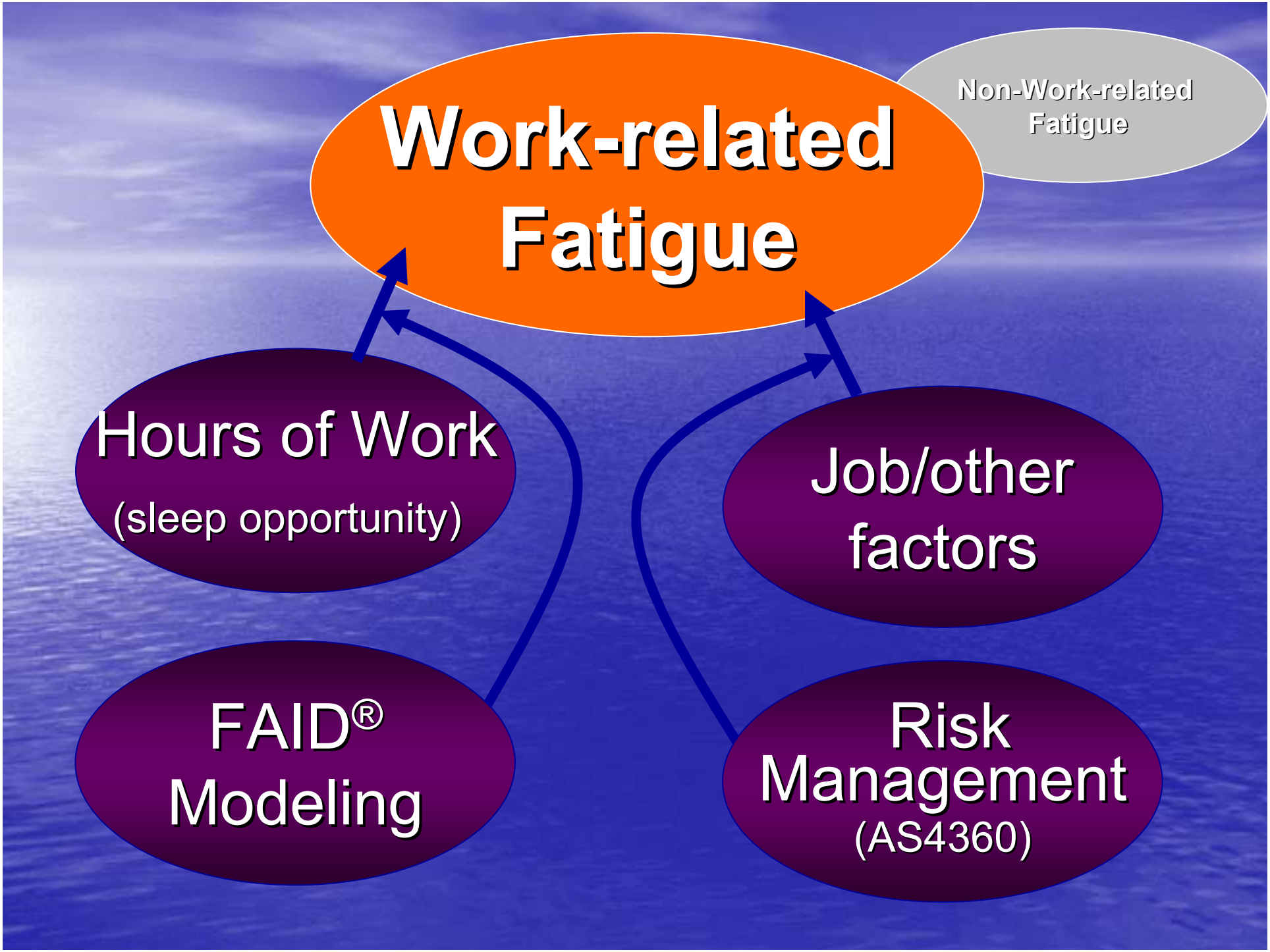
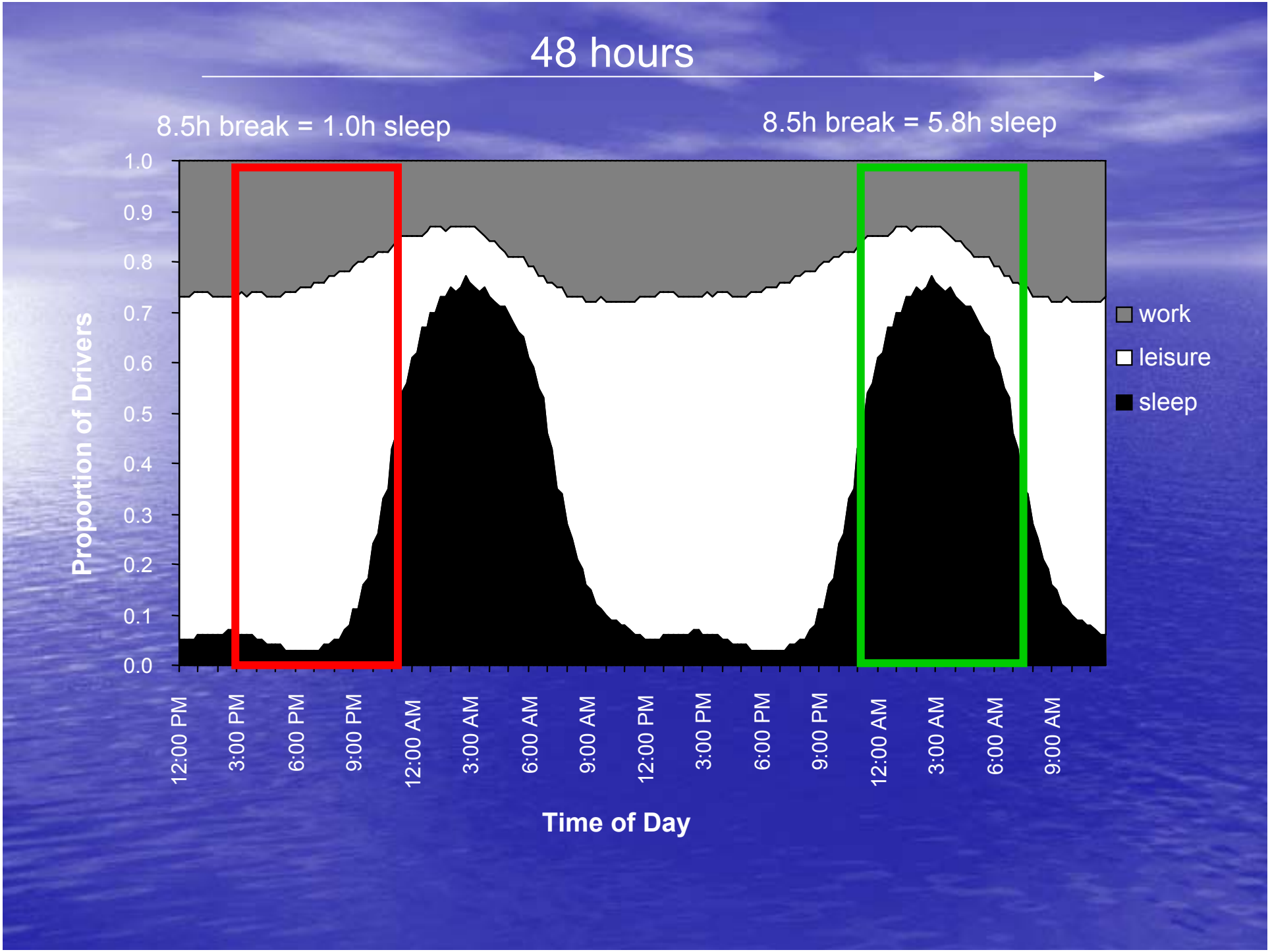

Work-related Fatigue
Non-Work-related Fatigue
Hours of Work
(sleep opportunity)
Job/other factors
FAID® Modeling
Risk Management
(AS4360)

- Estimates of work-related fatigue are based on statistical modelling of the amount of sleep likely to be obtained by individuals based on the time of day and duration of work and non-work periods over a 7 day period.
- Indicative fatigue is inferred from the estimate of sleep obtained.


48 hours
8.5h break = 1.0h sleep
8.5h break = 5.8h sleep
Proportion of Drivers
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
work
leisure
sleep
12:00 PM
3:00 PM
6:00 PM
9:00 PM
12:00 AM
3:00 AM
6:00 AM
9:00 AM
12:00 PM
3:00 PM
6:00 PM
9:00 PM
12:00 AM
3:00 AM
6:00 AM
9:00 AM
Time of Day

The Specific Determinants of Work-Related Fatigue are:

- The time of day of work & non-work periods
- The duration of work & non-work periods
- Work history in the preceding seven days
- The biological limits on recovery sleep
- *All based on Duty Time or Hours of Work*

FAID® Scores are Indicators Only

- FAID® scores are indicators only of the impact of sleep deprivation
- They are based on a statistical analysis of research performed into fatigue levels over a broad sample of our population, and only provide guidance on the fatigue of an individual

Levels of Work-Related Fatigue Scores

- Monday to Friday 09:00 to 17:00
  - 40 hour standard work week
  - FAID® Score of 40.
- Monday to Friday 23:00 to 07:00
  - 40 hour work week
  - FAID® Score of 80.

- A recent study (1) indicated that scores between 80 and 100 (that is, high fatigue) are equivalent to the predicted level of work-related fatigue achieved after 23-24 hours of continuous sleep deprivation (starting at 0800h).
- This result was observed when the sleep deprivation started at 0800h on a Monday, following a week working Monday to Friday 0900-1700h and with Saturday and Sunday off.

(1) Dawson, D. and Reid, K. Fatigue, alcohol and performance impairment. Nature July 1997, 388: 235.

FAID

- A FAID® score of 80 has been associated with performance impairment equivalent to that seen at a blood alcohol concentration of 0.05% or greater

What do Peak FAID® scores mean?

40 ← Monday – Friday Work Week

60 ← Commercial airline pilots

80 ← 5x 12h day shifts in a row

100 ← 2x 12h night shifts in a row

120 ← 7x 8h night shifts in a row

← Train Drivers

140 ← Truck Drivers & Mining

Rail Operations Research

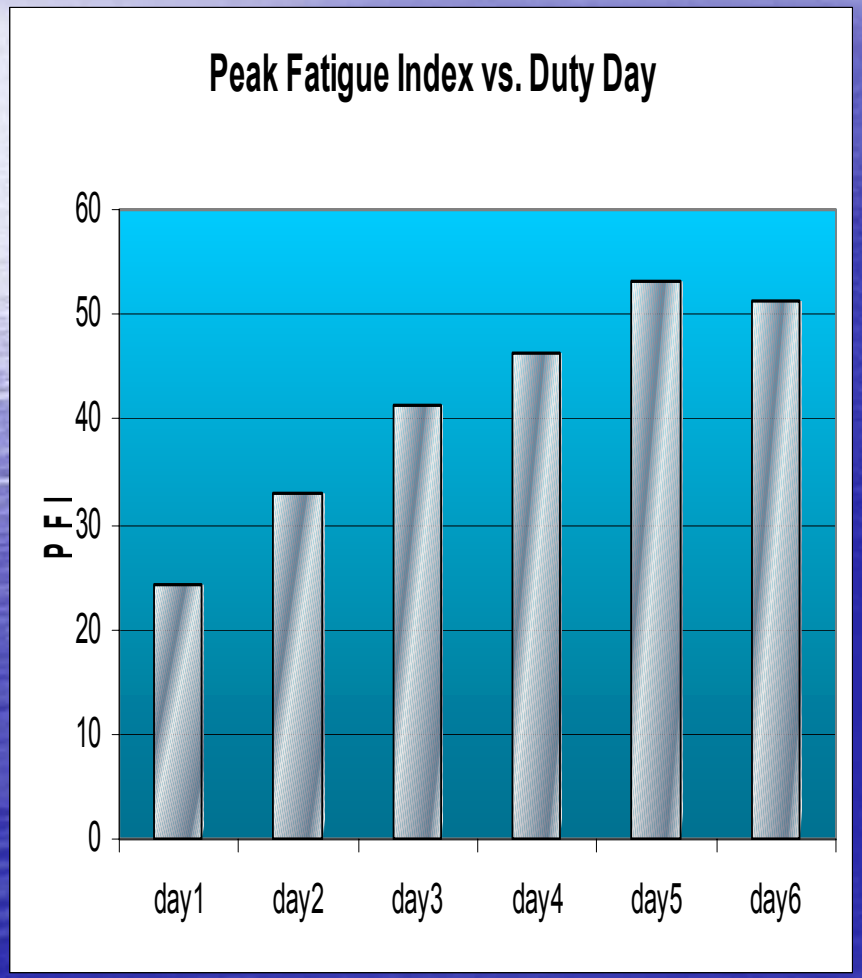
Simulator studies with locomotive engineers determined:

- FAID® Scores 90-100 - a significant increase in errors and high risk behaviors due to fatigue: e.g., less critical planning, improper braking techniques
- FAID® Scores 100 & above - likelihood of errors occurring doubled

Field observations of operating behaviors & analysis of black-box data revealed:

- Scores below 90 did not result significantly in increased errors or adverse behaviors
- FAID® Scores over 90 - errors increased significantly

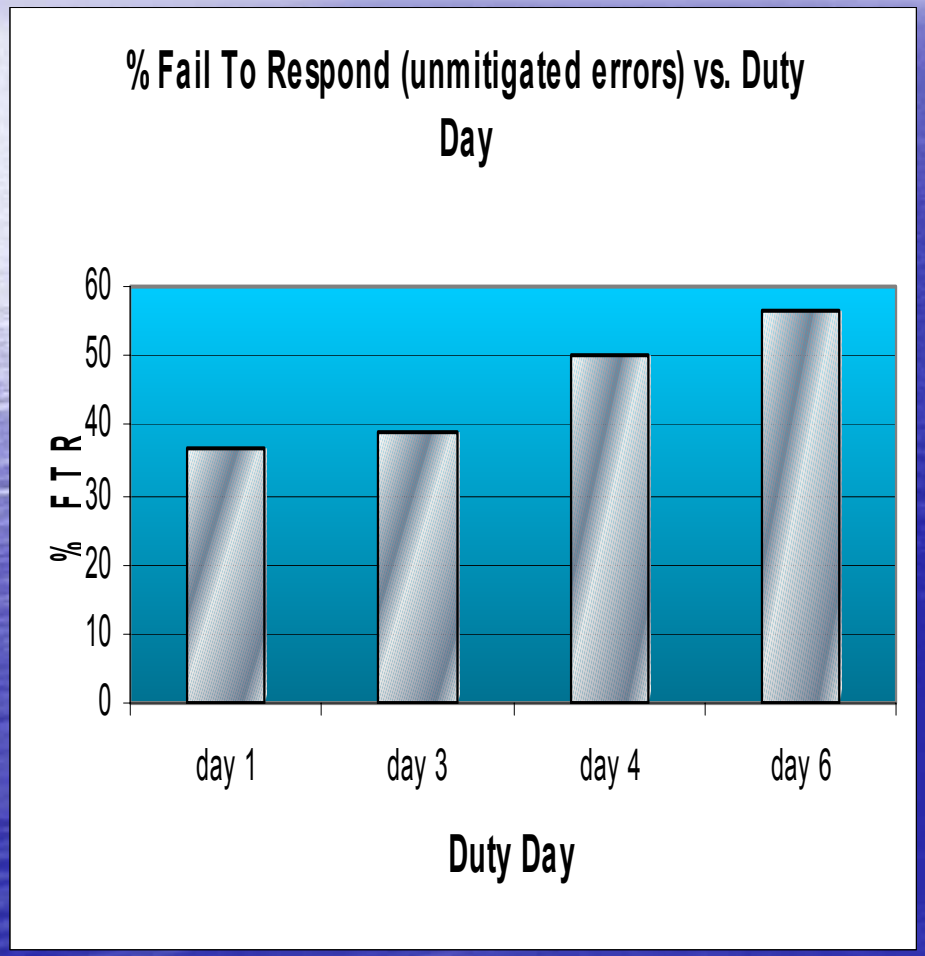
- Validation studies suggest that FAID® scores below 80 are broadly consistent with a safe system of work and scores above a 100 are broadly consistent with an unsafe system of work.
- These scores have been independently scrutinised and accepted as evidence by agencies including The Australian Transportation Safety Bureau (ATSB) and The Special Commission of Inquiry into the Waterfall Rail Accident near Sydney.



easyJet Project Experience:

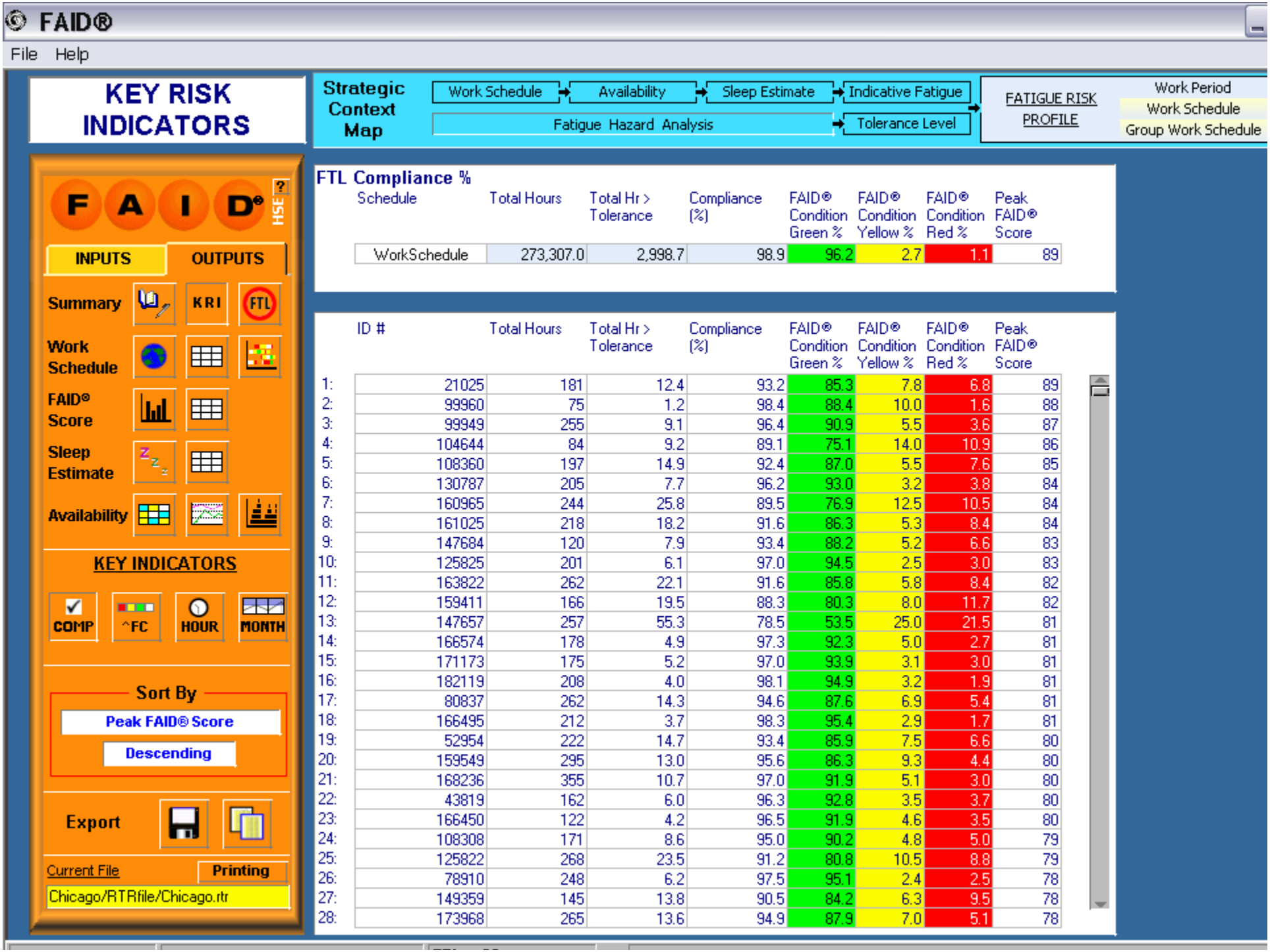
- Twenty crew rosters evaluated across study timeframe
- Performance trends correlate with LOSA FTR (Pearson correlation sign. @ 5% level)
- FAID® represents a useful tool for predicting cumulative fatigue effects

Performance Trends – **Failure to Respond (FTR)**



- Cumulative fatigue effects on performance throughout shift pattern.

- Assessment of fatigue-related hazards should be performed using risk assessment processes complying with risk assessment standards such as the Zurich Hazard Analysis process.
- Individuals and organisations must make their own assessment of the maximum levels of fatigue that should be allowed for various types of tasks.
- Individual responsibility for the amount of sleep obtained always over-rides FAID® estimates.



FTL Compliance %

Schedule	Total Hours	Total Hr > Tolerance	Compliance (%)	FAID® Condition Green %	FAID® Condition Yellow %	FAID® Condition Red %	Peak FAID® Score
WorkSchedule	273,307.0	2,998.7	98.9	96.2	2.7	1.1	89

	ID #	Total Hours	Total Hr > Tolerance	Compliance (%)	FAID® Condition Green %	FAID® Condition Yellow %	FAID® Condition Red %	Peak FAID® Score
1:	21025	181	12.4	93.2	85.3	7.8	6.8	89
2:	99960	75	1.2	98.4	88.4	10.0	1.6	88
3:	99949	255	9.1	96.4	90.9	5.5	3.6	87
4:	104644	84	9.2	89.1	75.1	14.0	10.9	86
5:	108360	197	14.9	92.4	87.0	5.5	7.6	85
6:	130787	205	7.7	96.2	93.0	3.2	3.8	84
7:	160965	244	25.8	89.5	76.9	12.5	10.5	84
8:	161025	218	18.2	91.6	86.3	5.3	8.4	84
9:	147684	120	7.9	93.4	88.2	5.2	6.6	83
10:	125825	201	6.1	97.0	94.5	2.5	3.0	83
11:	163822	262	22.1	91.6	85.8	5.8	8.4	82
12:	159411	166	19.5	88.3	80.3	8.0	11.7	82
13:	147657	257	55.3	78.5	53.5	25.0	21.5	81
14:	166574	178	4.9	97.3	92.3	5.0	2.7	81
15:	171173	175	5.2	97.0	93.9	3.1	3.0	81
16:	182119	208	4.0	98.1	94.9	3.2	1.9	81
17:	80837	262	14.3	94.6	87.6	6.9	5.4	81
18:	166495	212	3.7	98.3	95.4	2.9	1.7	81
19:	52954	222	14.7	93.4	85.9	7.5	6.6	80
20:	159549	295	13.0	95.6	86.3	9.3	4.4	80
21:	168236	355	10.7	97.0	91.9	5.1	3.0	80
22:	43819	162	6.0	96.3	92.8	3.5	3.7	80
23:	166450	122	4.2	96.5	91.9	4.6	3.5	80
24:	108308	171	8.6	95.0	90.2	4.8	5.0	79
25:	125822	268	23.5	91.2	80.8	10.5	8.8	79
26:	78910	248	6.2	97.5	95.1	2.4	2.5	78
27:	149359	145	13.8	90.5	84.2	6.3	9.5	78
28:	173968	265	13.6	94.9	87.9	7.0	5.1	78

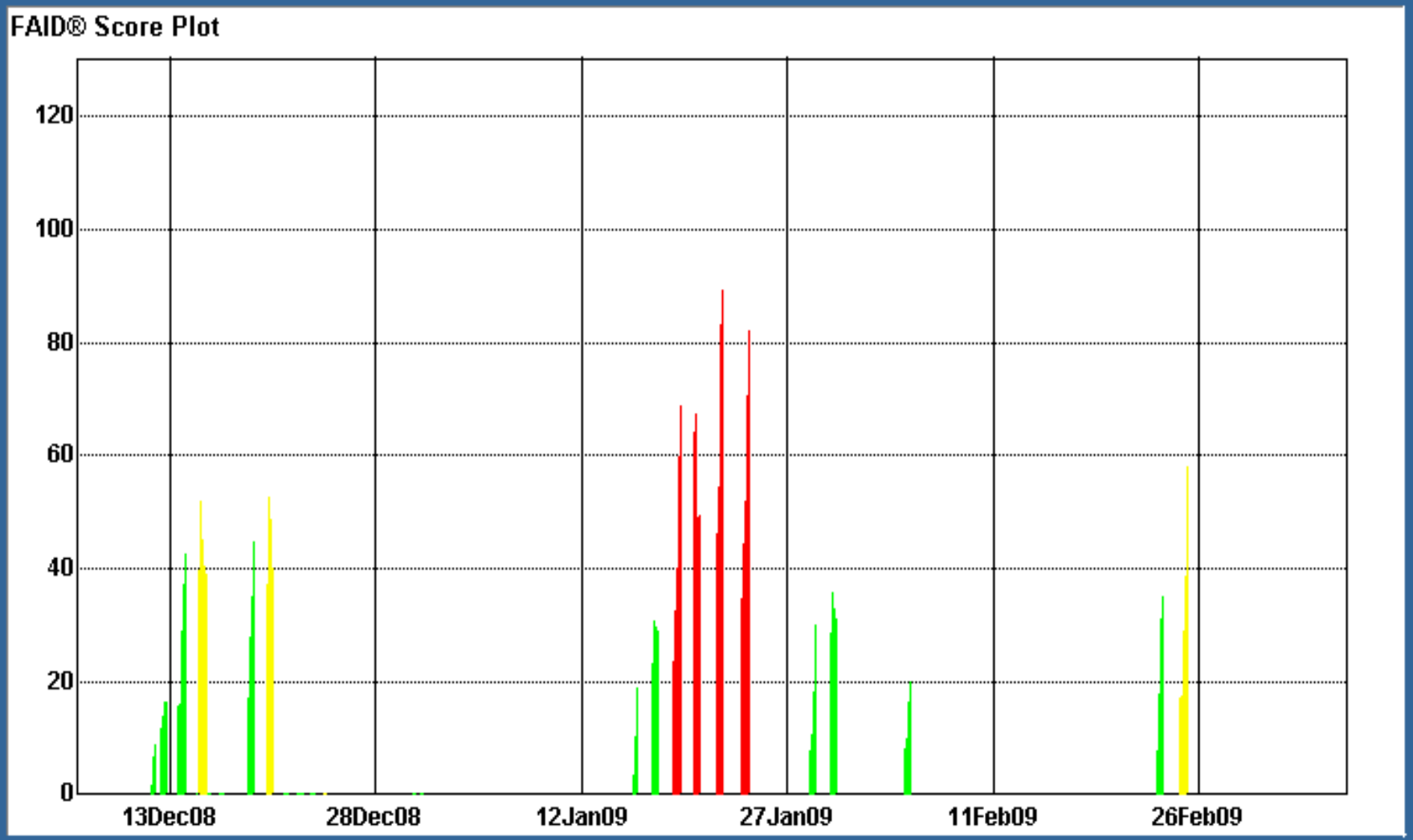
FAID

Summary

Details	Value
ID#	21025
Work Schedule	1

Results	
Peak FAID® Condition	Red
Peak FAID® Score	89

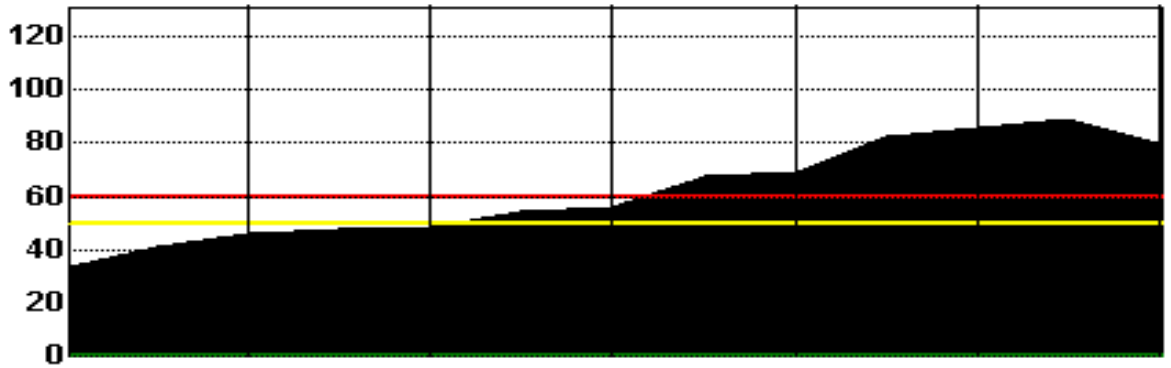
FAID® Score Plot



Summary

Details	Value
ID#	21025
Work Schedule	1

Results	
Peak FAID® Condition	Red
Peak FAID® Score	89



Work Period

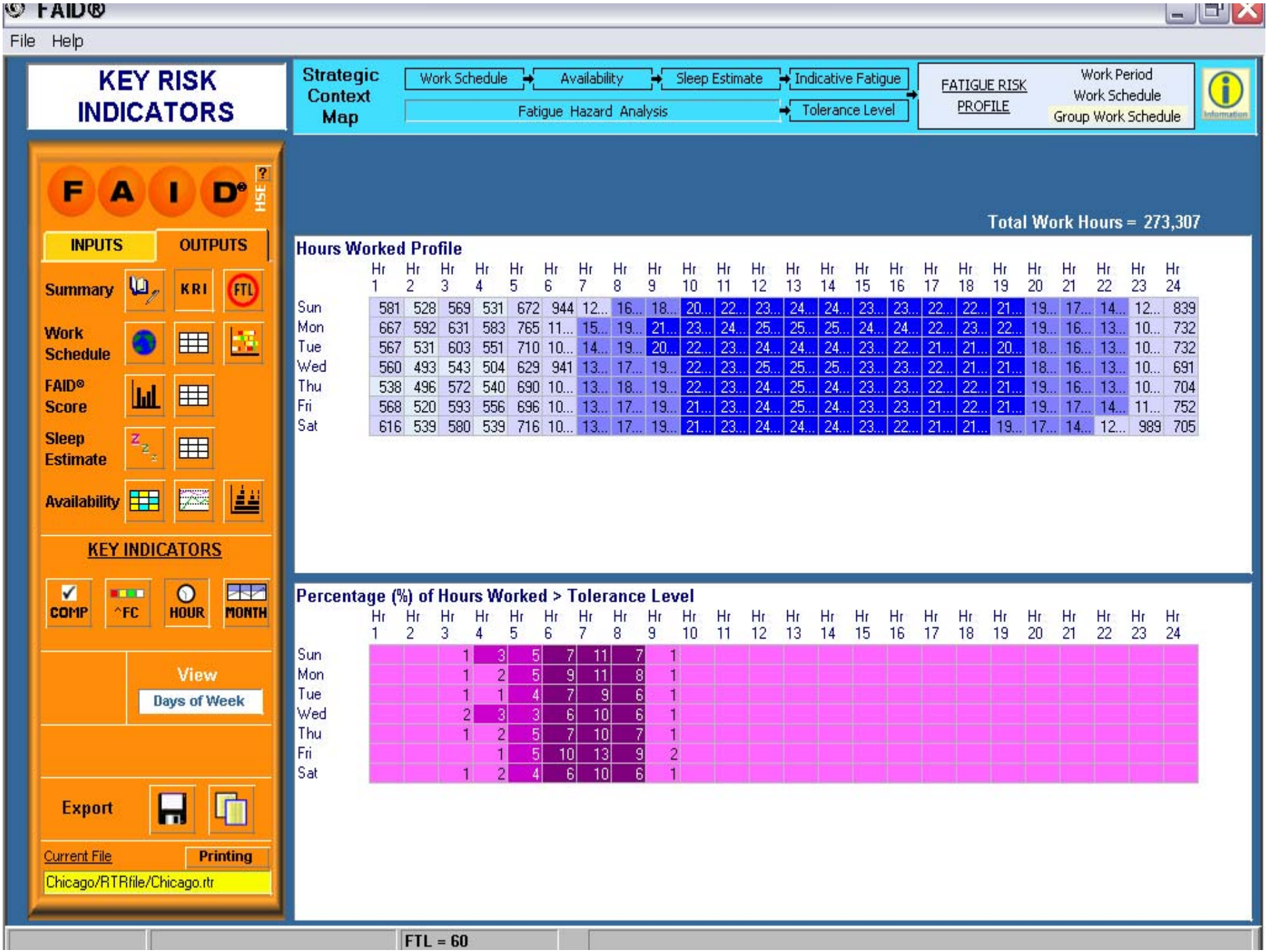
21 Jan 09 2001
to
22 Jan 09 0801

Legend

FTL
FTL - 10
FAID® Score

FAID® Score Table

	ID #	Non-Work	Start	Work	Task	FAID® Condition Green	FAID® Condition Yellow	FAID® Condition Red	Peak FAID® Score	Peak FAID® Cond	
3:	21025	22.9	13 Dec 08 1649	9.9	High	9hr 53min			43	-17	
4:	21025	25.6	15 Dec 08 0420	12.0	High	10hr 58min	1hr 2min		52	-8	
5:	21025	72.2	18 Dec 08 1634	10.4	High	10hr 23min			45	-15	
6:	21025	23.5	20 Dec 08 0225	11.4	High	9hr 51min	1hr 33min		53	-7	
7:	21025	627.0	15 Jan 09 1649	9.6	High	9hr 35min			19	-41	
8:	21025	25.9	17 Jan 09 0420	11.1	High	11hr 8min			31	-29	
9:	21025	25.4	18 Jan 09 1649	12.0	High	9hr 31min	1hr 42min	47min	69	9	
10:	21025	23.5	20 Jan 09 0420	10.7	High	4hr 18min	3hr 10min	3hr 16min	67	7	
11:	21025	29.0	21 Jan 09 2001	12.0	High	4hr 9min	2hr 11min	5hr 40min	89	29	
12:	21025	32.7	23 Jan 09 1645	12.0	High	5hr 52min	3hr 30min	2hr 38min	82	22	
13:	21025	108.1	28 Jan 09 1649	10.0	High	10hr 1min			30	-30	
14:	21025	25.5	30 Jan 09 0420	10.6	High	10hr 36min			36	-24	
15:	21025	117.9	4 Feb 09 1248	9.9	High	9hr 53min			20	-40	
16:	21025	429.3	22 Feb 09 2001	12.0	High	12hr 0min			35	-25	
17:	21025	32.7	24 Feb 09 1645	12.0	High	10hr 60min	1hr 0min		58	-2	


FAID®
File Help
KEY RISK INDICATORS
Strategic Context Map
Work Schedule
Availability
Sleep Estimate
Indicative Fatigue
Fatigue Hazard Analysis
Tolerance Level
FATIGUE RISK PROFILE
Work Period
Work Schedule
Group Work Schedule
F A I D®
HSE
INPUTS
OUTPUTS
Summary
KRI
FTL
Work Schedule
FAID® Score
Sleep Estimate
Availability
KEY INDICATORS
COMP
^FC
HOUR
MONTH
View
Days of Week
Export
Current File
Printing
Chicago/RTRfile/Chicago.rtr
Total Work Hours = 273,307
Hours Worked Profile
Hr 1 Hr 2 Hr 3 Hr 4 Hr 5 Hr 6 Hr 7 Hr 8 Hr 9 Hr 10 Hr 11 Hr 12 Hr 13 Hr 14 Hr 15 Hr 16 Hr 17 Hr 18 Hr 19 Hr 20 Hr 21 Hr 22 Hr 23 Hr 24
Sun 581 528 569 531 672 944 12... 16... 18... 20... 22... 23... 24... 24... 23... 23... 22... 22... 21... 19... 17... 14... 12... 839
Mon 667 592 631 583 765 11... 15... 19... 21... 23... 24... 25... 25... 25... 24... 24... 22... 23... 22... 19... 16... 13... 10... 732
Tue 567 531 603 551 710 10... 14... 19... 20... 22... 23... 24... 24... 24... 23... 22... 21... 21... 20... 18... 16... 13... 10... 732
Wed 560 493 543 504 629 941 13... 17... 19... 22... 23... 25... 25... 25... 23... 23... 22... 21... 21... 18... 16... 13... 10... 691
Thu 538 496 572 540 690 10... 13... 18... 19... 22... 23... 24... 25... 24... 23... 23... 22... 22... 21... 19... 16... 13... 10... 704
Fri 568 520 593 556 696 10... 13... 17... 19... 21... 23... 24... 25... 24... 23... 23... 21... 22... 21... 19... 17... 14... 11... 752
Sat 616 539 580 539 716 10... 13... 17... 19... 21... 23... 24... 24... 24... 23... 22... 21... 21... 19... 17... 14... 12... 989 705
Percentage (%) of Hours Worked > Tolerance Level
Hr 1 Hr 2 Hr 3 Hr 4 Hr 5 Hr 6 Hr 7 Hr 8 Hr 9 Hr 10 Hr 11 Hr 12 Hr 13 Hr 14 Hr 15 Hr 16 Hr 17 Hr 18 Hr 19 Hr 20 Hr 21 Hr 22 Hr 23 Hr 24
Sun 1 3 5 7 11 7 1
Mon 1 2 5 9 11 8 1
Tue 1 1 4 7 9 6 1
Wed 2 3 3 6 10 6 1
Thu 1 2 5 7 10 7 1
Fri 1 5 10 13 9 2
Sat 1 2 4 6 10 6 1
FTL = 60

- FAID® is being used as one tool within the Risk-based Fatigue Management Program
- Used by itself, FAID® is not a Risk-based Fatigue Management Program

“ TOOL, NOT A RULE ”

Self-awareness of Fatigue

- It is possible to be impaired by fatigue and not be aware of the degree of impairment
- It is possible to feel fatigued but still be capable of working safely & effectively

It looks complex, but don't panic!

- Once a thorough 'inventory' of exposures and existing controls/protections is done, most organisations discover that:

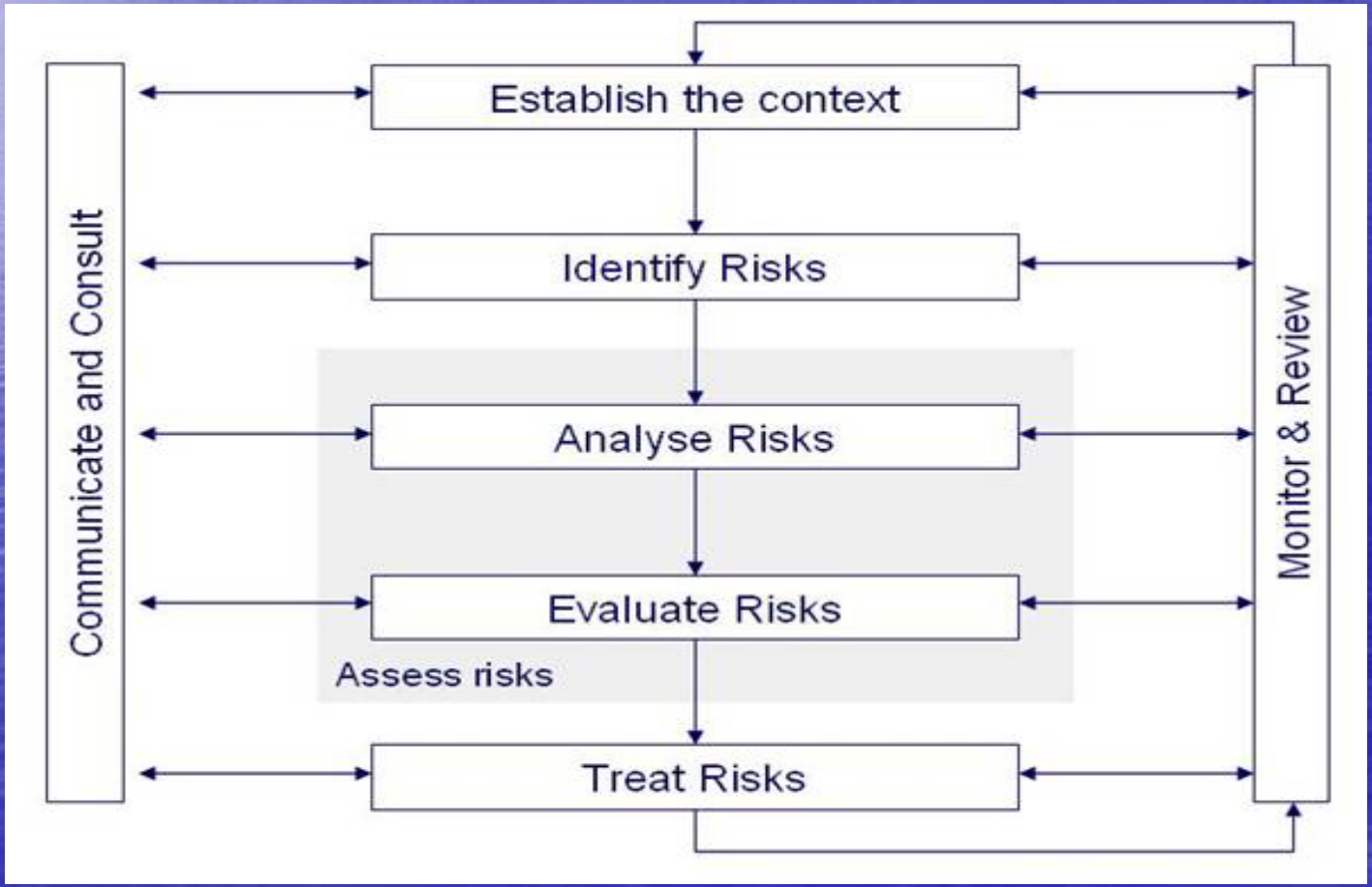
1. **Many exposures are already adequately addressed,**
2. **The areas requiring attention are isolated and specific, and**
3. **Managers, supervisors and employees can develop cost-effective solutions given adequate resources**

A certain degree of complexity is needed because:

- Although appealing in their simplicity, prescriptive limits on maximum shift lengths, minimum break times, minimum sleep, etc. fail to acknowledge variations in job demand and existing coping strategies
- Lower demand operations may therefore be unnecessarily restricted while operations that have evolved effective coping lose competitive advantage

Fatigue Hazard Analysis

utilises the framework of:
AS / NZS 4360,
CAN/CSA-Q850-1997,
BS 6079-3:2000
and Zurich Hazard Analysis



Faid Safe®

Risk-based Integrated Fatigue Management Solution

InterDynamics
Planning - Scheduling - Risk Systems

Shared Responsibility of Employee and Employer

Safety is the outcome of appropriately managed risks

Productivity + Quality of Life

Productivity
- Throughput
- Resources deployed

Fatigue Risk Self - management
Disciplined people
Disciplined thoughts
Disciplined actions
=> Greater Flexibility & Responsibility

SAFE WORKPLACE

Prescriptive Rules
Black & white
for people
not willing or not able
to implement
a self - managed system

Quality of Life
- Take - home pay
- Predictability
- Personal growth
- Values & beliefs alignment

Developed using HAZAID®

Hazard Catalog

No.	Hazard	Trigger	CM	SA	MM	MR	PI	BS	TR	WT	TF	EN	OT	Effect	Con...	Likel...	Existing Controls
1	A fatigue-related occurrence during commuting	Failure of personal responsibility, inadequate safety measures, family incident leading to time...		Y	Y	Y	Y	Y	Y	Y	Y	Y		Incapacity for duty, accident leading to LTI or death, aircraft delay, operational cost, employee income & pla...	II	D	Taxis for arduous duties, mobile phones for communicatio...
2	A fatigue-related occurrence during Pre-sign On/Sign On	Do not absorb critical information, insufficient sleep, task time-pressure, recovery from illness/absence, ...	Y	Y	Y	Y	Y	Y						One or more crew unfit for duty, critical information not communicated or inadequately communi...	IV	D	SOPs, refreshments, adequate length of time for activity, educ...
3	A fatigue-related occurrence during Pre-departure/Pre-take Off/Preparation & Readiness for Landing...	Delays, do not absorb critical information, insufficient sleep, task time-pressure, recovery / return from illness/ab...	Y	Y	Y	Y	Y	Y		Y	Y	Y		One or more crew/passenger injured, critical information not communicated or inadequately communi...	II	D	SOPs, refreshments, redundancy in who information is ...
4	A fatigue-related occurrence during Take Off/Landing	Delays, involuntary lapse/nap, inadequate stimulation, dim lighting, uncomfortable aircraft environment, do not ab...	Y	Y	Y	Y	Y		Y	Y	Y	Y		Delayed or inappropriate response to non-normal event, one or more crew/passenger injured (LTI or PAX equivalent...	II	D	SOPs, redundancy in who information is provided to,
5	A fatigue-related occurrence during Inflight/Service	Delays in service due to non-normal events, involuntary lapse/nap, inadequate stimulation, dim lighting, uncomfort...	Y	Y	Y	Y	Y			Y		Y		Delayed or inappropriate response to non-normal event, one or more crew/passenger injured (LTI or PAX equivalent...	I	D	SOPs, redundancy in who information is provided to, tr...
6	A fatigue-related occurrence during Post Arrival/Transport/Hotel Check-in	Delays (customs, immigration, baggage, transport, traffic, check-in, rooms late or not up to standard), no...	Y	Y	Y	Y	Y		Y	Y	Y	Y		Delayed or inappropriate response to non-normal event, one or more crew injured (LTI), critical information not ...	II	C	Policies, port specific briefs, redundancy in who information is ...

Graid®

File Help

Graid®

- Information
- User Guide
- Graid Scorecard
- New Analysis

FaidSafe®

			Importance	As Is	To Be
Exposures	Hazards	Fatigue hazards associated with the operational environment	XH	C	C
		Driving to / from work	H	B	B
		Sleeping conditions	M	B	B
	Hours of Work	Hours of operations (i.e. day / afternoon / night operations)	XH	C	C
		Nature of work schedules (i.e. rotating / fixed / on-demand / stan...	L	B	B
	Capacity	Seasonality impacts on workload vs workforce balance	H	A	A
		Seasonality impacts on workforce profile	M	A	A
	Culture	Pay incentives which encourage personal fatigue	H	C	C
		Prevalence of second jobs	M	B	C
		Cultural expectations which encourage longer than planned hou...	M	B	B
		Cultural issues that lead to less than normal sleep hours	M	B	B
		Workforce turnover	L	A	A
		Sleeping Disorders	L	A	A
Safeguards	Primary	Work schedule design	H	E	A
		Hours of work risk assessment	H	C	A
		Fatigue hazard analysis methodology	H	C	B
		Fatigue Tolerance Level (FTL)	M	B	B
		Workforce capacity planning	M	A	A
		Fatigue safe policies and procedures	L	C	A
		Communication and consultation frameworks	L	C	B
	Secondary	Competency and awareness	H	D	B
		Compliance with corporate legislative fatigue safety standard	M	E	E
	Tertiary	Contingency and emergency procedures	H	C	B
		Incident and accident reporting	M	C	B
		Audit - periodic assessment of fatigue risk controls	M	C	B

As Is

To Be

Potential Rating Good

Current Rating Poor

Current Score 154

Potential Score 72

User Level idZRE Professional