NTSB National Transportation Safety Board

Managing Fatigue in Aviation: NTSB Investigations and Recommendations

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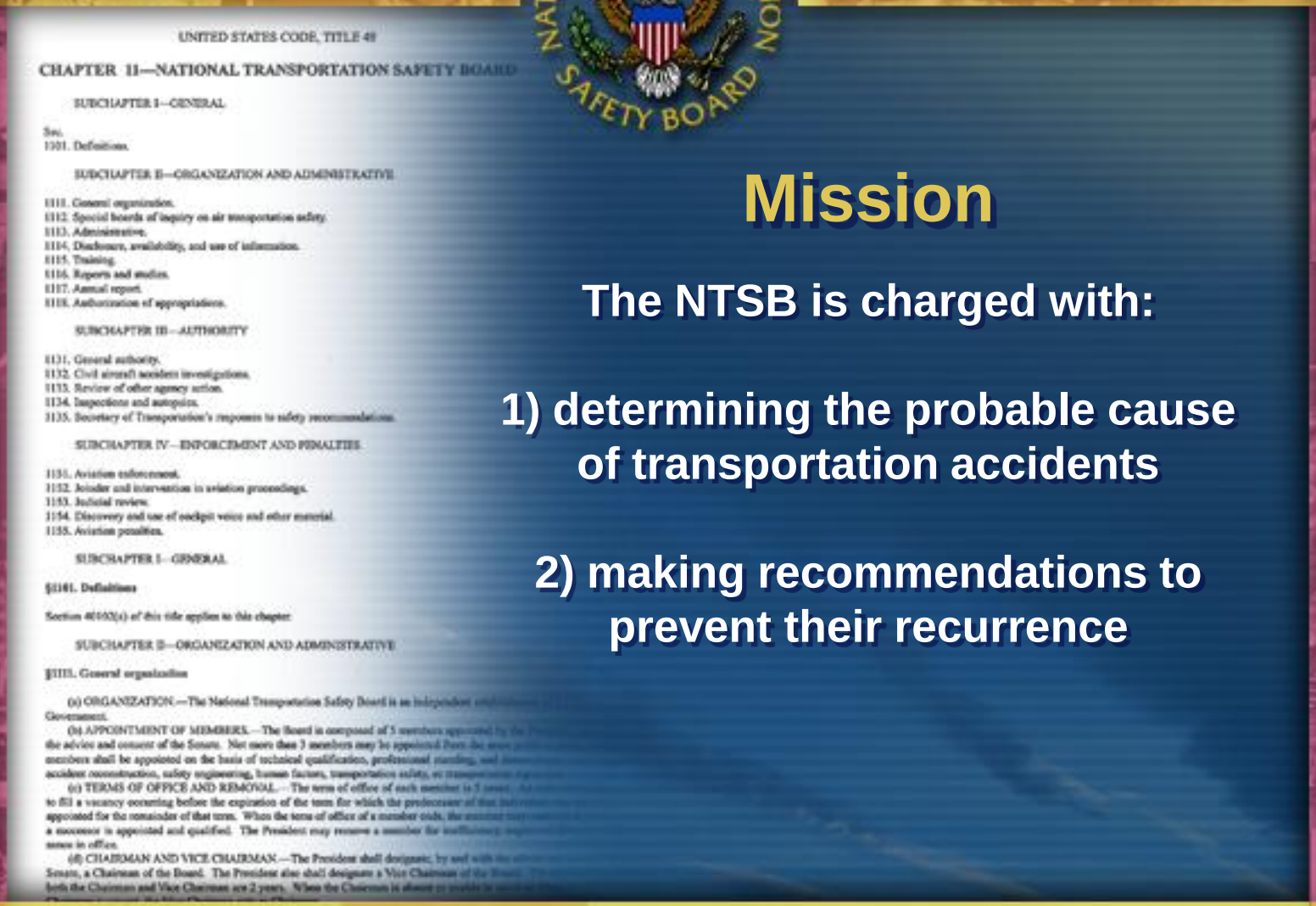
Board Member

Air Charter Safety Foundation
February 29, 2012



UNITED STATES CODE, TITLE 49

CHAPTER 11—NATIONAL TRANSPORTATION SAFETY BOARD

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SUBCHAPTER I—GENERAL

§1101. Definitions

Section 40102(a) of this title applies to this chapter.

SUBCHAPTER II—ORGANIZATION AND ADMINISTRATIVE

§1111. General organization

(a) ORGANIZATION.—The National Transportation Safety Board is an independent

Government.

(b) APPOINTMENT OF MEMBERS.—The Board is composed of 5 members appointed by the

the advice and consent of the Senate. Not more than 3 members may be appointed from the same

members shall be appointed on the basis of technical qualification, professional standing, and

accident reconstruction, safety engineering, human factors, transportation safety, or

(c) TERMS OF OFFICE AND REMOVAL.—The term of office of each member is 5 years. An

to fill a vacancy occurring before the expiration of the term for which the predecessor of that

appointed for the remainder of that term. When the term of office of a member ends, the

a successor is appointed and qualified. The President may remove a member for inefficiency,

terms in office.

(d) CHAIRMAN AND VICE CHAIRMAN.—The President shall designate, by and with the

Senate, a Chairman of the Board. The President also shall designate a Vice Chairman of the Board.

both the Chairman and Vice Chairman are 2 years. When the Chairman is absent or unable to

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:

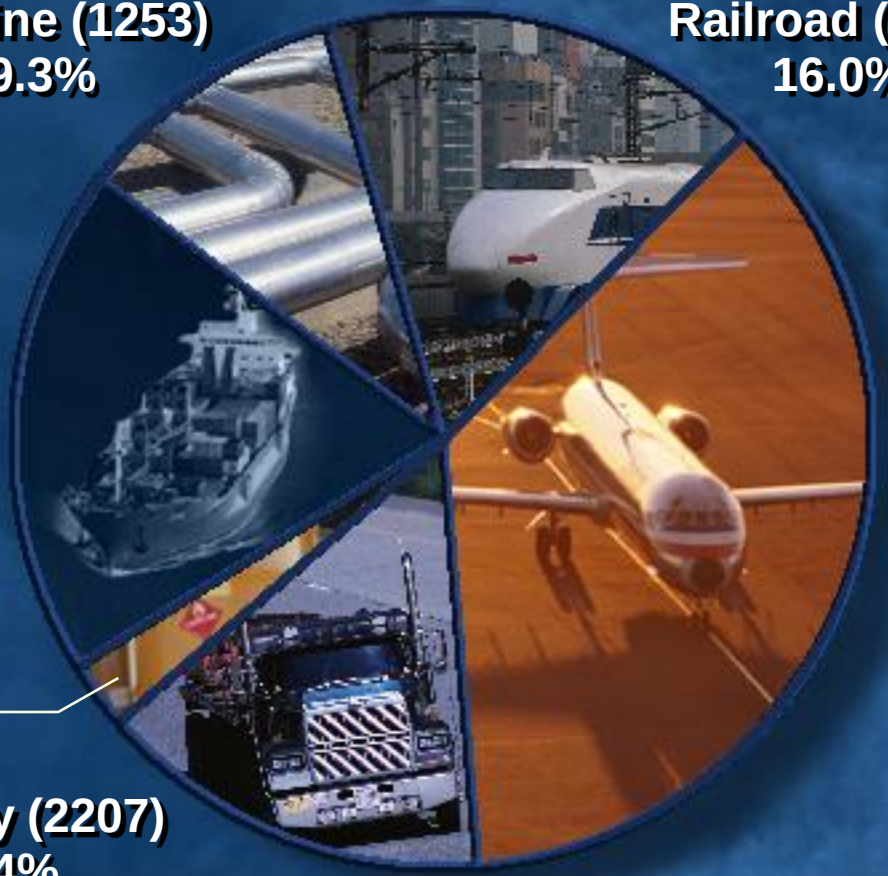
Aviation, highway, rail, marine, pipeline, and hazardous material accidents

PG&E/San Bruno Gas Pipeline Explosion

NTSB

- 130,000+ accident investigations
- ~13,500 safety recommendations
- 82% acceptance rate

13,454 Safety Recommendations issued since 1967

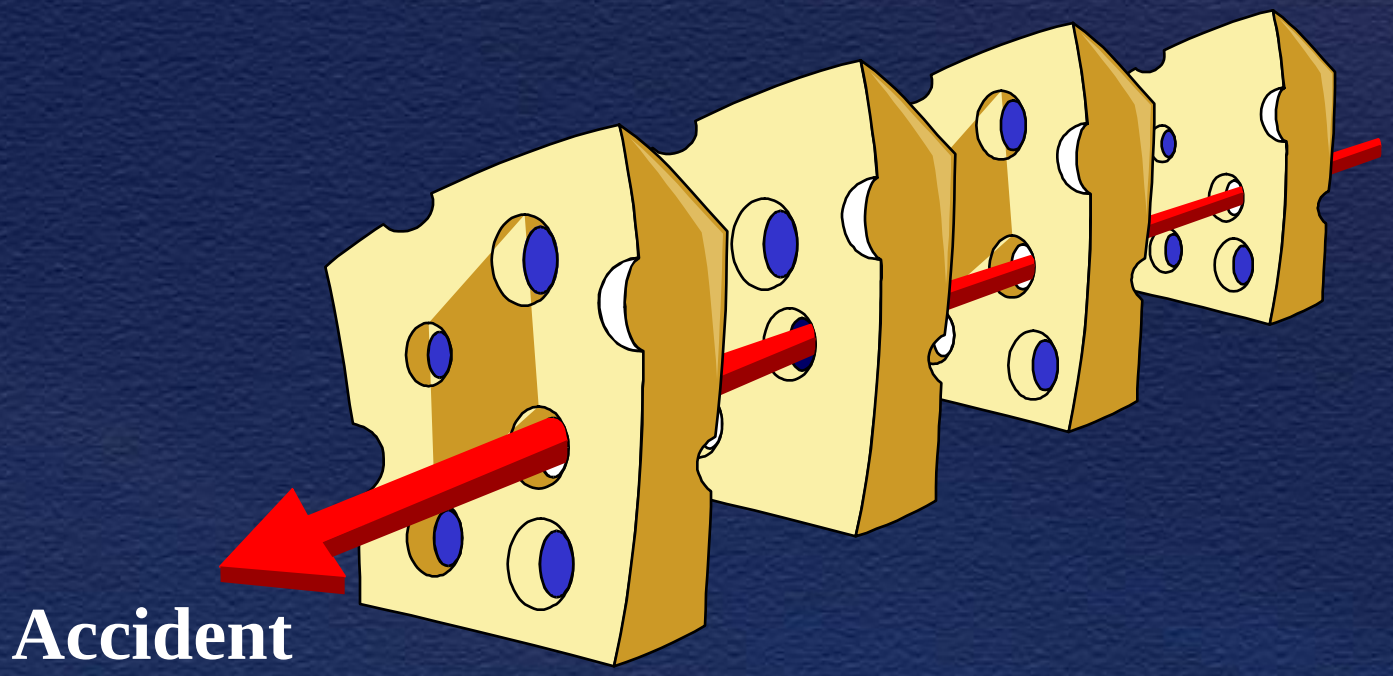


Rev: July 1, 2011

Major product: safety recommendations

Moral compass and industry conscience

“Swiss Cheese” Model (Reason)



Successive layers of defenses, barriers, and safeguards

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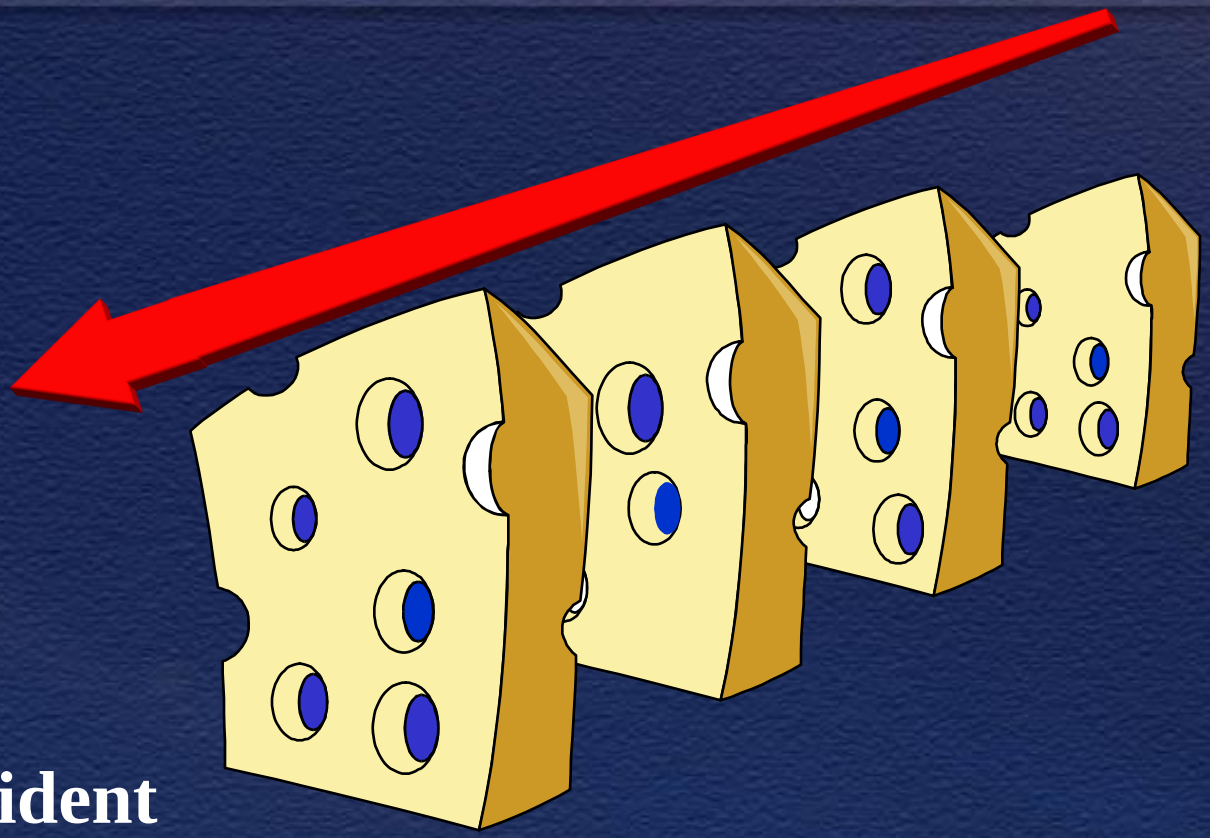
The Challenge (Haueter)



Successive layers of defenses, barriers, and safeguards

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Honorable John K. Lauber:

No Accident ≠

Safe Operation

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Go! Flight 1002

- early starts, multiple segment days, sleep apnea

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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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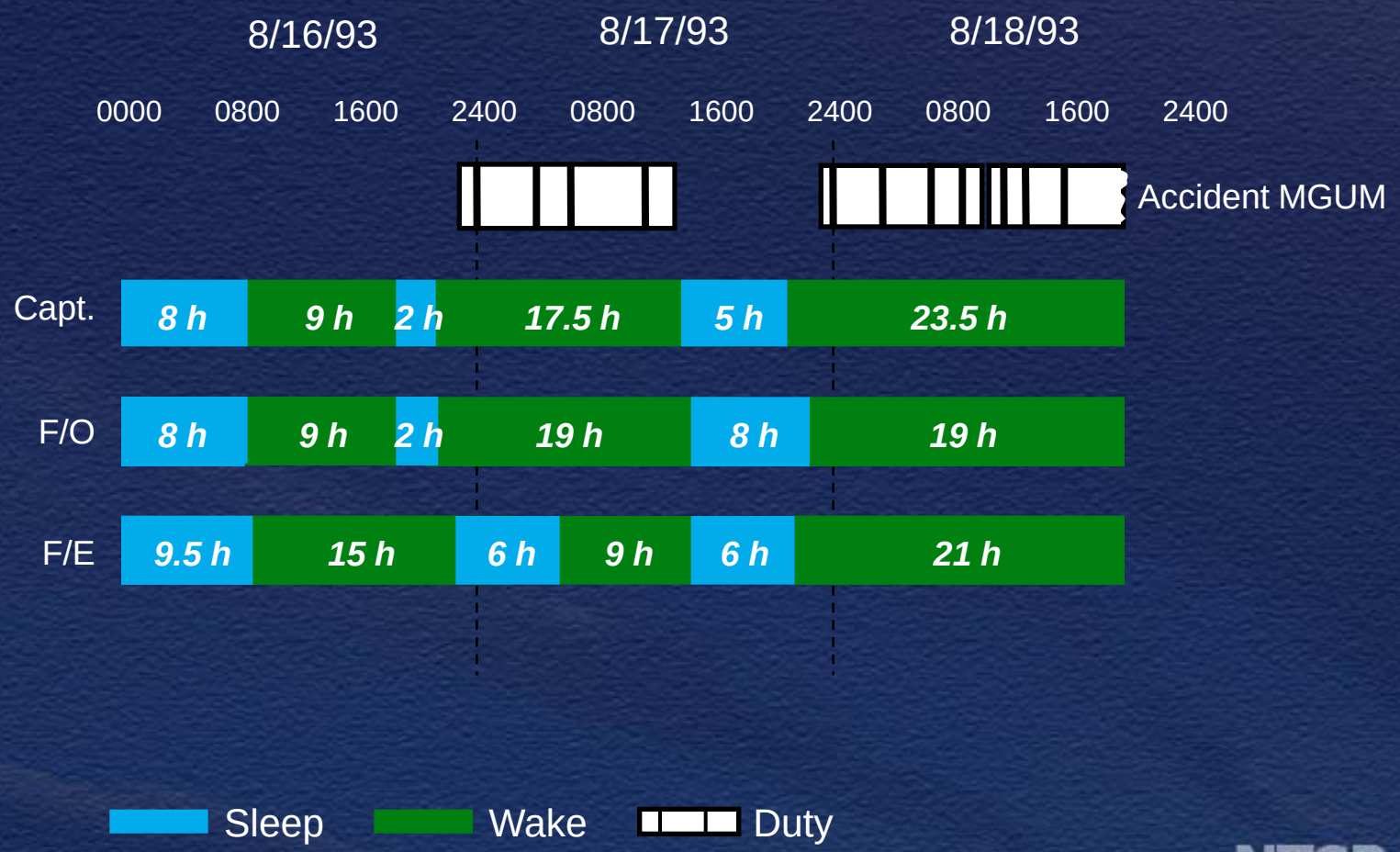
Crew Sleep History



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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

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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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Challenges of a 24/7 Society

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Fatigue Risks

Fatigue can degrade every aspect of human capability.

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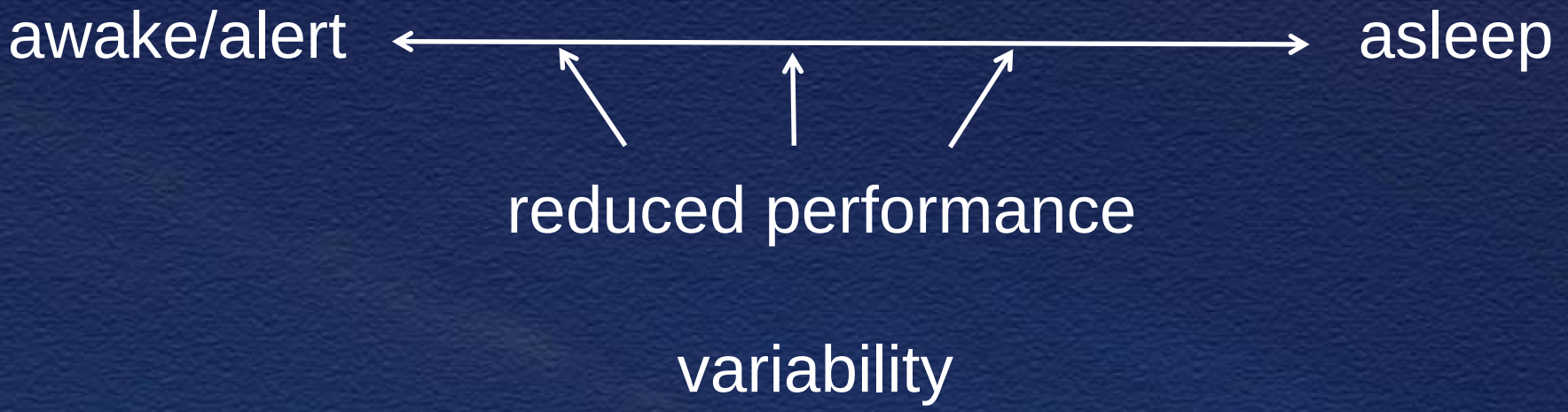
Fatigue Risks



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Performance Reduced 20-50+%

Reaction time

Memory

Communication

Judgment

Attention

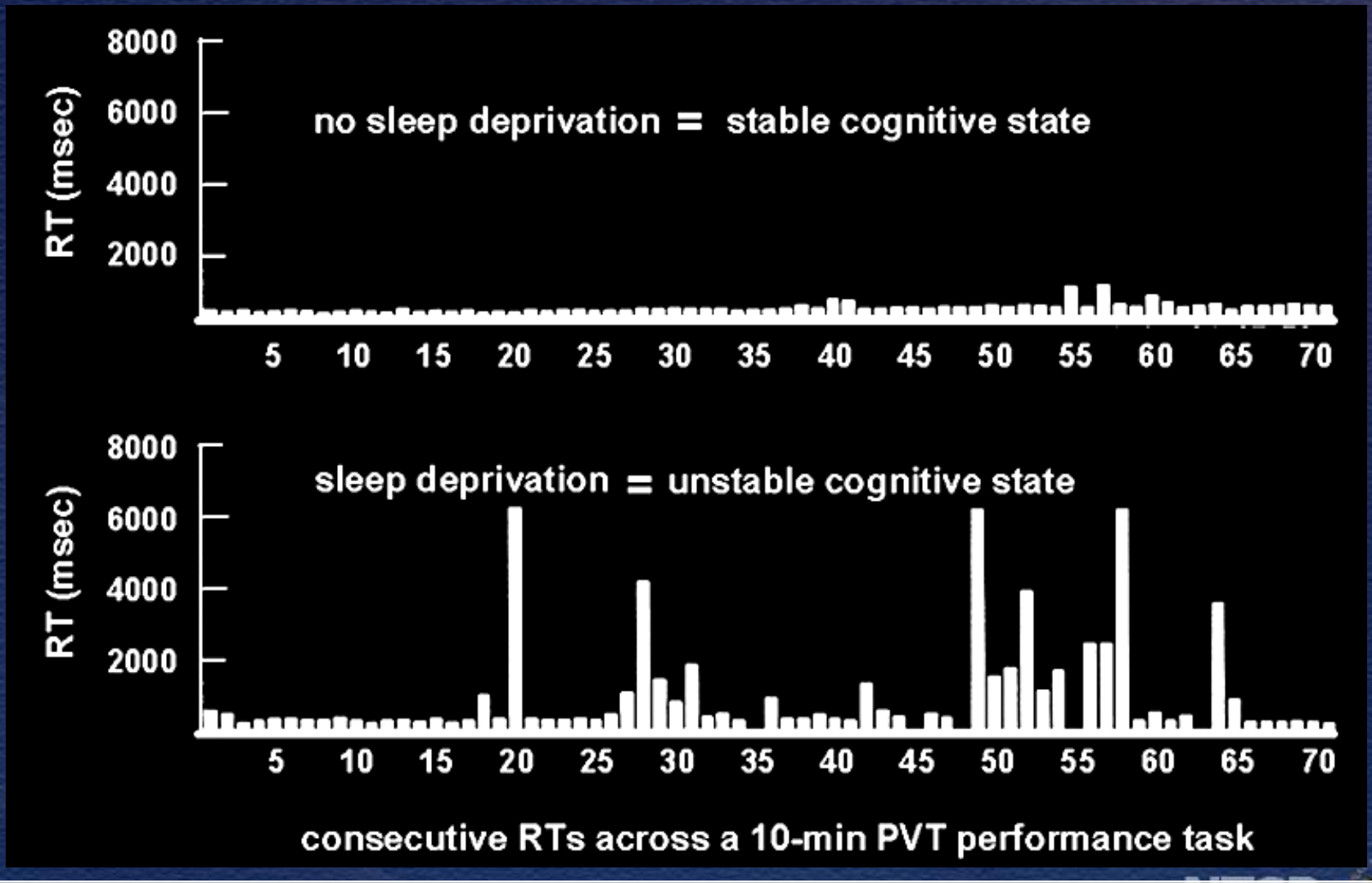
Mood

Impaired mood

Situational awareness

Concentration

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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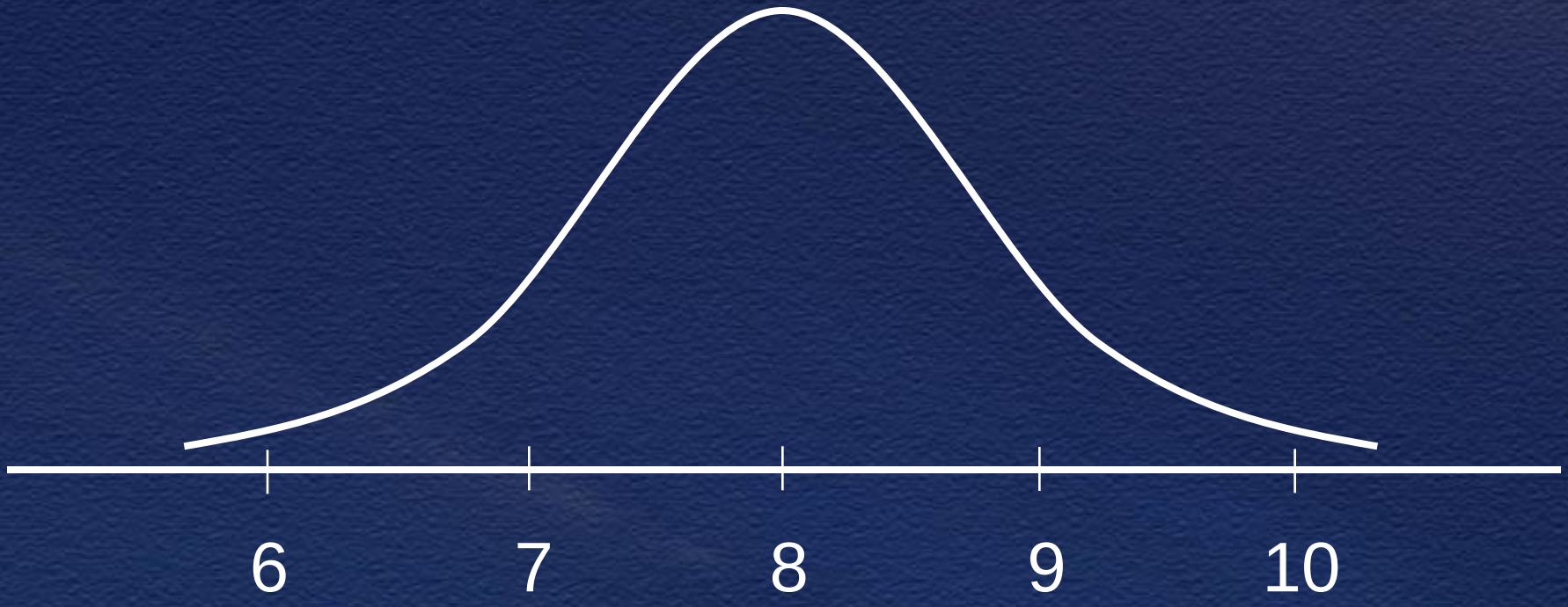
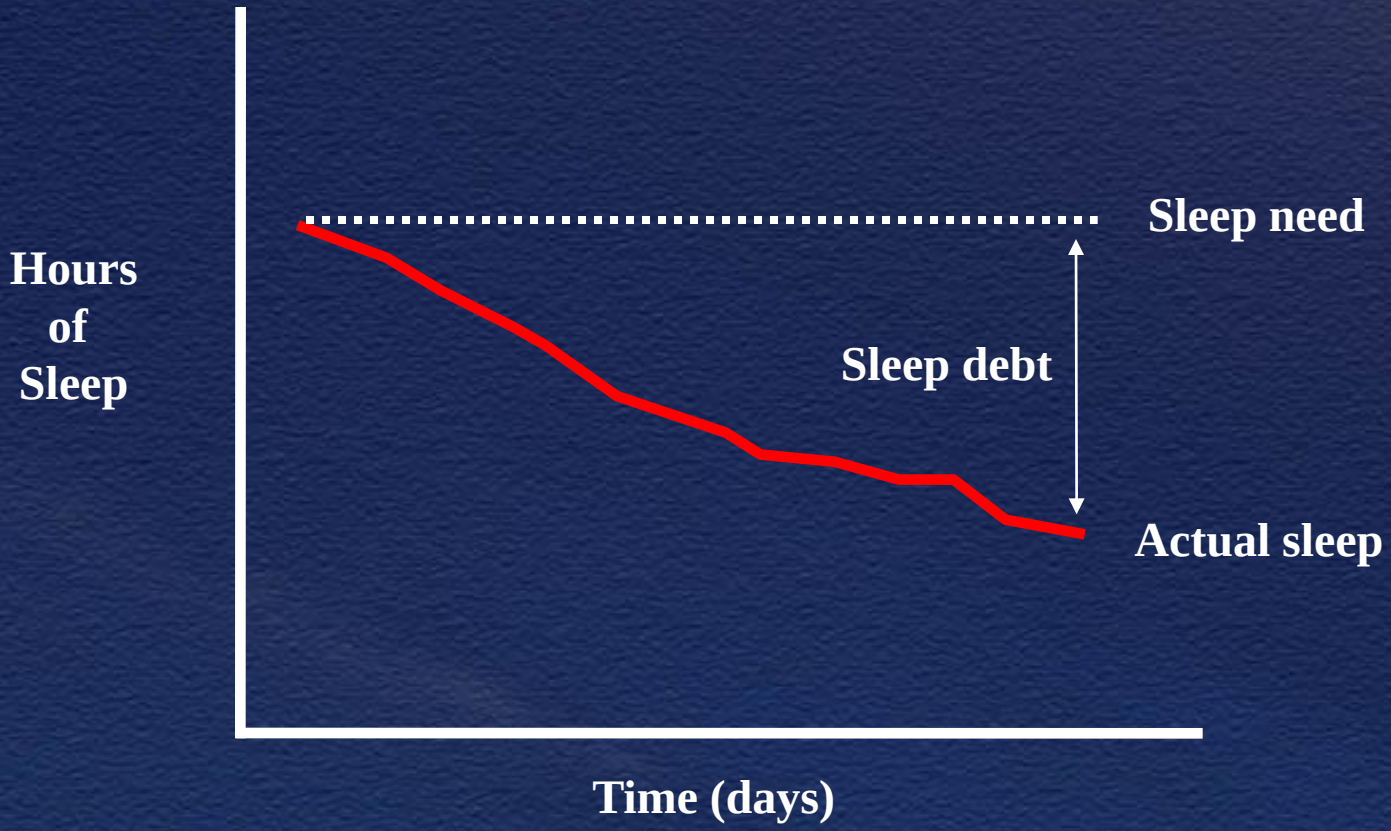
Sleep Requirement



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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NASA Long-Haul Study Circadian Results

- 80% of crewmembers showed circadian variation in temperature (ave period = 25.7 hr)
- 20% had no detectable circadian rhythm

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“Adapting” to Shift Work

- In most instances, complete circadian adaptation to night shift work never occurs
  - early morning light prevents adaptation
  - reversion to day-active schedule on days off

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Fatigue Factors

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

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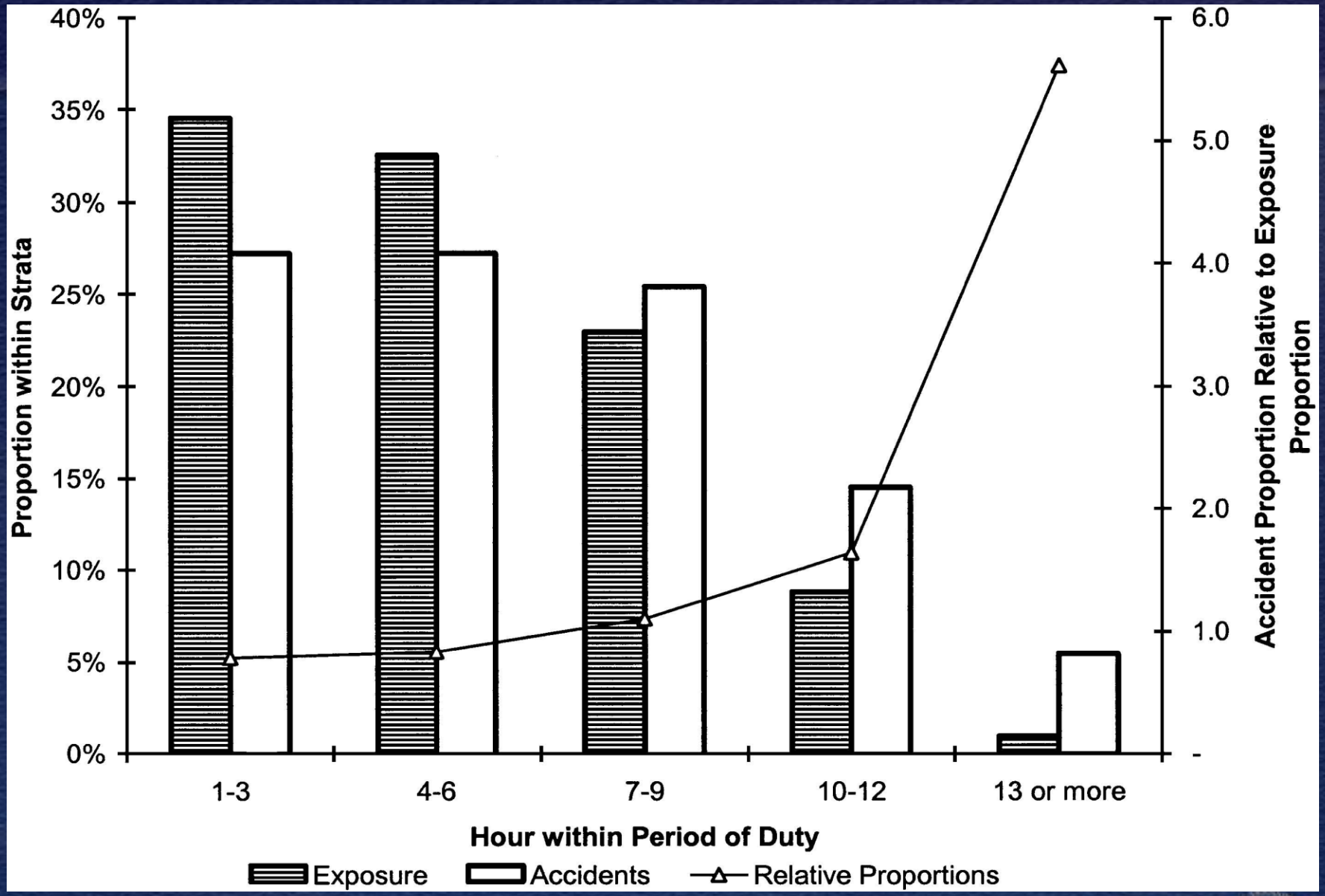
40%
35%
30%
25%
20%
15%
10%
5%
0%
Proportion within Strata
6.0
5.0
4.0
3.0
2.0
1.0
-
Accident Proportion Relative to Exposure
Proportion
1-3
4-6
7-9
10-12
13 or more
Hour within Period of Duty
Exposure
Accidents
Relative Proportions

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
- SA performance = .06 - .08 BAC

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Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders

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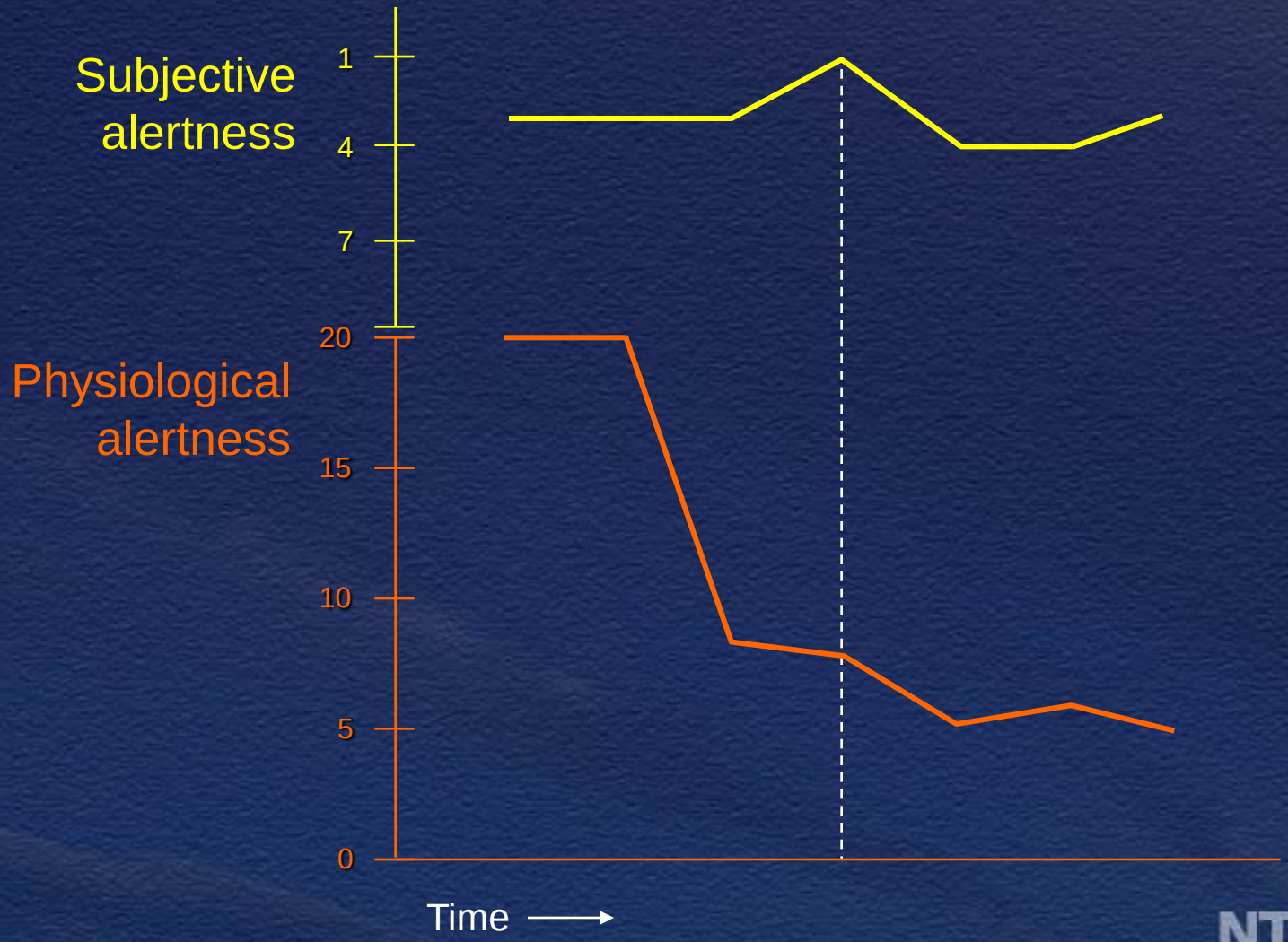
Alertness Reports Often Inaccurate



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

HOME | NEWS & EVENTS | TRANSPORTATION SAFETY | ACCIDENT INVESTIGATIONS | DISASTER ASSISTANCE | LEGAL | ABOUT

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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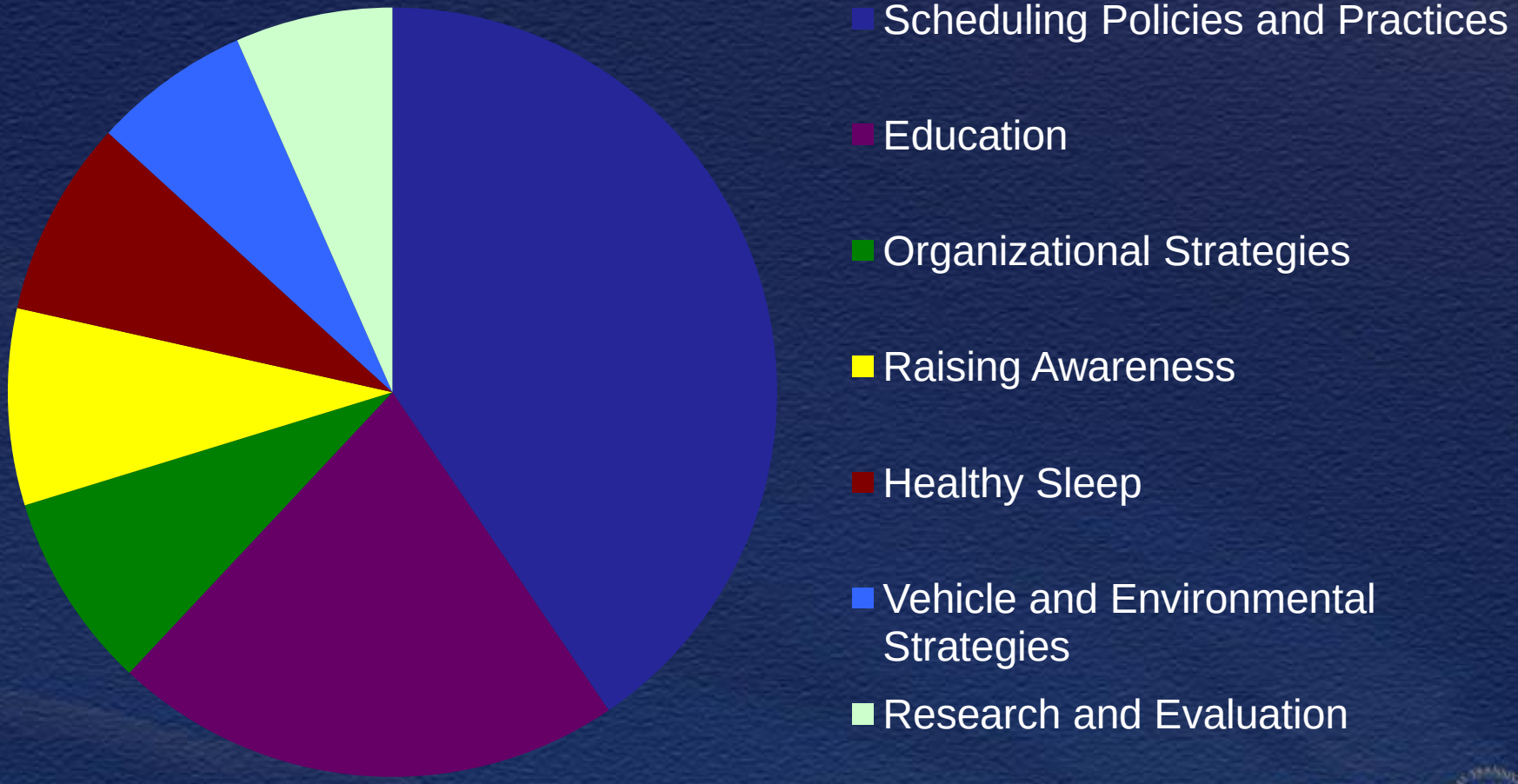
Complex Issue: Requires Multiple Solutions



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NTSB Recommendations: 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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NTSB Recommendations: 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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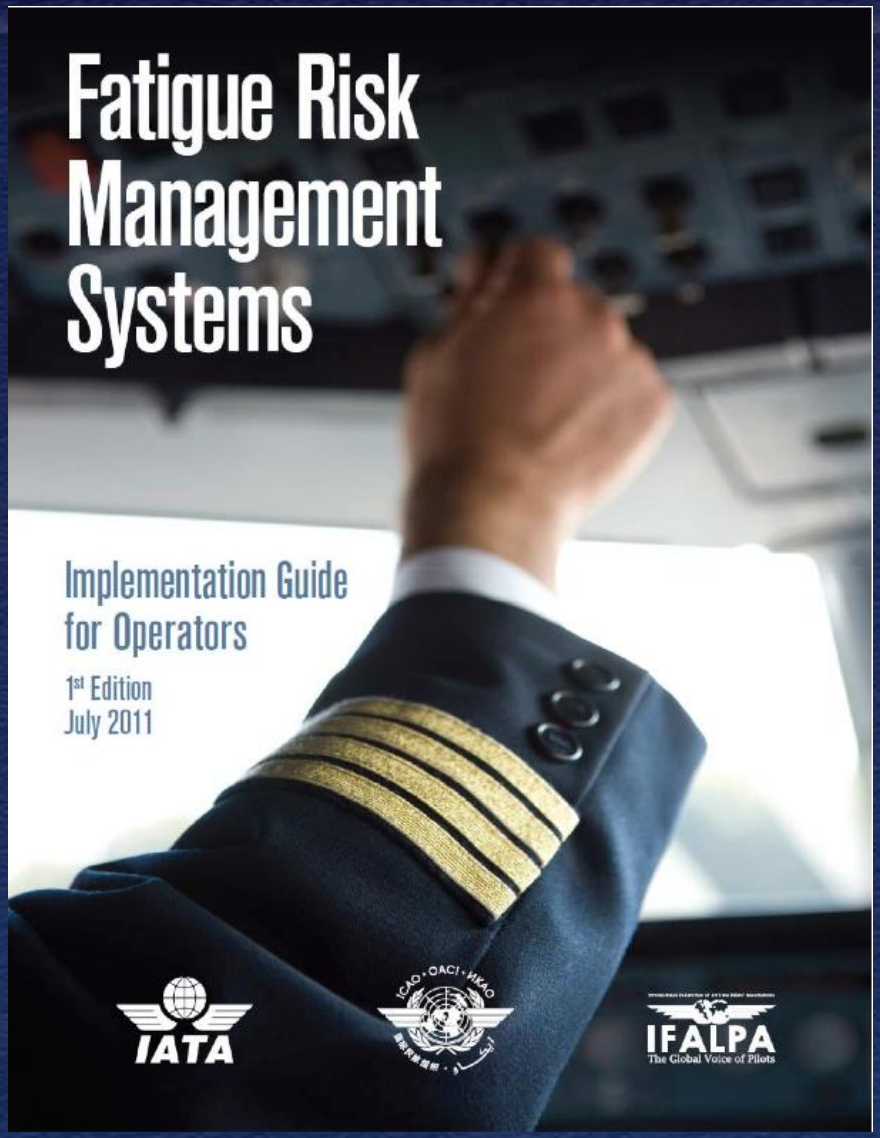
Example



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NTSB Recommendations: 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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NTSB Recommendations: Education/Strategies

- Include information on use of strategies: naps, caffeine, etc.
- No recommendations on specific personal strategies

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Example: NASA Planned Rest Study

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Changing Safety Culture

Safety goal . . .

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