

Human Factors: Education or Thought Control

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Inspection Authorization Renewal
Hinds Community College – Aviation Department
March 3, 2007



Federal Aviation
Administration



**Maybe we all need
some “thought
control?”**

What is in it for you?

**Most of our errors are in thinking rather than
lack of knowledge.**

**Think about your actions that may lead to
error.**

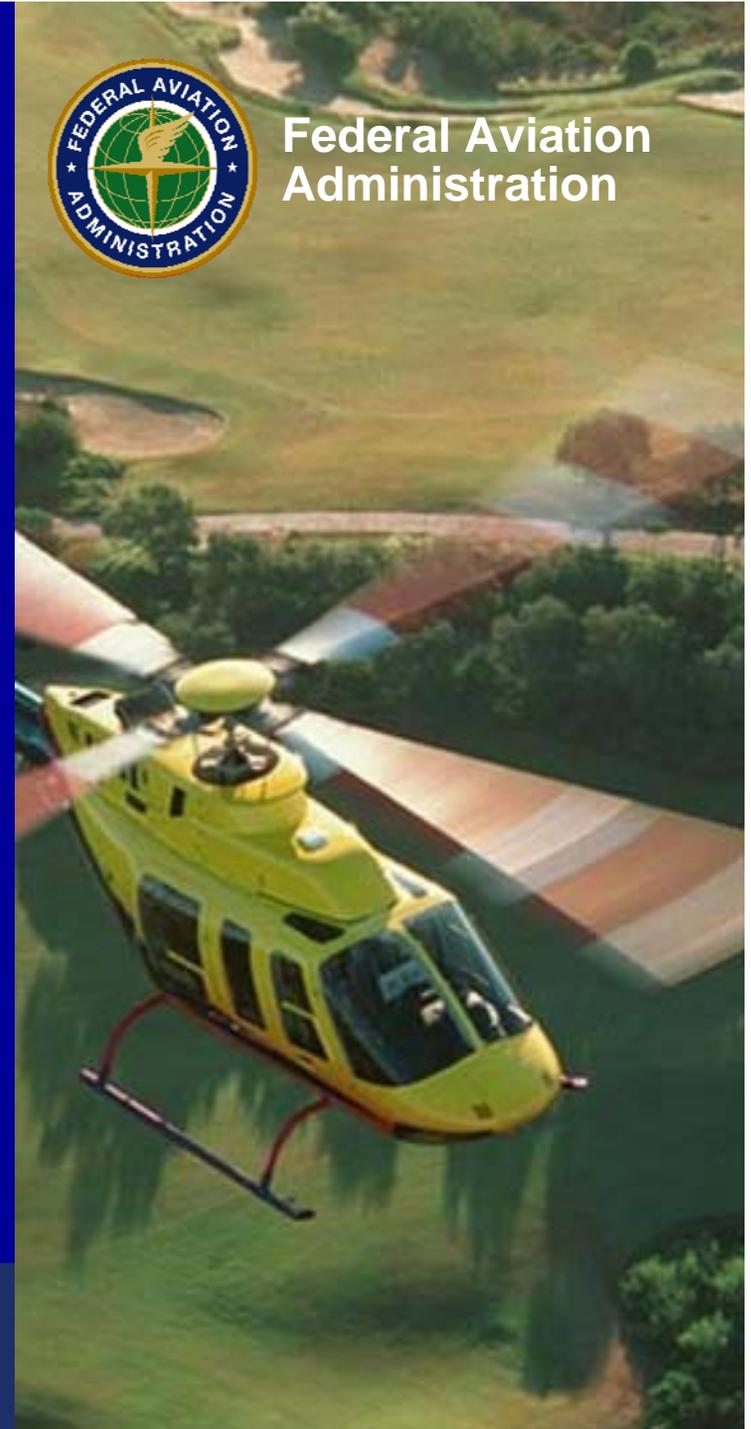
Save time and money?

Apply principles to life.

Inspection Authorization Renewal
Hinds Community College – Aviation Department
Raymond, MS
March 21, 2007

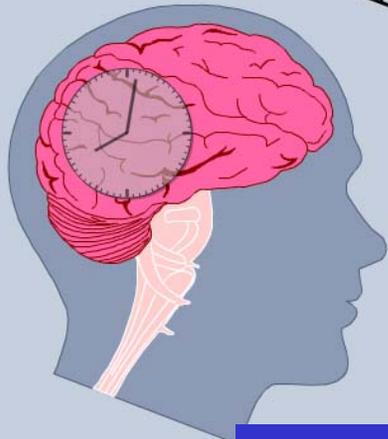


**Federal Aviation
Administration**



Timing is everything!

Presentation Time!!



Nuclear powerplants of Chernobyl in Russia
Three-Mile Island in the U.S.



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Technical Training, www.ltthf.com

[Link](#)



Presentation Plans

- Speak in straight forward terms
- Reinforce your current knowledge
- Offer new concepts and/or new ways to explain old concepts
- Provide links for more information
- Have a few laughs?



Put on your “Human Factors Spectacles”



But first, look at the “Person in the mirror”



Agenda

Safety Data with Human Factors Implications

Human Factors Fundamentals and Review

Break

Human Factors Fundamentals and Review

Operator's Manual for HF in Aviation Maintenance

Optional

2007 FAA Human Factors Activities



Agenda

Safety Data with Human Factors Implications

Human Factors Fundamentals and Review

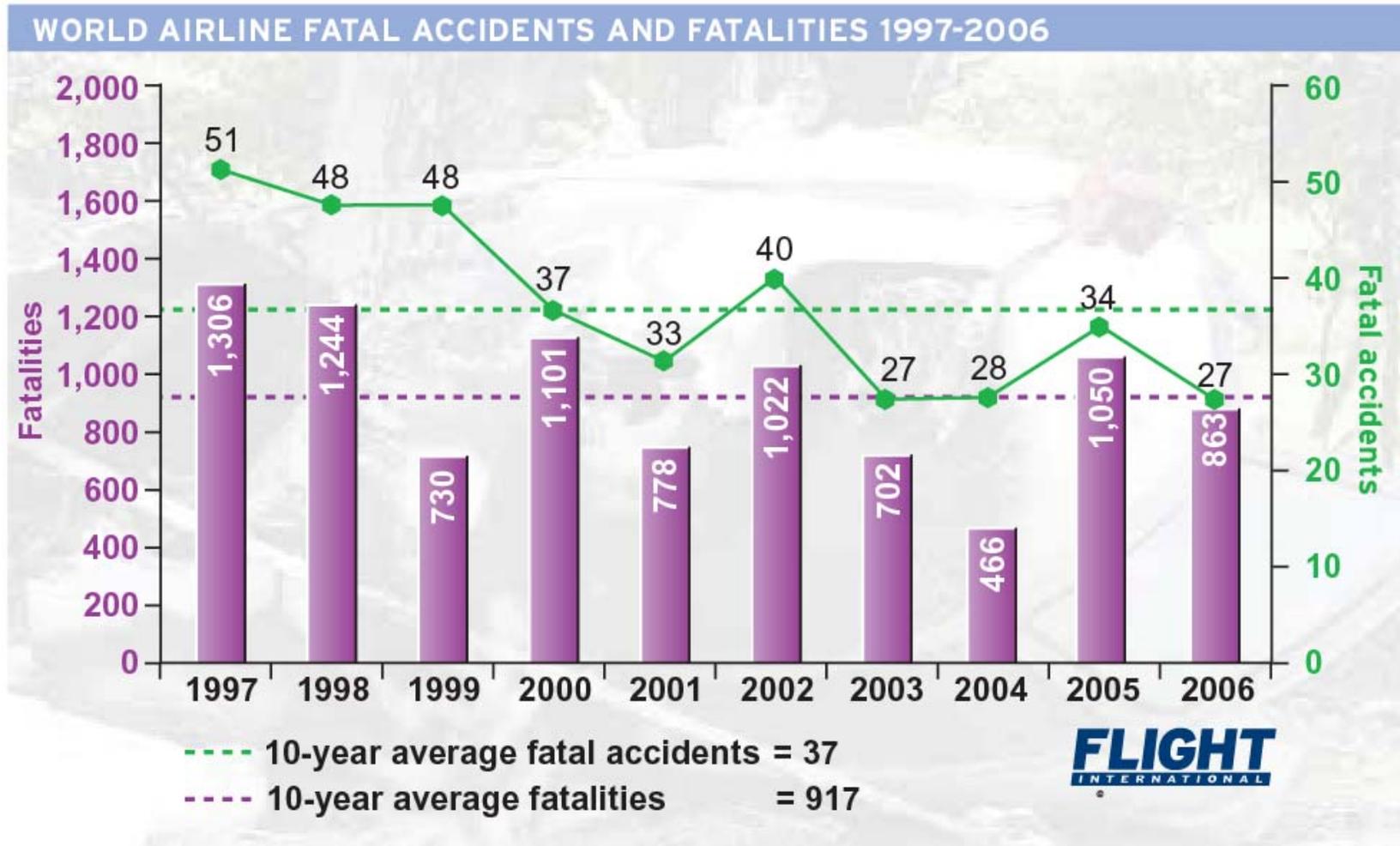
Human Factors Fundamentals and Review

Operator's Manual for HF in Aviation Maintenance

2007 FAA Human Factors Activities

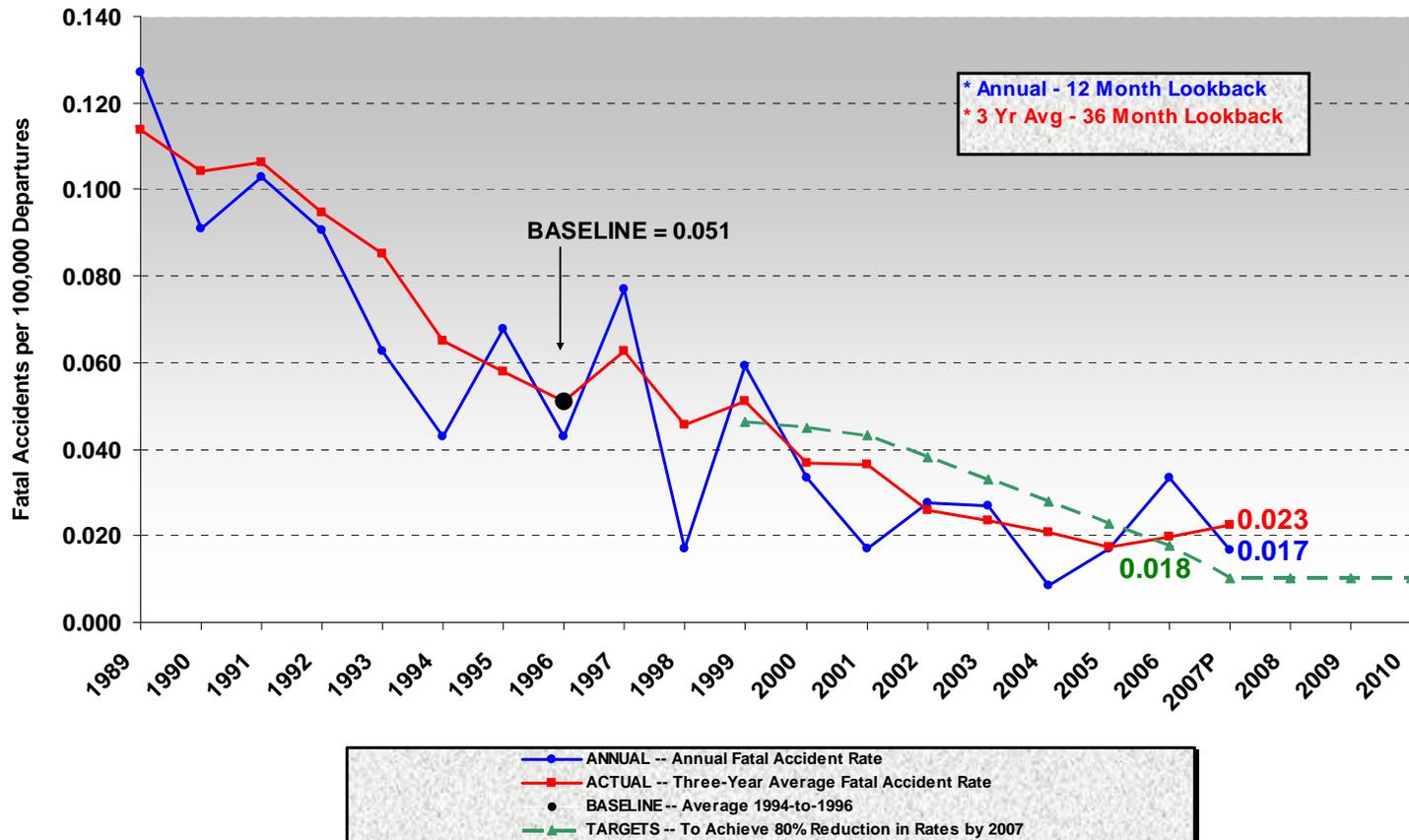


World Airline Accidents and Fatalities 1997-2006



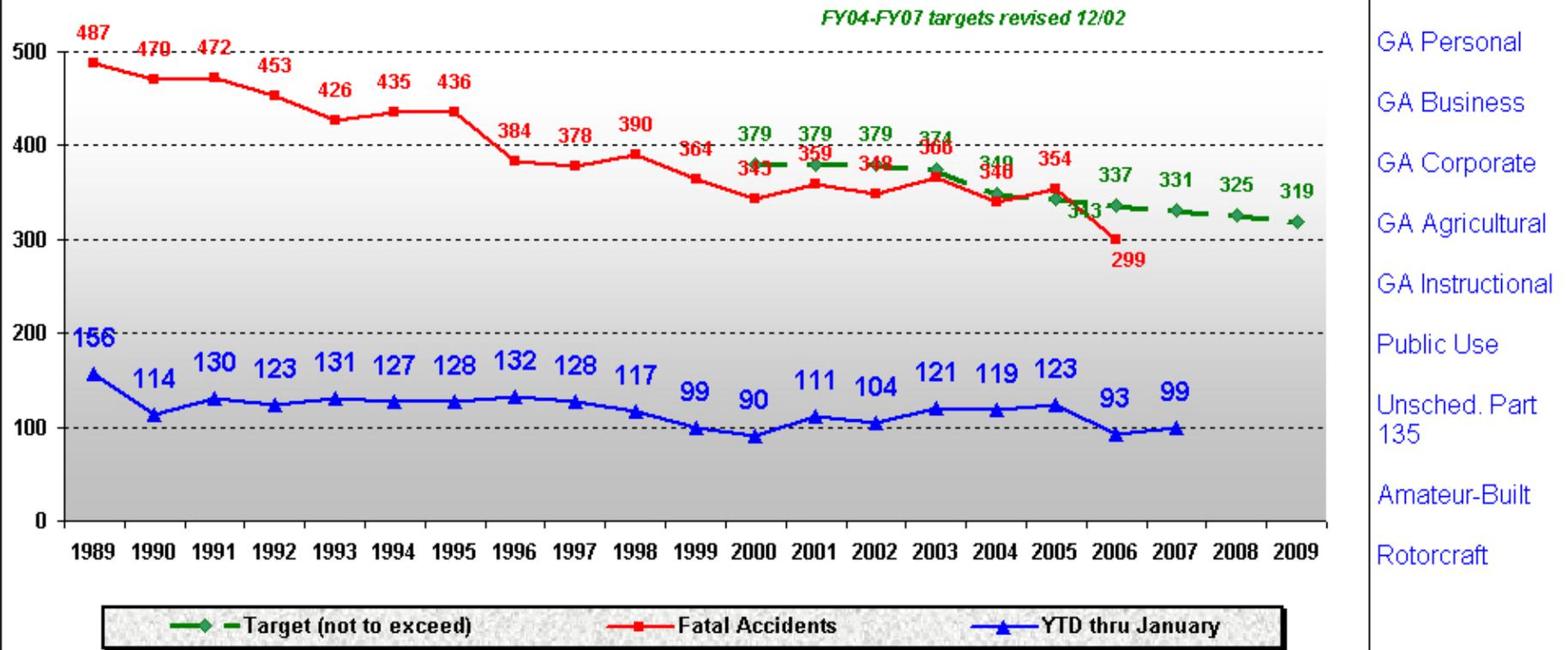
US Air Carrier Accident Rates/Targets

COMPARISON of AIR CARRIER FATAL ACCIDENT RATES/TARGETS
 (Air Carrier includes all Part 121 and Scheduled 135 Carriers)
 FY 2007 (as of January)



GA Fatal Accidents

COMPARISON of GENERAL AVIATION FATAL ACCIDENTS/TARGETS
(General Aviation includes General Aviation and Unscheduled Part 135)



- GA Personal
- GA Business
- GA Corporate
- GA Agricultural
- GA Instructional
- Public Use
- Unsched. Part 135
- Amateur-Built
- Rotorcraft

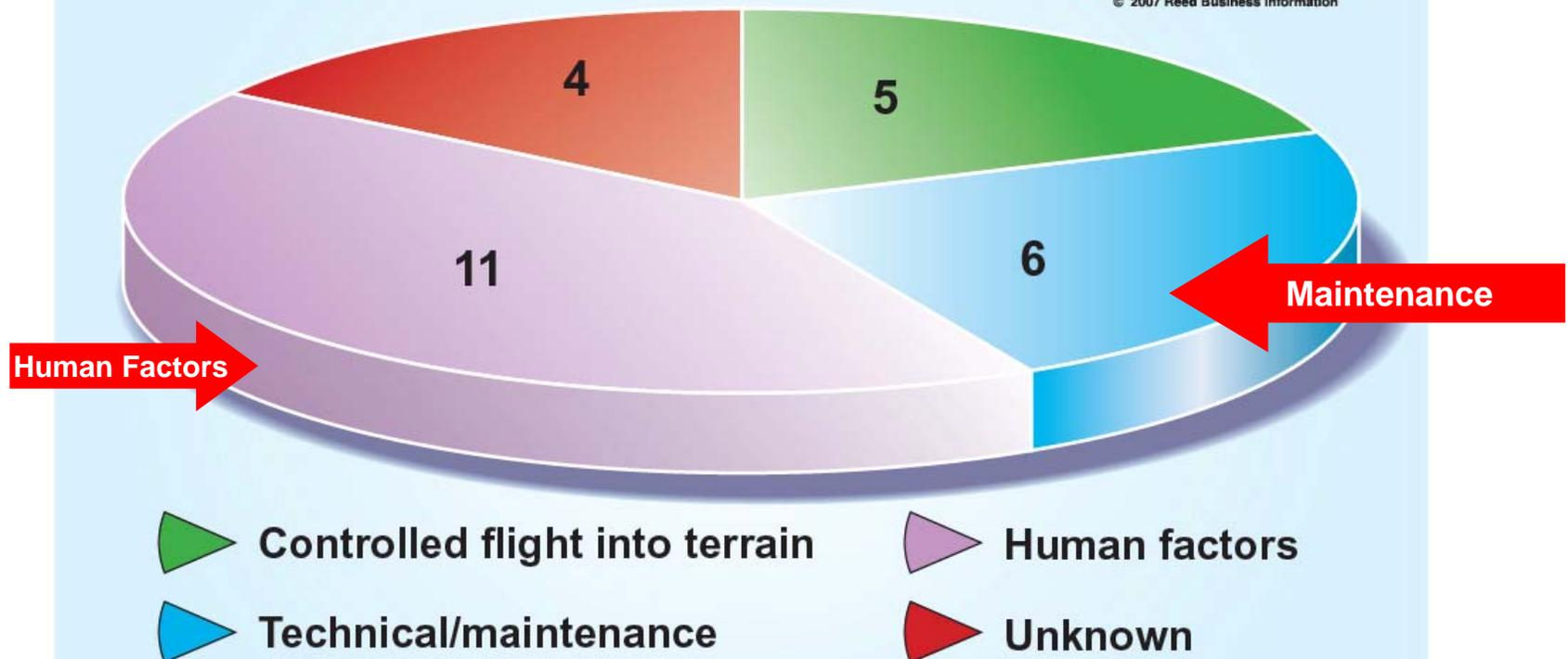


Human Factors #1 Causal Factor

FATAL AIRLINE CRASHES BY ACCIDENT CATEGORY/ MAIN CAUSAL FACTOR

Number of accidents

FLIGHT
INTERNATIONAL
© 2007 Reed Business Information



Implications of the 2005-2006 Safety Stats for Mx HF

- **There are “opportunities for improvement”**
- **Maintenance and technical issues are areas of concern**
- **Technical manuals!!**
- **Human factors challenges are ever present**



Agenda

Safety Data with Human Factors Implications

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2007 FAA Human Factors Activities



Tiger Woods takes golf lessons



Mx Human Factors has evolved in 20 years!



Events where Maintenance was a Factor

American Airlines DC-10	1979
Eastern Airlines L1011	1982
Aloha Airlines B737	1988
United Airlines DC-10	1989
Continental Express EMB120	1994
Northwest Airlines	1995
Valu-Jet DC-9	1995
Lufthansa A320	2001

INTRODUCTION TO HUMAN

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[Link](#)

Example Maintenance Error

Jan 2000	Alaska Airlines	Boeing MD-80	Jackscrew for Elevator Control
Mar 2001	Lufthansa Airbus	A320	Mis-wired side stick
Apr 2001	Emery Worldwide	DC-8	Reversed hyd. check-valve
Aug 2001	Air Transat	A310	Fuel exhaustion over Atlantic
May 2002	China Airlines	B747-200	In flight break-up at 35K Ft.
Jan 2003	Air Midwest	Beech1900D	Trim Rigging
Aug 2003	Colgan Air	Beech 1900D	Trim Rigging
Jan 2006	Continental	B737-500	Engine Run-up
July 2006	Spectrum Aircraft	Spectrum 33	Mis-Rigging

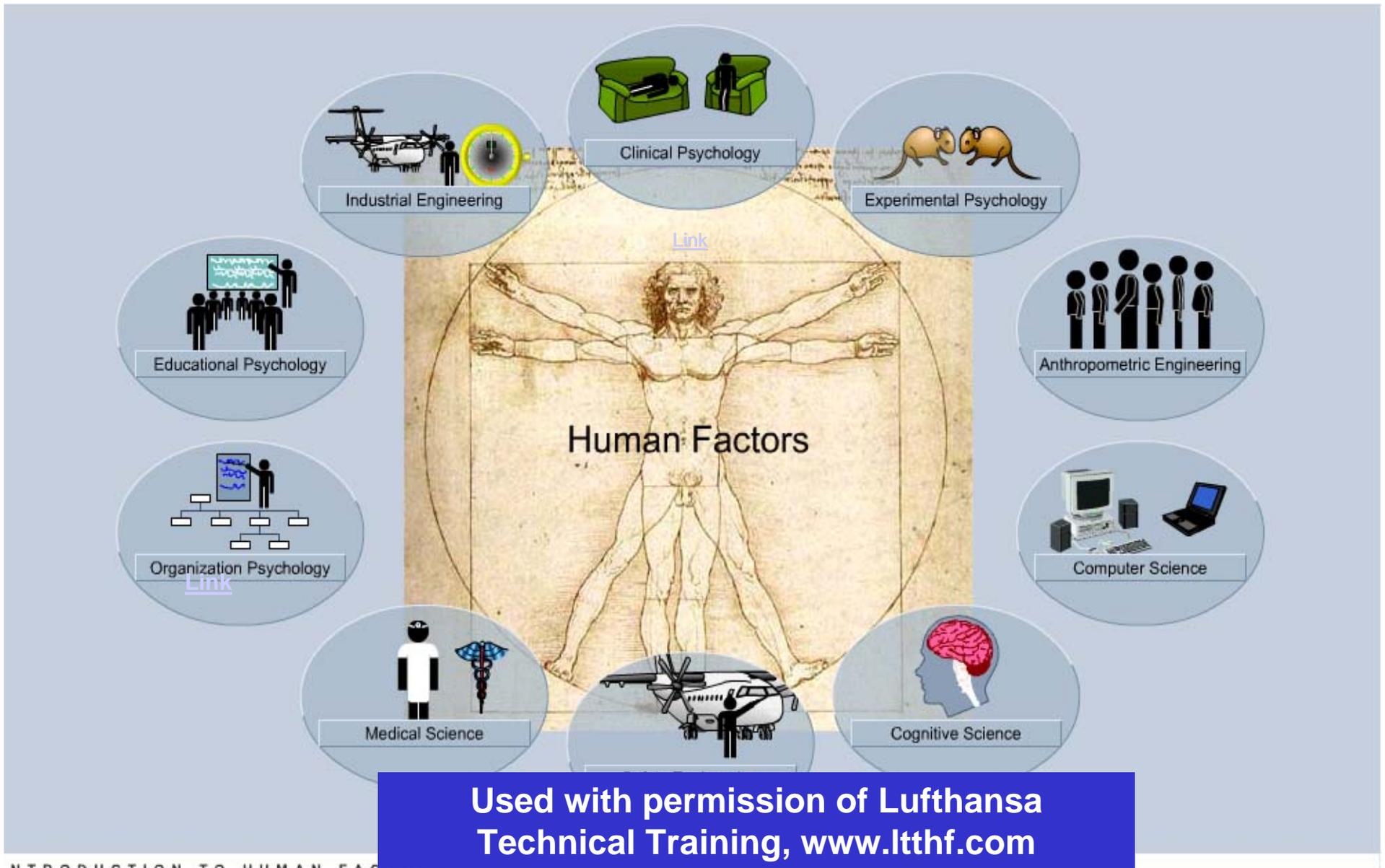


List “Human Factors” related to maintenance?

HUMAN FACTORS



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Technical Training, www.ltthf.com



The PEAR MODEL

A photograph of a single pear, showing its characteristic shape and color gradient from green at the bottom to yellow and red at the top. The pear is positioned vertically and casts a soft shadow to its right. Overlaid on the left side of the pear is the acronym 'PEAR' in a bold, black, sans-serif font. Each letter of the acronym is underlined with a short horizontal line.

People
Environment
Actions
Resources

Maddox & Johnson, 1996

[Link](#)

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Raymond, MS
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Federal Aviation
Administration



PEAR





PEOPLE



Physical Factors

- Physical size
- Gender
- Age
- Strength
- Sensory limitations

Physiological Factors

- Nutritional factors
- Health
- Lifestyle
- Fatigue
- Chemical dependency

Psychological Factors

- Workload
- Experience
- Knowledge
- Training
- Attitude
- Mental or emotional state

Psychosocial Factors

- Interpersonal conflicts
- Personal loss
- Financial hardships
- Recent divorce



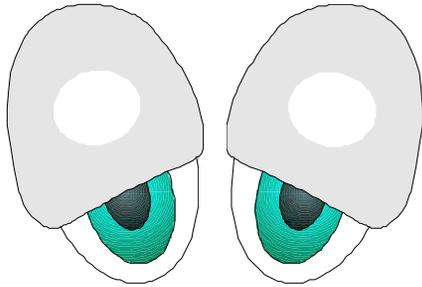
Can a machine do this job?



**People
Environment
Actions
Resources**

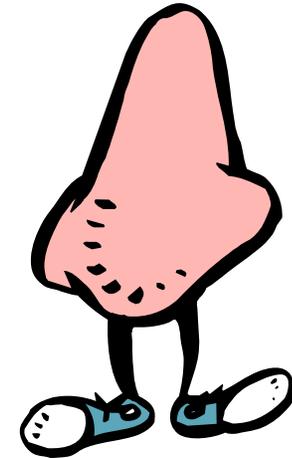


Sensing and Perception



Human Senses

Human Factors
Human Factors
Human Factors



How to Remember the 5 Senses



A Test / Example of.....(Volunteer Needed)

As quickly as possible, say the color of each word on the screen.



desk

rock

cat

spoon

book



dog

house

table

car

tree



red

blue

gray

purple

green



What is this?

IB



What is this now?

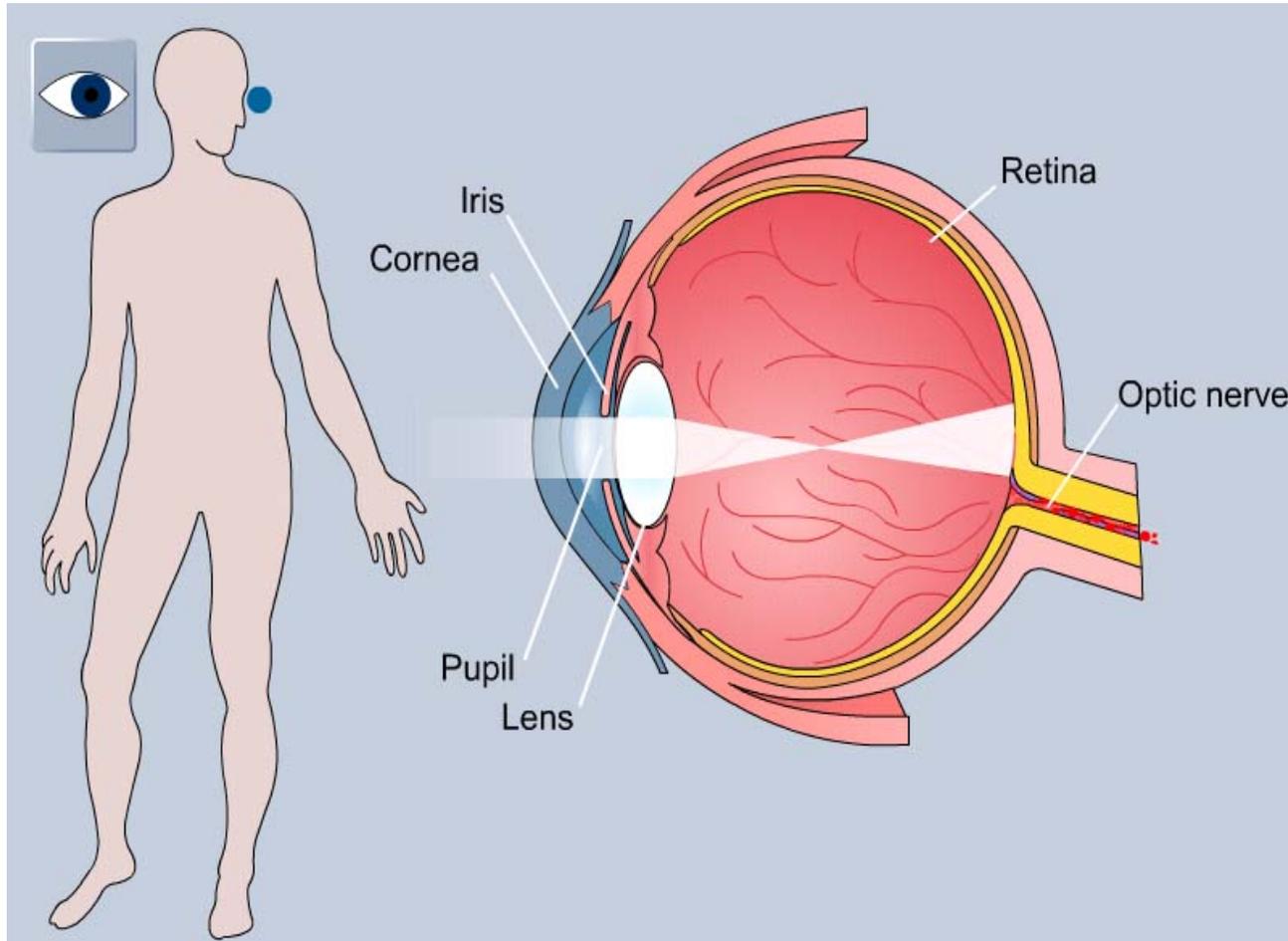
A, B, C, D, E, F
10, 11, 12, 13, 14

Both the letter “B” and the number “13” are the same figure. However, the context determines how you perceive them.

(Coren, et al, (1994), Sensation and Perception, Harcourt Brace College Publishers)



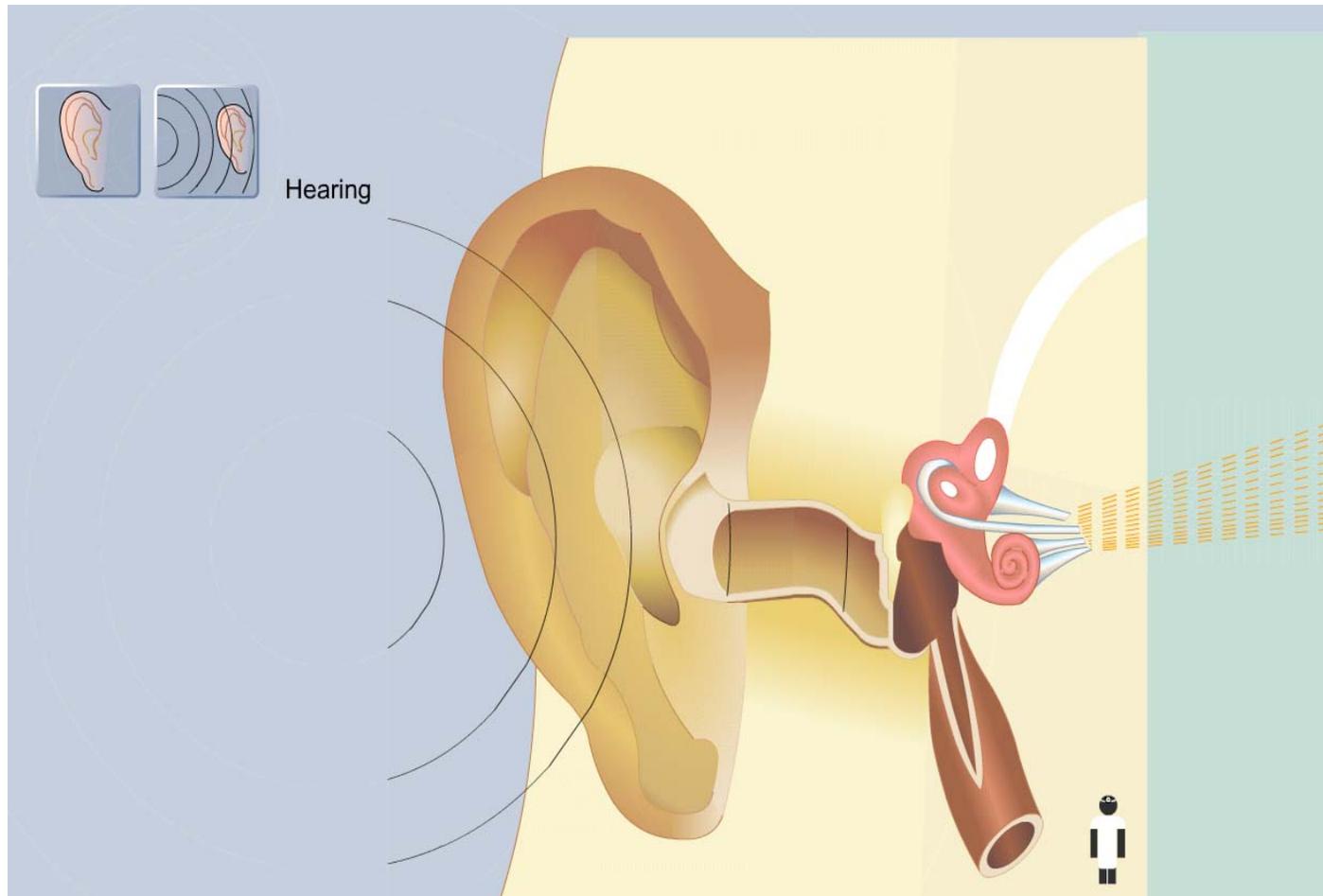
Seeing



[Link](#)

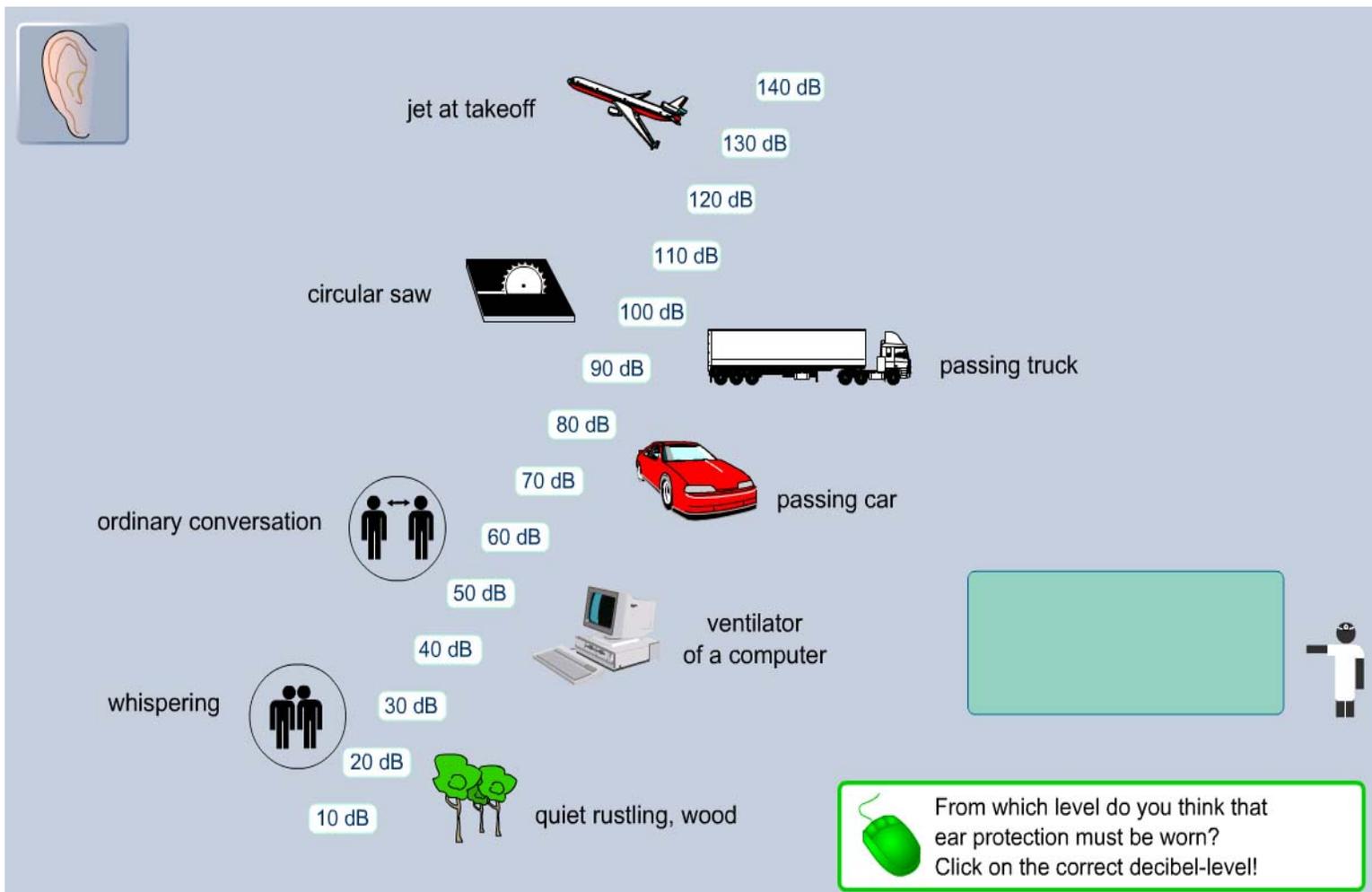


Hearing



[Link](#)

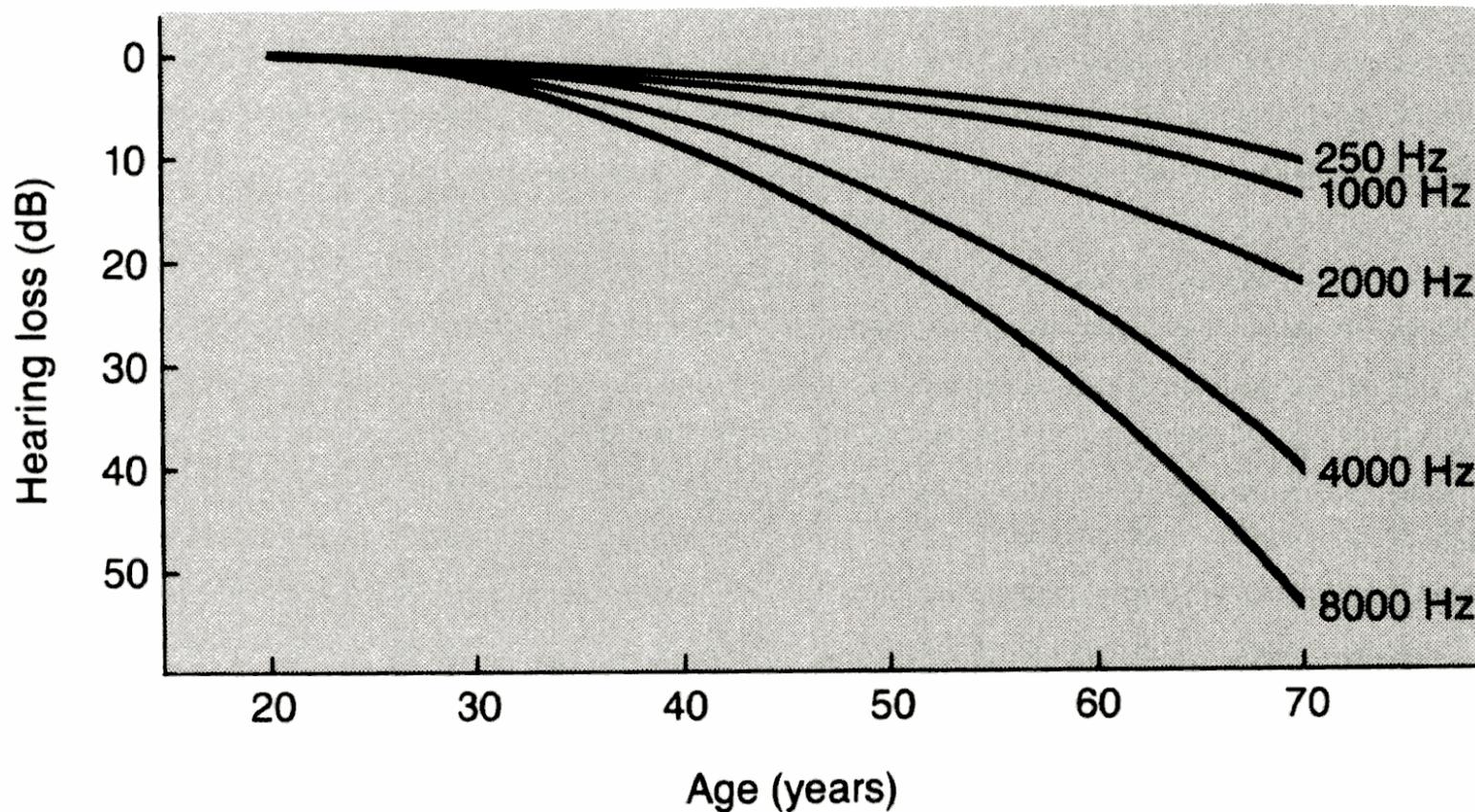
Safe Sound Levels



[Link](#)



Mother Nature is Cruel ☹️



Ability to hear stimuli, especially in the high ranges, decreases with age. (McFarland et al. (1960), *Journal of Gerontology*, 15, 149-154)

What does this mean?



Link



The Fatigue Issue is not New!

“O sleep, O gentle sleep, Nature’s soft nurse”

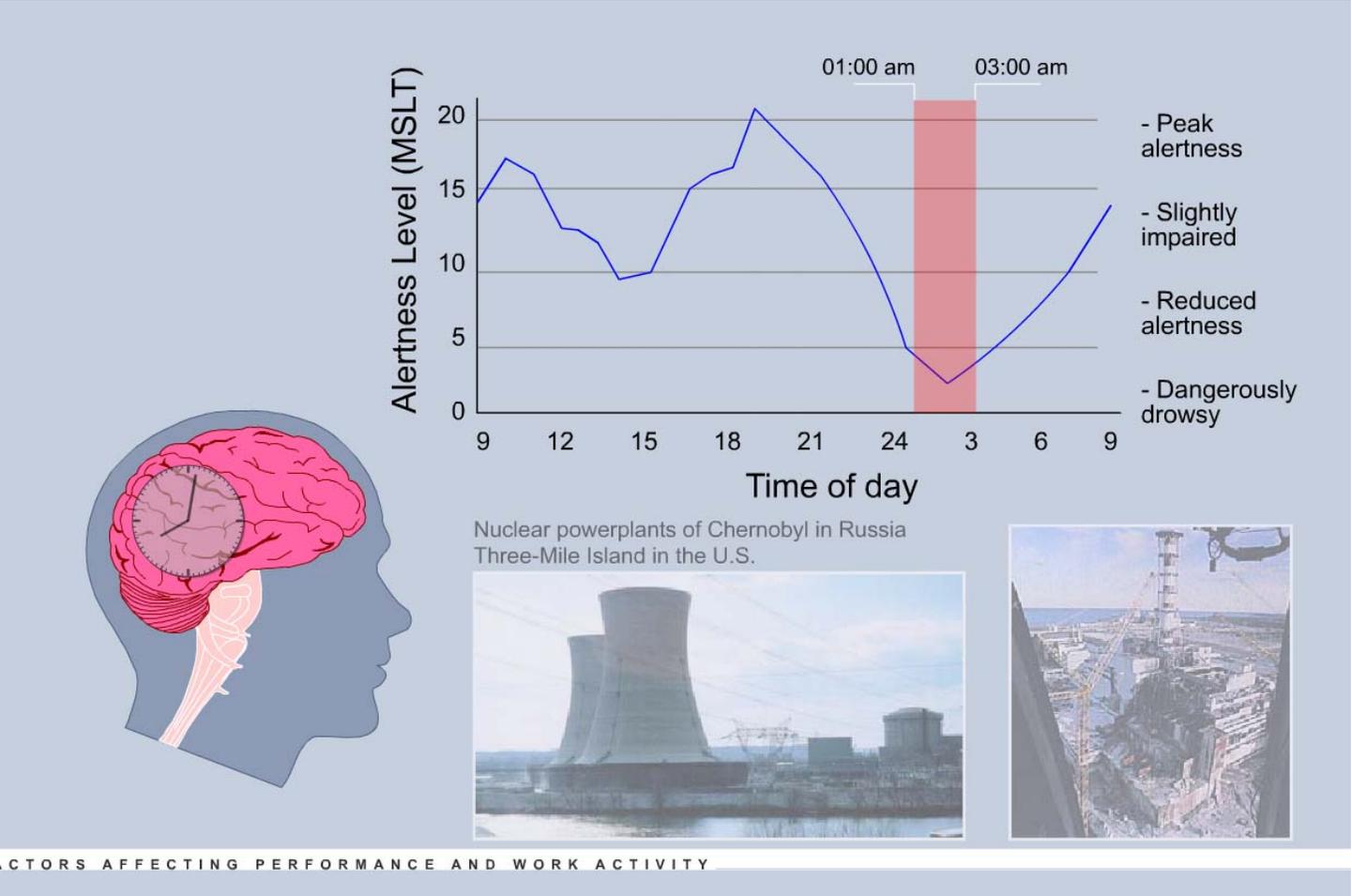
William Shakespeare



1564-1616



Bad Things can happen when not alert!



[Link](#)



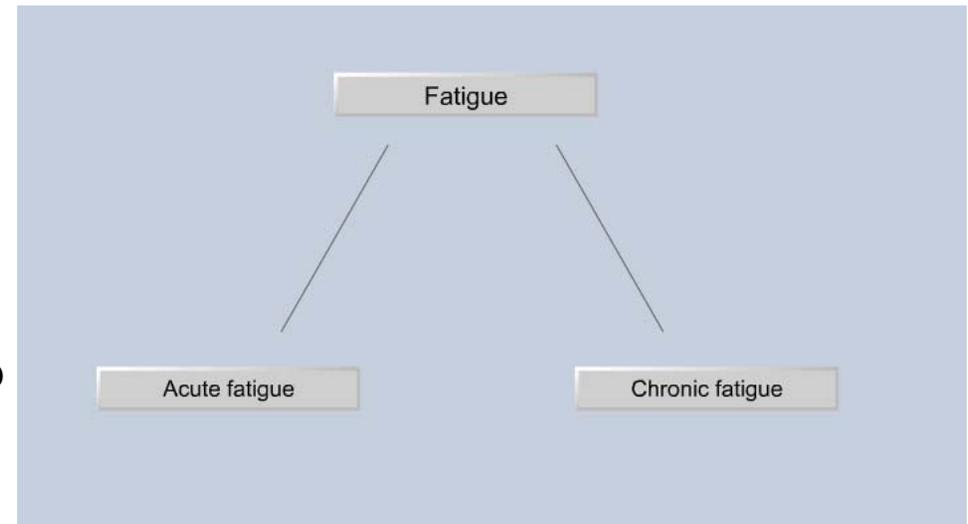
Types of Fatigue

Acute Fatigue

Intense

Short Duration

Cured with a good night's sleep



Chronic Fatigue (harder to fix)

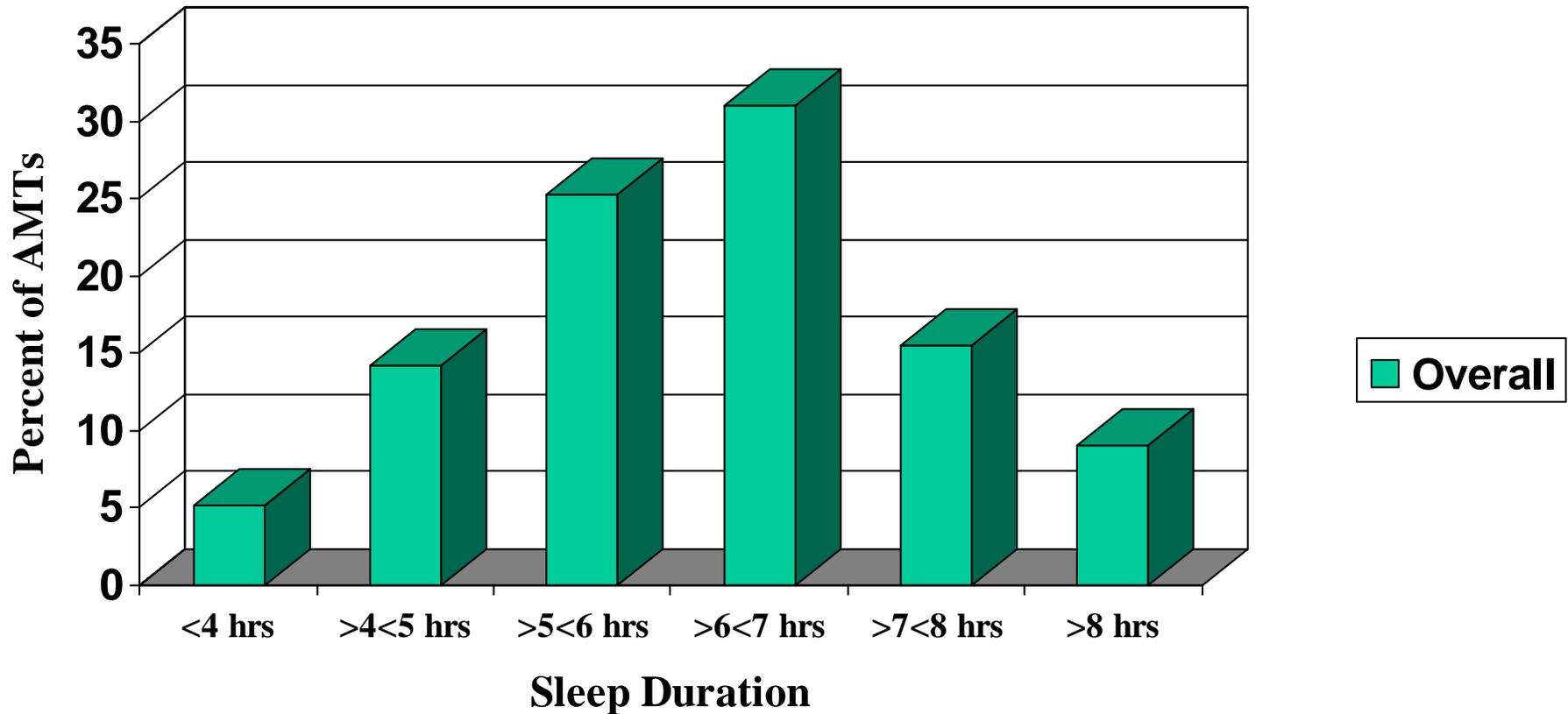
Frequent recurrence

Long duration

Slow recovery

Often a physical sickness or mental stress causing chronic fatigue.

Percent of AMTs from All Shifts by Sleep Duration



Johnson, et al, 2001



An Excellent Website about Sleep

National Sleep Foundation
Waking America to the Importance of Sleep®

SEARCH
E-NEWSLETTER SIGN UP

Get Involved | Donate Now | Sleep Shop | Press Room | En Español | Find a Sleep Center | E-Newsletter | Text Size + -

RESOURCES

- ▶ Topics: A to Zzzzs
- ▶ How Sleep Works
- ▶ Sleep for All Ages
- ▶ NSF Programs & Initiatives
- ▶ Events and Activities
- ▶ Tools and Quizzes
- ▶ Press Room
- ▶ Sleep Shop
- ▶ DrowsyDriving.org
- ▶ SleepforKids.org

Especially For:

Are You Getting Good Sleep? [Click here to find out >>](#)

▶ 1 2 3

ALL ABOUT SLEEP

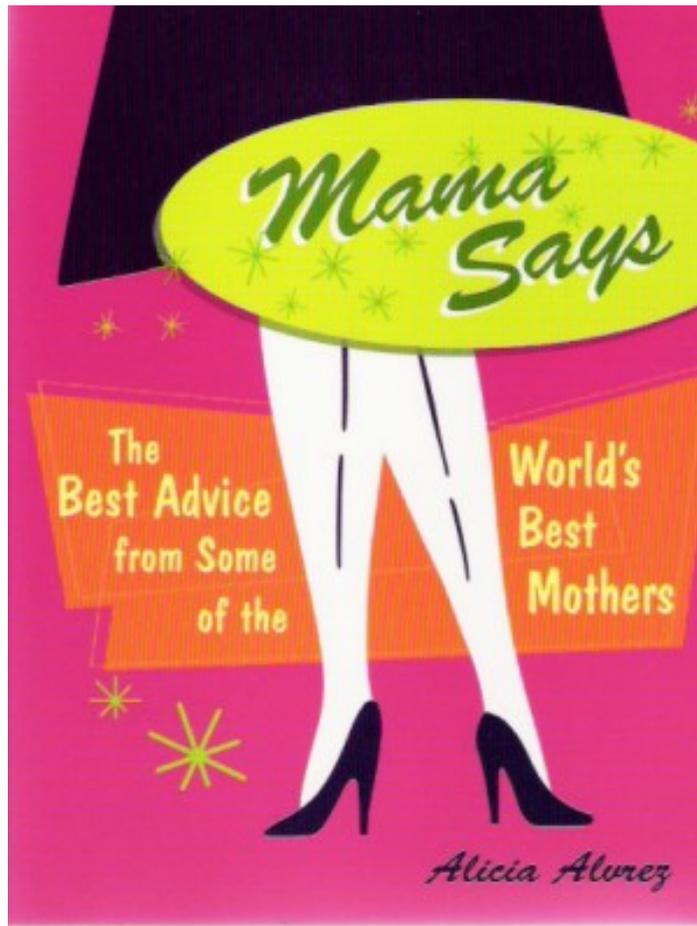
- AM I GETTING GOOD SLEEP?
- DO I HAVE A SLEEP DISORDER?
- WHY IS SLEEP IMPORTANT?
- SLEEP FOR ALL AGES
- HOW CAN I GET INVOLVED?

FEATURES

- ★ Get an Official Sleep Challenge T-Shirt or Door Hanger!
- ★ National Sleep Awareness Week®



Regarding sleep: Do what your mama told you.



Agenda

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Human Factors Fundamentals and Review

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2007 FAA Human Factors Activities





PEAR





Environment



Physical

- Weather
- Location inside/outside
- Workspace
- Shift
- Lighting
- Sound level
- Safety

Organizational

- Personnel
- Supervision
- Labor-management relations
- Pressures
- Crew structure
- Size of company
- Profitability
- Morale
- Corporate culture



Can you List Some Environmental Risks & Preventions?

- Stories?
- Examples?
- What did you do about it?
- What are you going to do about it?
-
-
-





Actions



Steps to perform a task
Sequence of activity
Number of people involved
Communication requirements
Information control requirements

Knowledge requirements
Skill requirements
Attitude requirements
Certification requirements
Inspection requirements



A Couple of Slides to Help Understand Error



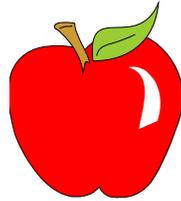
"To minimize error, it is necessary to understand error."

HUMAN ERROR

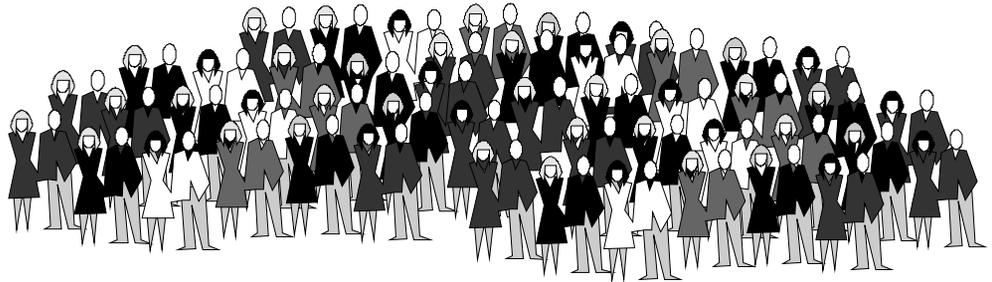


The Greatest Hazard to Aircraft is?

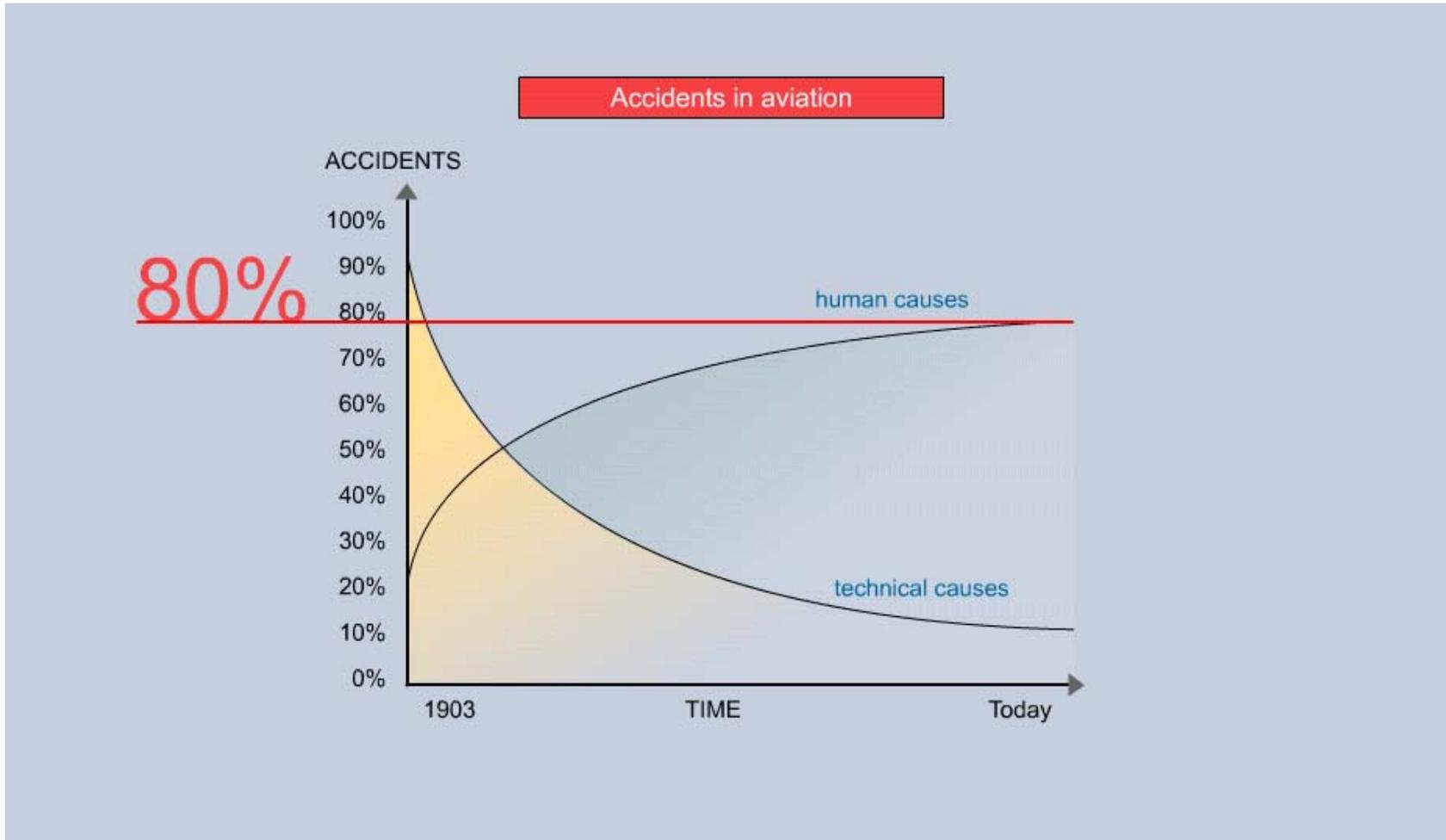
Gravity



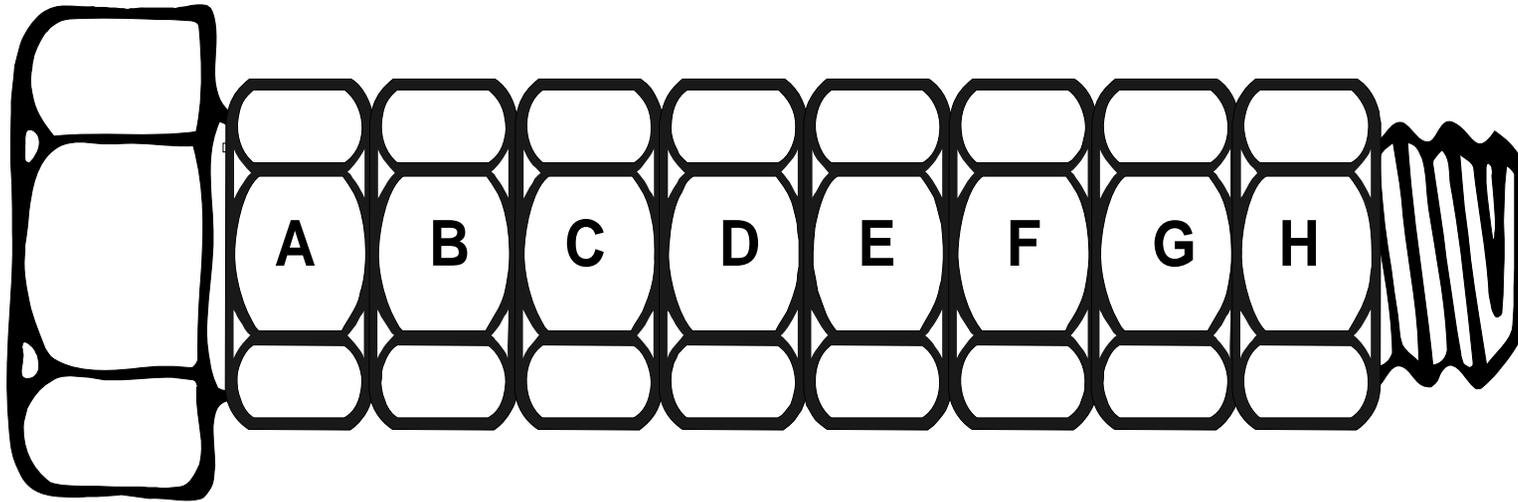
Humans



The 80% Human Error in Events!



High Chance of Error



- **Only One way to disassemble**
- **40,000+ ways to error in reassembly!**

Thanks to Prof. J. Reason

Error Definitions

Definitions of Error

unintentionally

intentionally

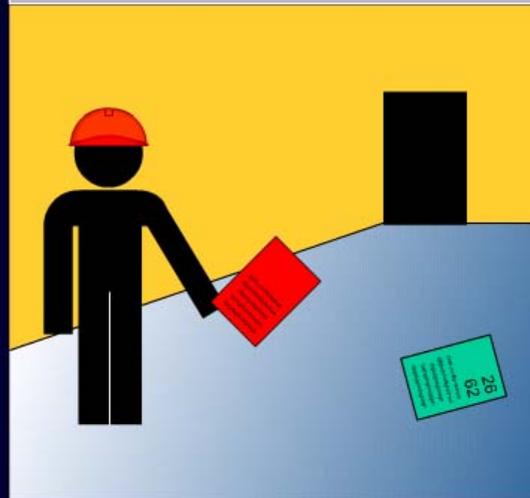
SLIP

A slip is merely a good plan poorly executed.



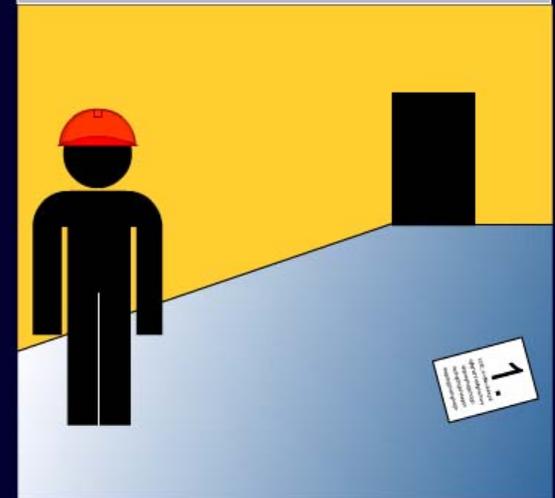
MISTAKE

A mistake is a "bad plan."



VIOLATION

A violation is a very serious mistake.



Active and Latent Error: An Important HF Concept

|Different kinds of ERROR|

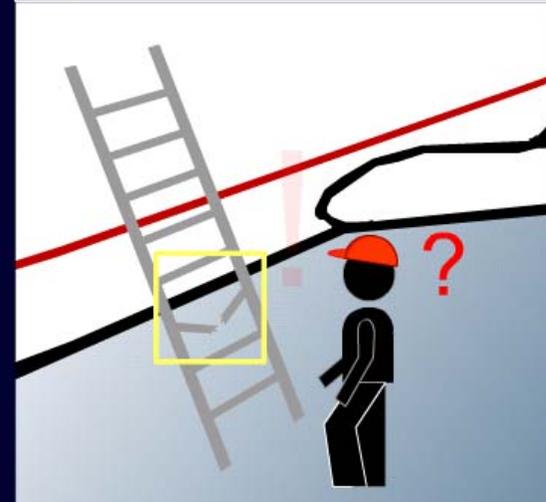
Active error

specific individual activity
that is an obvious event



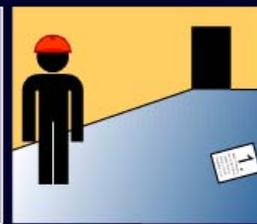
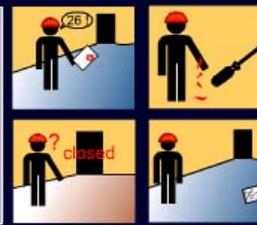
Latent error

company issues
that lead up to the event



Define the Errors: For Discussion

|Different kinds of ERROR|

<p>A) Berndt misreads a torque value. It is 62 and he sees 26.</p>		<p>D) Ted does not use the job card because he already knows the job from memory.</p>	
<p>B) Klaus cuts his hand when he slips from the wrench.</p>		<p>E) All are "latent errors".</p>	
<p>C) Brian does not use a new locking device because the parts room was closed at the time he needed the hardware.</p>			

 Which of these examples is a "latent error"? Please click on one of the boxes!

Boeing's top 7 Errors

276 Inflight shutdowns (1994)

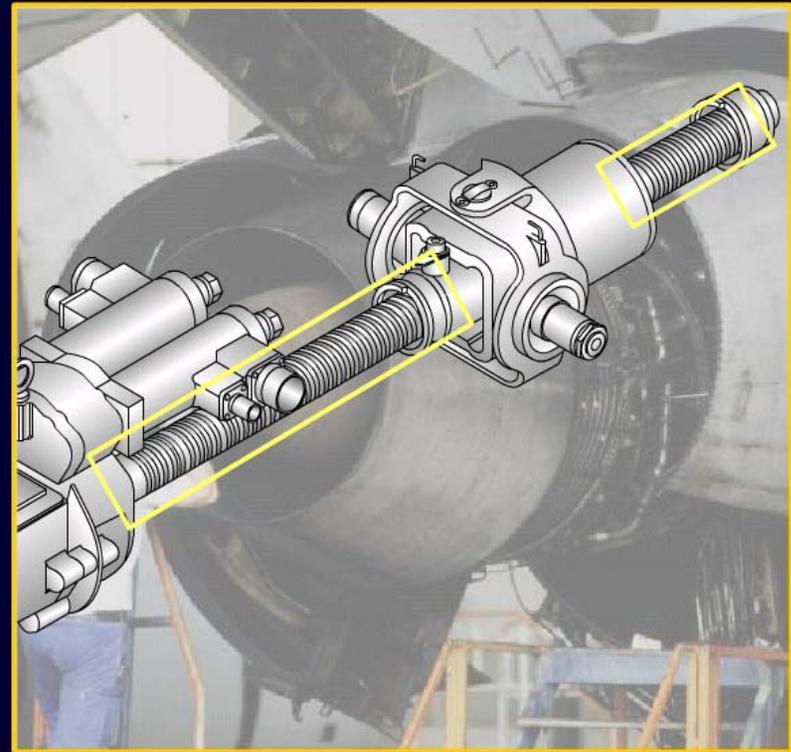
- Incomplete installation (33%)
- Damage on installation (14.5%)
- Improper installation (11%)
- Equipment not installed or missing (11%)
- FOD (6.5%)
- Improper troubleshooting, inspection, test (6%)
- Equipment not activated or deactivated (4%)



The CAA Error List Shown in LTT WBT

List of maintenance errors over 3 years

- 1.) Incorrect installation
- 2.) Electrical wiring
- 3.) Cross connections
- 4.) Forgotten tools and parts
- 5.) Failure to lubricate



The 12 Common Human Errors



[Link](#)

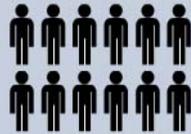


Iceberg Model

The Iceberg Model



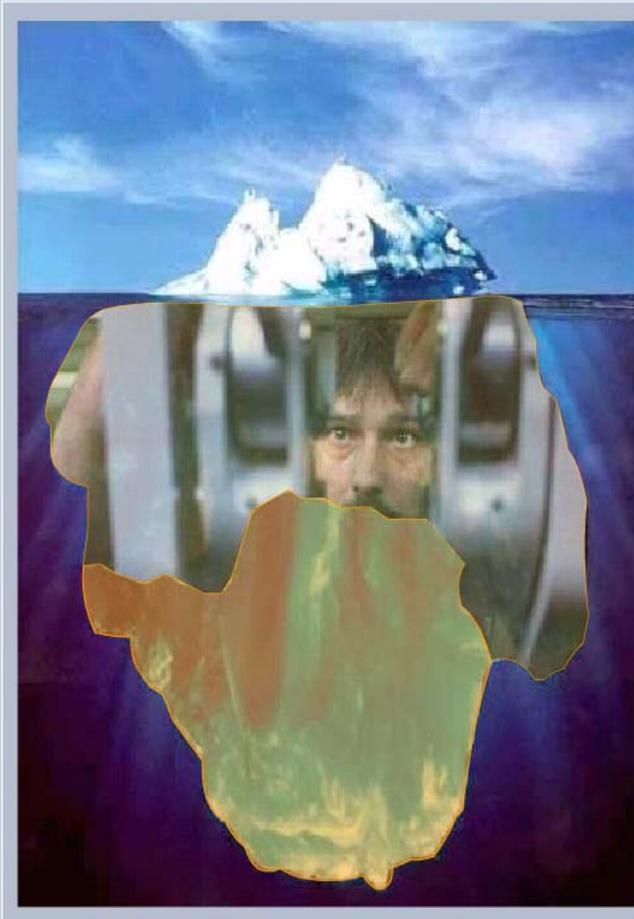
Time



People



Money



Tools



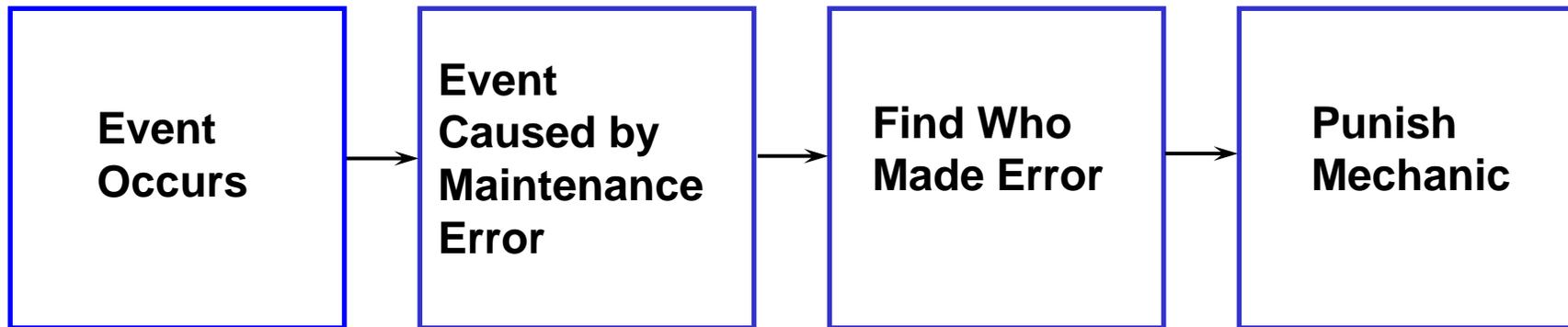
Manuals



Computer

Traditional Error Investigation Process

(a.k.a., Your system?)



Philosophy of Error Reporting (Boeing-MEDA)

- **Staff do not make errors on purpose**
- **Maintenance errors are made because of a series of related contributing factors**
- **Most of the contributing factors are part of maintenance organization processes and can be changed**

Slide provided by Boeing, Dr. Bill Rankin

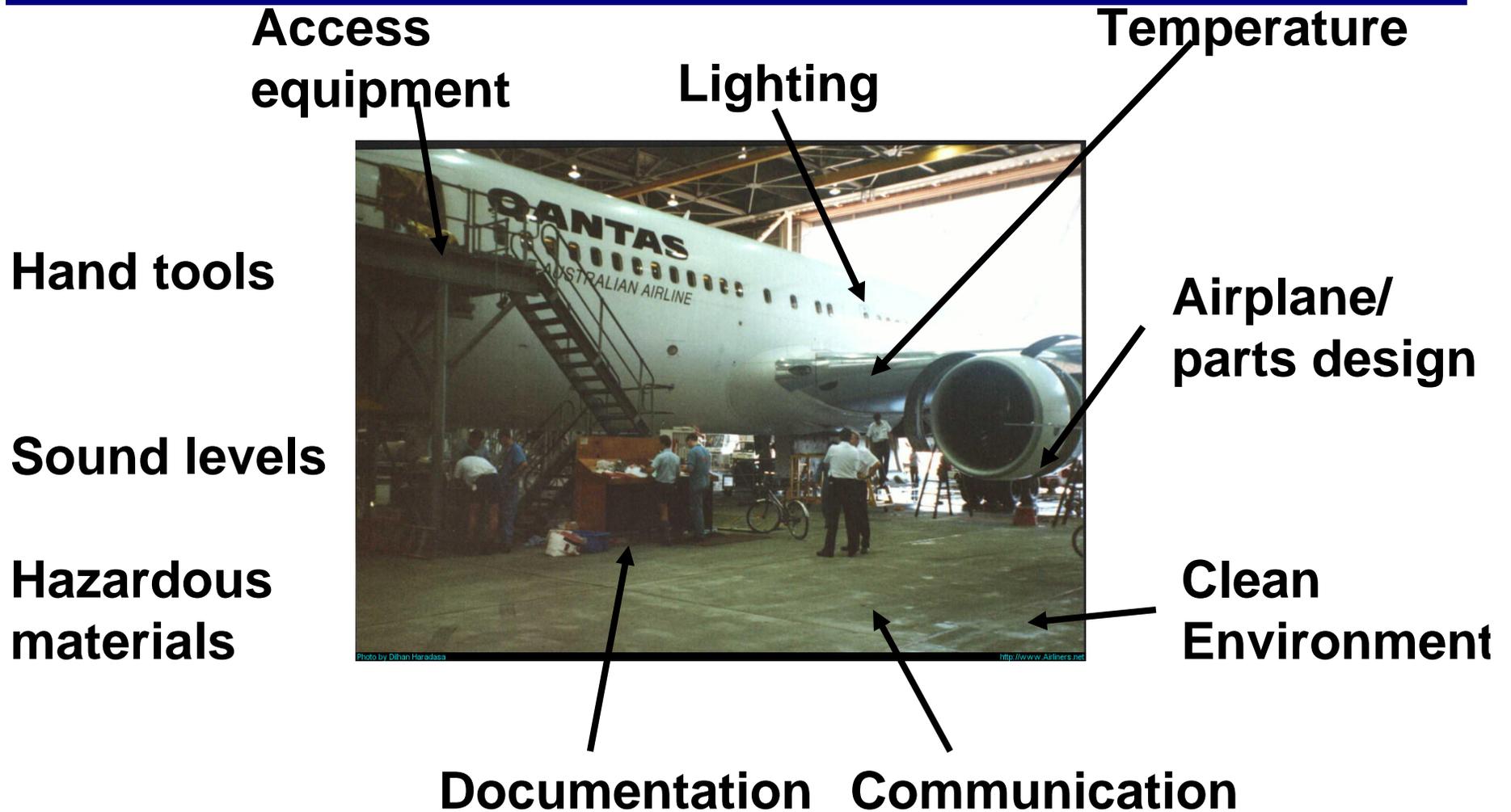


More MEDA Philosophy

- **Maintenance program must be viewed as a system, where the mechanic is one part of the system**
- **Addressing lower level events helps prevent more serious events**



Contributing Factors: Anything that affects how a mechanic does his/her job.





Resources



Procedures/work cards
Technical manuals
Other people
Test equipment
Tools
Computers/ software
Paperwork/ signoffs

Ground handling equipment
Work stands and lifts
Fixtures
Materials
Task lighting
Training
Quality systems



Can you list some resource-related risks?

- Stories?
- Examples?
- What did you do about it?
- What are you going to do about it?
-
-
-



Agenda

Safety Data with Human Factors Implications

Human Factors Fundamentals and Review

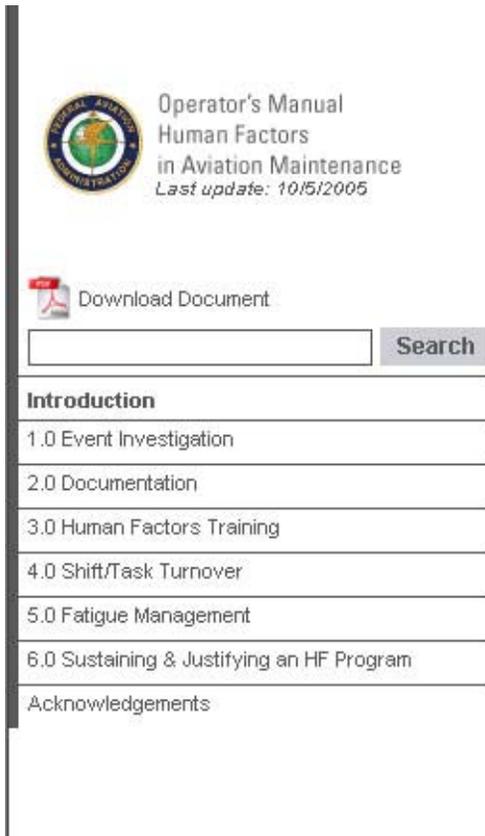
Human Factors Fundamentals and Review

Operator's Manual for HF in Aviation Maintenance

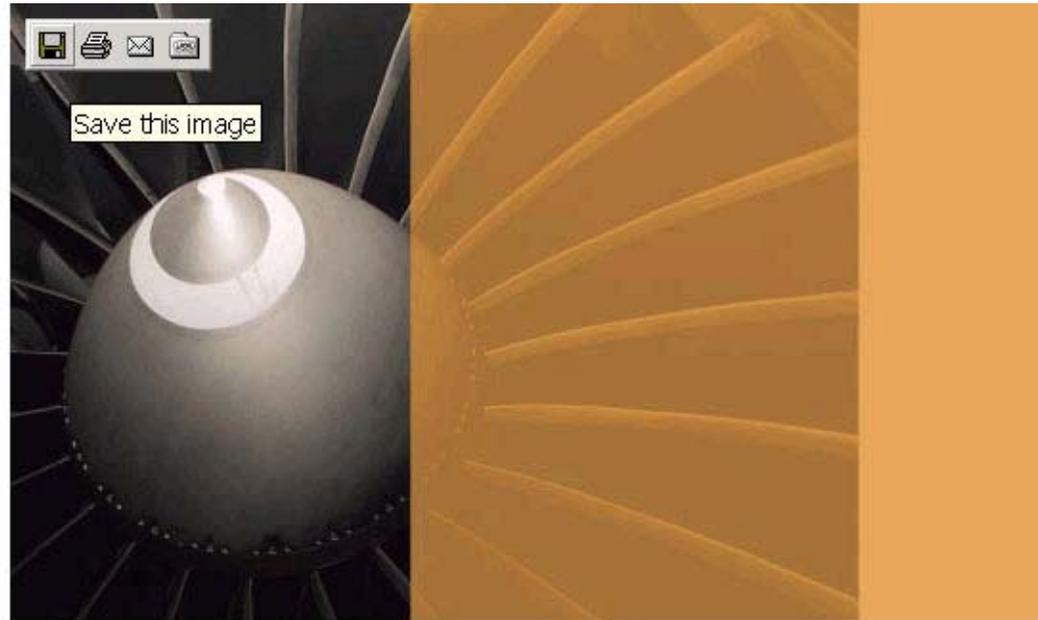
2007 FAA Human Factors Activities



A Reference for Error Reporting



The screenshot shows the top portion of a web page. On the left is the FAA logo. To its right, the text reads: "Operator's Manual Human Factors in Aviation Maintenance Last update: 10/5/2005". Below this is a "Download Document" button with a PDF icon. Underneath is a search bar with a "Search" button. A table of contents is visible, listing sections: Introduction, 1.0 Event Investigation, 2.0 Documentation, 3.0 Human Factors Training, 4.0 Shift/Task Turnover, 5.0 Fatigue Management, 6.0 Sustaining & Justifying an HF Program, and Acknowledgements.



Introduction

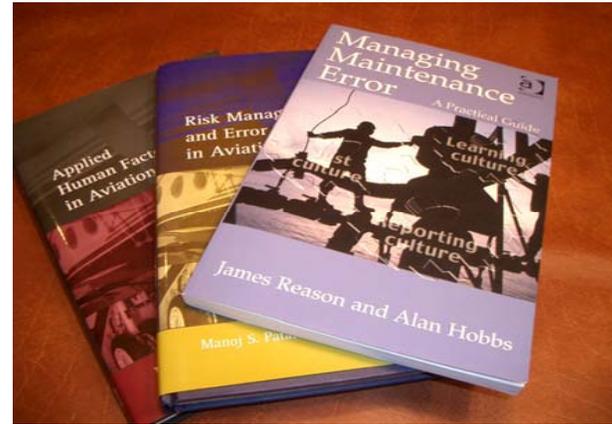
This manual is in response to the industry's requests for a simple and manageable list of actions to implement a Maintenance Human Factors (MHF) program. A panel of experts selected the following six topics for such a program to be successful:

www.hf.faa.gov/opsmanual

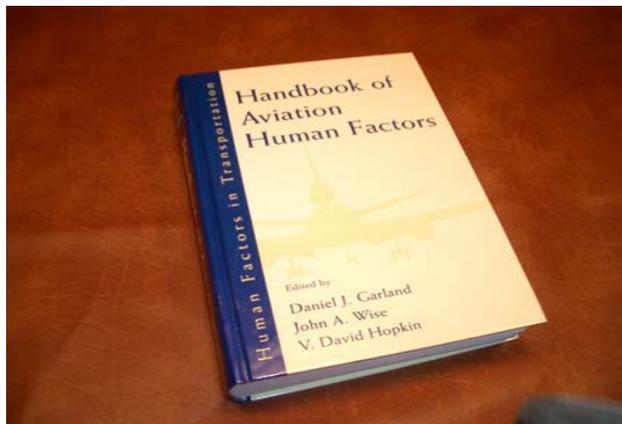
Plenty of HF Guidance in the World!



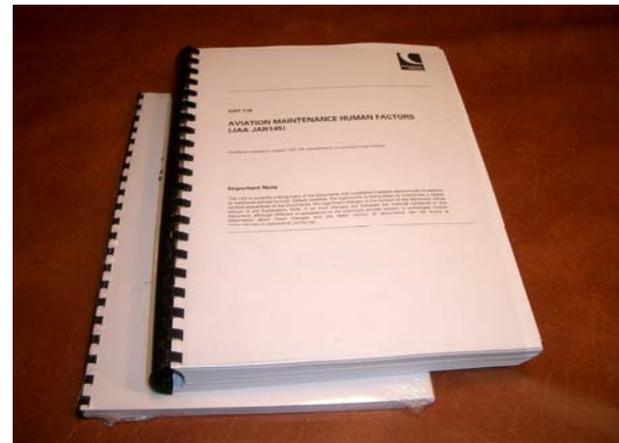
900 pgs.
1996



551 pgs.
2003-04

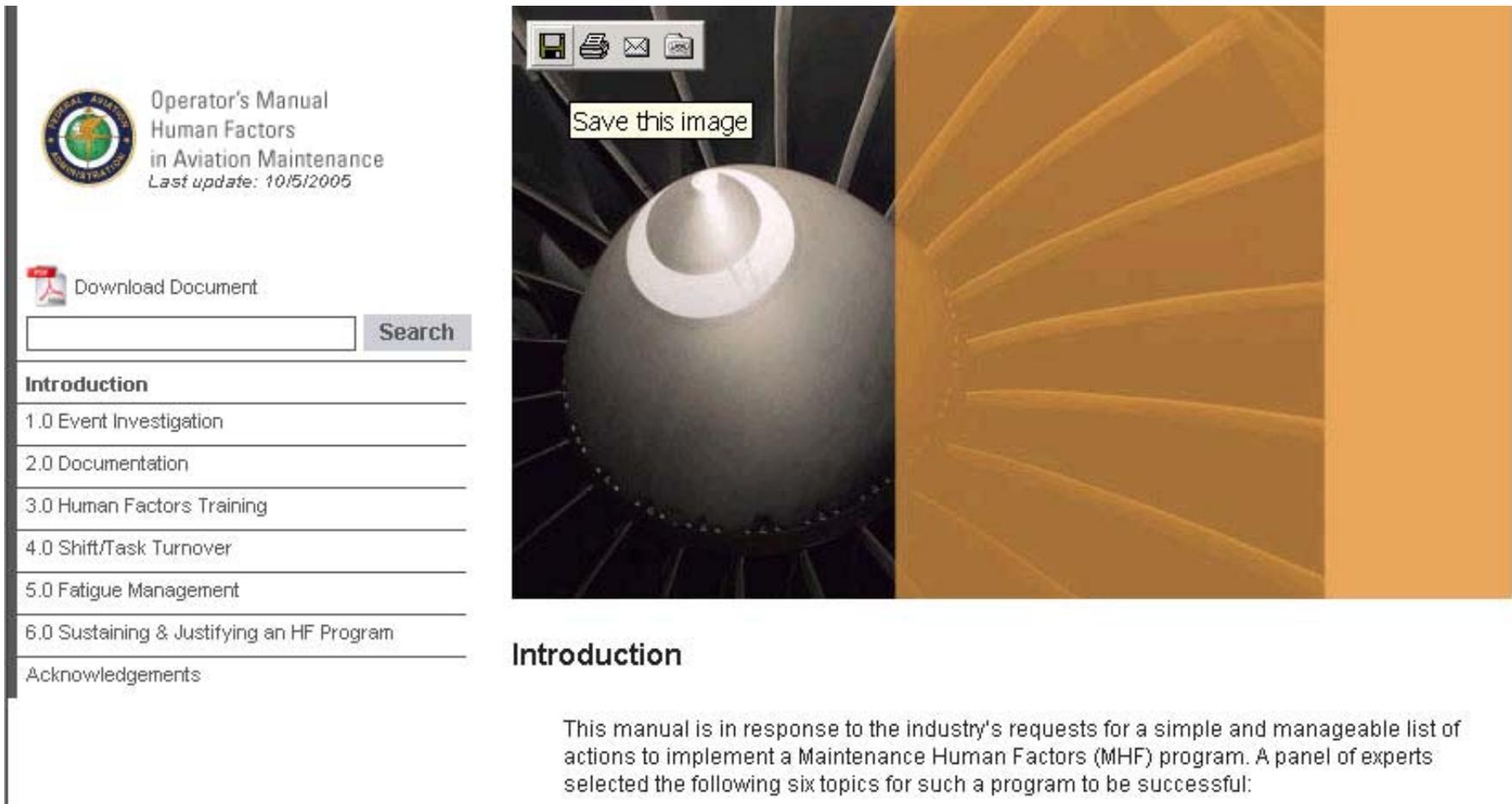


695 pgs.
1999



1000 pgs.
2002

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Operator's Manual
Human Factors
in Aviation Maintenance
Last update: 10/5/2005

Download Document

Search

Introduction
1.0 Event Investigation
2.0 Documentation
3.0 Human Factors Training
4.0 Shift/Task Turnover
5.0 Fatigue Management
6.0 Sustaining & Justifying an HF Program
Acknowledgements

Introduction

This manual is in response to the industry's requests for a simple and manageable list of actions to implement a Maintenance Human Factors (MHF) program. A panel of experts selected the following six topics for such a program to be successful:

www.hf.faa.gov/opsmanual

Goals for *The Operator's Manual*

- **Keep it short**
- **Keep it straightforward & applied**
- **If author has to explain then not included in *The Manual***
- **The “Automobile Owner’s Manual” test**
- **Chapter Titles may be enough!**
- **Web-based and nice print-outs**





"Jackscrew assembly failure caused by excessive wear resulting from insufficient lubrication... contributing factors included extended lubrication and end-play check intervals, lack of available parts, organizational norms, regulatory oversight issues, etc."

NTSB AAR-02/01 FINAL REPORT

1. Event Investigation

of 5 > >>



"Departures from approved procedures included failures to solicit and give proper shift-change turnover reports, failures to use maintenance work cards as approved, failures to complete required maintenance/inspection shift turnover forms, and a breach in the integrity of the quality control."

NTSB AAR-92/04 EAGLE LAKE

4. Shift Turnover

> >>



"Mechanics would benefit from using Airliner Maintenance Manuals with more specific instructions for critical flight system procedures."

NTSB/AAR-04/01

2. Documentation



"A combination of 16 hours of straight work compounded by influenza contributed to fatigue and falling asleep at the wheel..."

AIRPORT INTERNAL REPORT

5. Fatigue/Alertness

5 > >>



"The Safety issues raised in this report include: The Human Factors aspects of air carrier maintenance and inspection for the continuing airworthiness of transport category airplanes, to include repair procedures and the training, certification and qualification of mechanics and inspectors."

NTSB AAR-89/03 FINAL REPORT

3. HF Training

of 5 > >>



"...various initiatives come and go sometimes based on corporate whims... a sustainable maintenance human factors program must have shared support from senior management and all levels of company personnel... the program must show value in continuing safety, worker job satisfaction, and cost control..."

W.B. JOHNSON, FAA

6. Sustainment & Cost

5 > >>



All Chapters are the same format

1. Brief Description
2. Why it is important
3. How to implement a program
4. How to know if it is working
5. Key References (3)



Sample Display from Operator's Manual



Operator's Manual
Human Factors
in Aviation Maintenance
Last update: 10/25/2005



Download Document

Search

Introduction

1.0 Event Investigation

2.0 Documentation

3.0 Human Factors Training

4.0 Shift/Task Turnover

5.0 Fatigue Management

6.0 Sustaining & Justifying an HF Program

6.1 Why Program Sustainability is important

6.2 How to sustain a MHF program

6.3 How to know it is working

6.4 Why Cost Justification is important

6.5 How to implement measures to quantify
Maintenance Human Factors investments
for cost justification

6.6 Key References

Acknowledgements



"...various initiatives come and go sometimes based on corporate whims... a sustainable maintenance human factors program must have shared support from senior management and all levels of company personnel... the program must show value in continuing safety, worker job satisfaction, and cost control..."

W.B. JOHNSON, FAA

6.0 Sustaining & Justifying an HF Program

The first five topic areas of this document recommended specific actions. The topics of Program Sustainability and Cost Justification are general and apply to all aspects of a MHF program. MHF programs often get off to a good start but then struggle over time. Challenges to program sustainability include changes in policies and projects when management changes, a lack of cost justification, and limited program integration. The ideas presented here help sustain multiple MHF initiatives and provide a straightforward consideration of cost justification.



Key References for Each Chapter



6.0 Sustaining & Justifying an HF Program

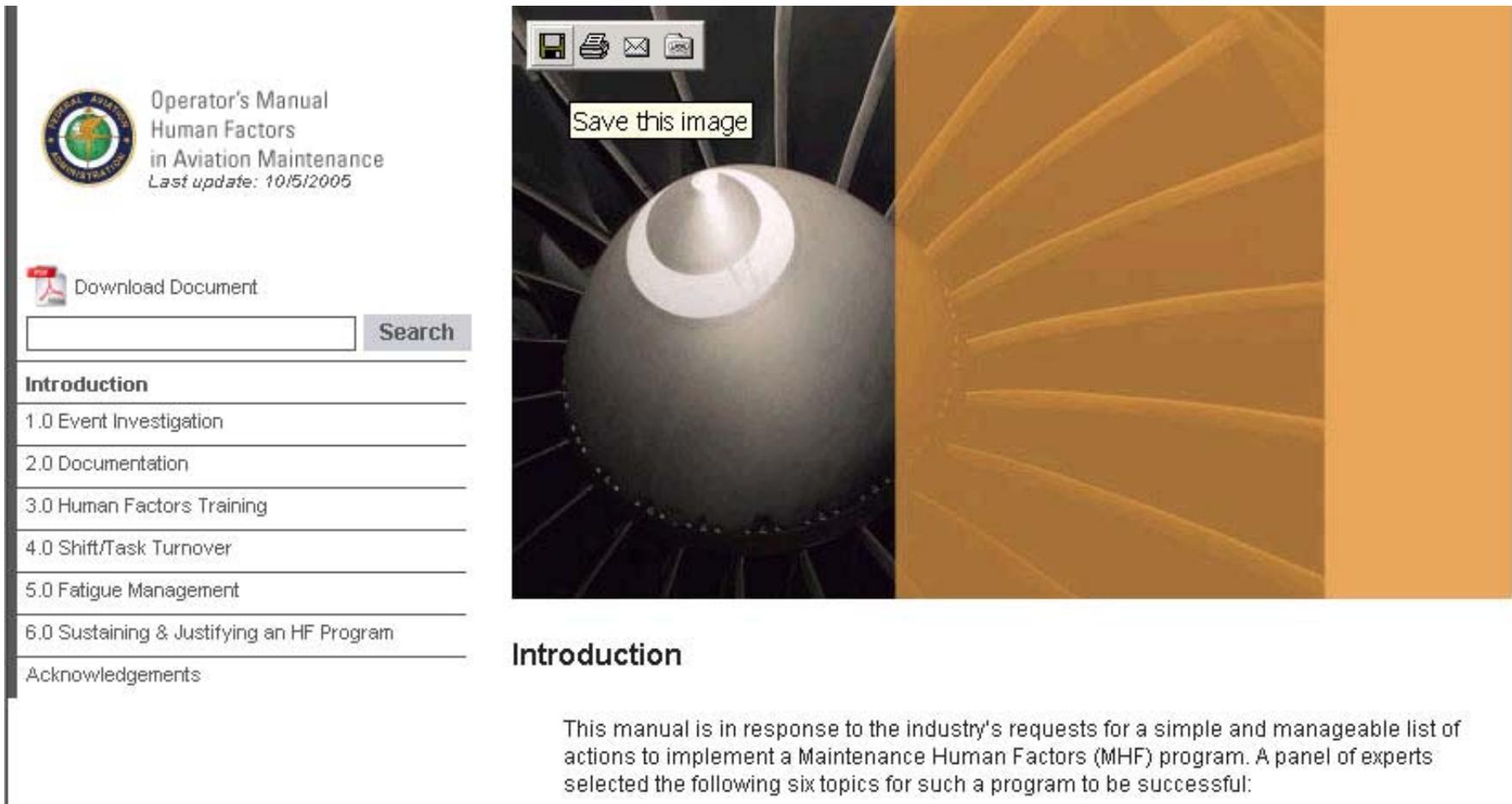
6.6 Key References

- A. Sustaining & Justifying an HF Program presentation ([Download Document](#)).
- B. Stelly, J. and Poehlman, K. 2000. Investing in Human Factors Training: Assessing the Bottom Line. Presented at the 14 th Annual Human Factors in Aviation Symposium. Vancouver, Canada. ([Download Document](#)).
- C. Patankar, M.S., and Taylor, J.C. (2004). *Risk management and error reduction in aviation maintenance*. Aldershot, U.K.: Ashgate Publishing ([Amazon.com](#)).
- D. Johnson W.B., Sian, I.B., and Watson, J. (2000). Measuring the impact of human factors interventions. SAE Meeting on Advances in Aviation Safety, Daytona Beach, Florida, April 11-13, 2000. ([Download Document](#)).

3 key references
plus slides



This is Website Home Page



Operator's Manual
Human Factors
in Aviation Maintenance
Last update: 10/5/2005

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Acknowledgements

Introduction

This manual is in response to the industry's requests for a simple and manageable list of actions to implement a Maintenance Human Factors (MHF) program. A panel of experts selected the following six topics for such a program to be successful:

www.hf.faa.gov/opsmanual

Agenda

Safety Data with Human Factors Implications

Human Factors Fundamentals and Review

Human Factors Fundamentals and Review

Operator's Manual for HF in Aviation Maintenance

Optional

2007+ FAA Human Factors Activities



- **International Conference (ATA)**



18th FAA/ATA International Symposium
Human Factors
Maintenance and Ramp Safety

- **Unmanned Aerial Systems (NASA)**



- **International Survey on HF in Maintenance (CAMI)**



Challenges – High Priorities

- **Maintenance HF Regulations: 65, 121, 135,145, 147.**
- **Advanced Technologies, VLJs, Rotorcraft, UAVs, Avionics, Commercial Space travel, Aging Aircraft,**
- **General Aviation Maintenance HF**
- **SMS in Maintenance**



2007 HF Conference - Your Invitation

2007 HF Symposium



19th FAA/ATA International Symposium

Human Factors

in Maintenance and Airport Service Safety

September 5-6, 2007

Evening "Kick-off" Reception on September 4, 2007

Hyatt Regency Orlando International Airport Hotel

Orlando, Florida, USA

www.airlines.org



Agenda Topics (2007) Suggestions welcomed

- Regulatory Session
- Just Cultures and Event Reporting
- The Cost of Error
- Human Factors Training Showcase
- Ground Service Challenges and Solutions
- Safety Management Systems
- Applied R&D Projects (?)
- Contract Services
- Ground Service Equipment/Technology

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19 Organizations as Speakers

- AAR Corporation
- Airbus
- Alaska Airlines
- American Airlines -TWU
- ATA
- Boeing
- Continental Airlines
- Civil Aerospace Medical Inst.
- Delta Air Lines
- FAA
- FEDEX Express
- ICAO
- JDB & Associates (J. Goglia)
- Lufthansa Technical Training
- NASA
- Transport Canada
- Trinity College Dublin
- US Airways
- 3 Plaines Software



Summary

Safety Data with Human Factors Implications

Human Factors Fundamentals and Review

Operator's Manual for HF in Aviation Maintenance

2007+ FAA Human Factors Activities

Inspection Authorization Workshop
February 25, 2006



**Federal Aviation
Administration**



What to Remember

- **PEAR**
- **Human Factors Spectacles**
- **Dirty Dozen**
- **Remember what your mother told you about sleep**
- **Don't forget your sleep calculator**
- **Look at www.hf.faa.gov/opsmanual**

Thank You

