



# National Transportation Safety Board

## Managing Fatigue in Aviation Ops: An NTSB Perspective

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# NATIONAL TRANSPORTATION SAFETY BOARD

- 1) determining the probable cause of transportation accidents**
- 2) making recommendations to prevent their recurrence**





# All Modes

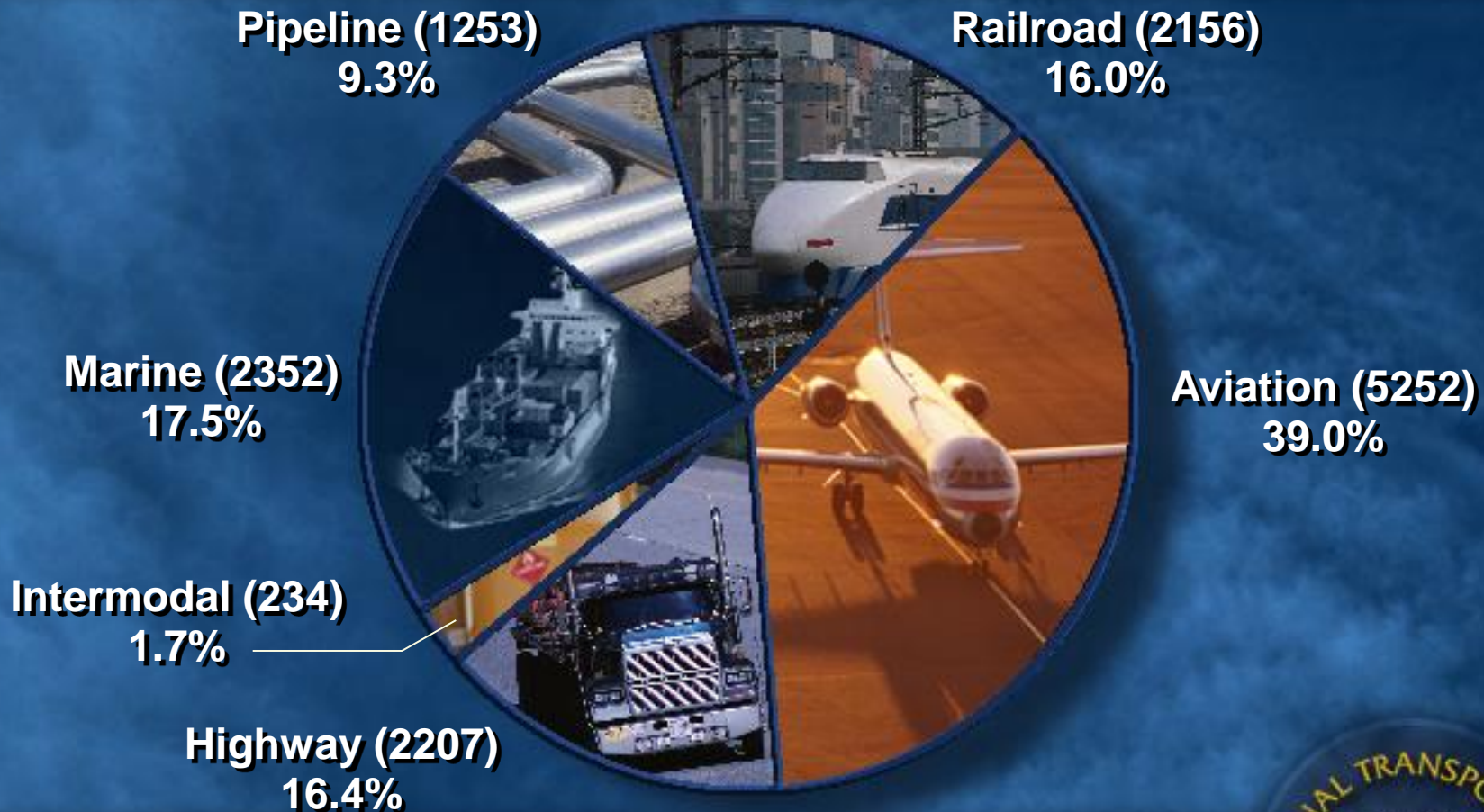


# Independent Federal Agency: Created in 1967

- ~ 132,000 accident investigations
- 13,500+ safety recommendations
- ~ 2,500 organizations/recipients
- 82% acceptance rate



# 13,454 Safety Recommendations issued since 1967



# NTSB Characterized as:

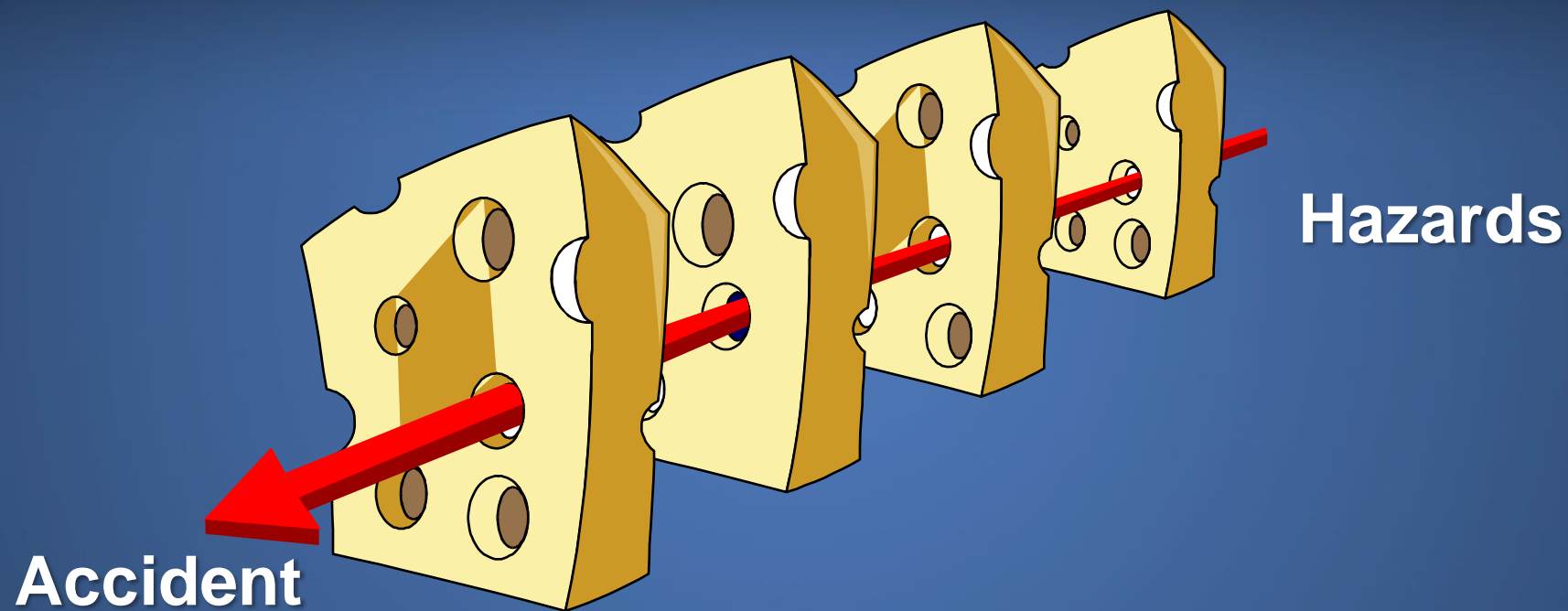
‘moral compass and industry conscience’

NTSB Chairman Deborah A.P. Hersman



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# “Swiss Cheese” Model (Reason)



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  $\neq$   
Safe Operation



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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

First NTSB aviation accident investigation  
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...”



# Owatonna, MN (July 31, 2008)



8 fatalities



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# Probable Cause/Contributing Factors

“Contributing to the accident were . . .  
(2) fatigue, which likely impaired both  
pilots’ performance; . . .”



# 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





# Challenges of a 24/7 Society



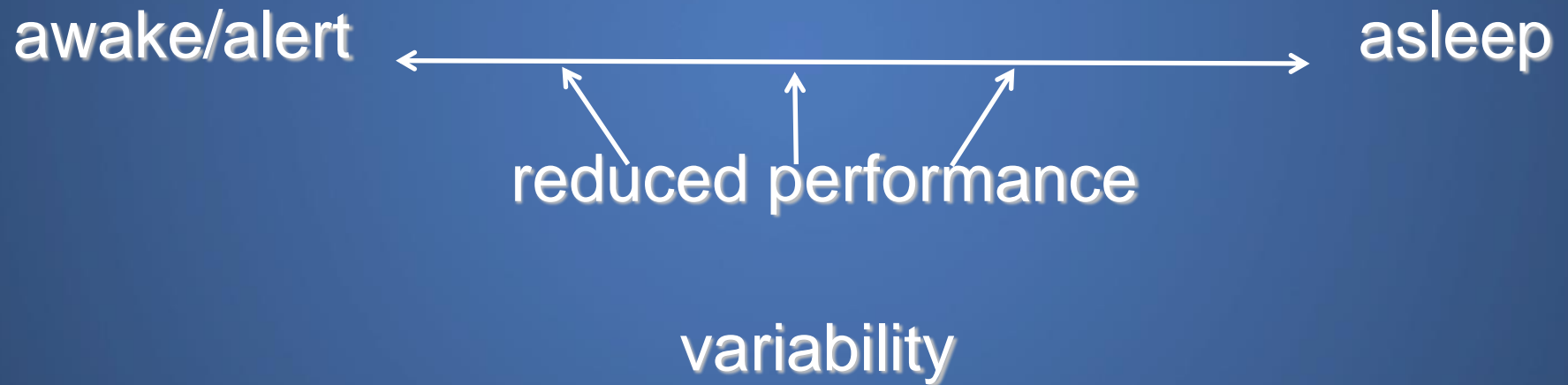
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# Fatigue Risks

Fatigue can degrade  
every aspect of  
human capability.



# Fatigue Risks

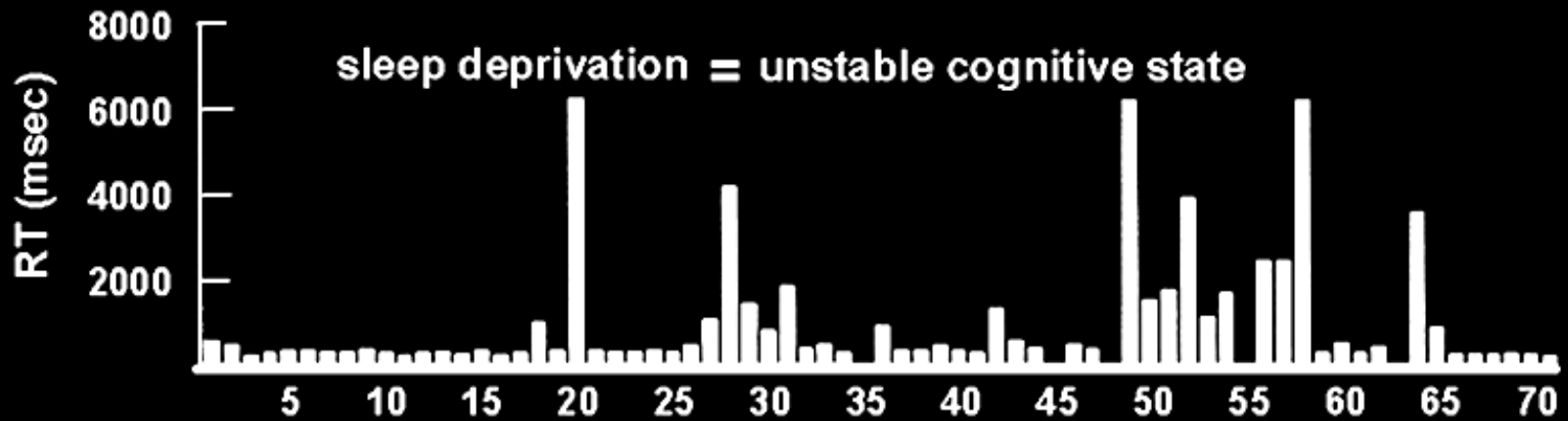
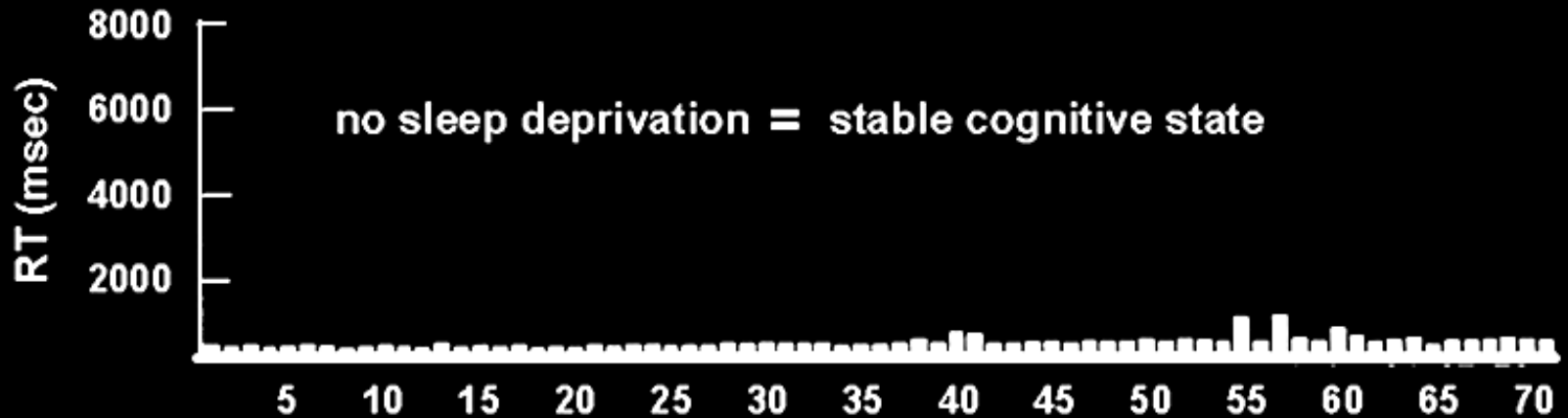


# Fatigue Risks

- degraded 20 – 50%+:
  - reaction time
  - memory
  - communication
  - situational awareness
  - judgment
  - attention
  - mood
- increased:
  - irritability
  - apathy
  - attentional lapses
  - microsleeps



# Fatigue and Reaction Times



consecutive RTs across a 10-min PVT performance task

# Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders

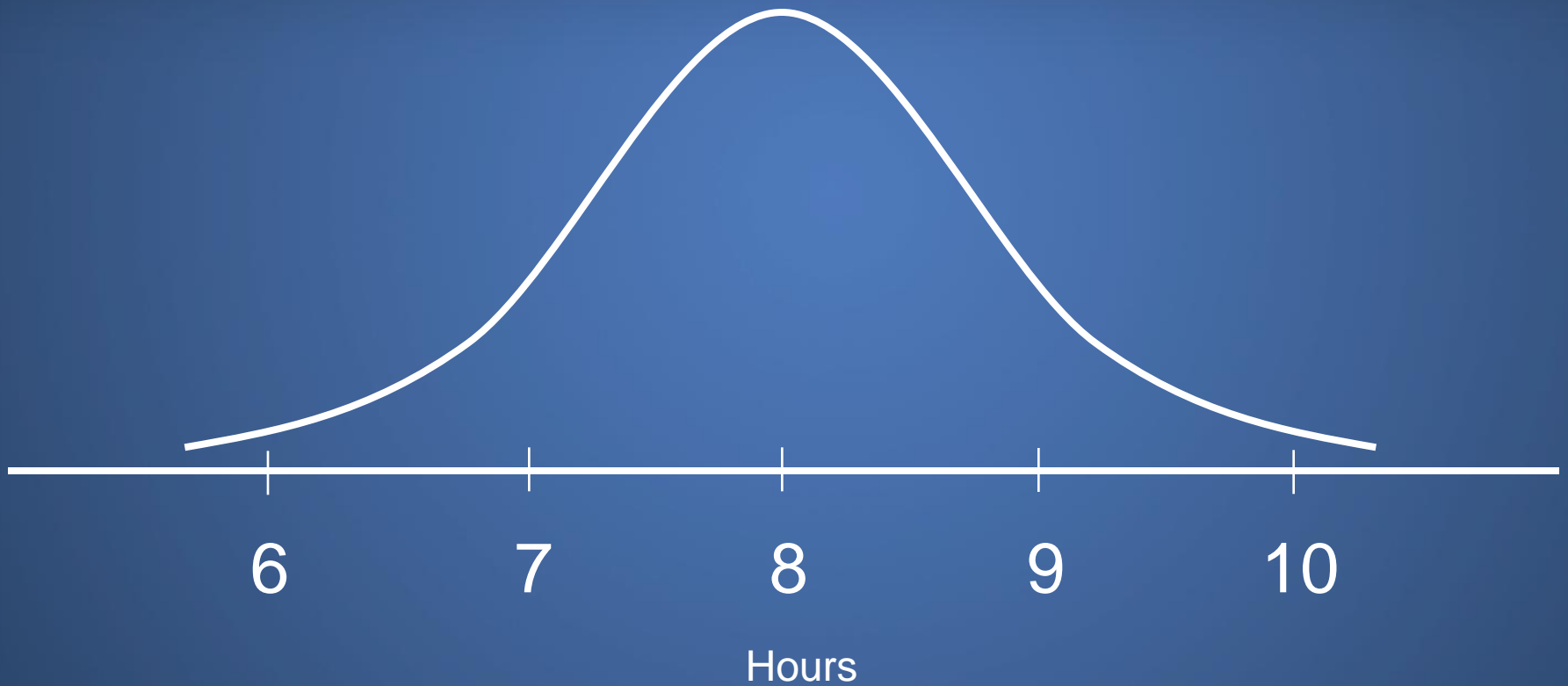


# Fatigue Factors

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

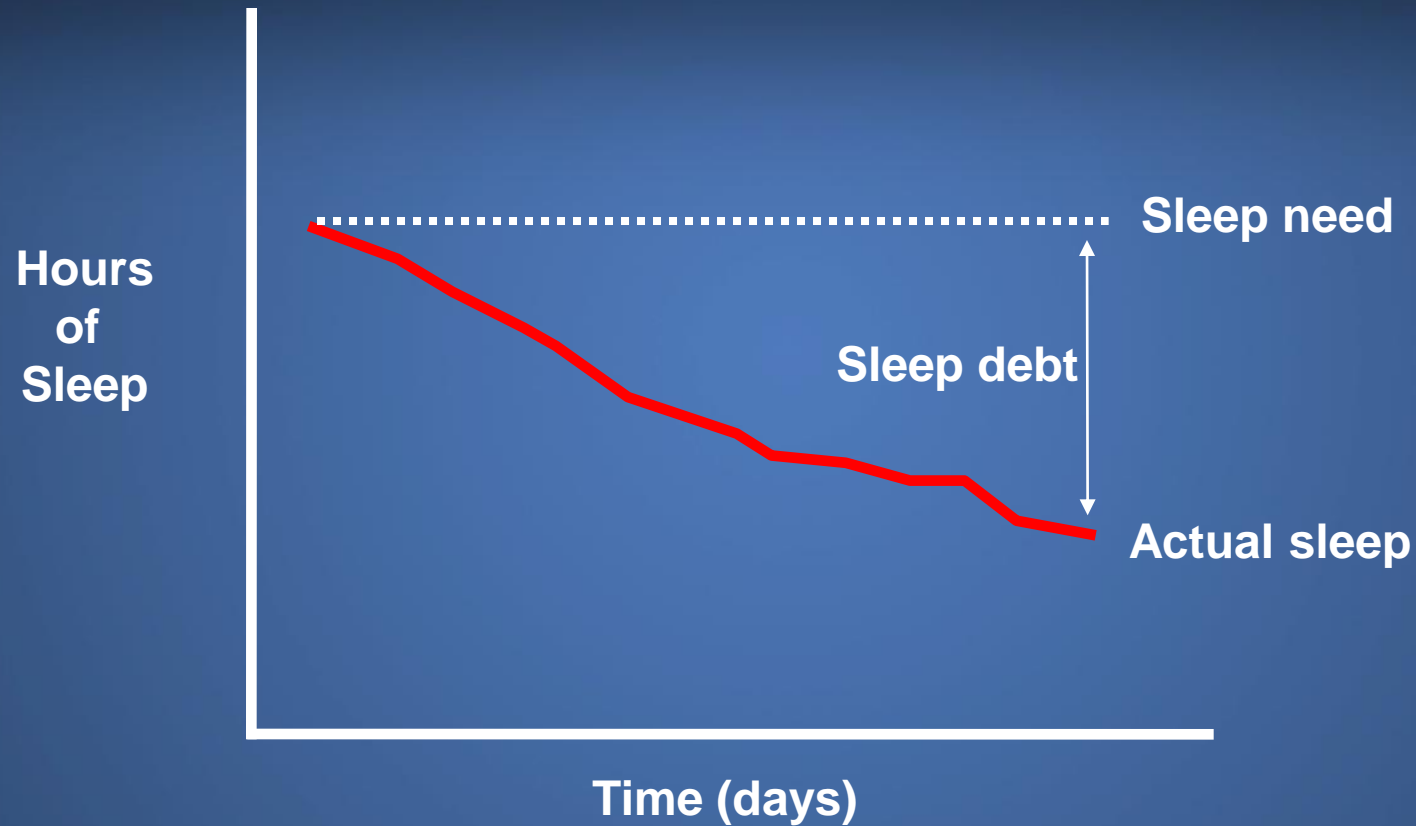


# Sleep Requirement





# Cumulative Sleep Debt



Sleep Need – Actual Sleep = Sleep Debt

Sleep debt grows cumulatively over time



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# Fatigue Factors

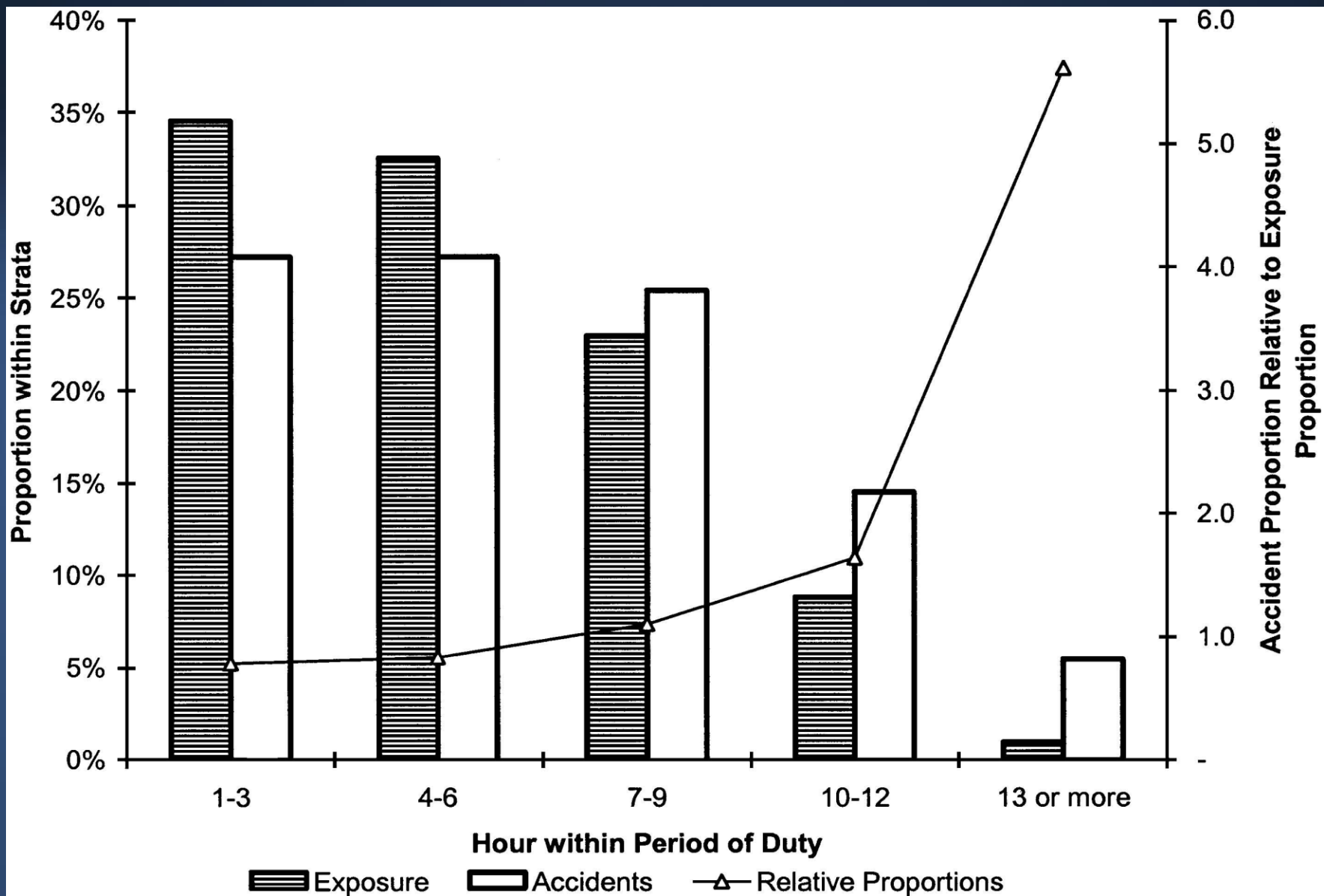
- sleep
- circadian clock
  - 'sleepy' windows
  - 'alert' windows
  - irregular schedule
  - time zones
- hours awake
- sleep disorders



# Fatigue Factors

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





# Fatigue Factors

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



# Sleep Apnea is a Safety Risk

- > 6 times increased risk for car crash
- SA performance = .06 - .08 BAC

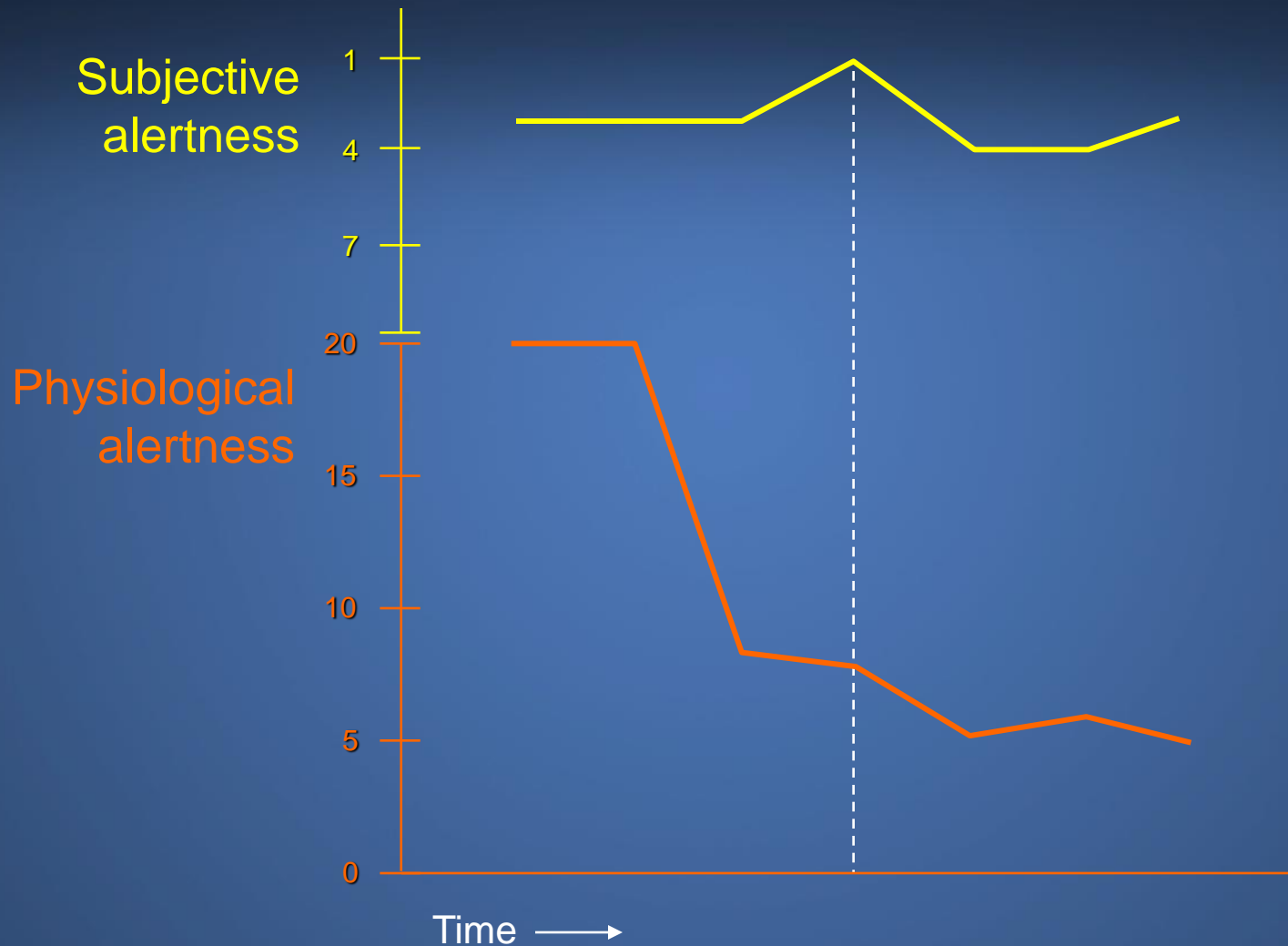


# Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders



# Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986



# NTSB Safety Recommendations: Fatigue

- 40 years ago: May 10, 1972
- “Revise FAR 135 to provide adequate flight and duty time limitations.” (A-72-55)
- Classified “Closed-Unacceptable”





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



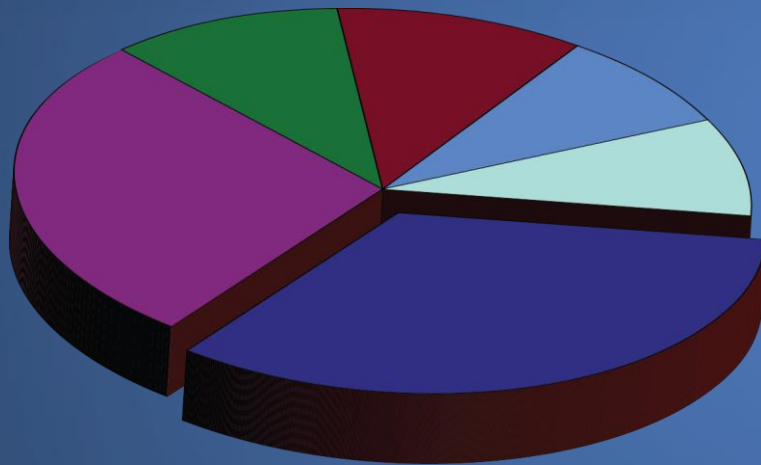
# NTSB Recommendations

- MOST WANTED since 1990
- ~200 fatigue recommendations



# Complex Issue:

## Requires Multiple Solutions



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



# 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



# NTSB Recommendations: Education/Strategies

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



# Example: NASA Planned Rest Study



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# Manage Fatigue = Enhance Safety

- Culture change
- Get educated
- Acknowledge
- Act!





Good sleep, safe travels.



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