Human Factors Applied to You: An FAA Update for 2006-07

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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.

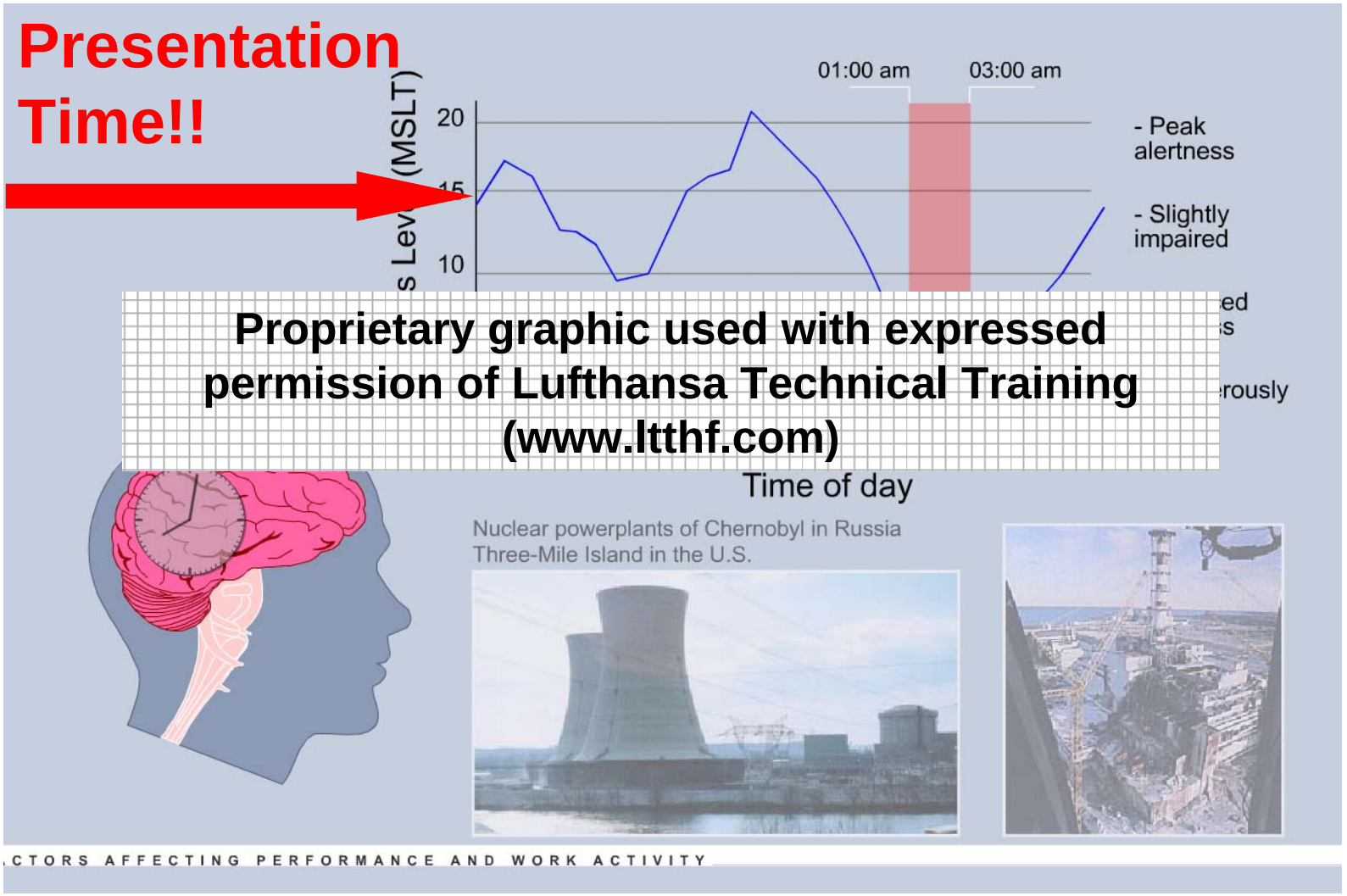
Save time and money?

Apply principles to life.

Aviation North Expo 2006

Timing is everything!

Presentation Time!!



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CTORS AFFECTING PERFORMANCE AND WORK ACTIVITY

Link

Human Factors Spectacles

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?

Agenda

2005 International Safety Data with Human Factors Implications

Human Factors Fundamentals and Review

Break

Status of US & International Regulations

Operator‘s Manual for HF in Aviation Maintenance

2006+ FAA Human Factors Activities

Agenda

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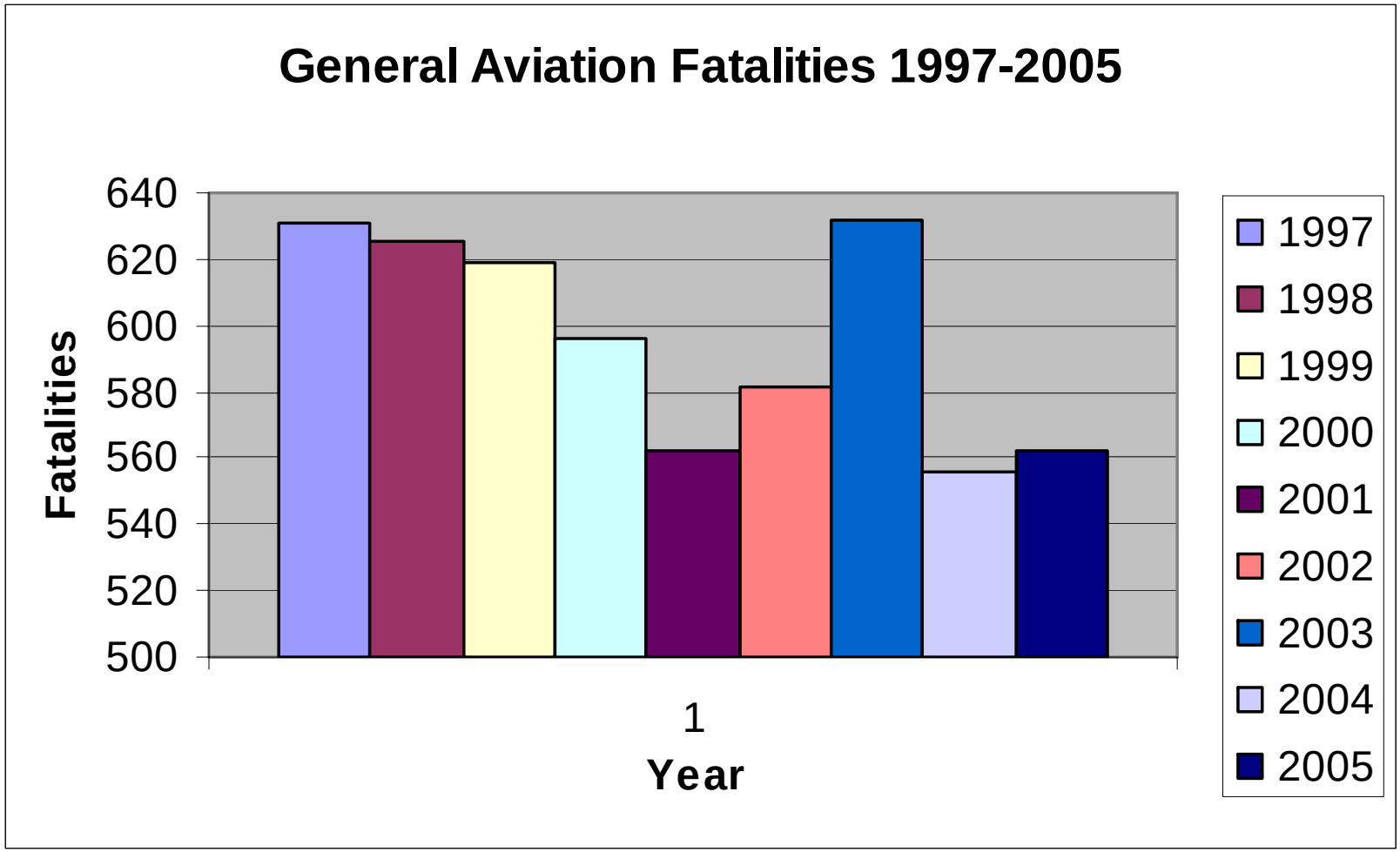
GA Fatalities Stable 2004-2005



BTS/NTSB Data 2005-2006

Implications of the 2005 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

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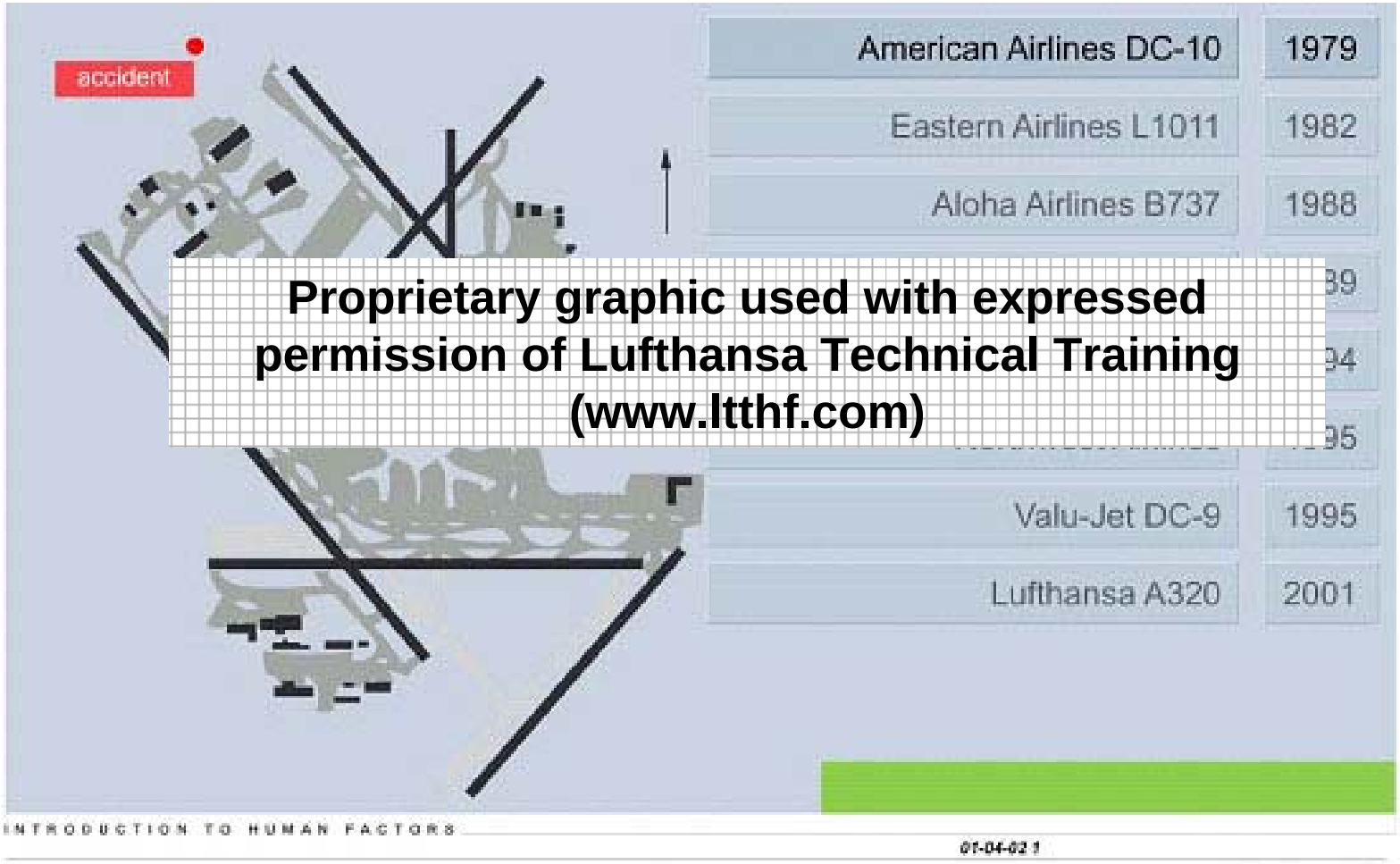
Mx Human Factors has evolved in 20 years!

Events where Maintenance was a Factor

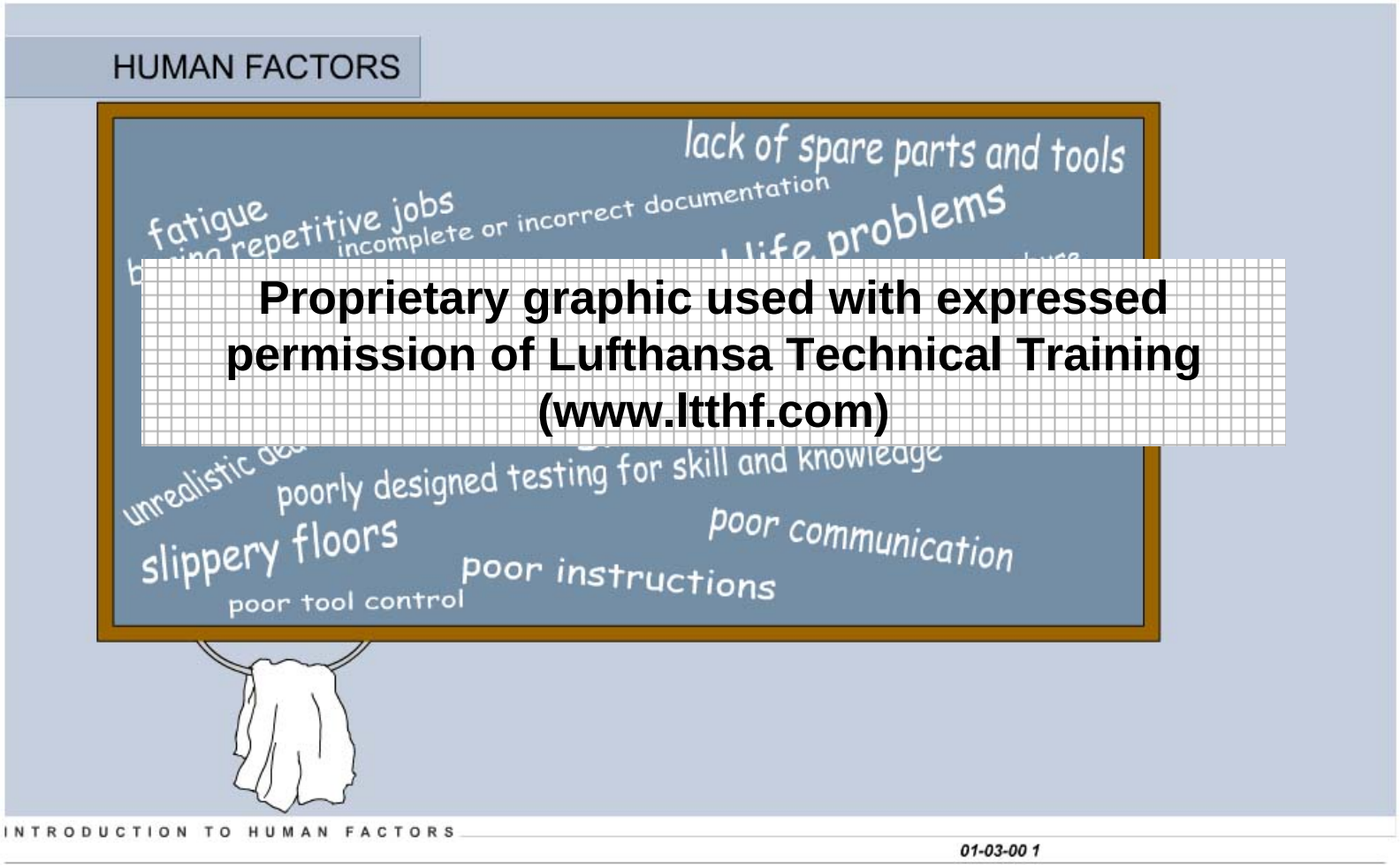


Link

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?



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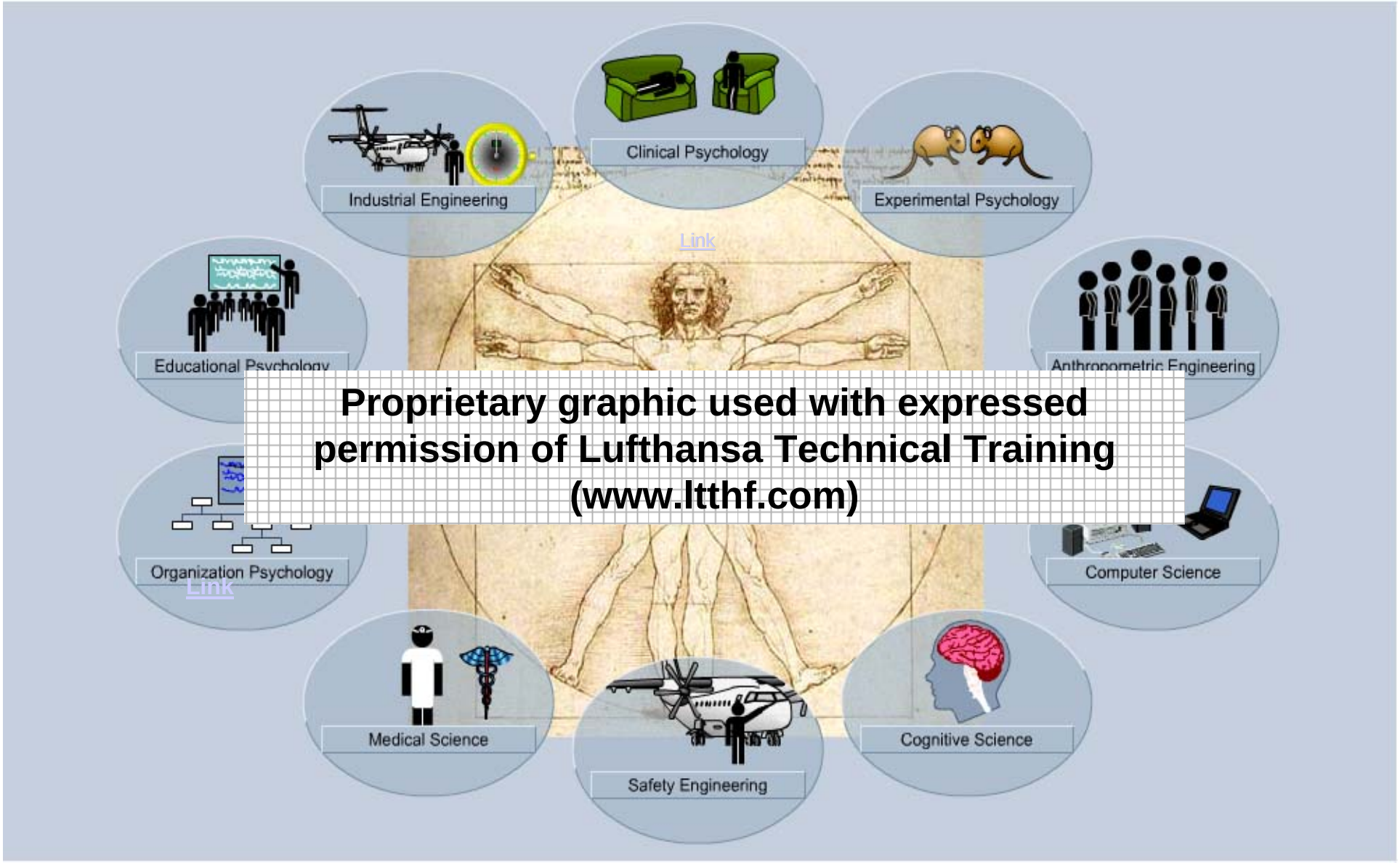
Clinical Psychology
Industrial Engineering
Experimental Psychology
Link
Educational Psychology
Anthropometric Engineering
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Organization Psychology
Link
Computer Science
Medical Science
Safety Engineering
Cognitive Science

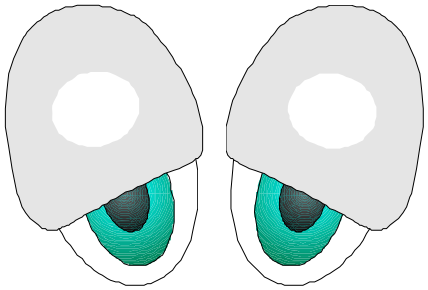
The PEAR MODEL

Maddox & Johnson, 1996

Link

Can a machine do this job?

Sensing and Perception

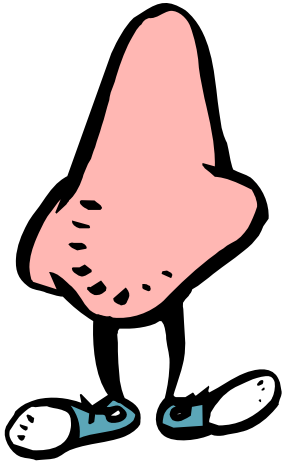


Human Senses

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

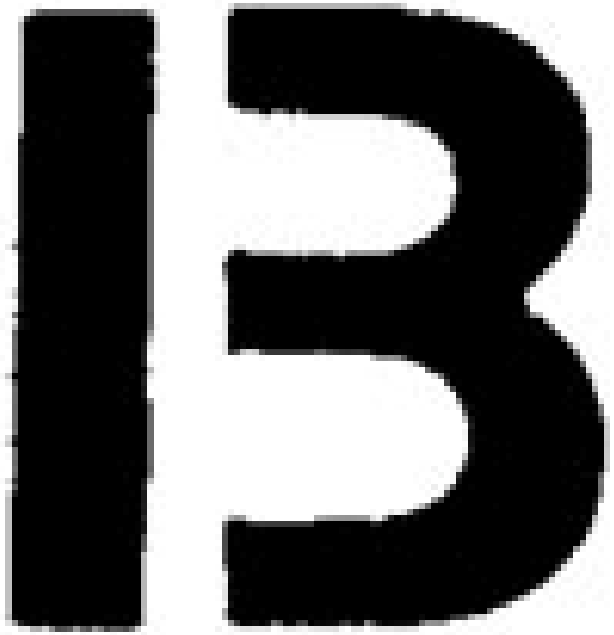
blue

gray

purple

green

What is this?

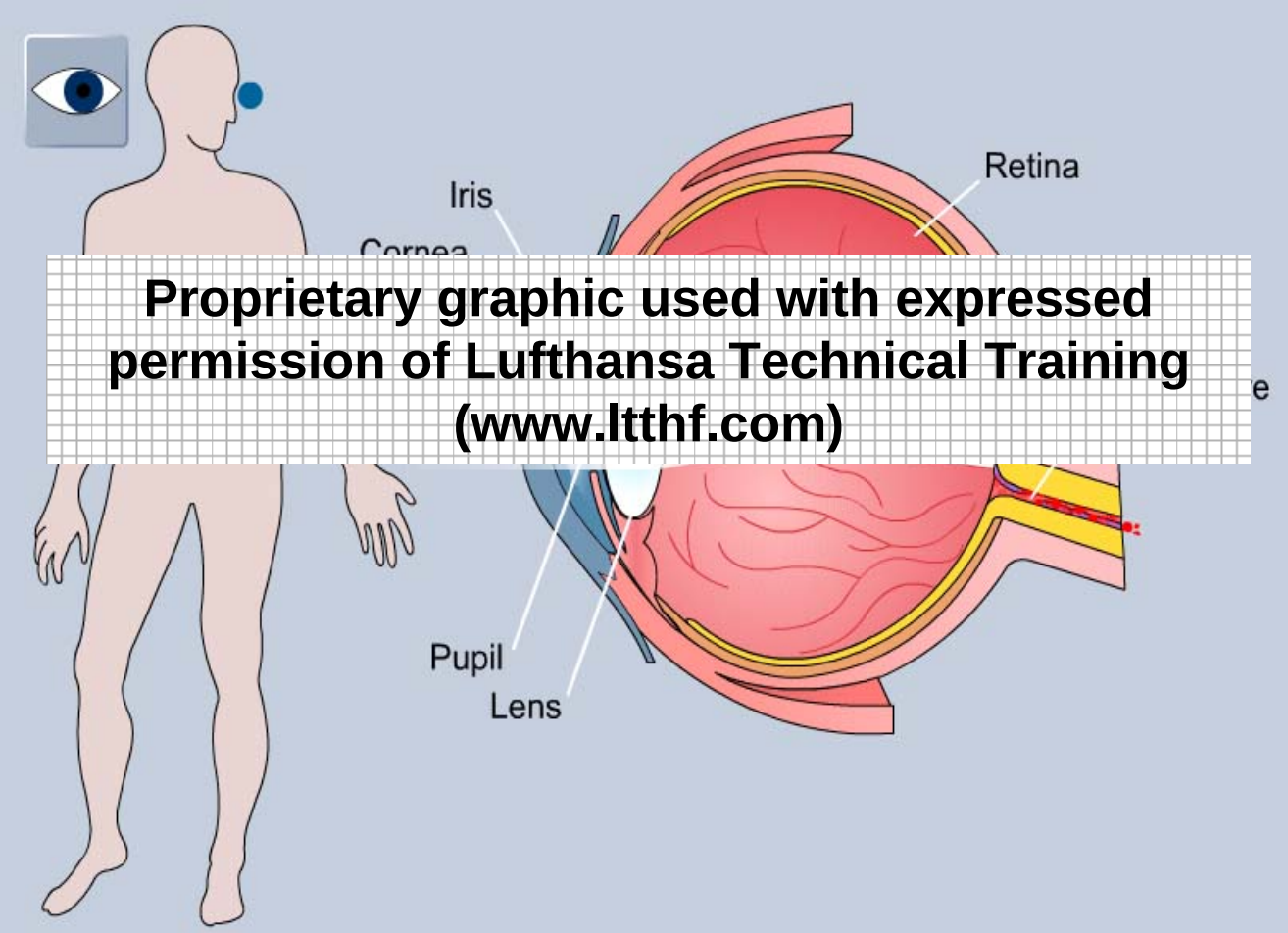


What is this now?

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



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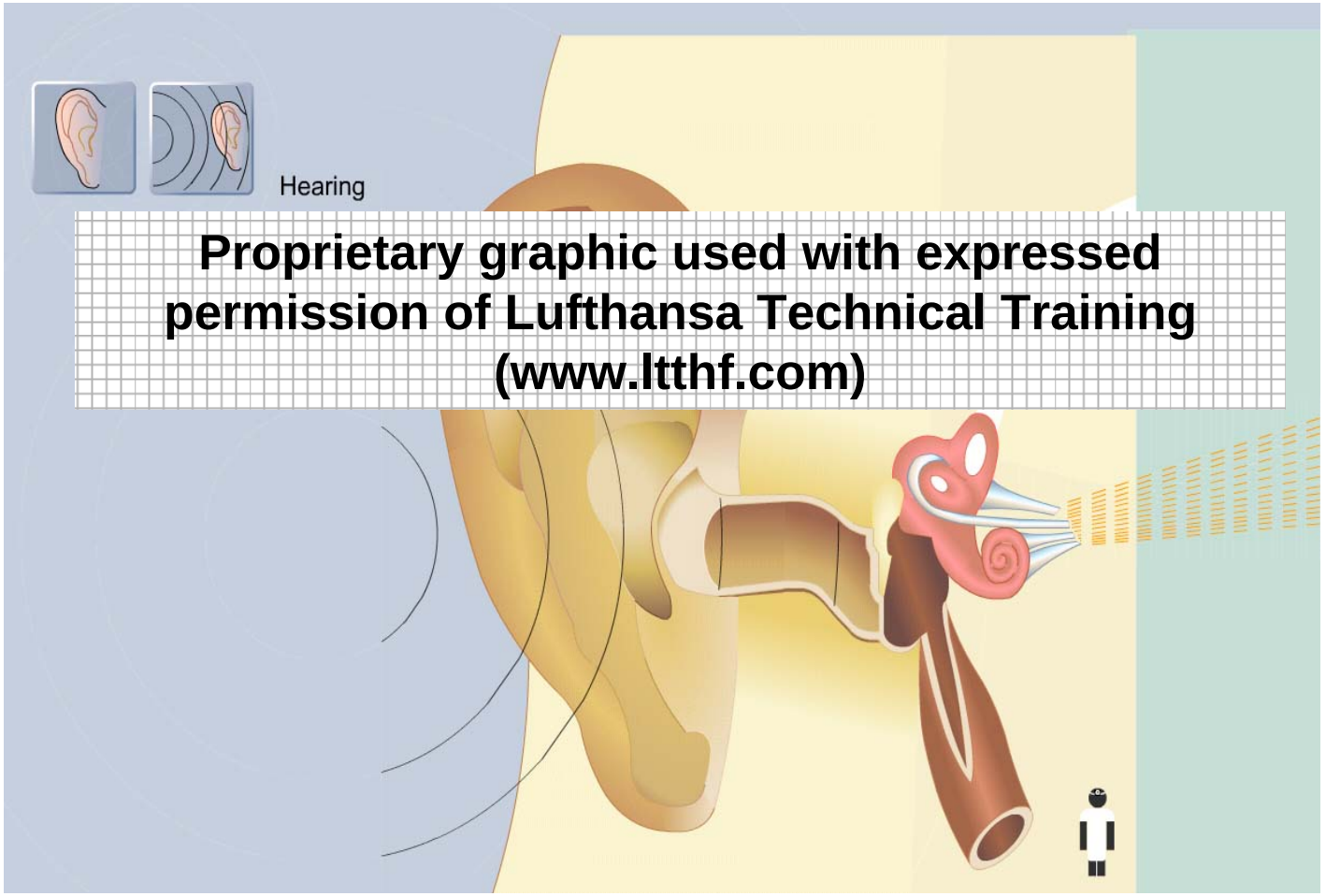
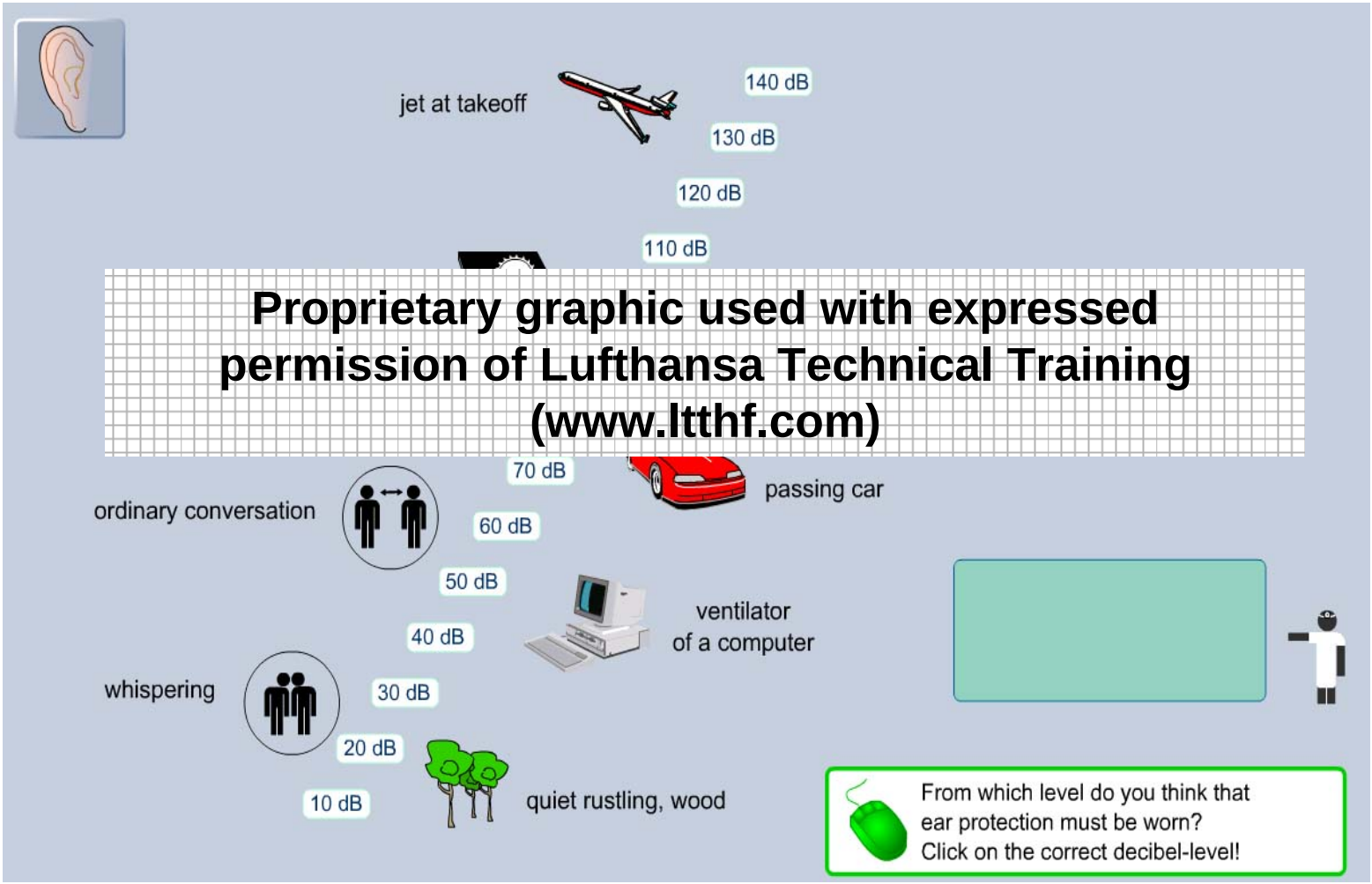
Link

Hearing



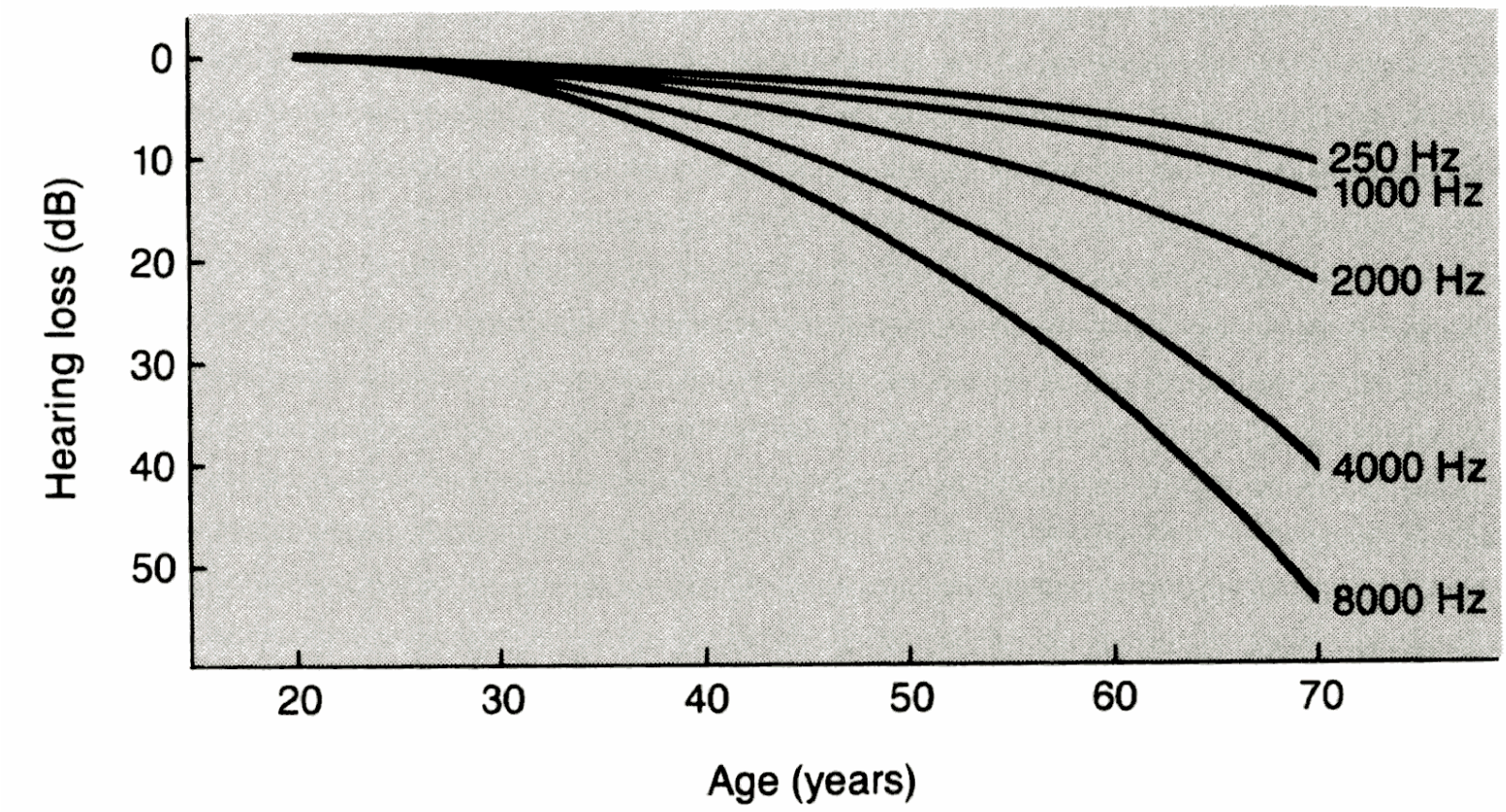
Link

Safe Sound Levels



Link

Mother Nature is Cruel ☹

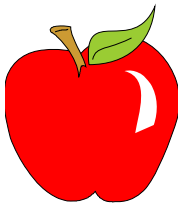


Ability to hear stimuli, especially in the high ranges, decreases with age. (McFarland et al. (1960), *Journal of Gerontology*, 15, 149-154)

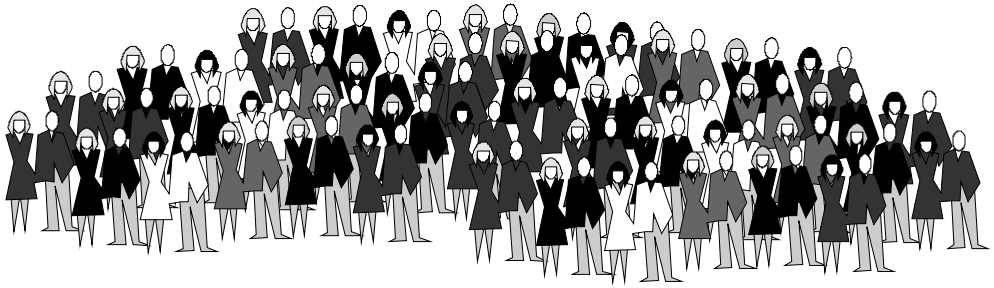
A Couple of Slides to Help Understand Error

The Greatest Hazard to Aircraft is?

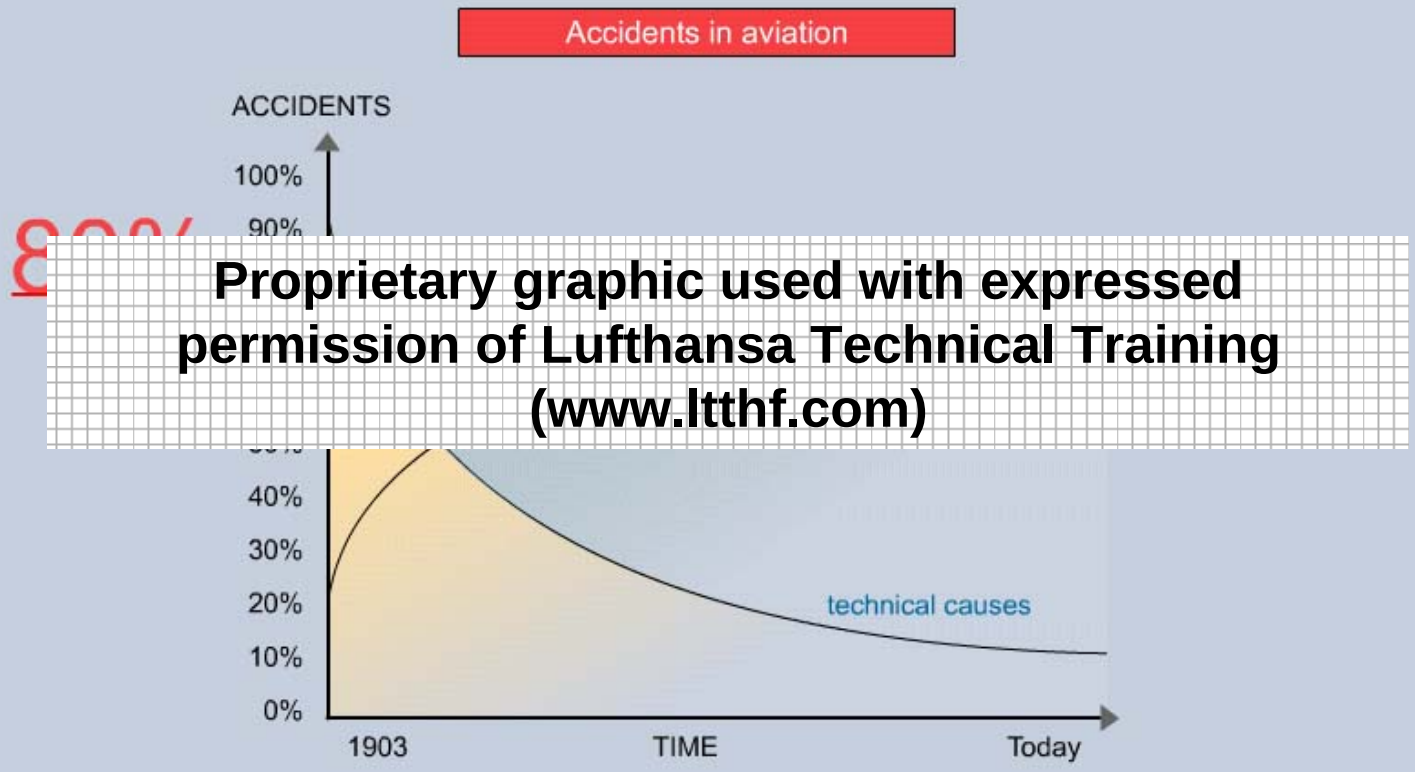
Gravity



Humans



The 80% Human Error in Events!



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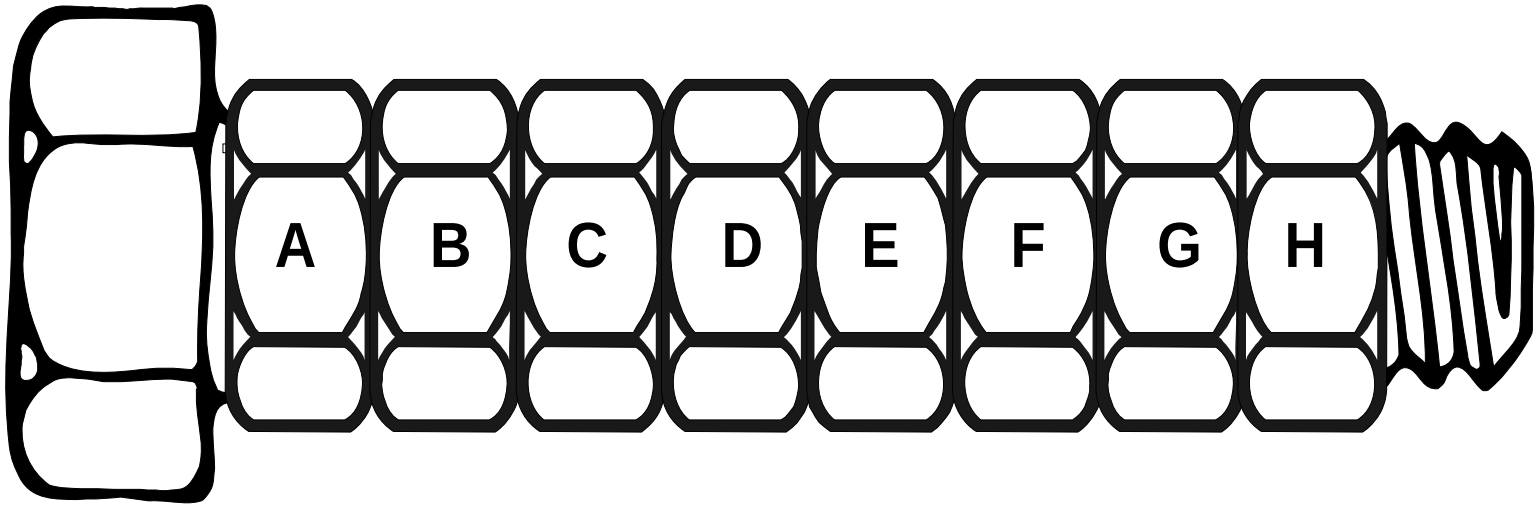
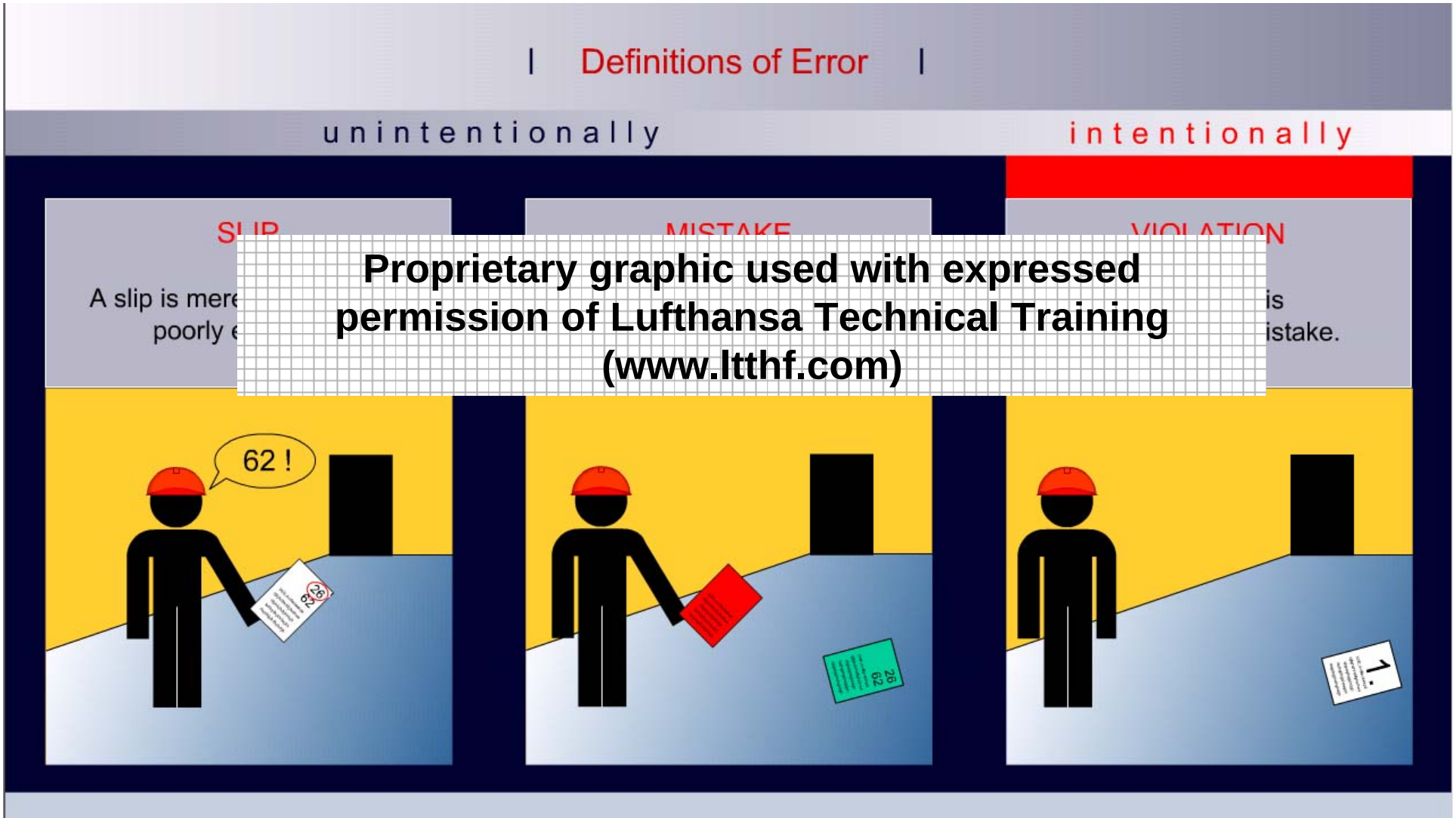
High Chance of Error



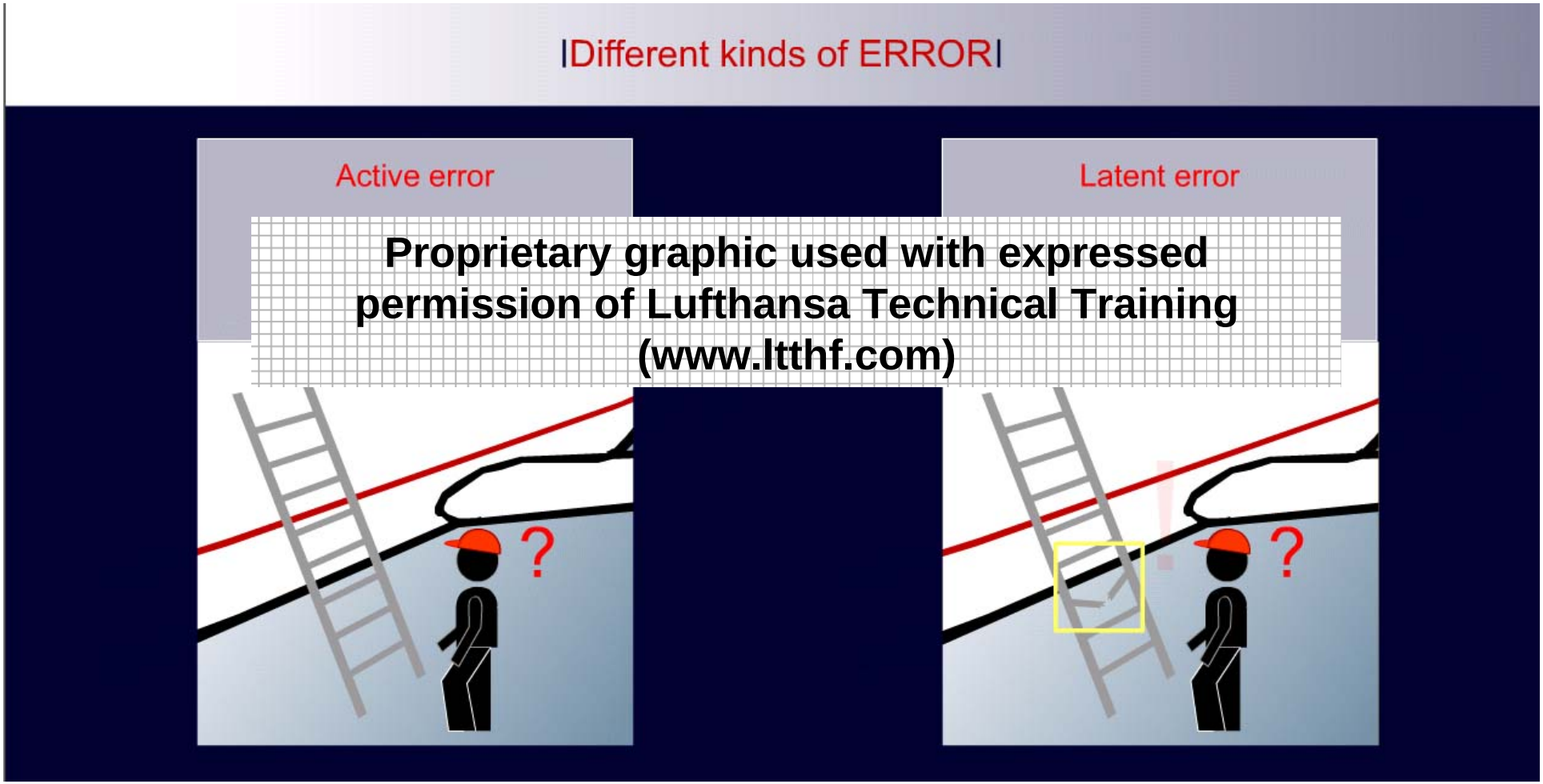
- **Only One way to disassemble**
- **40,000+ ways to error in reassembly!**

Thanks to Prof. J. Reason

Error Definitions



Active and Latent Error: An Important HF Concept



Define the Errors: For Discussion

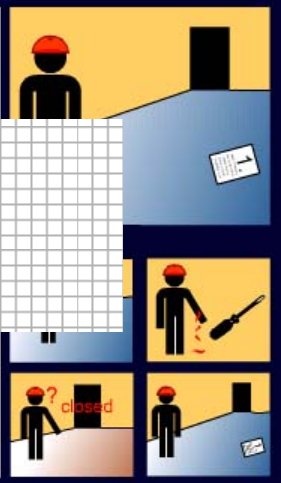
|Different kinds of ERROR|

A) Berndt misreads a torque value. It is 62 a

B) Klaus cuts his hand when he slips from the wrench.

C) Brian does not use a new locking device because the parts room was closed at the time he needed the hardware.

D) Ted does not use the job card because he



All are "latent errors".

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

Boeing's top 7 Errors

276 In-flight 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

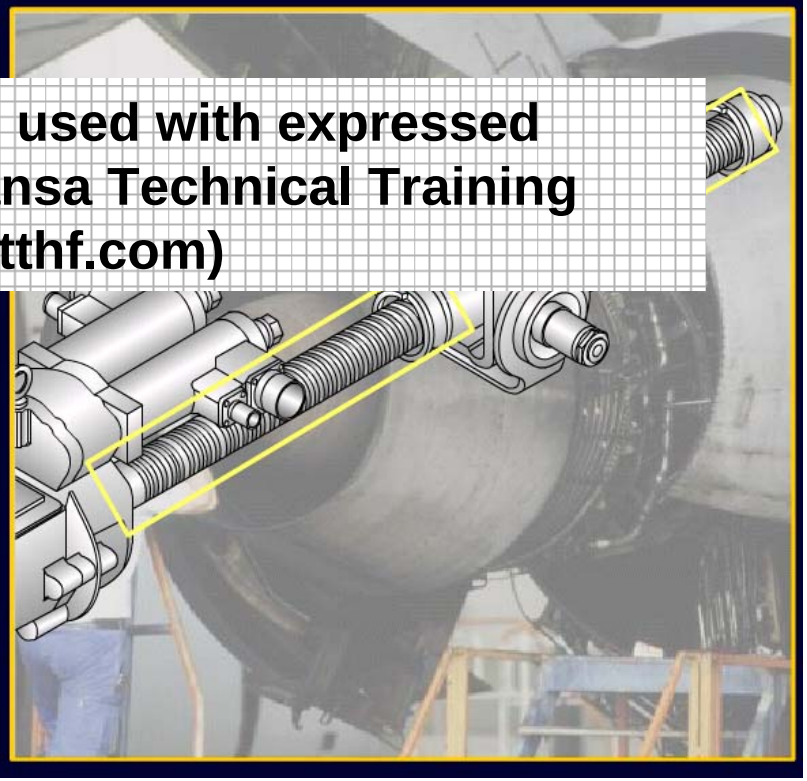
1.) Incorrect installation

2.) Electri

3.) Cross

4.) Forgotten tools and parts

5.) Failure to lubricate



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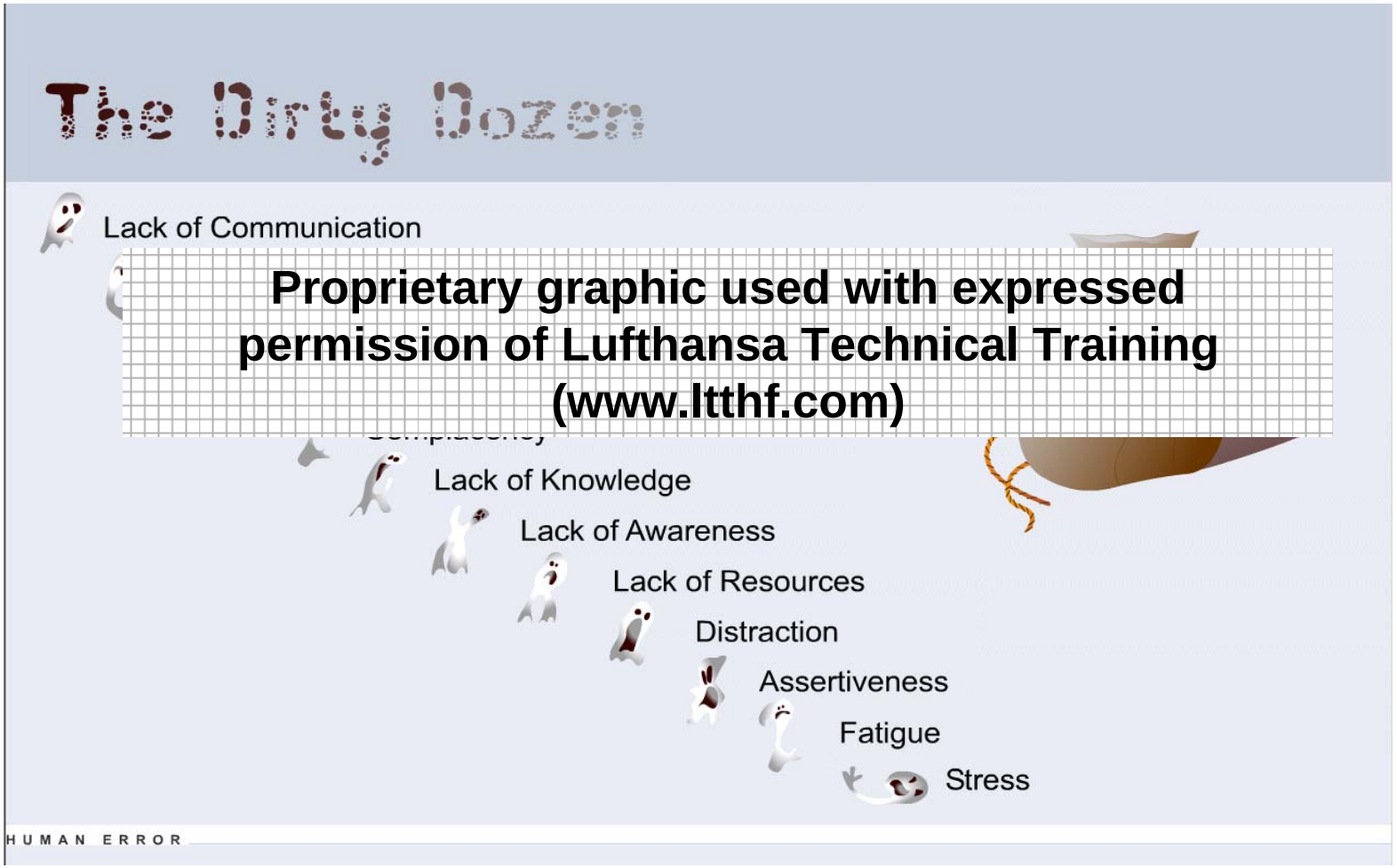
The 12 Common Human Errors



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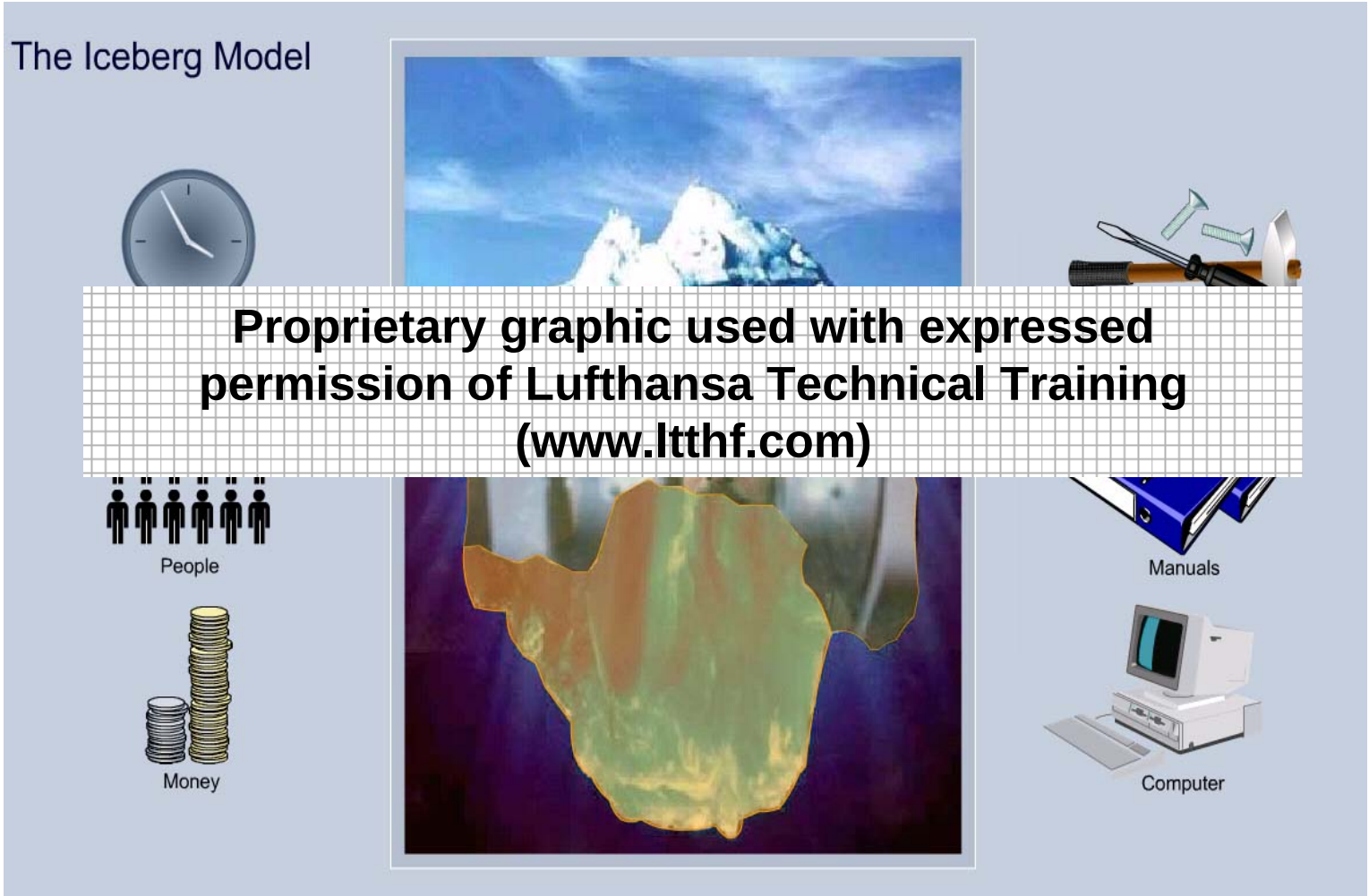
Link

Iceberg Model



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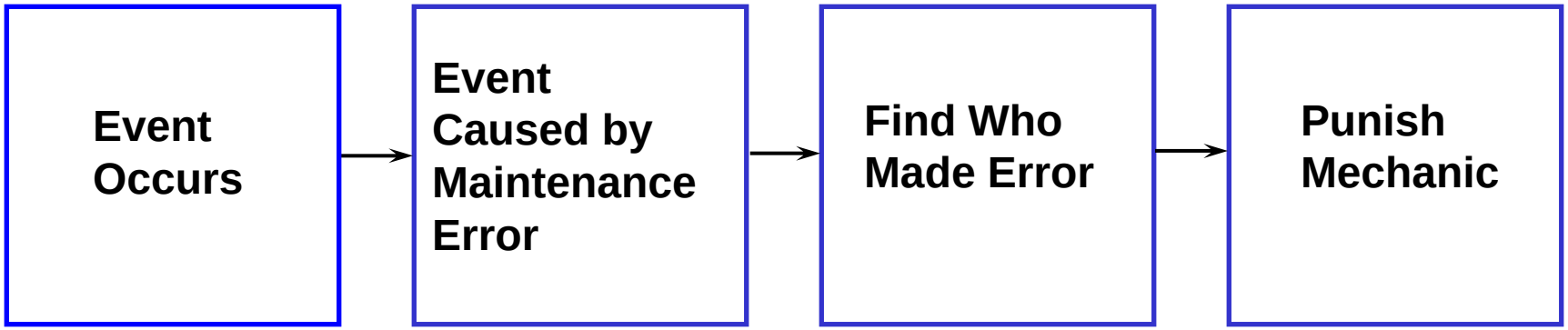
Traditional Error Investigation Process

(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.

Access equipment

Lighting

Temperature

Hand tools

Airplane/ parts design

Sound levels

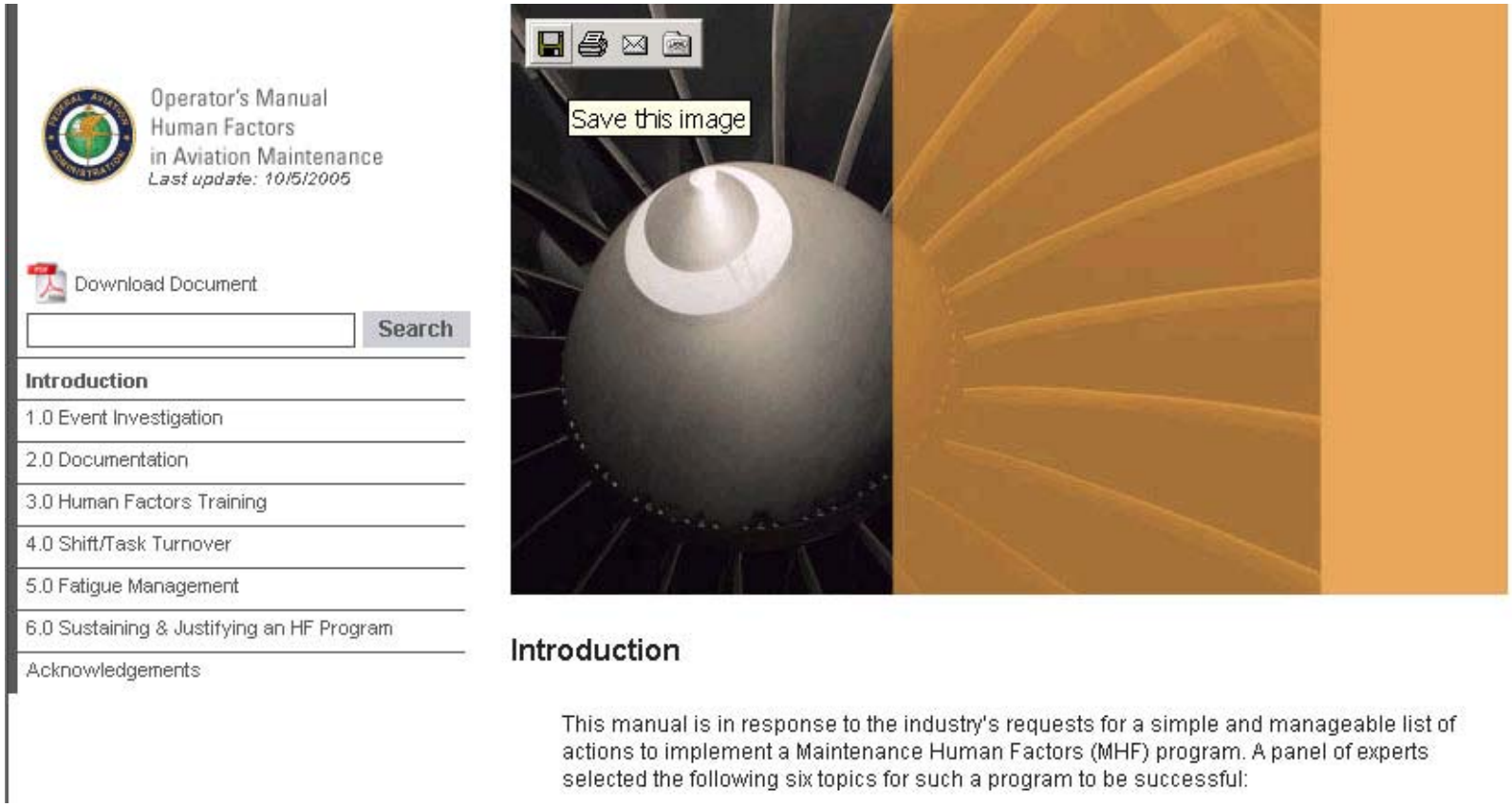
Hazardous materials

Clean Environment

Documentation

Communication

A Reference for Error Reporting



www.hf.faa.gov/opsmanual

What does this mean?

Link

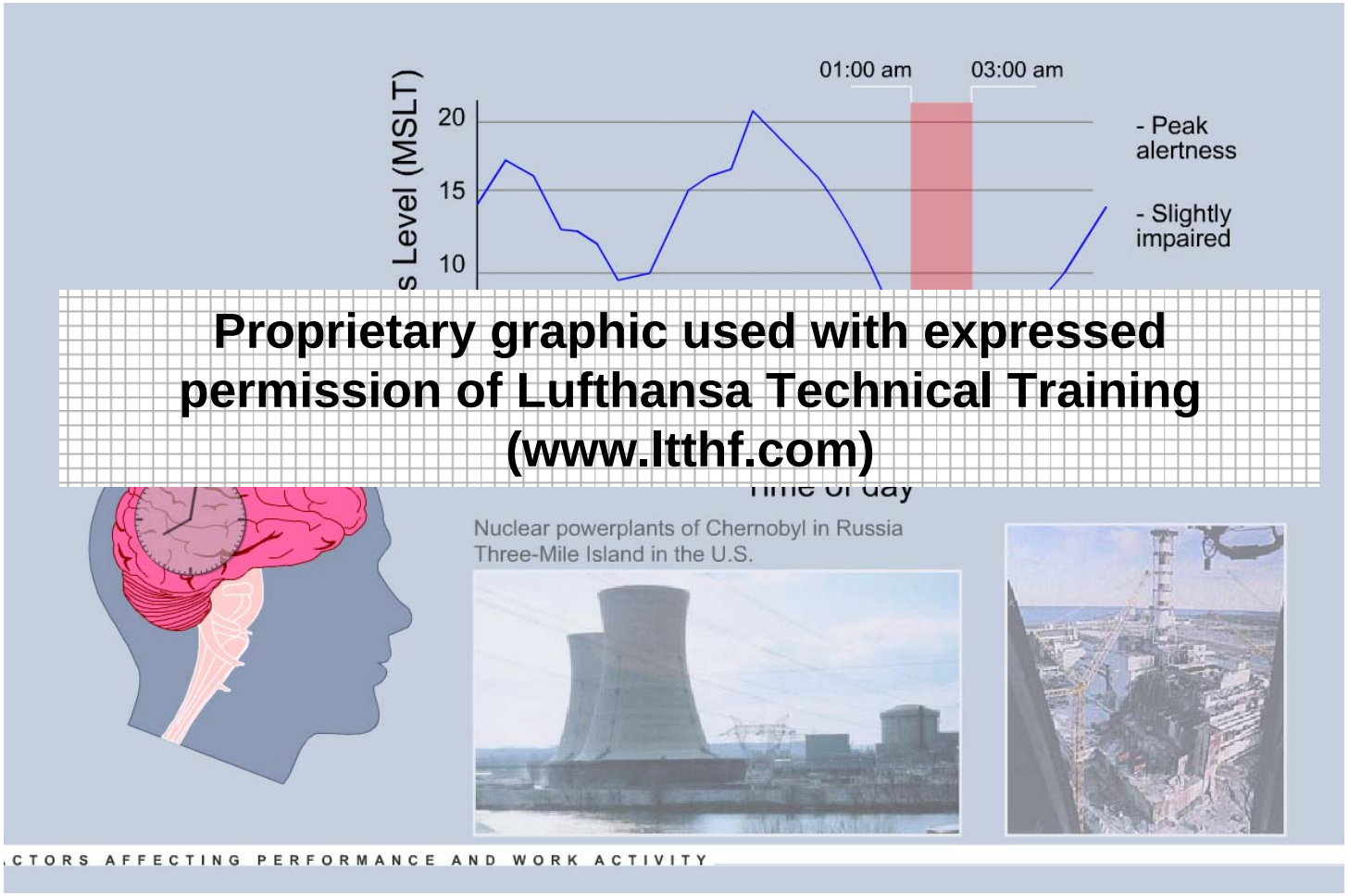
The Fatigue Issue is not New!

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

William Shakespeare

1564-1616

Bad Things can happen when not alert!

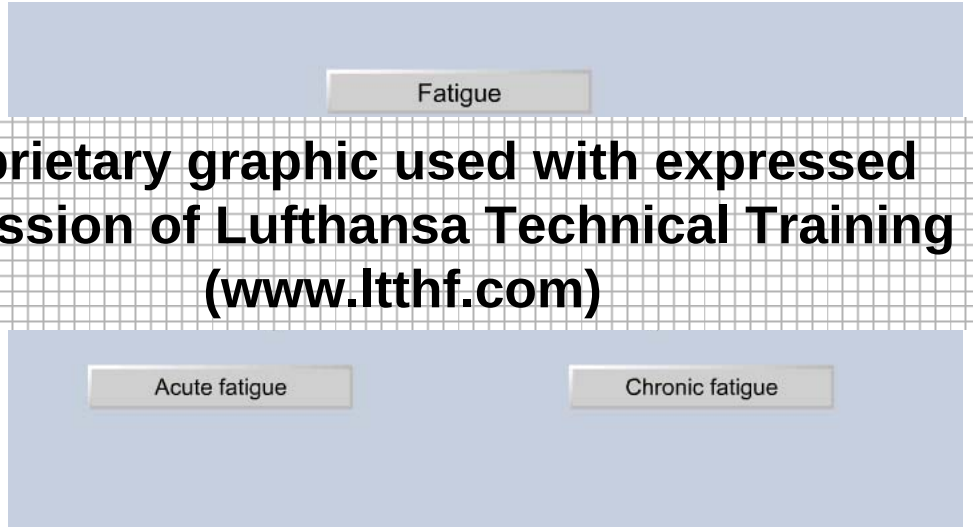


Link

Types of Fatigue

Acute Fatigue

- Intense
- Short Duration
- Cured with a good night's sleep



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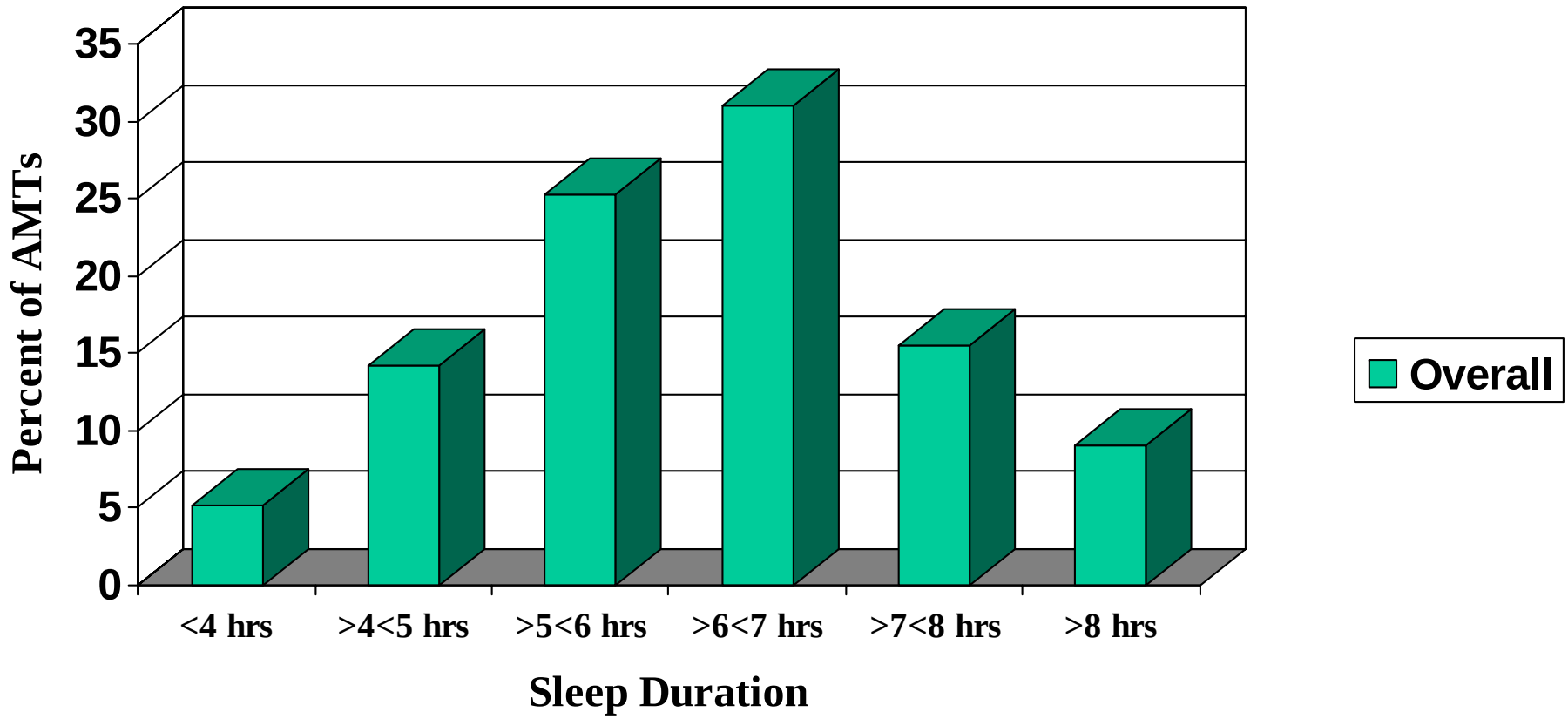
Chronic Fatigue (harder to fix)

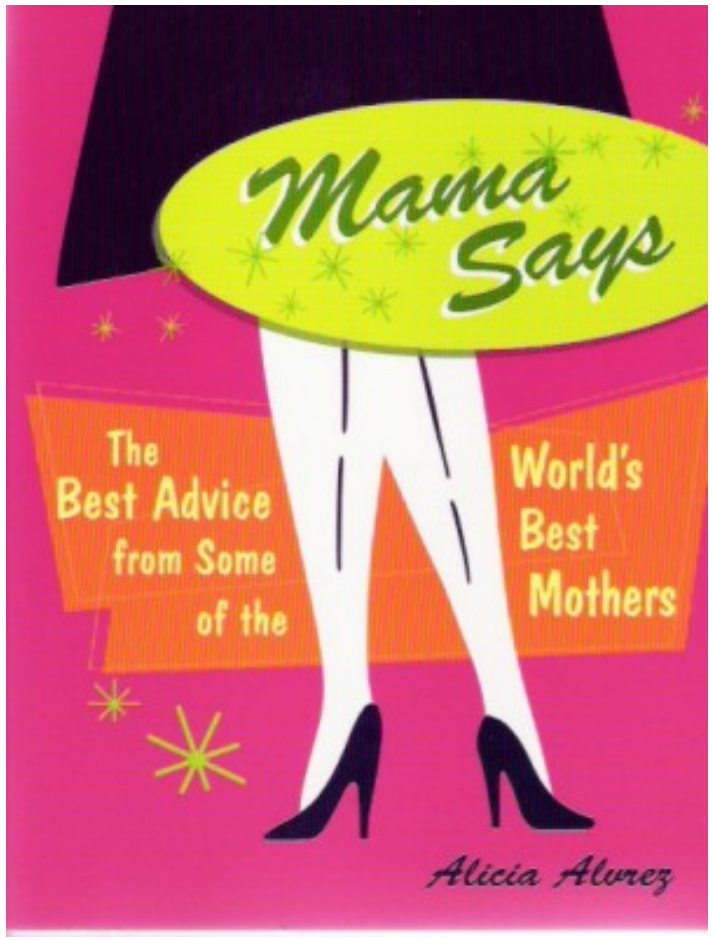
- Frequent recurrence
- Long duration
- Slow recovery
- Often a physical sickness or mental stress causing chronic fatigue.

Percent of AMTs from All Shifts by Sleep Duration



Johnson, et al, 2001

Regarding sleep: Do what your mama told you.



Agenda

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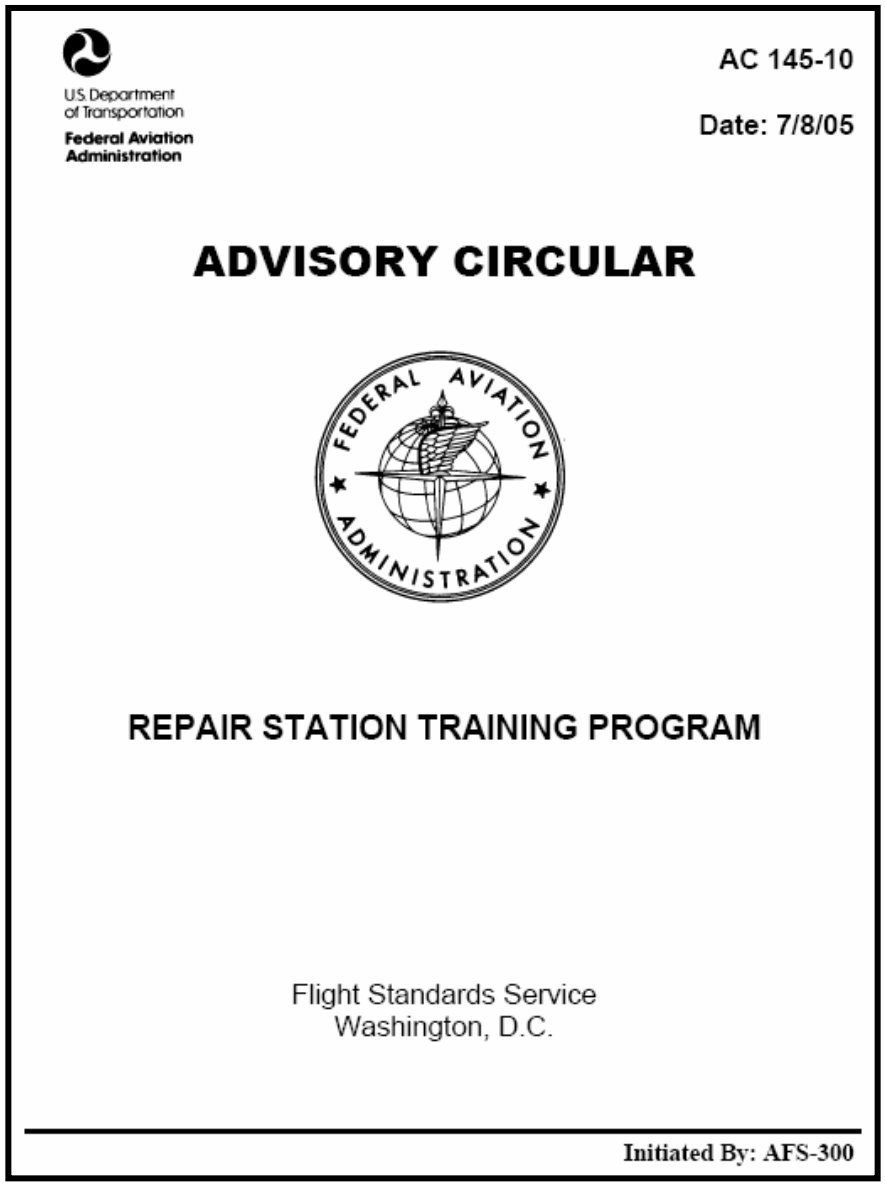
Comparing International Regulations

Topic	ICAO	EASA	TC	FAA
HF for Initial Certification	Annex 1	145.A.30(e) incl AMC&GM 145.A.30(i)	CAR 573.06	No
Continuation Training for HF	Annex 6	145.A.35 (d)	CAR 573.06	Recommended in ACs
Error Management System	Guidance	145.A.60	CAR 1	Rec, 145.211
Fatigue Management System	Guidance	145.A.30(d) incl. AMC	Proposed, now awaiting consul.	Guidance in Tech Pubs 121.377
Accountable Executive	No	145.A.30	CAR 106	No
Published HF Guidance Materials	Doc 9683-AN/950	GM145.A.30 (e) &Part 66 Appendix I M9	TP 13459	AC120-72
Documentation Reporting Requirement	Guidance	145.A.45	CAR 573.08	145.109 121.369
Safety Culture/Safety Management System	Under development Annex 6	145.A.65	CAR 573.30	Continuing Analysis and Surveillance System
Procedural Non-compliance	Guidance	145.A.65 (c)	CAR 571.05	No
Planning of tasks, equipment, and spares	Guidance	145.A.47	No	145.109
Shift and task handover	Guidance	145.A.47	CAR 573.08	121.369 (b) 9 135.427(b) 9
Error capturing (duplicate inspections)	Guidance	145.A.65 (b)3	CAR 571.10	121.371



U.S. Department of Transportation
Federal Aviation Administration

AC 145-10

Date: 7/8/05

ADVISORY CIRCULAR

REPAIR STATION TRAINING PROGRAM

Flight Standards Service
Washington, D.C.

Initiated By: AFS-300

FAA HF Guidance for Part 145

- FAA AC 145-10, Ch. 3, §301(c)

> - The FAA **concurs** with European Authorities in that human factors training related to maintenance practices would provide an additional margin of safety to the repair industry;
> - A human factors training program should be related to **maintenance practices** where possible;

- At this time it is recommended. It is not an FAA regulation.
- EASA Certificate holder's must follow EASA rules

HBAW 06-04 Accepting an HF Training Program

(1) Attend an entire training session.

(2) Do training requirements match and company priorities (Ref. AC 120-72) ?

(3) Is the human factors training is a cooperative development between the workforce and management.

(4) Is training is provided to appropriate work groups?

(5) Is content and delivery techniques match the audience.

HBAW 06-04 Accepting an HF Training Program (Con't)

(6) Check for training evaluation. Verify that feedback is provided to the instructors and management.

(7) Key references in the Operator's Manual for Human Factors in Aviation Maintenance provide additional information helpful for evaluation.

(8) These same steps are applicable to acceptance or approval of an EASA Human Factors Training Program.

Agenda

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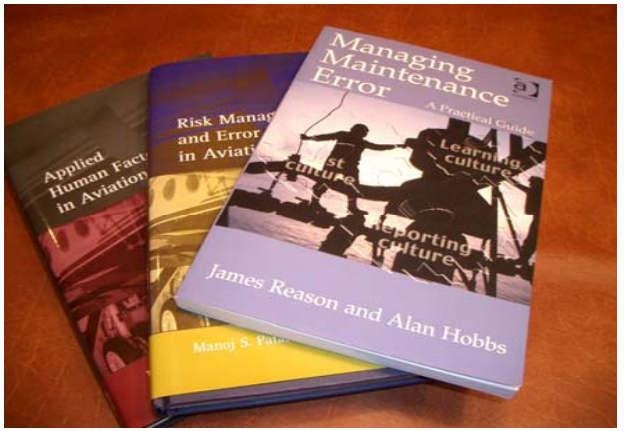
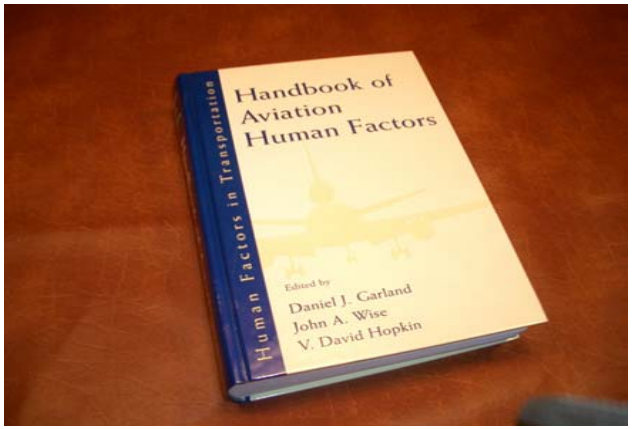
Plenty of HF Guidance in the World!

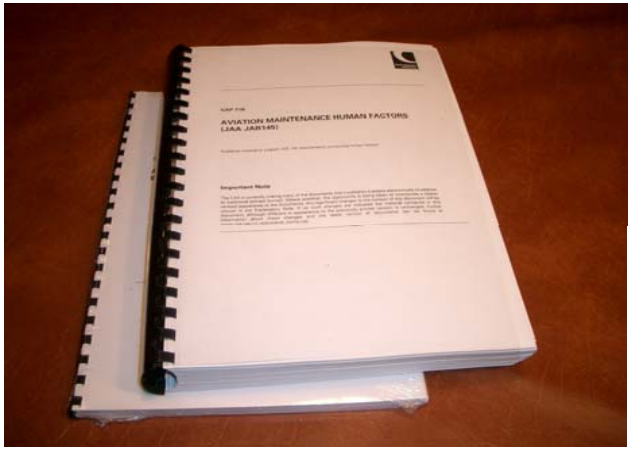
900 pgs.
1996



551 pgs.
2003-04

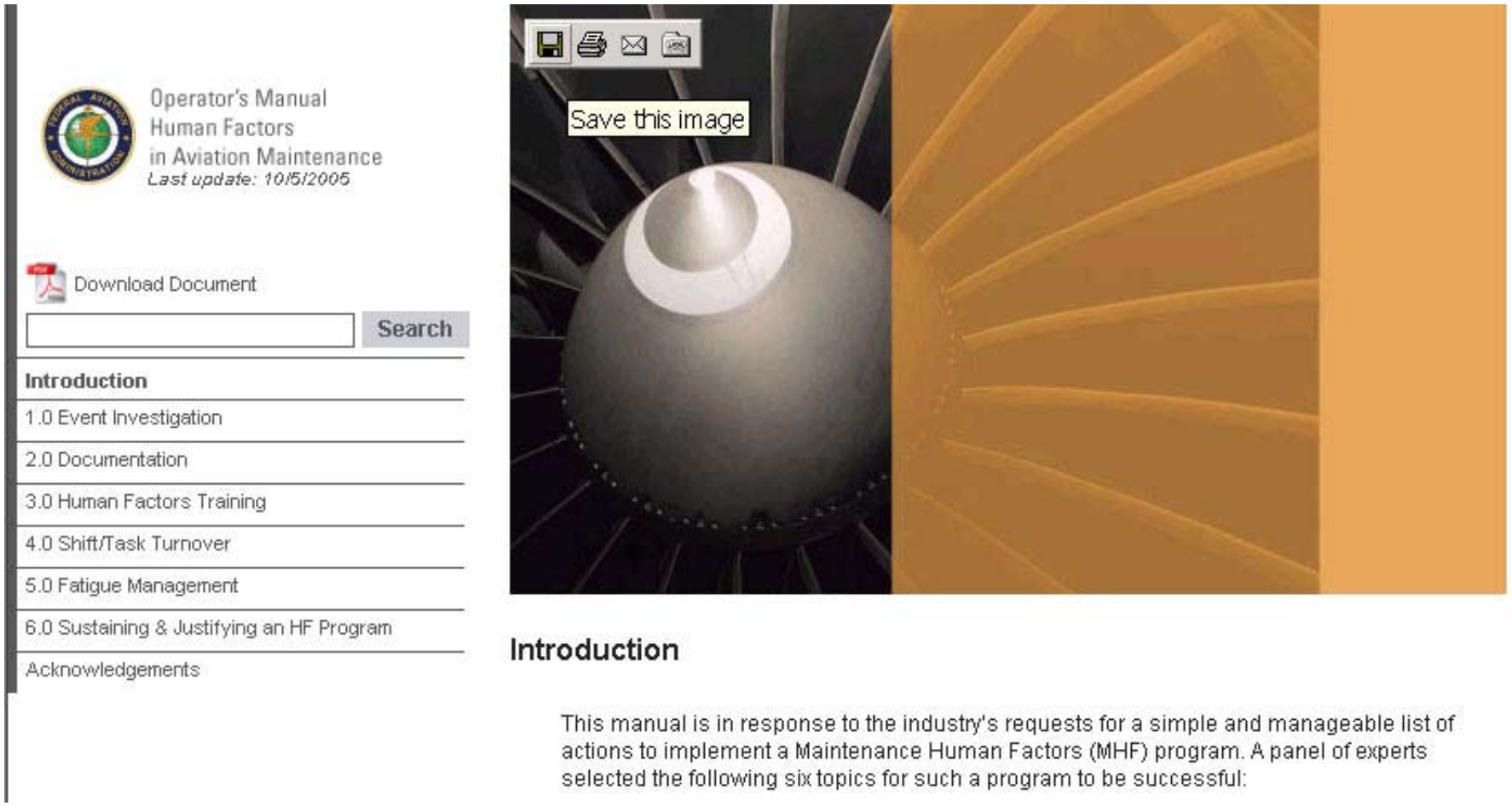


695 pgs.
1999



1000 pgs.
2002

This is Website Home Page



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

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

NTSB/AAR-04/01

2. Documentation

"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

"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

"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

"...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

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

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

3 key references plus slides

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).

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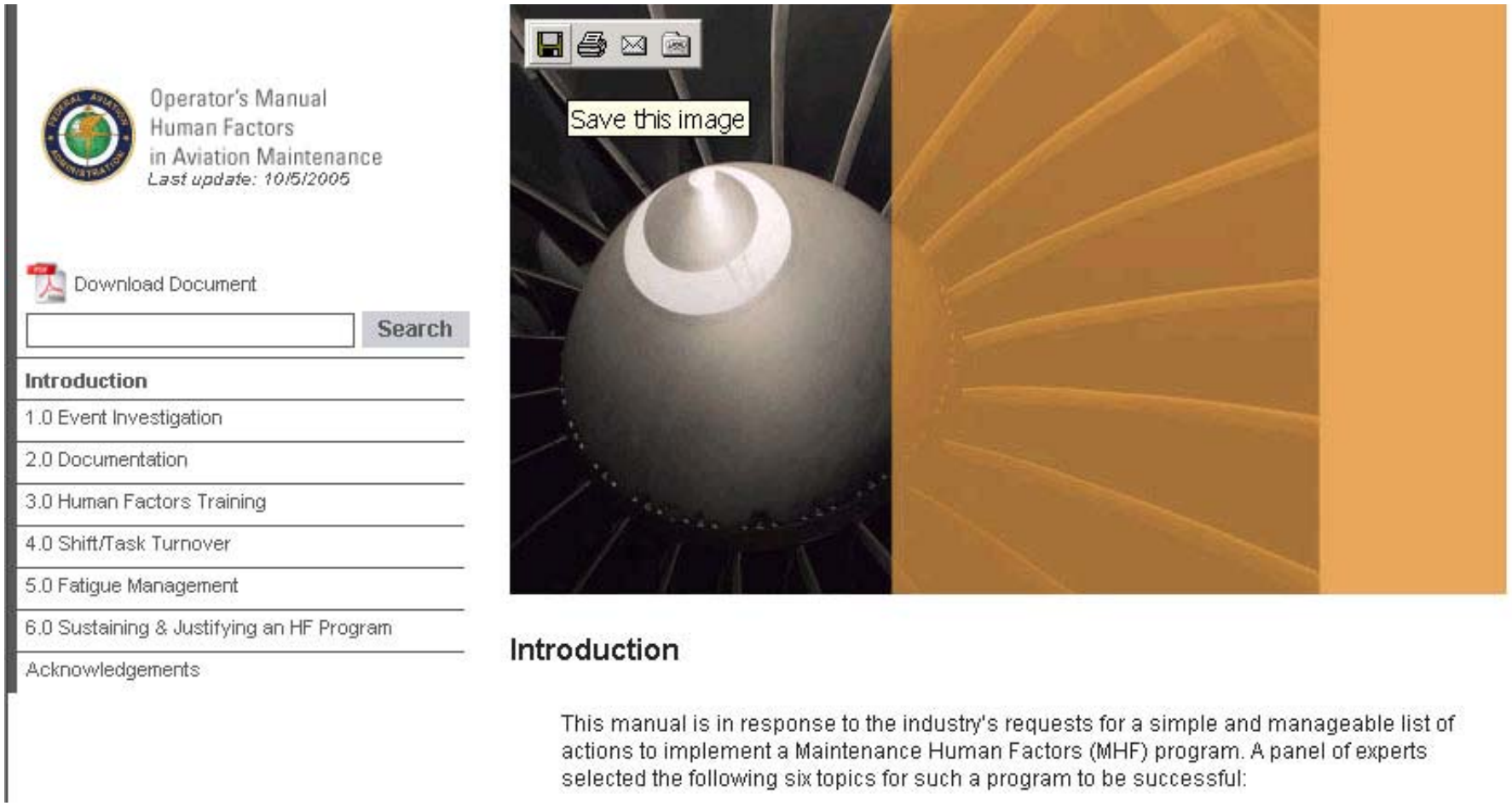


www.hf.faa.gov/opsmanual

Agenda

2005 International Safety Data with Human Factors Implications

Human Factors Fundamentals and Review

Status of US & International Regulations

Operator‘s Manual for HF in Aviation Maintenance

2006+ FAA Human Factors Activities

- **International Conference (ATA)**

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

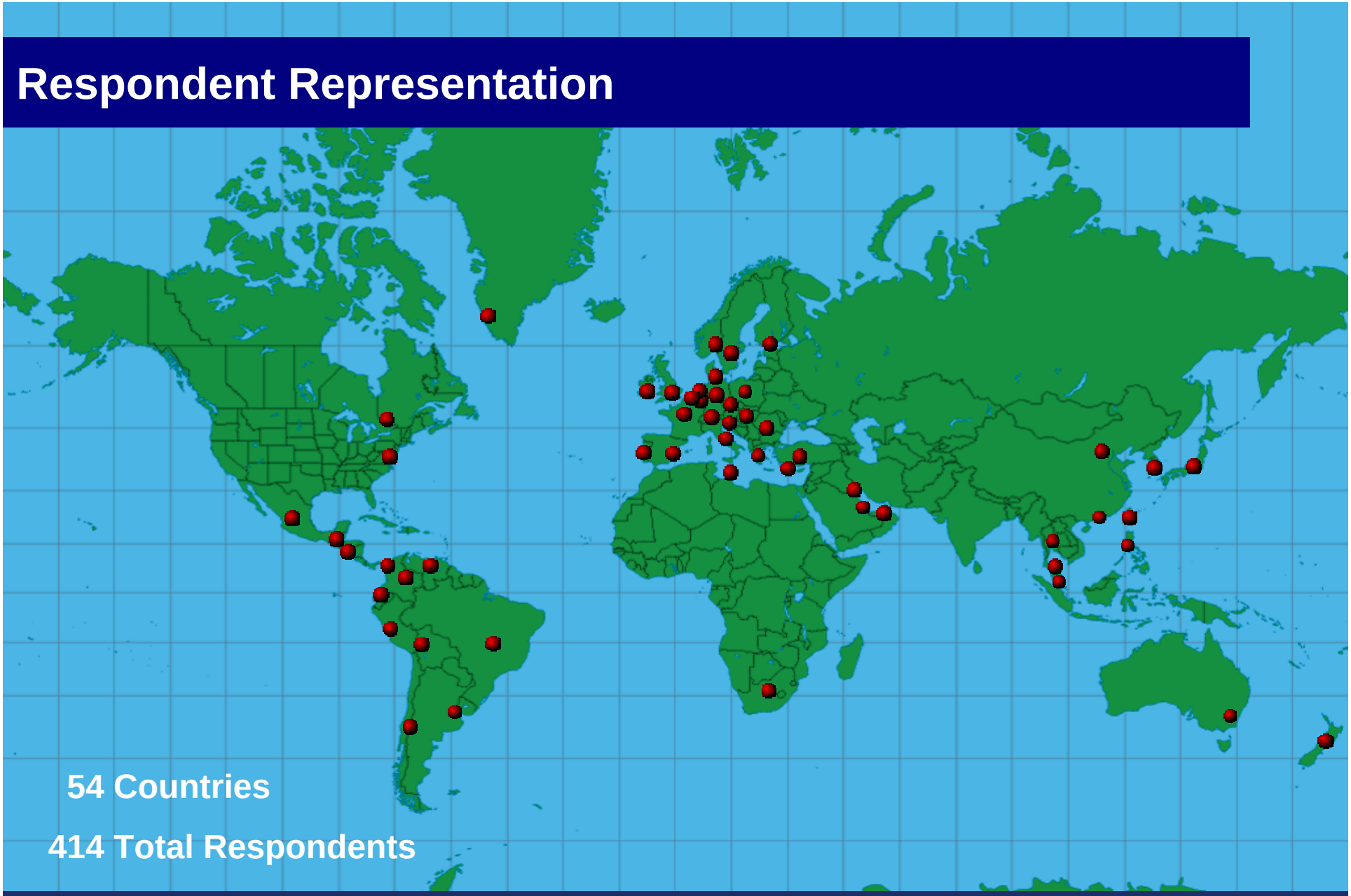
- **Unmanned Aerial Systems (NASA)**

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

Survey Goals and Methods

- Purpose: Assess status of maintenance HF
- Focus: program support and motivation, organizational policies, fatigue management, error management, and training.
- Distribution: Online survey (80 items) 630 addresses.
- Returns: 414 respondents (66%) from 54 countries.
- Experience: 65% > 20 yrs. maintenance experience.

Respondent Representation



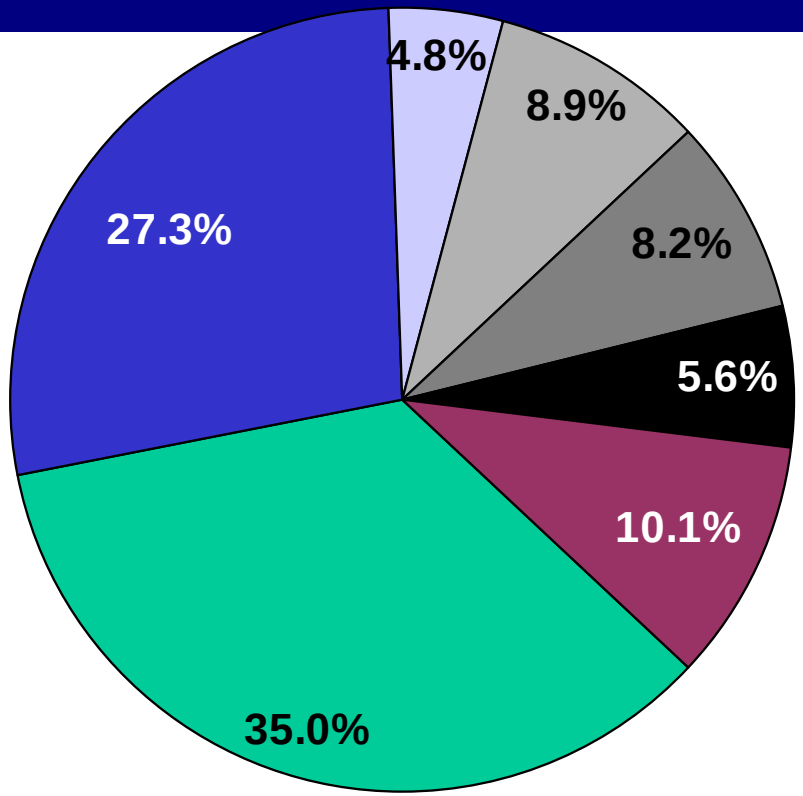
54 Countries

414 Total Respondents

Aviation North Expo 2006

Federal Aviation Administration

Where do you work?

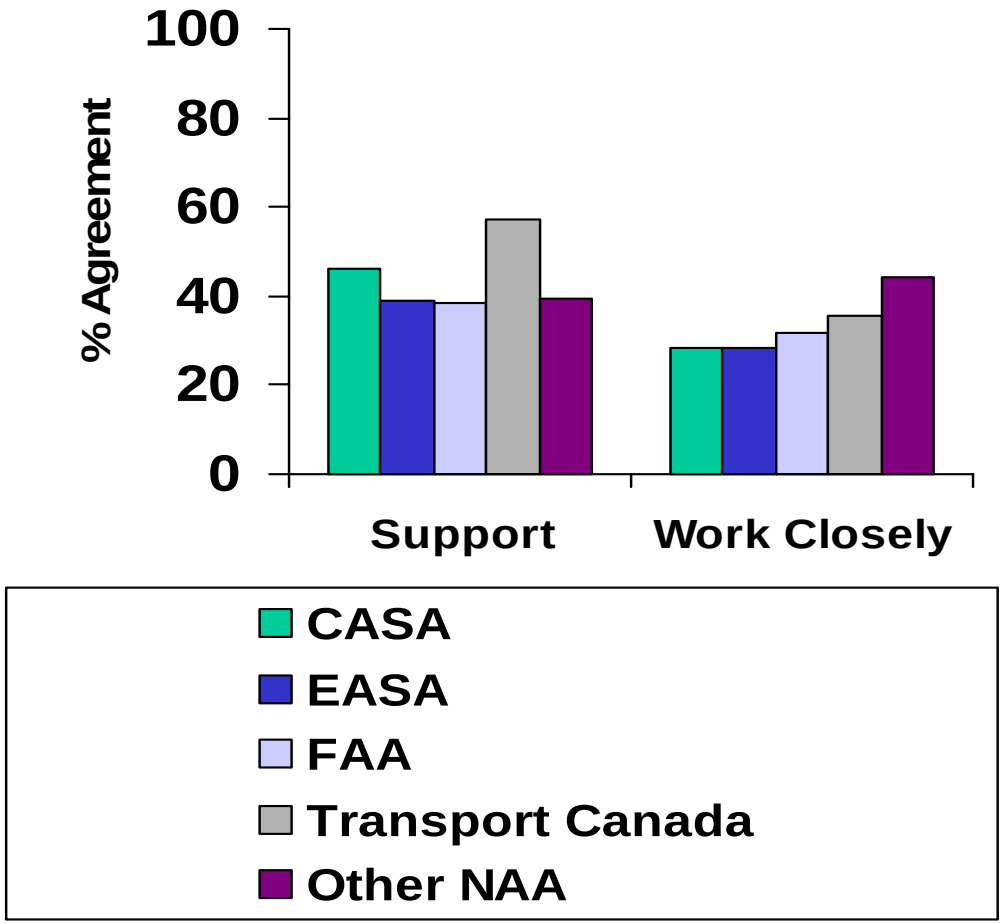


Regulatory Compliance

Which is the primary regulatory authority your maintenance operations are designed to be in compliance with? N=404

Civil Aviation Safety Authority (CASA) N=19	4.7%
European Aviation Safety Agency (EASA) N=95	23.5%
Federal Aviation Administration (FAA) N=182	45%
Transport Canada N=36	8.9%
Other National Aviation Authority N=72	17.8%

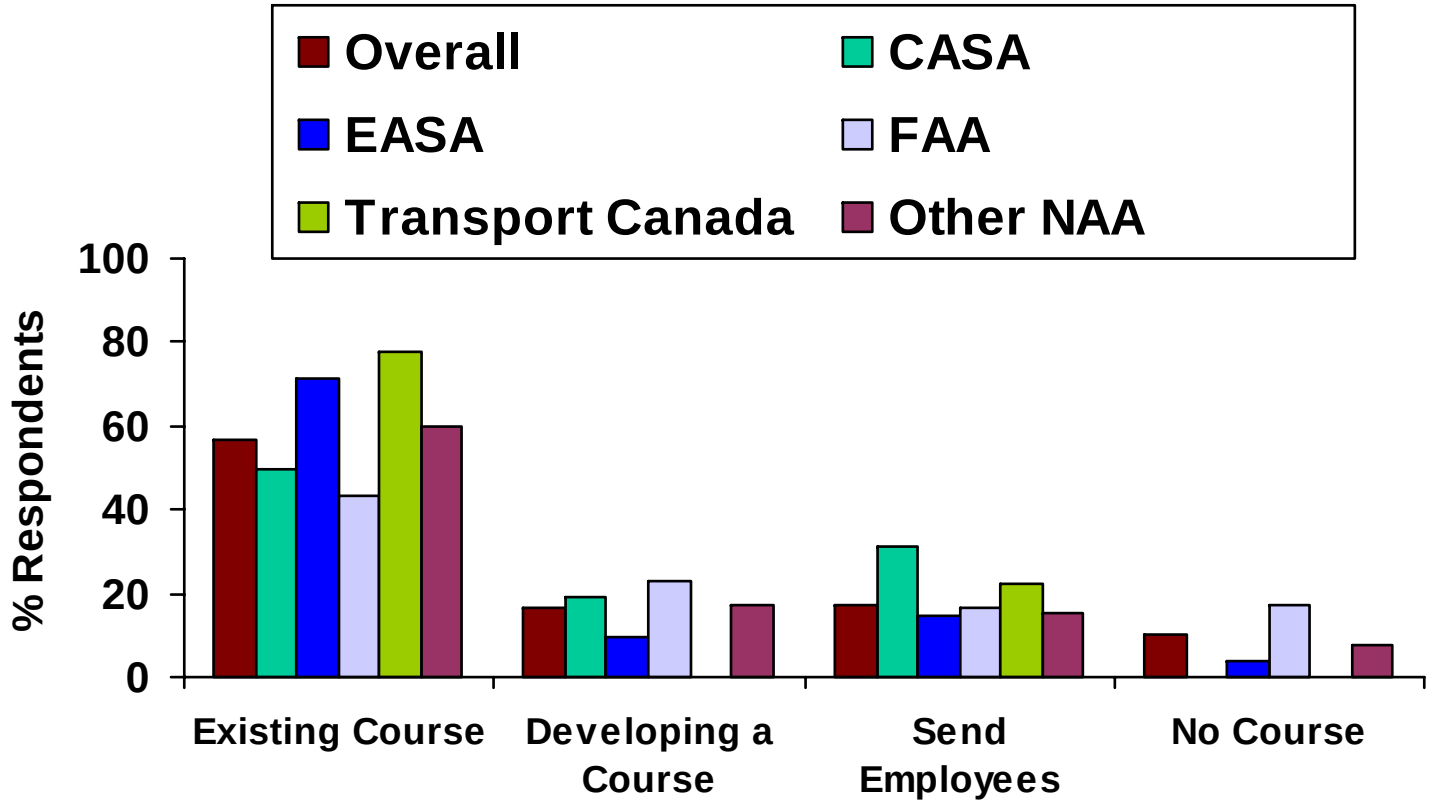
Regulatory Support and Close Work



Fatigue is “Important” but few programs

- Impact of fatigue was recognized by 82.1%.
- Fatigue Management System
  - Overall, 25% have a fatigue management system.
- Training on Fatigue Management
  - 35.9% provide training on fatigue management.

Transport Canada and EASA have HF Training



Challenges – High Priorities

- **Maintenance HF Regulations: 65, 121, 135,145, 147.**
- **Fatigue R&D? Guidance? Regulation?**
- **Advanced Technologies, VLJs, Rotorcraft, UAVs, Avionics, Commercial Space travel, Aging Aircraft, …..**
- **General Aviation Maintenance HF**
- **SMS in Maintenance**

Summary

- 2005 Safety Data with HF Implications
- Human Factors Fundamentals and Review
- Int'l Regulations
- Operator's Manual for HF in Aviation Maintenance
- 2006+ FAA Human Factors Activities

Federal Aviation Administration

Inspection Authorization Workshop
February 25, 2006

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