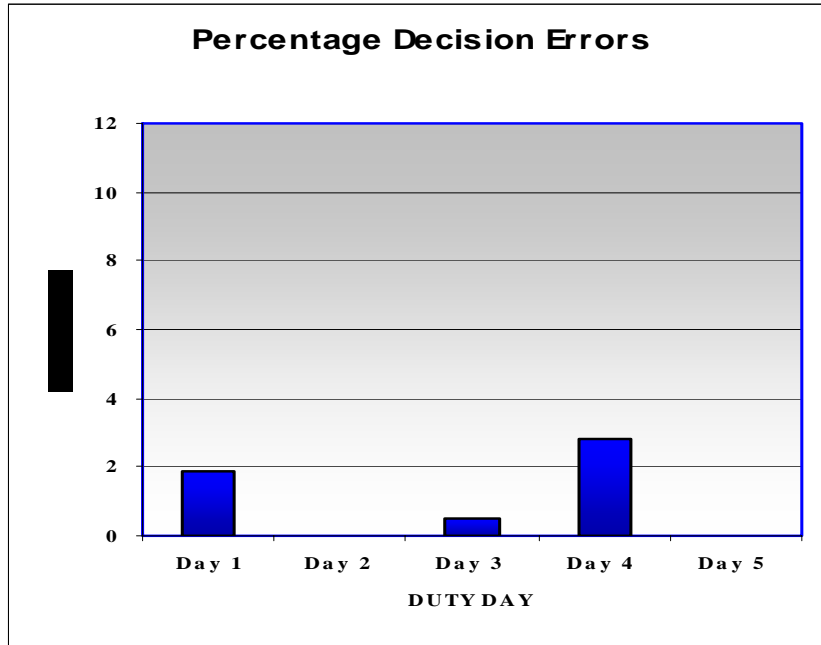
- One-Way ANOVA:
- $F(4, 213) = 1.181$;
- $P > 0.05$ (0.320)
- No sig. diff.



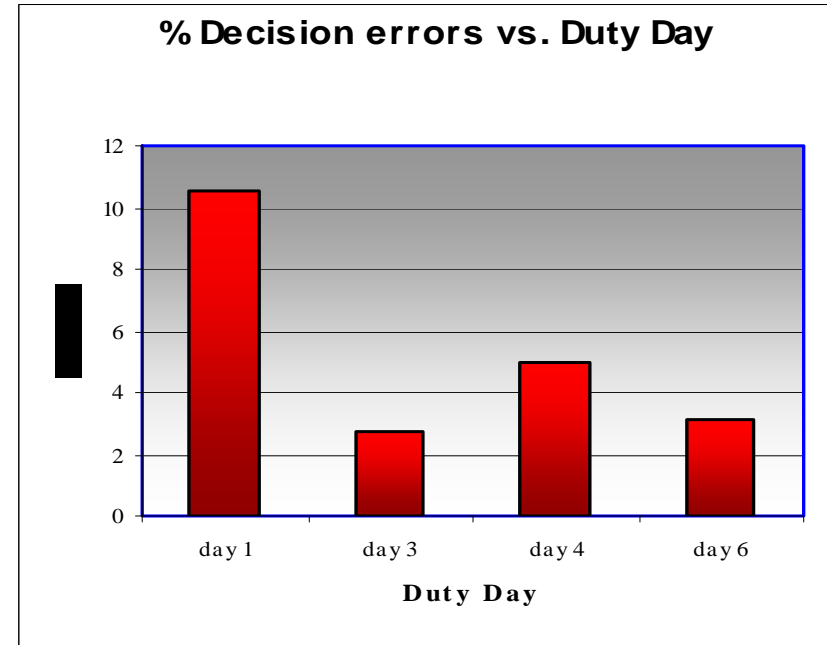
Mean error per sector = 5.2

Decision Errors

5254



6/3



One-Way ANOVA:

$F(4, 170) = 1.794$

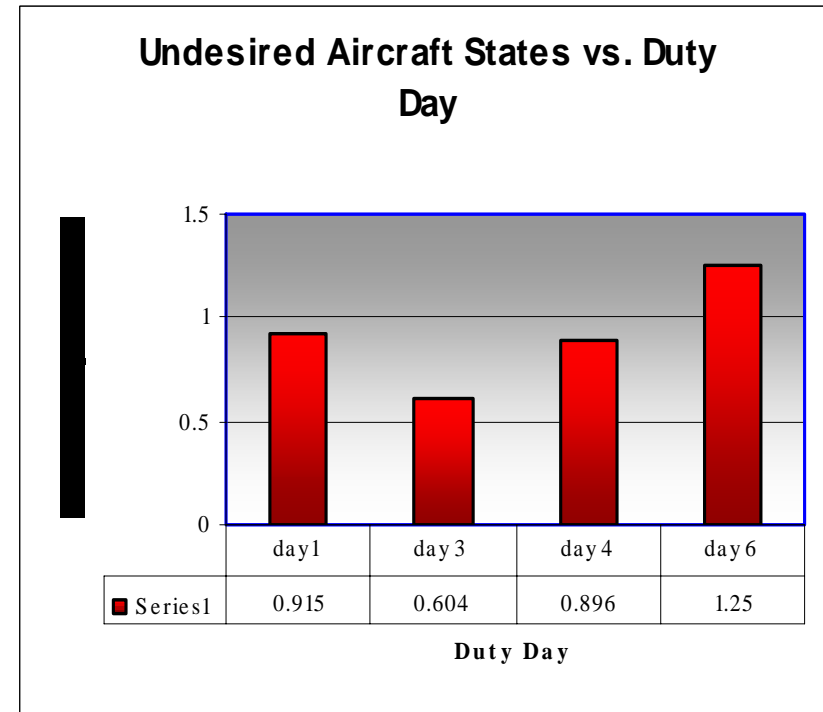
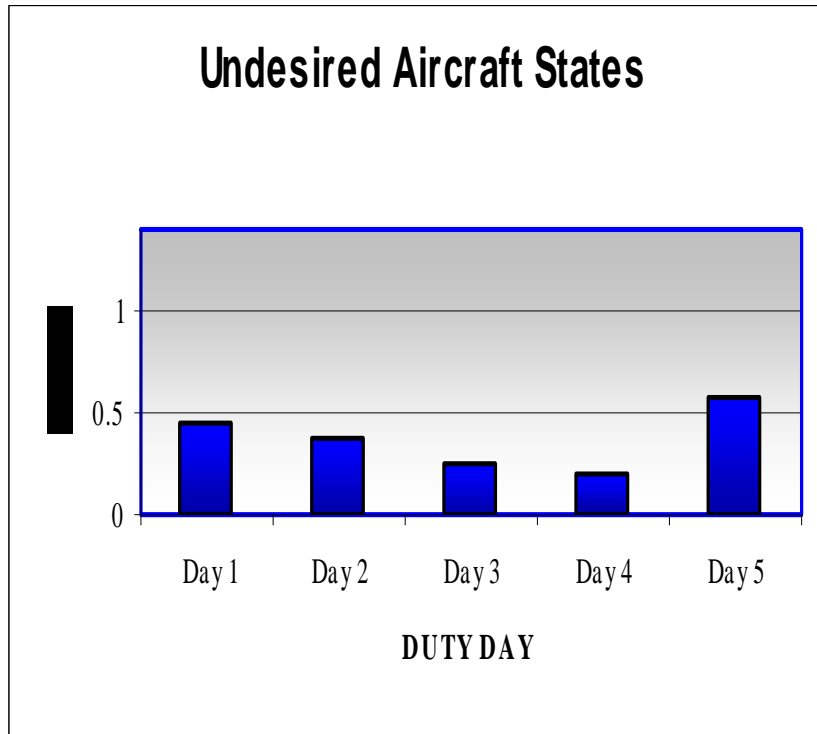
$p > .05$

Non-significant.

Undesired Aircraft States – Duty Day

5/2/5/4

6/3



Mean = 0.36

One-Way ANOVA:

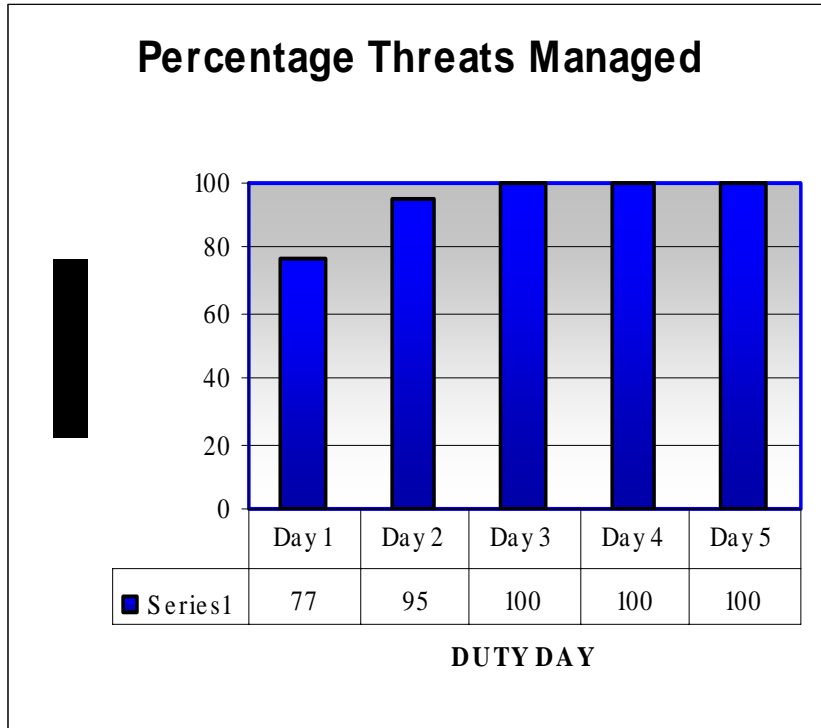
P>.05 (non- sig.)

No sig. diff. B/n groups.

Mean = 1 UAS per sector

Threat Management – Duty Day

5/4/5/2



Mean = 94%

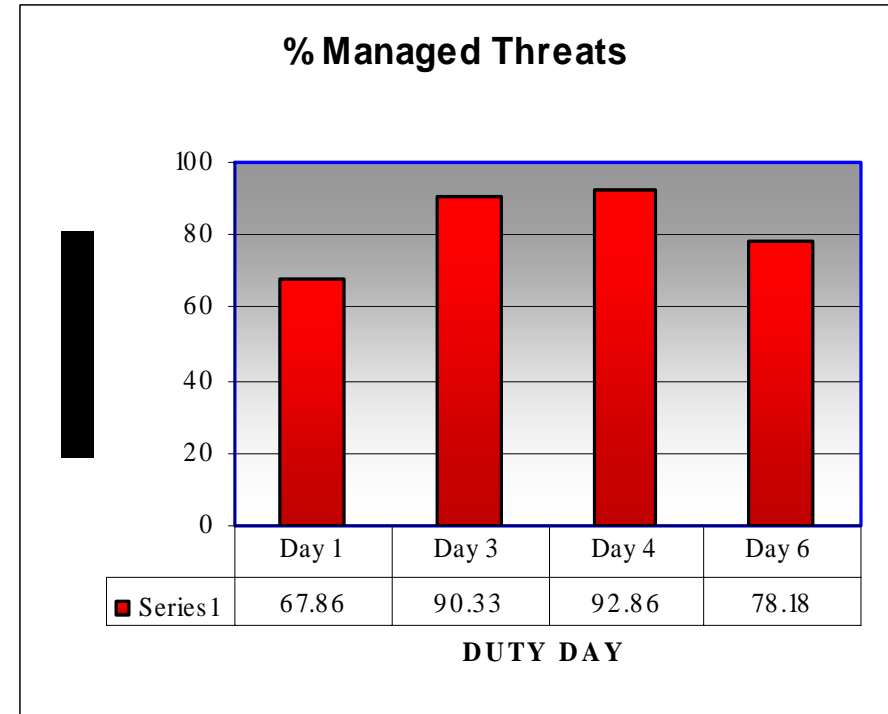
One –Way ANOVA:

$F(4, 71) = 3.14, p < .05$

Sig. Diff btwn the groups.

1&2 vs. 3, 4 &5

6/3



Mean = 82%

FAID Analysis

- To date 20 Awake participant rosters have been submitted to Interdynamics for analysis out of an expected total of 25 (Awake)
- A Benchmark Peak Fatigue Threshold (PFT) of 75 has been used in this FAID Diagnostic. The Australian Civil Aviation Safety Authority (CASA) has established guidelines for the General Aviation Industry of a maximum allowable PFT of 75, compared to a figure of 80 for normal operations and a setting of 65 for Search and Rescue helicopter operations.

FAID analysis 5254 rosters

Pilot #ID	Total Hours Worked	Total Hours > 75.0 Threshold	Compliance Hours (%)	PFI	PFR		#Very Low	#Low	#Mod	#High	#Very High	Total
552	472.8	0.0	100.0	71.5	-3.5	# Duties	57	3	0	0	0	60
662	426.0	0.0	100.0	68.1	-6.9	# Duties	54	1	0	0	0	55
667	368.1	0.0	100.0	64.2	-10.8	# Duties	48	0	0	0	0	48
1600	550.2	2.0	99.6	78.8	3.8	# Duties	69	3	0	1	0	73
1603	441.7	0.0	100.0	66.9	-8.1	# Duties	59	0	0	0	0	59
2020	554.3	0.0	100.0	74.2	-0.8	# Duties	70	1	2	0	0	73
2063	412.5	1.0	99.8	77.8	2.8	# Duties	52	0	1	1	0	54
2073	514.1	2.0	99.6	81.9	6.9	# Duties	68	1	2	1	0	72
2345	417.3	0.0	100.0	73.9	-1.1	# Duties	57	0	1	0	0	58
2387	369.7	0.0	100.0	71.6	-3.4	# Duties	45	1	0	0	0	46
2465	536.4	4.0	99.3	87.3	12.3	# Duties	66	2	0	0	1	69
2625	401.0	0.0	100.0	73.1	-1.9	# Duties	48	2	1	0	0	51
2686	442.8	2.0	99.5	79.7	4.7	# Duties	51	2	0	1	0	54
2721	466.2	1.5	99.7	81.5	6.5	# Duties	55	2	0	1	0	58
3251	385.0	1.8	99.5	81.2	6.2	# Duties	47	2	1	1	0	51
3871	491.5	3.0	99.4	81.9	6.9	# Duties	65	1	0	1	0	67
5564	466.5	0.0	100.0	74.9	-0.1	# Duties	57	1	3	0	0	61
8476	389.2	0.0	100.0	62.5	-12.5	# Duties	53	0	0	0	0	53
9646	461.4	0.0	100.0	73.5	-1.5	# Duties	56	0	1	0	0	57
9649	414.2	0.0	100.0	62.3	-12.7	# Duties	55	0	0	0	0	55
TOTAL	8980.9	17.3	99.8%									
Avg	449.0	0.9	99.8%			# Duties	1132	22	12	7	1	1174
						% Risk Category	96.4%	1.9%	1.0%	0.6%	0.0%	99.9%

FAID Analysis - Comparison of 6/3 vs. 5254

Measures of relative risk between the patterns:

1. Comparison against benchmark (75 PFR):

6/3 pattern: +12.6

5254 pattern: -0.7

2. Risk Categorisations:

6/3 pattern: 1.2% of duties in the very high risk area

5254 pattern: 0.01% of duties in the very high risk area

This confirms that the current roster pattern and operating conditions carry significantly **less risk** than that which applied to the 6-3 roster pattern.

AWAKE Ltd Summary

How well do pilots sleep across the roster?

Sleep efficiency is consistently good across the roster

What effect does fatigue have on performance across the roster?

There is no evidence for a fatigue-related decrement in performance

How much sleep do pilots get across the 5/2/5/4 roster?

Overall a “reasonable” amount

An average of 34 min more on lates than on earlies

Investigate strategies for improving sleep duration

e.g. matching for chronotype or lifestyle

Case Studies

Phase one

4 case studies involving crew fatigue as a causal factor occurred under the 6/3 pattern

Phase two

No fatigue related events have occurred under the 5254 pattern

Balpa Survey Results 70% Membership return

Overall, which roster would you prefer to work?

6/3: 7%

5/2/5/4: 93%

In your experience of the 6/3 roster and the 5/2/5/4 roster, which do you feel:

enables a better work/life balance?

enables you to get more sleep?

least tired/fatigued on?

more alert on?

enables a more regular sleep pattern?

enables you to perform most safely at work?

Percentage

	Same	6/3	5/2/5/4	Don't know
enables a better work/life balance?	14%	7%	77%	2%
enables you to get more sleep?	16%	2%	74%	7%
least tired/fatigued on?	7%	2%	91%	-
more alert on?	9%	-	84%	7%
enables a more regular sleep pattern?	5%	-	93%	2%
enables you to perform most safely at work?	14%	-	84%	2%

Performance Benefits 5254 Pattern

- Reduced operational risk
- Less fatiguing work patterns and reduced duty hours for crew
- Reduction in Insurance Liability with application of HFMP© process (£4 million)
- Improved crew productivity by 7%
- Increased roster stability
- Improved crew lifestyle, reduced sickness
- Improved pilot retention and reduction in training liability