Ensuring Supply Quality and Safety with Attention to Human Factors

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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

<table>
<thead>
<tr>
<th>Date</th>
<th>Company</th>
<th>Aircraft</th>
<th>Error Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 2000</td>
<td>Alaska Airlines</td>
<td>Boeing MD-80</td>
<td>Jackscrew for Elevator Control</td>
</tr>
<tr>
<td>Mar 2001</td>
<td>Lufthansa Airbus</td>
<td>A320</td>
<td>Mis-wired side stick</td>
</tr>
<tr>
<td>Apr 2001</td>
<td>Emery Worldwide</td>
<td>DC-8</td>
<td>Reversed hyd. check-valve</td>
</tr>
<tr>
<td>Aug 2001</td>
<td>Air Transat</td>
<td>A310</td>
<td>Fuel exhaustion over Atlantic</td>
</tr>
<tr>
<td>May 2002</td>
<td>China Airlines</td>
<td>B747-200</td>
<td>In flight break-up at 35K Ft.</td>
</tr>
<tr>
<td>Jan 2003</td>
<td>Air Midwest</td>
<td>Beech1900D</td>
<td>Trim Rigging</td>
</tr>
<tr>
<td>Aug 2003</td>
<td>Colgan Air</td>
<td>Beech 1900D</td>
<td>Trim Rigging</td>
</tr>
<tr>
<td>July 2006</td>
<td>Spectrum Aircraft</td>
<td>Spectrum 33</td>
<td>Mis-Rigging</td>
</tr>
</tbody>
</table>
List some “Human Factors” related to maintenance?

Proprietary graphic used with expressed permission of Lufthansa Technical Training (www.ltthf.com)
Proprietary graphic used with expressed permission of Lufthansa Technical Training (www.ltthf.com)
The 12 Common Human Errors

Lack of Communication

Lack of Knowledge

Lack of Awareness

Lack of Resources

Distraction

Assertiveness

Fatigue

Stress

Proprietary graphic used with expressed permission of Lufthansa Technical Training (www.ltthf.com)
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.........
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

<table>
<thead>
<tr>
<th>Topic</th>
<th>ICAO</th>
<th>EASA</th>
<th>TC</th>
<th>FAA</th>
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</thead>
<tbody>
<tr>
<td>HF for Initial Certification</td>
<td>Annex 1</td>
<td>145.A.30(e) incl AMC&amp;GM 145.A.30(l)</td>
<td>CAR 573.06</td>
<td>No</td>
</tr>
<tr>
<td>Continuation Training for HF</td>
<td>Annex 6</td>
<td>145.A.35 (d)</td>
<td>CAR 573.06</td>
<td>Recommended in ACs</td>
</tr>
<tr>
<td>Error Management System</td>
<td>Guidance</td>
<td>145.A.60</td>
<td>CAR 1</td>
<td>Rec, 145.211</td>
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<tr>
<td>Fatigue Management System</td>
<td>Guidance</td>
<td>145.A.30(d) incl. AMC</td>
<td>Proposed, now awaiting consul.</td>
<td>Guidance in Tech Pubs 121.377</td>
</tr>
<tr>
<td>Accountable Executive</td>
<td>No</td>
<td>145.A.30</td>
<td>CAR 106</td>
<td>145</td>
</tr>
<tr>
<td>Published HF Guidance Materials</td>
<td>Doc 9683-AN/950</td>
<td>GM145.A.30 (e) &amp;Part 66 Appendix I M9</td>
<td>TP 13459</td>
<td>AC120-72, Ops Manual, FAA Website</td>
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<tr>
<td>Documentation Reporting Requirement</td>
<td>Guidance</td>
<td>145.A.45</td>
<td>CAR 573.08</td>
<td>145.109 121.369</td>
</tr>
<tr>
<td>Procedural Non-compliance</td>
<td>Guidance</td>
<td>145.A.65 (c)</td>
<td>CAR 571.05</td>
<td>ASAP</td>
</tr>
<tr>
<td>Planning of tasks, equipment, and spares</td>
<td>Guidance</td>
<td>145.A.47</td>
<td>No</td>
<td>145.109 121.369</td>
</tr>
<tr>
<td>Shift and task handover</td>
<td>Guidance</td>
<td>145.A.47</td>
<td>CAR 573.08</td>
<td>121.369 (b) 135.427(b) 9</td>
</tr>
<tr>
<td>Error capturing (duplicate inspections)</td>
<td>Guidance</td>
<td>145.A.65 (b)3</td>
<td>CAR 571.10</td>
<td>121.371</td>
</tr>
</tbody>
</table>
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 a cooperative development between the workforce and management?

(4) Is training 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

695 pgs. 1999

551 pgs. 2003-04

1000 pgs. 2002
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:
“Jack screw 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

Shift / Task Turnover
Chapter 4

“A combination of 16 hours of straight work compounded by influenza contributed to fatigue and falling asleep at the wheel…”

AIRPORT INTERNAL REPORT

“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 whim... 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.E. JOHNSON, FAA

SUSTAINING & JUSTIFYING AN HF PROGRAM
Chapter 6

“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 EASTUFLAS

EVENT INVESTIGATION
Chapter 1

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

NTSB AAR-03/01

DOCUMENTATION
Chapter 2

FATIGUE MANAGEMENT
Chapter 5

ASA Meeting – Dallas, TX
November 3, 2006

Federal Aviation Administration
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)
“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

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.
6.0 Sustaining & Justifying an HF Program

6.6 Key References

A. Sustaining & Justifying an HF Program presentation (Download Document).


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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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Q&A

Thank you