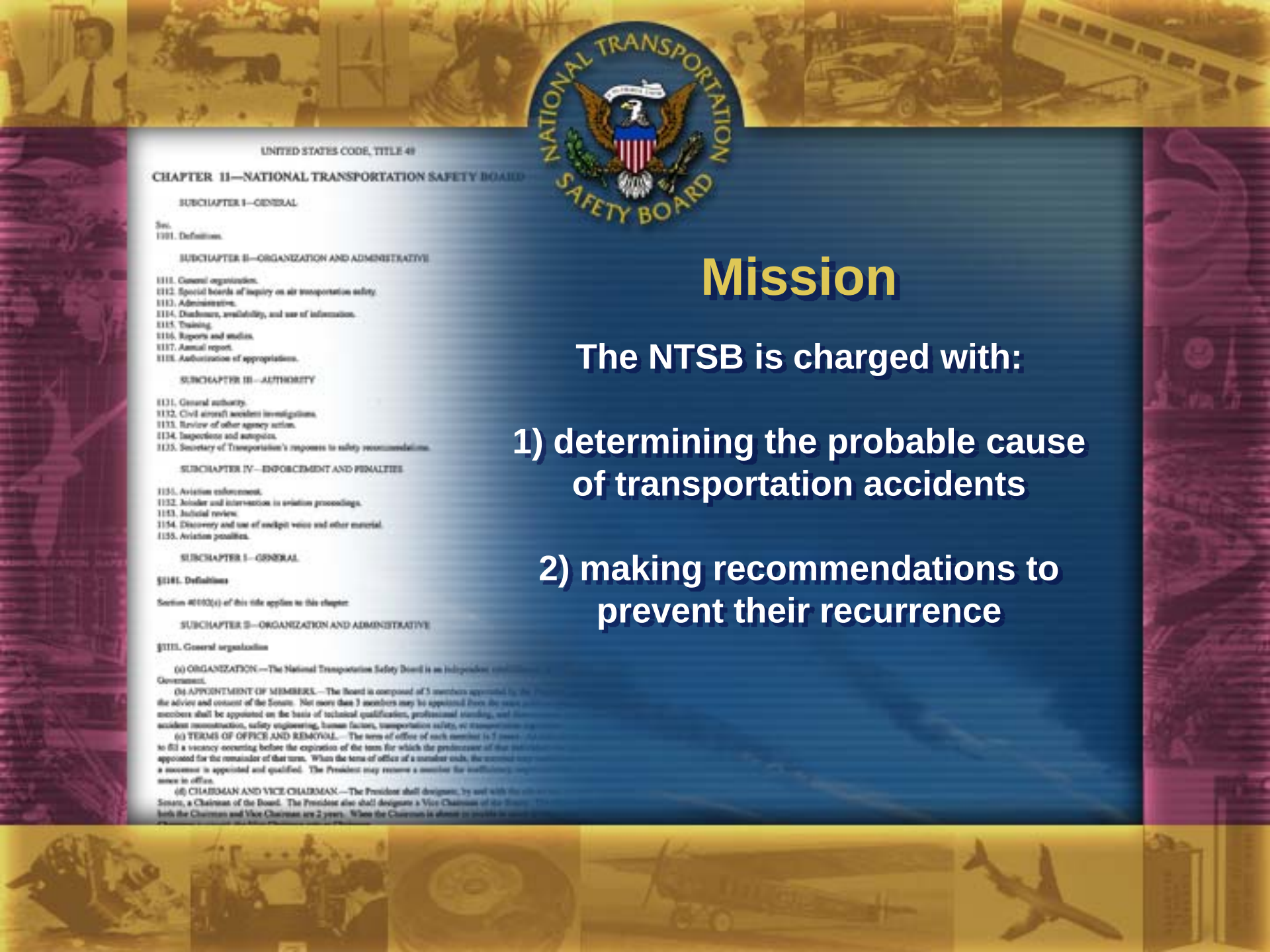
NTSB National Transportation Safety Board

Managing Fatigue in Aviation Ops: An NTSB Perspective

Honorable Mark R. Rosekind, Ph.D.
Board Member

Bombardier Safety Standdown
October 25, 2011



Mission

The NTSB is charged with:

1) determining the probable cause of transportation accidents

2) making recommendations to prevent their recurrence

The NTSB is Responsible for Investigating:

Aviation, highway, rail, marine, pipeline, and hazardous material accidents

PG&E/San Bruno Gas Pipeline Explosion

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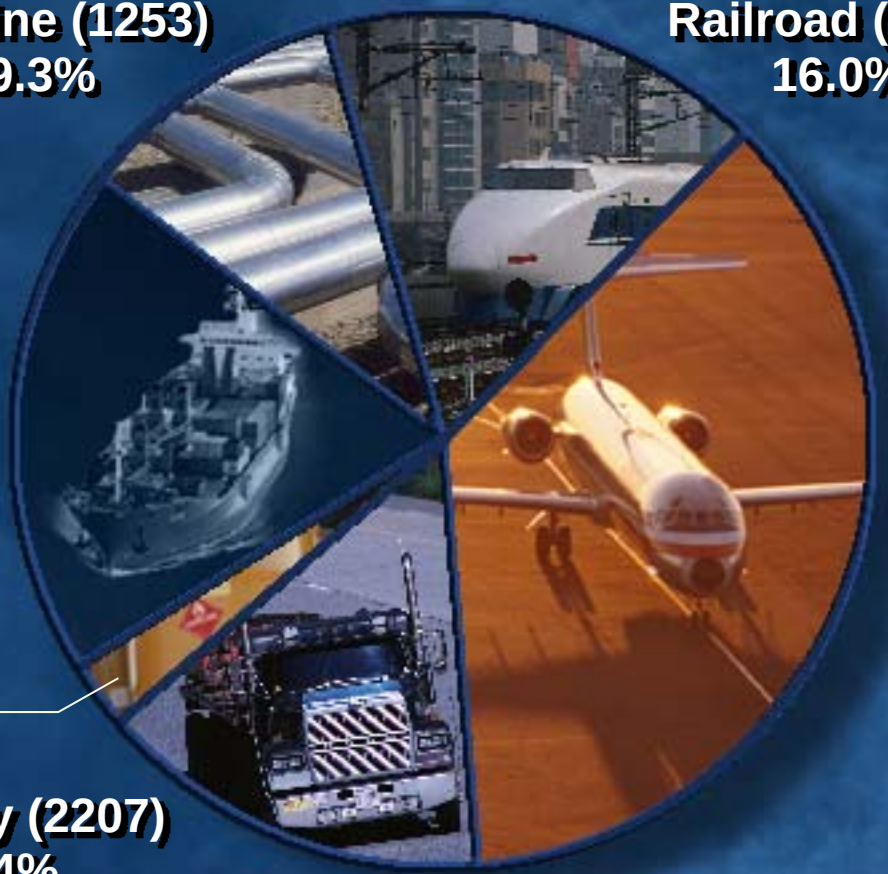
- 130,000+ accident investigations
- 13,000+ safety recommendations
- 82% acceptance rate

13,454 Safety Recommendations issued since 1967

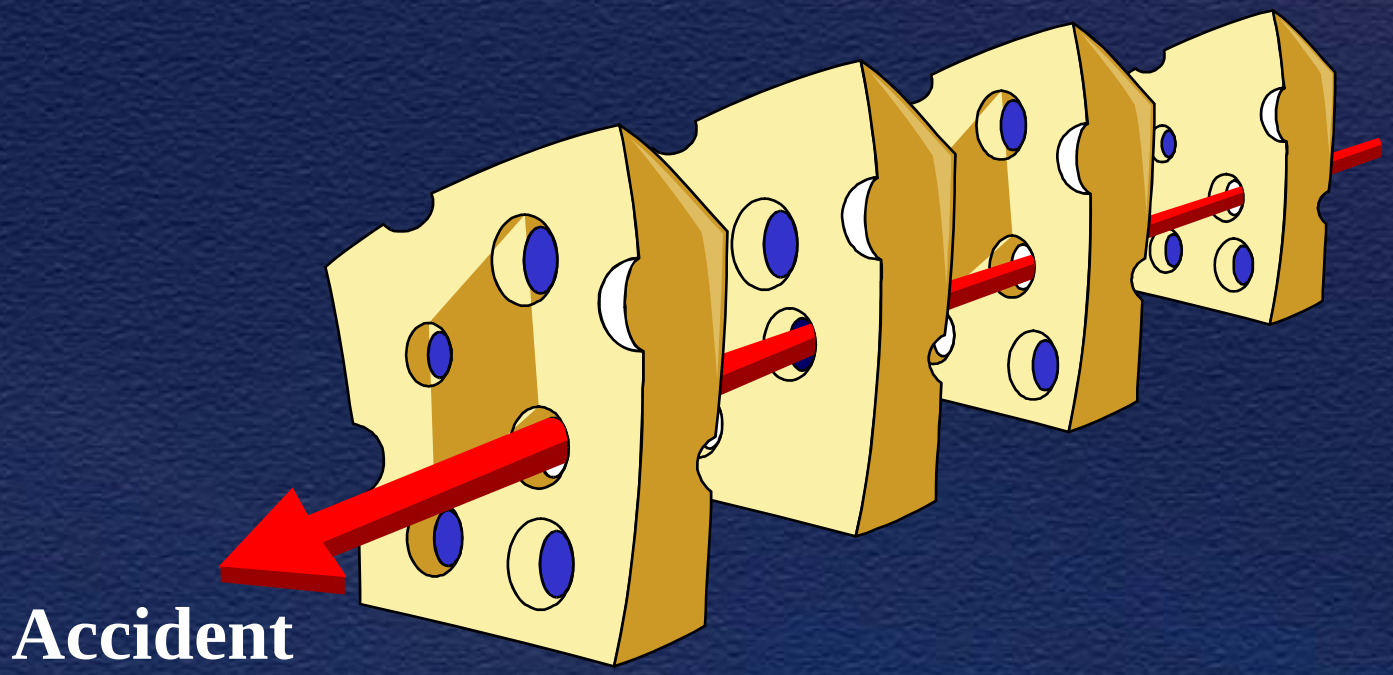


Rev: July 1, 2011

Major product: safety recommendations

Moral compass and industry conscience

“Swiss Cheese” Model (Reason)



Successive layers of defenses, barriers, and safeguards

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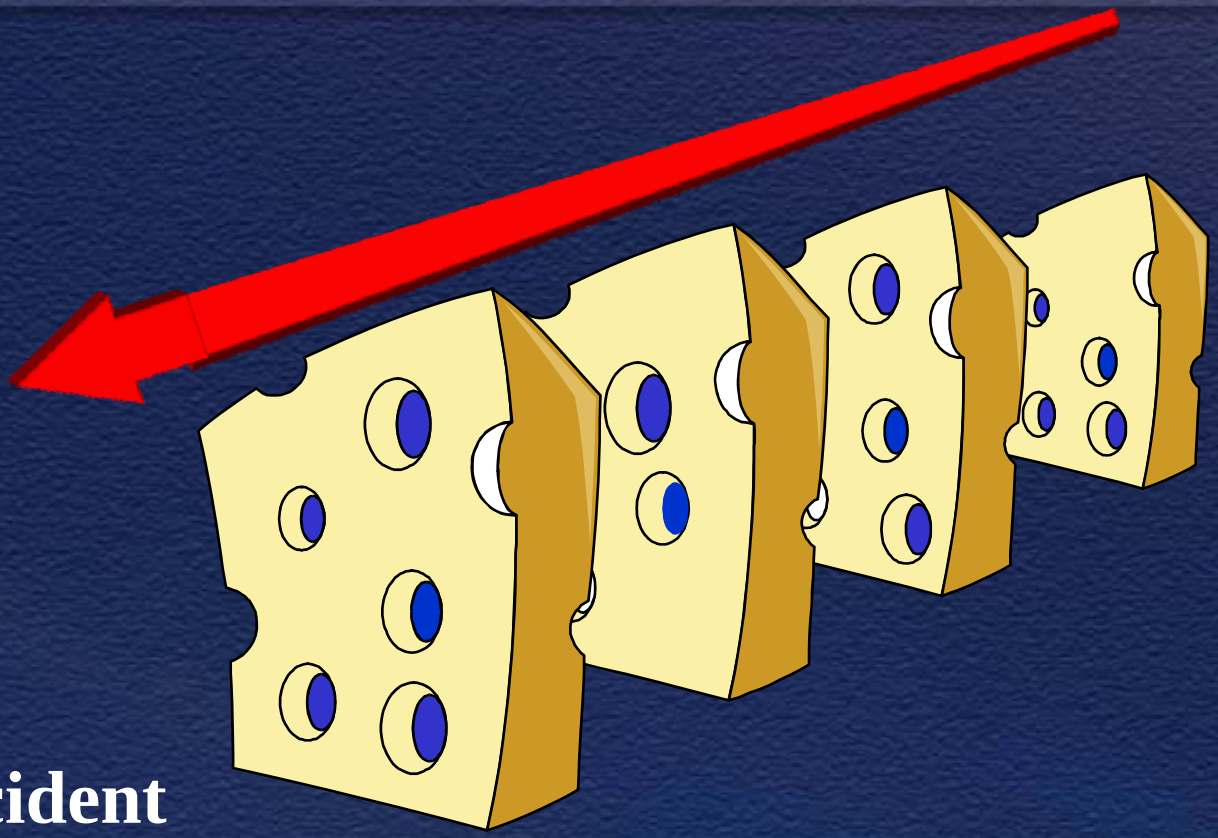
The Challenge (Haueter)



Successive layers of defenses, barriers, and safeguards

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Go! Flight 1002

- early starts, multiple segment days, sleep apnea

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Honorable John K. Lauber:

No Accident ≠

Safe Operation

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Guantanamo Bay Cuba

First NTSB aviation accident to cite fatigue as probable cause

- acute sleep loss, sleep debt, circadian disruption

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Observed Performance Effects

- Degraded decision-making
- Visual/cognitive fixation
- Poor communication/coordination
- Slowed reaction time

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Uncontrolled In-Flight Collision with Terrain
AIA Flight 808, Douglas DC-8-61, N814CK
U.S. NAS, Guantanamo Bay, Cuba, August 18, 1993

"The National Transportation Safety Board determines that the probable causes of this accident were the impaired judgment, decision making, and flying abilities of the captain and flight crew due to the effects of fatigue…"

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Owatonna, MN (July 31, 2008)

8 fatalities

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Owatonna Crew Fatigue Factors

- acute sleep loss (Capt/FO)
- cumulative sleep debt (FO)
- early start time (Capt/FO)
- excessive sleep need (Capt)
- insomnia (FO)
- self-medicate/prescription sleep med (FO)

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Probable Cause/Contributing Factors

"Contributing to the accident were . . . (2) fatigue, which likely impaired both pilots' performance; . . ."

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Lubbock, TX (January 27, 2009)

2 injuries

Probable Cause/Contributing Factors

"Contributing to the accident were . . .

4) fatigue due to the time of day in which the accident occurred and a cumulative sleep debt, which likely impaired the captain's performance."

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Fatal Airline Accidents (Examples) (fatigue cited)

- 8/97 Guam: 228 fatalities
- 6/99 Little Rock AK: 11 fatal
- 10/04 Kirksville MO: 11 fatalities
- 8/06 Lexington KY: 49 fatalities
- 7/08 Owatonna MN: 8 fatalities
- 2/09 Buffalo NY: 49 fatalities

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Fatigue Risks

Fatigue can degrade every aspect of human capability.

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Fatigue Risks

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Fatigue Risks

- reduced (20 – 50%+):

  - reaction time
  - memory
  - communication
  - situational awareness
  - judgment
  - attention
  - mood
  - more . . .

- increased:

  - irritability
  - apathy
  - attentional lapses
  - microsleeps

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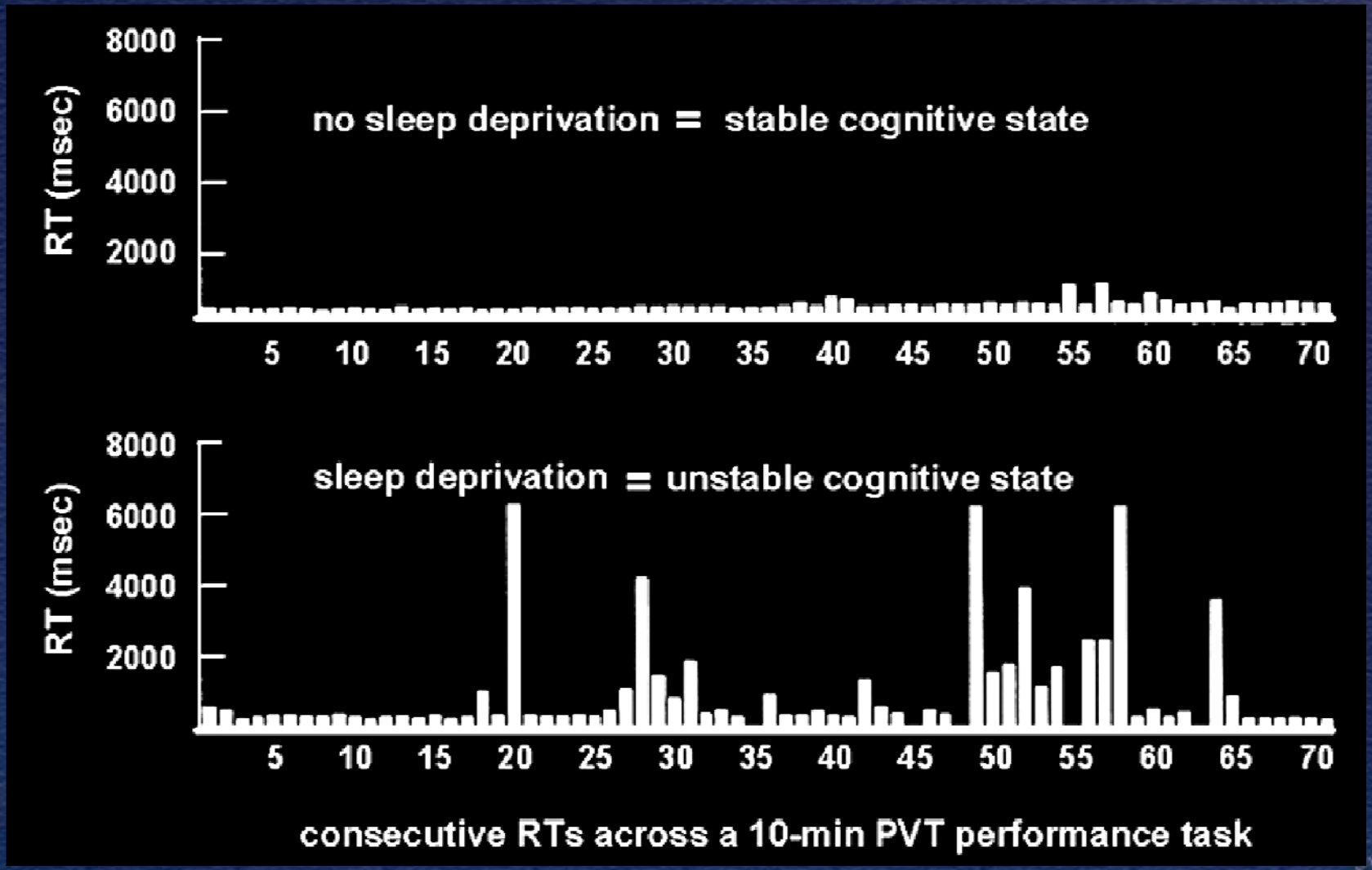
Fatigue and Reaction Times



Doran SM, Van Dongen HP, Dinges DF. Sustained attention performance during sleep deprivation: evidence of state instability. *Archives of Italian Biology: Neuroscience* 2001;139:253-267.

Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders

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Fatigue Factors

- sleep
  - acute sleep loss
  - cumulative sleep debt
- circadian clock
- hours awake
- sleep disorders

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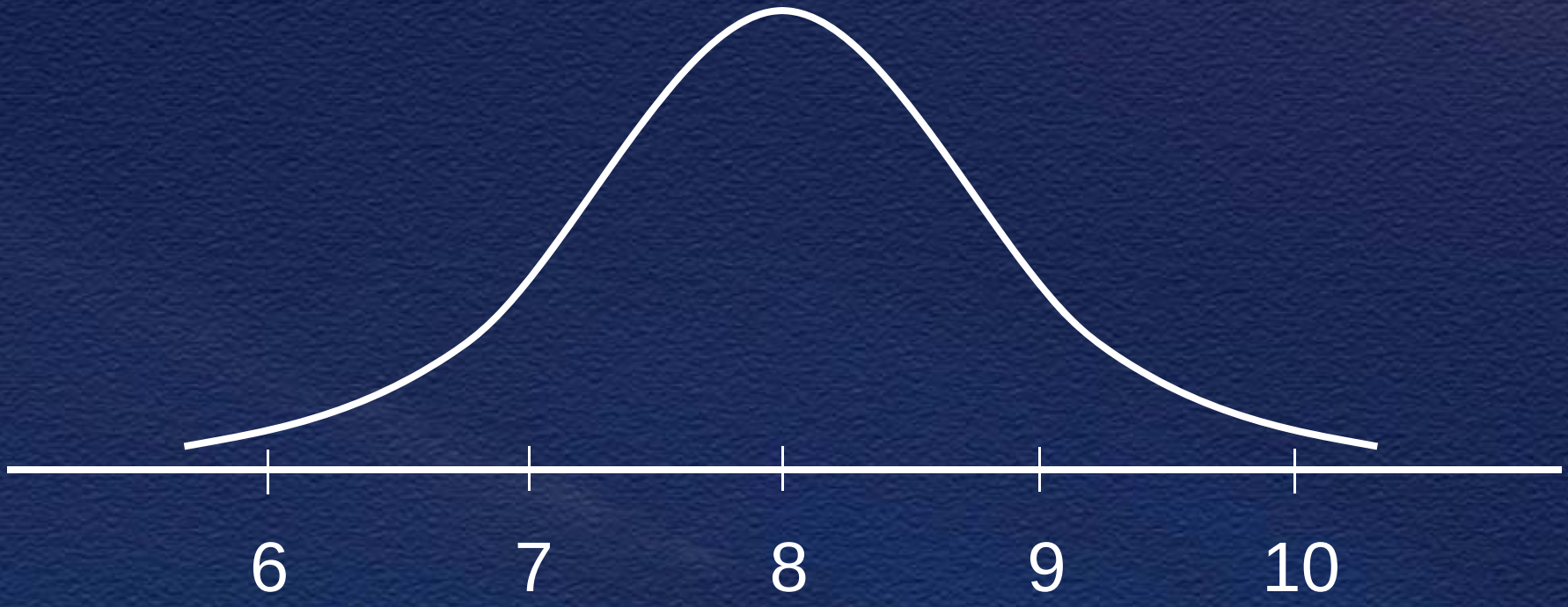
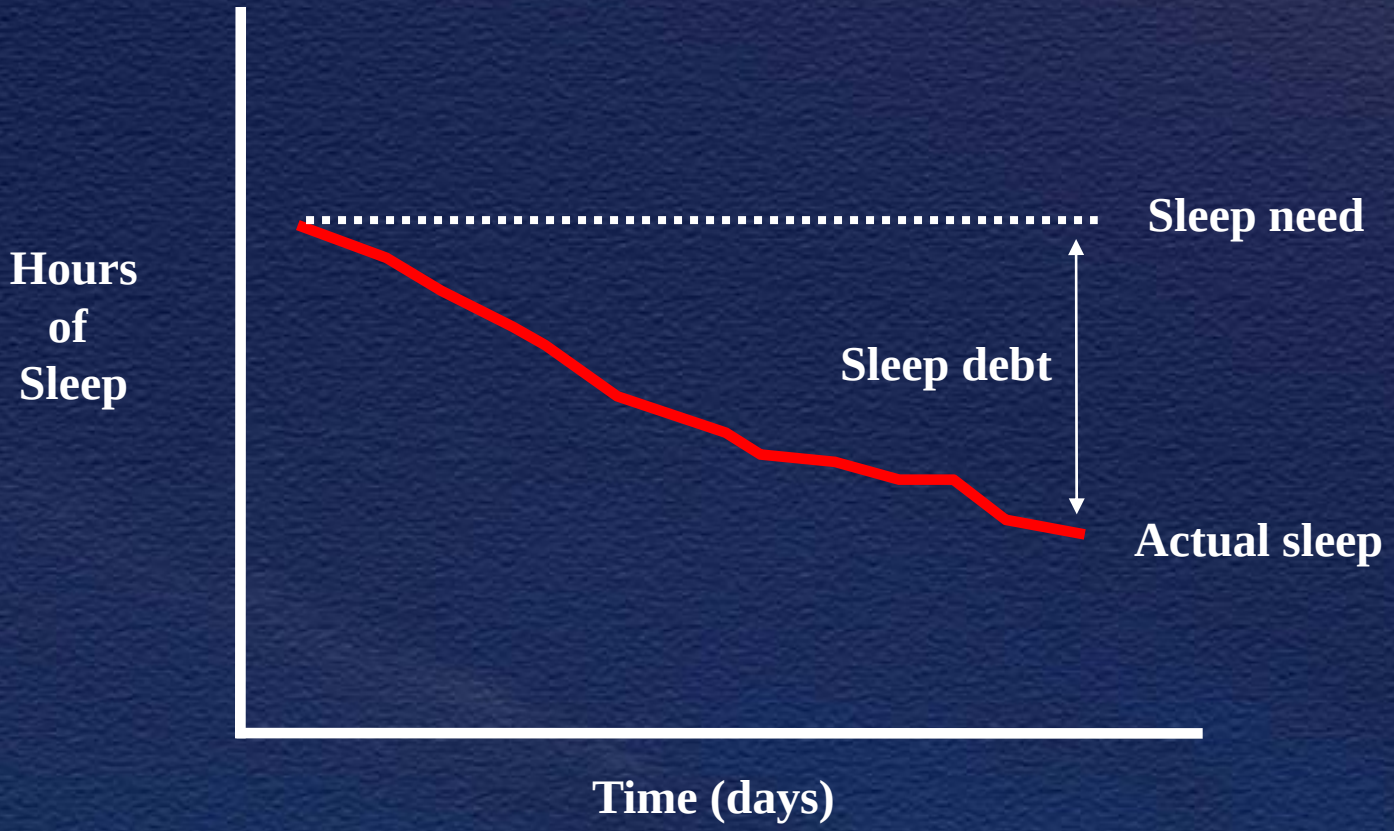
Sleep Requirement



Cumulative Sleep Debt



Sleep Need – Actual Sleep = Sleep Debt

Sleep debt grows cumulatively over time

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Fatigue Factors

- sleep
- circadian clock
  - ‘sleepy’ windows
  - ‘alert’ windows
  - irregular schedule
  - time zones
- hours awake
- sleep disorders

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Fatigue Factors

- sleep
- circadian clock
- hours awake
  - > 12 hrs
  - > 16 hrs
  - 24 hrs
- sleep disorders

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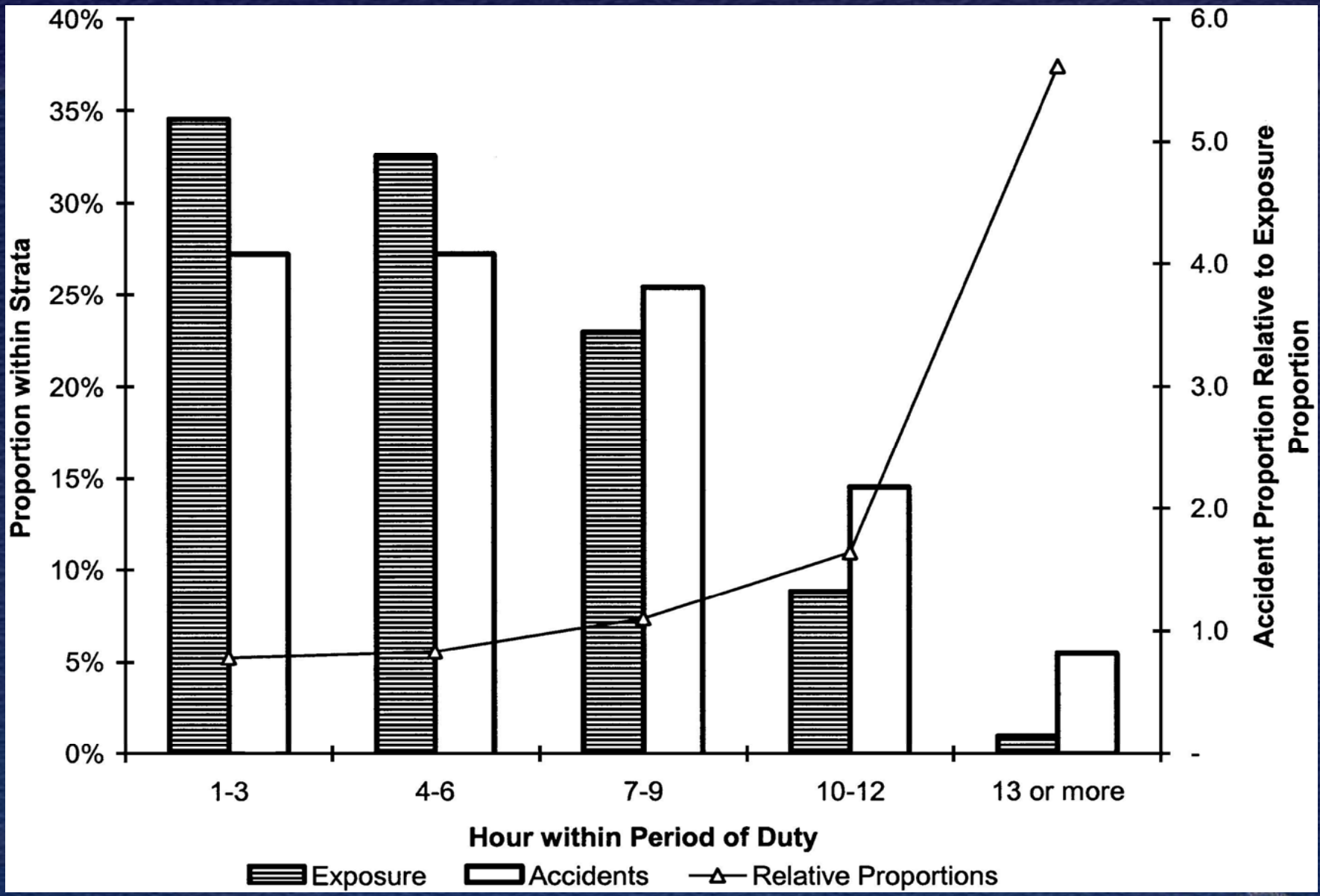
40%
35%
30%
25%
20%
15%
10%
5%
0%
Proportion within Strata
6.0
5.0
4.0
3.0
2.0
1.0
-
Accident Proportion Relative to Exposure Proportion
1-3
4-6
7-9
10-12
13 or more
Hour within Period of Duty
Exposure
Accidents
Relative Proportions

Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders
  - ~ 90 sleep disorders
  - sleep apnea

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Sleep Apnea is a Safety Risk

- > 6 times increased risk for crash
- > 7 times increased risk for multiple crashes
- SA performance = .06 - .08 BAC

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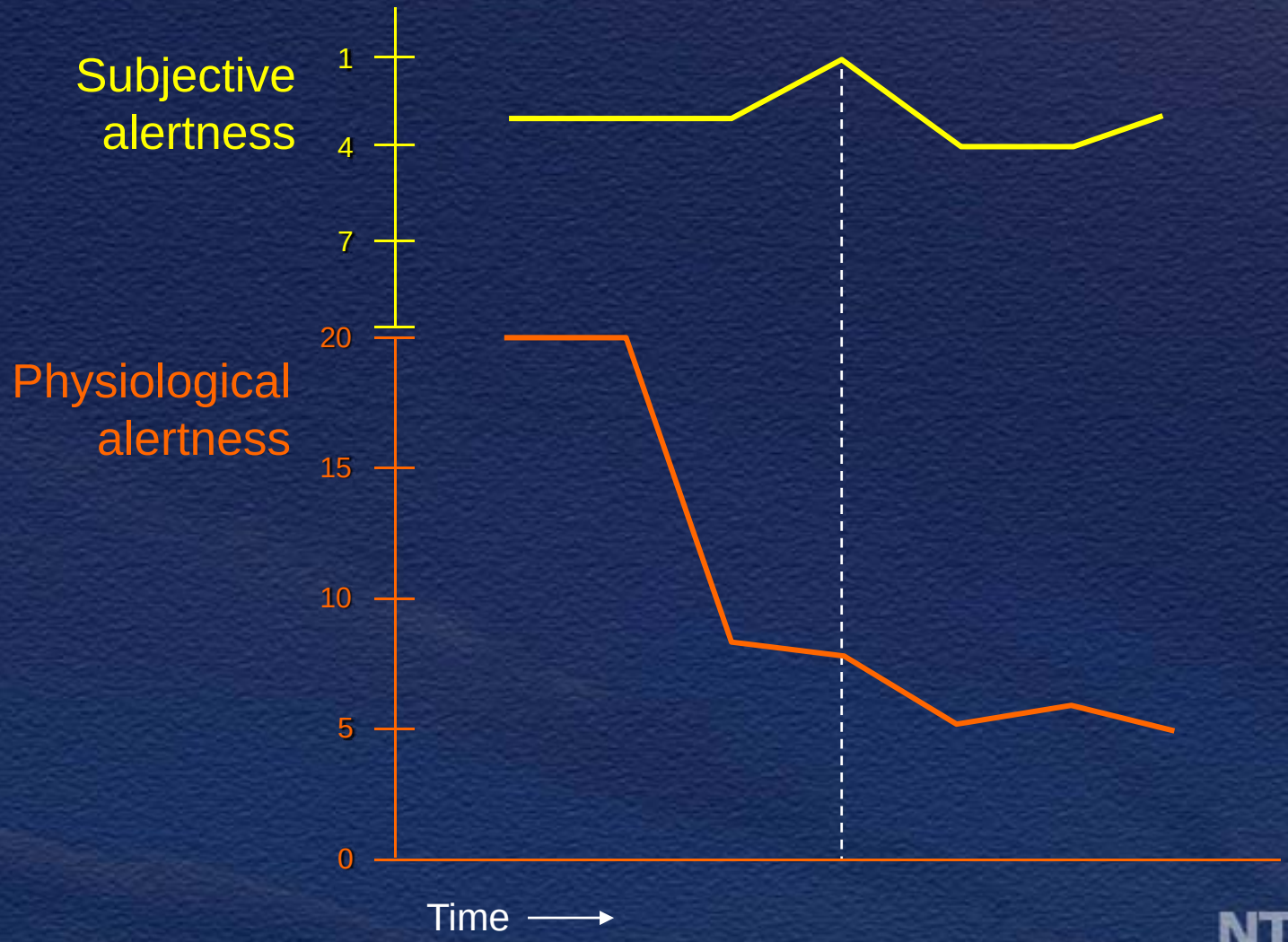
Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986

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NTSB Most Wanted List

Critical changes needed to reduce transportation accidents and save lives.

NATIONAL TRANSPORTATION SAFETY BOARD

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Home > Transportation Safety > Most Wanted List

SHARE

MOST WANTED LIST

A program to increase the public's awareness of, and support for, action to adopt safety steps that can help prevent accidents and save lives.
The following are ten of the current issues.

Addressing Human Fatigue

General Aviation Safety

Safety Management Systems

Runway Safety

Bus Occupant Safety

Pilot & Air Traffic Controller Professionalism

Recorders

Teen Driver Safety

Addressing Alcohol-Impaired Driving

Motorcycle Safety

NTSB Recommendations

- MOST WANTED since 1990
- ~200 fatigue recommendations

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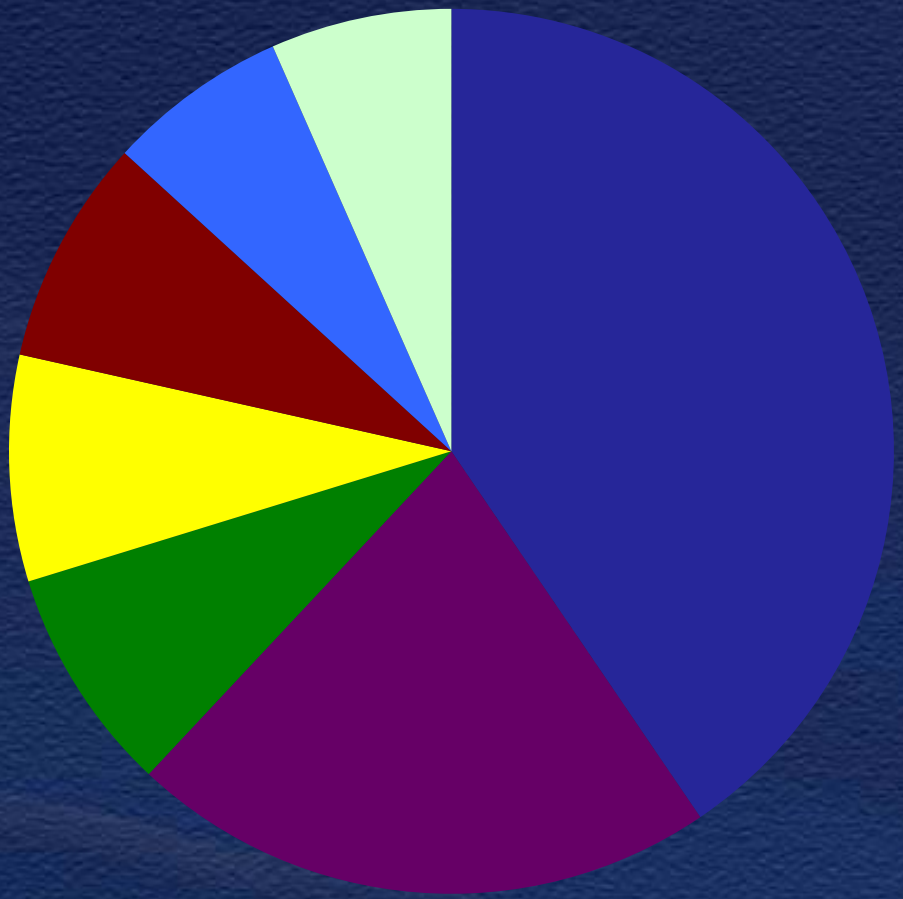
Complex Issue: Requires Multiple Solutions



- Scheduling Policies and Practices
- Education
- Organizational Strategies
- Raising Awareness
- Healthy Sleep
- Vehicle and Environmental Strategies
- Research and Evaluation

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Education/Strategies

- Develop a fatigue education and countermeasures training program
- Educate operators and schedulers
- Include information on use of strategies: naps, caffeine, etc.
- Review and update materials

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Education

- Education vs. awareness
- Science based information
- Foundation for any fatigue efforts
- Address broad/applied content:
  - how fatigue affects performance
  - how to minimize fatigue risks
  - fatigue countermeasures/strategies
  - support with policies

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Hours of Service / Scheduling

- Science-based hours of service
- Allow for at least 8 hours of uninterrupted sleep
- Reduce schedule irregularity and unpredictability

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Fatigue Management Systems

- Develop guidance based on empirical and scientific evidence for operators to establish fatigue management systems
- Develop and use a methodology that will continually assess the effectiveness of fatigue management systems

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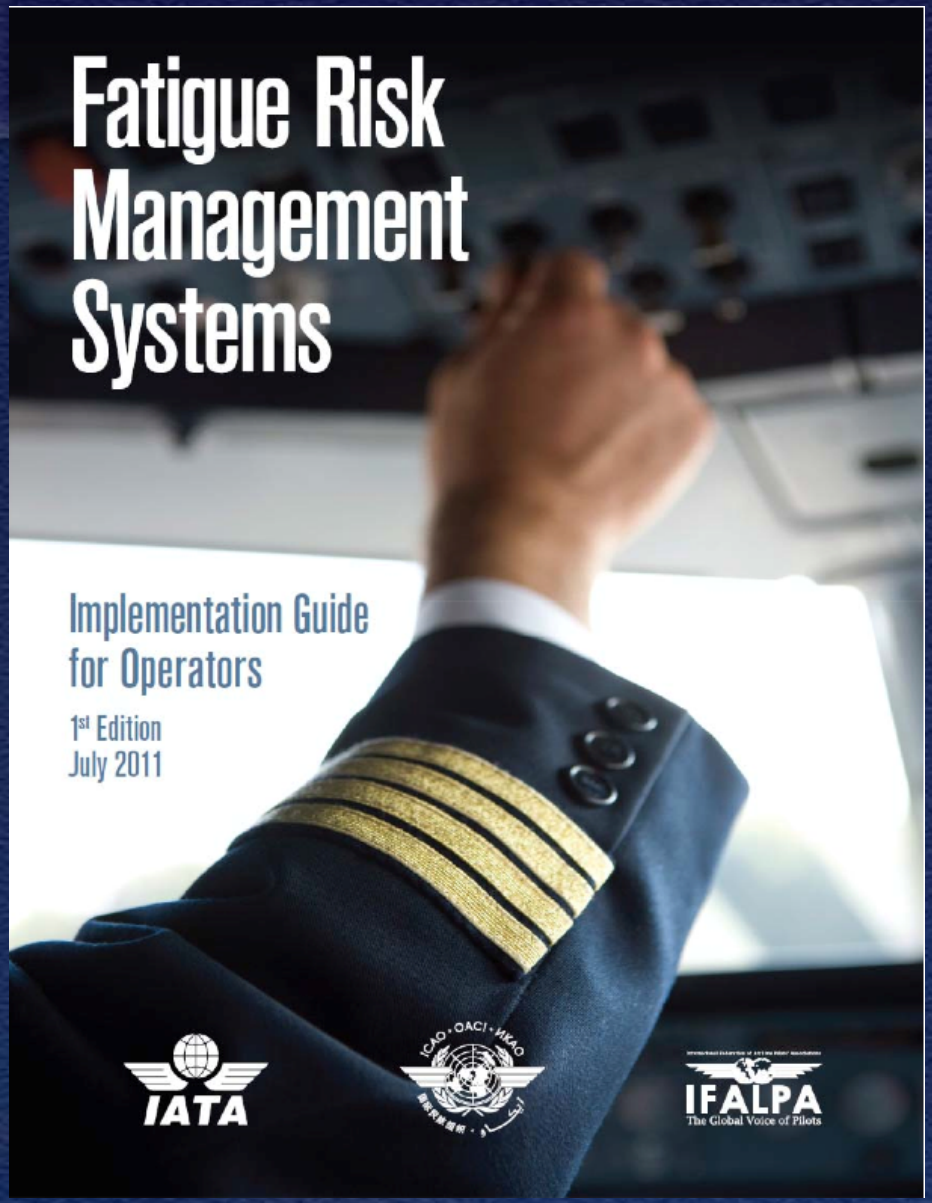
Fatigue Risk Management Systems
Implementation Guide for Operators
1st Edition
July 2011
IATA
ICAO • OACI • ИКАО
IFALPA
The Global Voice of Pilots


Doc 9966 - UNEDITED VERSION
ICAO • OACI • ИКАО
FRMS
Fatigue Risk Management Systems
Manual for Regulators
2011 Edition

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Fatigue Management Programs

- Comprehensive approach
- Multiple components
- Science based
- Continuously evaluated and updated
- Complements HOS regulations

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Bombardier Safety Standdown: 15 Years Changing Safety Culture

Embrace change . . .

Honor knowledge with action . . .

Be Safer!

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