

# Ensuring Supply Quality and Safety with Attention to Human Factors

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**AVIATION SUPPLIERS**  
ASSOCIATION



Federal Aviation  
Administration



# Human Factors Spectacles



# Agenda

Why Human Factors

A Model for Audit

The Operator's Manual for Human Factors in Aviation Maintenance

Q&A



# Maintenance Errors and the Consequences

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
July 2006	Spectrum Aircraft	Spectrum 33	Mis-Rigging



# List some “Human Factors” related to maintenance?

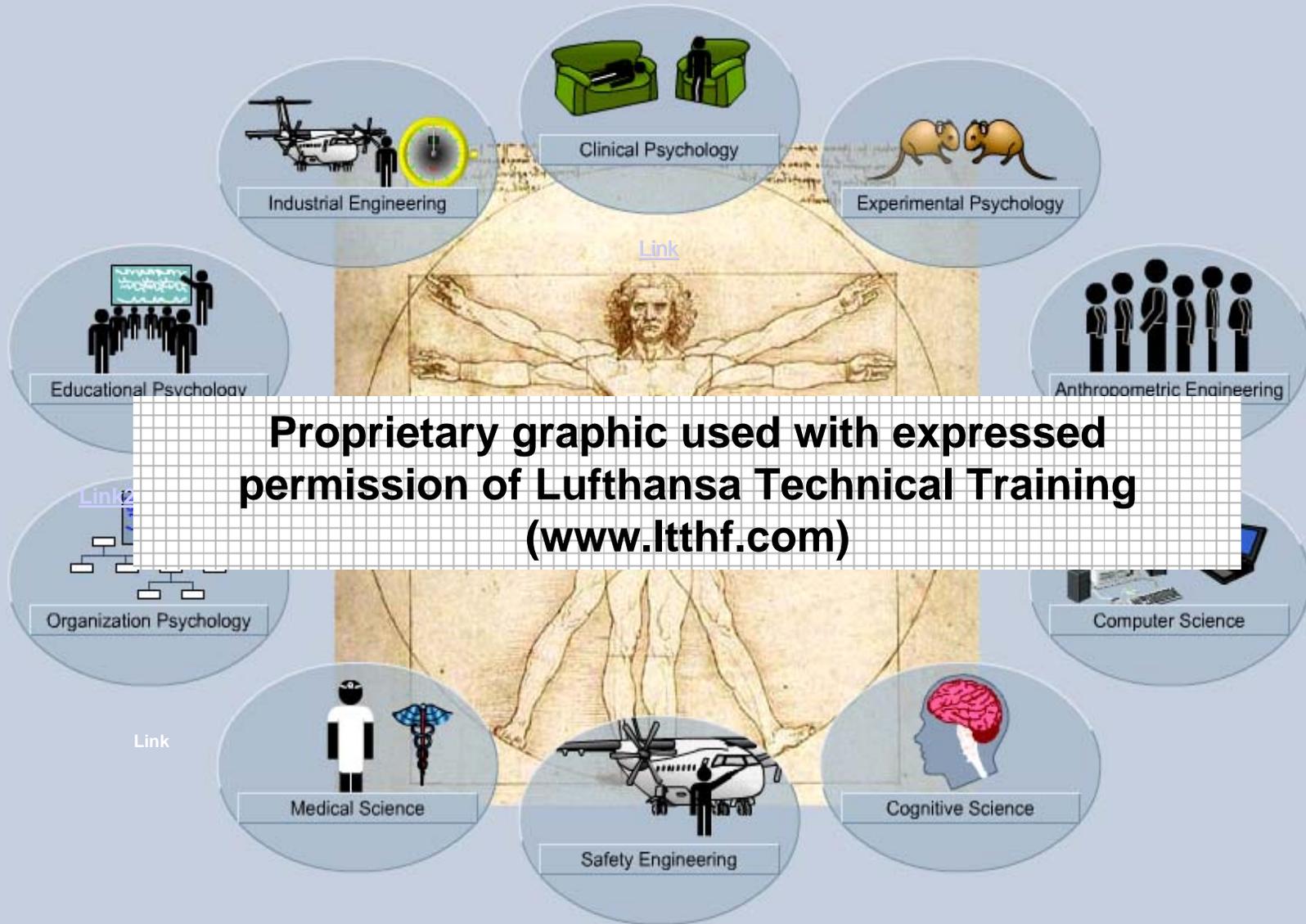
HUMAN FACTORS

fatigue  
boring repetitive jobs  
incomplete or incorrect documentation  
lack of spare parts and tools  
training  
personal life problems  
substance abuse  
unrealistic testing  
poorly designed testing for skill and knowledge  
slippery floors  
poor tool control  
poor instructions  
poor communication

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INTRODUCTION TO HUMAN FACTORS

01-03-00 1



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# The 12 Common Human Errors

## The Dirty Dozen

Lack of Communication

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Lack of Knowledge

Lack of Awareness

Lack of Resources

Distraction

Assertiveness

Fatigue

Stress

HUMAN ERROR

[Link](#)

# Human Factors Goal – Simply Stated

Ensure continuing safety and efficiency by paying attention to issues surrounding human performance.



# How to Accomplish the Goal



Pay attention to:

- the people,
- the environment in which they work,
- the actions they perform,
- and the resources necessary to perform the work.

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## Types of Human Factors Audits?

- **Regulatory Check:** Does the program comply with the regulations?
- **Sanity Check:** Is the HF program matched to company needs?
- **Performance Check:** Does the program change performance?
- **Financial Check:** Does it return on the investment?
- **Can the audit be replicated?**

***In any case an audit must measure those human performance attributes that will affect quality, efficiency, cost control, and safety.....***



**People  
Environment  
Actions  
Resources**



# PEAR Details: People

- **Physical Factors**
- **Physical size**
- **Sex**
- **Age**
- **Physical characteristics**
- **Strength**
- **Sensory limitations**
- **Physiological Factors**
- **Nutrition**
- **Health**
- **Lifestyle**
- **Alertness**
- **Fitness for Duty**
- **Chemical Dependence**
- **Psychological Factors**
- **Workload**
- **Experience**
- **Knowledge**
- **Training**
- **Attitude**
- **Mental or emotional state**
- **Psychosocial Factors**
- **Interpersonal conflicts**
- **Personal loss**



# PEAR Details: Environment

## Physical Environment

- Weather
- Location inside/outside
- Workspace
- Shift
- Lighting
- Noise
- Safety



- Morale
- Culture

# PEAR Details: Actions

- **Steps to complete task**
- **Task sequencing**
- **Performance standards**
- **Number of people involved**
- **Communication**
  - **Oral**
  - **Visual**
  - **Written**
- **Information Control requirements**



# PEAR Details: Resources

- Procedures/Work Cards
- Manuals/Bulletins/FARs
- Test Equipment
- Hand/Power Tools
- Machine Tools
- Computers/Software
- Paperwork/Signoffs
- Time
- Forklifts/tugs
- Ladders/steps/work platforms
- Cranes hoist/jacks
- Fixtures
- Materials
- Task Lighting
- Manpower
- Training



## FAA has the fewest Human Factors requirements

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	145
Published HF Guidance Materials	Doc 9683-AN/950	GM145.A.30 (e) &Part 66 Appendix I M9	TP 13459	AC120-72, Ops Manual, FAA Website
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	ASAP
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

# FAA HF Guidance for Part 145

- FAA AC 145-10, Ch. 3, §301(c)

- The FAA **concur**s 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.



# Critical Elements to Assess Safety Culture\*

- Organizational Commitment
- Managerial Involvement
- Employee Empowerment
- Accountability System
- Reporting System

\*(Weigmann, Zhang, vonThaden, Sharma, and Mitchell, 2002)



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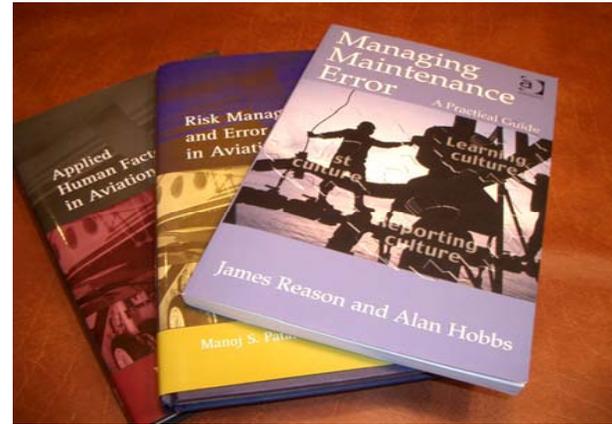
Q&A



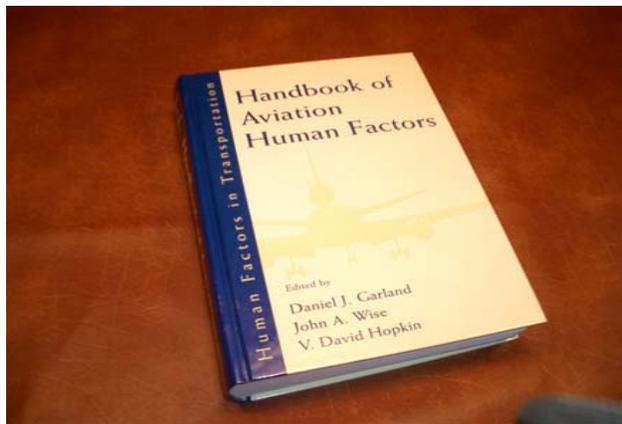
# Plenty of HF Guidance in the World!



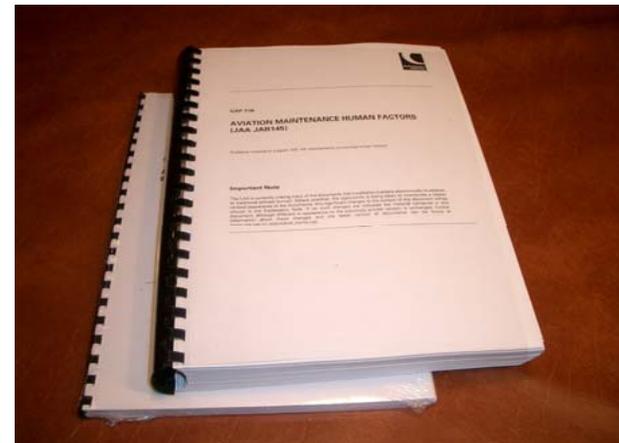
900 pgs.  
1996



551 pgs.  
2003-04



695 pgs.  
1999



1000 pgs.  
2002



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*Last update: 10/5/2005*



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### Introduction

1.0 Event Investigation

2.0 Documentation

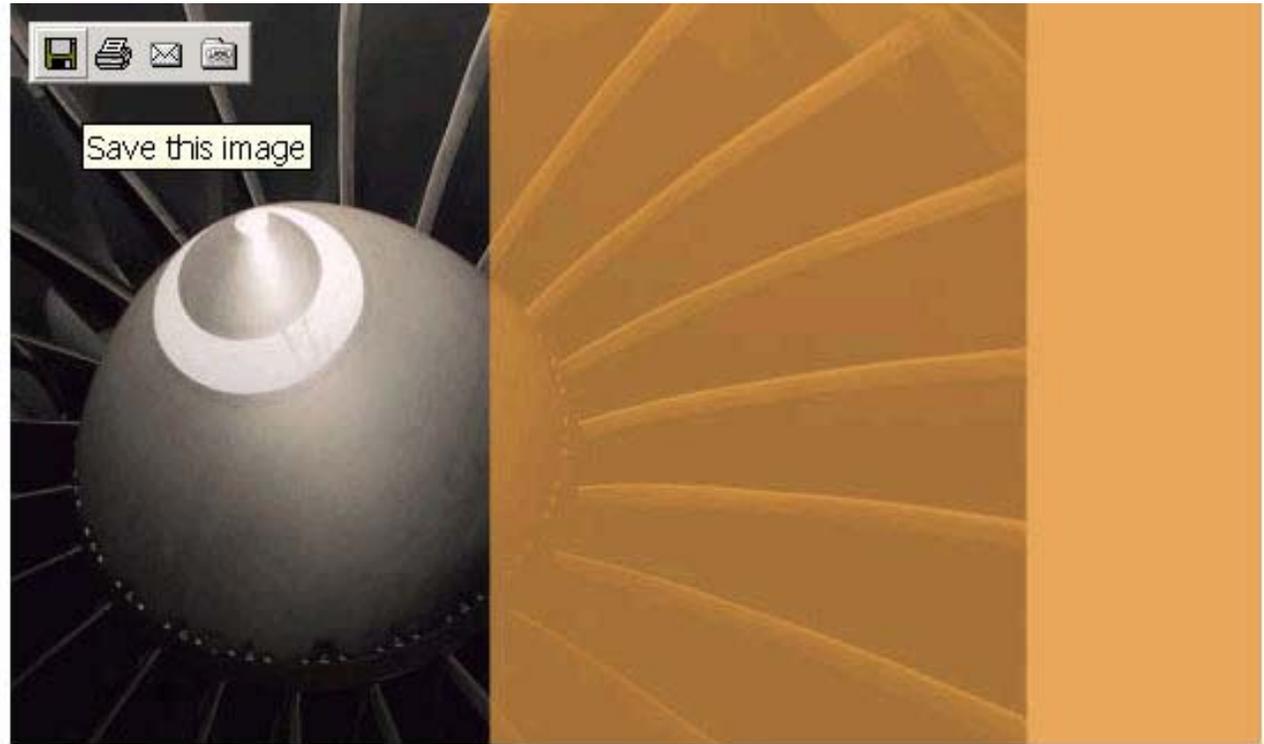
3.0 Human Factors

4.0 Shift/Task Turnover

5.0 Fatigue Management

6.0 Sustaining & Overhaul

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:



*"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

## EVENT INVESTIGATION

Chapter 1

<< < Page 1 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

## Shift / Task Turnover

Chapter 4

<< < Page 1 of 5 > >>



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

NTSB/AAR-04/01

## DOCUMENTATION

Chapter 2

<< < Page 1 of 5 > >>



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

AIRPORT INTERNAL REPORT

## FATIGUE MANAGEMENT

Chapter 5

<< < Page 1 of 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



*"...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

## SUSTAINING & JUSTIFYING AN HF PROGRAM

Chapter 6

<< < Page 1 of 5 > >>

## HUMAN FACTORS TRAINING

Chapter 3

<< < Page 1 of 5 > >>

# Operator's Manual 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)





Operator's Manual  
Human Factors  
in Aviation Maintenance  
Last update: 07.26.05





Introduction

1.0 Event Investigation

2.0 Documentation

3.0 Human Factors Training

4.0 Shift/task Handover

5.0 Fatigue Management

**6.0 Sustaining & Justifying an HF Program**

> 6.1 Why is Program Sustainability important?

6.2 How to sustain an HF program.

6.3 How do you know it is working?

6.4 Why is Cost Justification Important?

6.5 How to implement measures to quantify HF investments for cost justification.

6.6 What are the applicable regulations and references regarding Program Sustainability and Cost Justification?



"Maintenance human factors programs have come and gone based on the whim of the management in charge."

Continuing safety, a solid business case, and/or regulations are necessary to sustain a program"

## SUSTAINING & JUSTIFYING AN HF PROGRAM

6.0.0.0

<< < Page 1 of 5 > >>

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 Human Factors program. These 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 Human Factors initiatives and provide a straightforward consideration of cost justification.

### 6.1 Why is Program Sustainability important?

- Reducing errors and breaking error chains takes time to achieve, because a number of difficult organizational changes need to be accomplished. Some of these changes include understanding errors, developing both appropriate corrective actions and proactive error management techniques, putting in place effective training for leadership and workforce, implementing various process improvements, and fostering a cultural change.
- Motivation and enthusiasm for programs will subside if programs are constantly changing like a "flavor of the day."
- Programs must be sustained long enough to collect measurement data and demonstrate Return on Investment (ROI)

### 6.2 How to sustain an HF program.

- Establish a Steering Committee to develop and monitor planning and implementation of maintenance Human Factors programs.
- Start with a reasonable program plan with sufficient detail to secure a policy-level commitment from the leadership. Understand that this plan may change as the program evolves.



# 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





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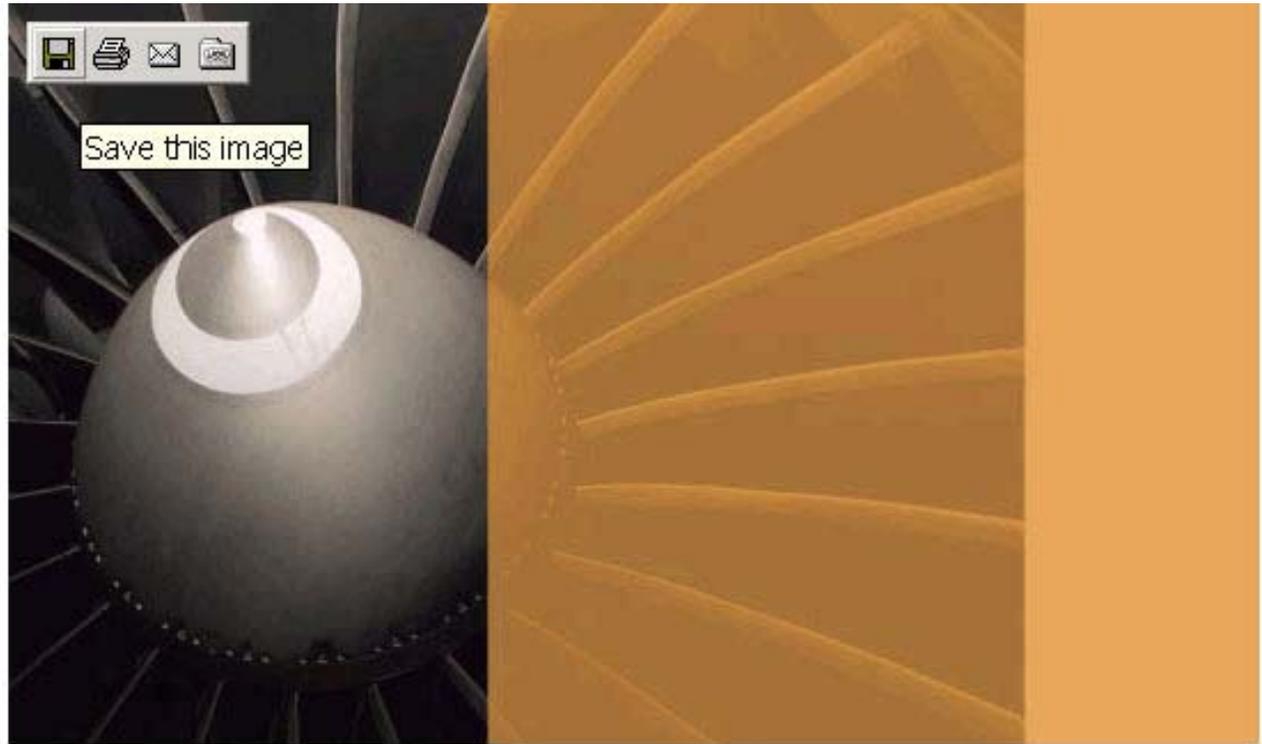
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[www.hf.faa.gov/opsmanual](http://www.hf.faa.gov/opsmanual)



# Challenges for FAA and Industry

- **Maintenance HF Regulations: 65, 121, 135,145, 147.**
- **Fitness for Duty Issues**
- **Advanced Technologies, VLJs, Rotorcraft, UAVs, Avionics, Commercial Space travel, Aging Aircraft, .....**
- **Ensuring Quality & Safety in all Maintenance Organizations**
- **General Aviation Maintenance HF**
- **SMS in Maintenance**



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*Thank you*

