Fundamentals of Human Factors in Aviation Maintenance

Jay Hiles
Federal Aviation Administration
ASI Maintenance Human Factors
Headquarters

John.j.hiles@faa.gov
202 267 8625

ICT October 31, 2006
FEDERAL AVIATION ADMINISTRATION

- FAA – (AFS-330)
- Air Carrier Maintenance Branch
- Maintenance Human Factors
- Background
FEDERAL AVIATION ADMINISTRATION

ANOTHER NEW ADDITION TO THE FAA

Dr. Bill Johnson

• Chief Scientist and Technical Advisor for Maintenance Human Factors (CSTA)
Human Factors Video

A Vision for Aviation Maintenance
PRESENTATION GOAL

• My goal today is to provide you with a brief overview of what maintenance Human Factors is all about.

• It is my hope that you will take something away from this presentation to help reinforce the importance of having a good Human Factors program!
ARE YOUR READY?

• This is a somewhat interactive presentation…

  In other words, If I ask a question, you need to respond!
AVIATION ACCIDENTS

HUMAN CAUSES

MACHINE CAUSES

1903

TIME

TODAY

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%

TODAY
• So what is this stuff called Maintenance Human Factors?
Human Factors

- focuses on human beings and their interaction with:
  - products
  - equipment
  - facilities
  - procedures
  - environments

... that we use at work and everyday living.
Human Factors

Attention to:

• the **People**,  
• the **Environment** in which they work,  
• the **Actions** they perform,  
• and the **Resources** necessary to perform the work.
People

- Physical Factors
  - Physical size
- Sex
- Age
- Physical characteristics
  - Strength
- Sensory limitations
- Physiological Factors
  - Nutrition
- Health
- Lifestyle
- Alertness

- Chemical Dependence
- Psychological Factors
  - Workload
- Experience
- Knowledge
- Training
- Attitude
  - Mental or emotional state
- Psychosocial Factors
  - Interpersonal conflicts
- Personal loss
- Fitness for Duty
Physical Environment
- Weather
- Location inside/outside
- Workspace
- Shift
- Lighting
- Noise
- Safety

Organizational Environment
- Personnel
- Supervision
- Union/Management relations
- Pressures
- Crew structure
- Size of company
- Profitability
- Morale
- Culture
Actions

• Steps to complete task
• Task sequencing
• Performance standards
• Number of people involved
• Communication
  • Oral
  • Visual
  • Written
• Information Control requirements
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
Good Human Factors

Ensuring continuing safety and efficiency by paying attention to issues surrounding human performance.
Good Human Factors Practices

Should also -

• Put emphasis on human beings –
  • and how the design of products influences how people interact with them.
Focus on Human Factors

Example:

- Take a machine or product that is the result of human factors technology, and it is usually:
  - Safer
  - Easier to use
  - Results in less fatigue
  - More satisfying to the user

How about an aviation example or two?
Designing systems to fit people

- Aircraft
- Automobiles
- Computer Work Stations
- Safety Features
The information below represents events that led to the development of Human Factors in the airline industry.

- United Airlines Flt 173, Portland, Oregon, December 28, 1978
- Aloha Airlines Flt 243, Maui, Hawaii, April 28, 1988
- Air Ontario Flt 1363, Dryden, Ontario, March 10, 1989

- Cockpit Resource Management (CRM)
- Crew Resource Management (LOFT)
- Line Oriented Flight Training (HPIM)
- Human Performance in Maintenance (MRM)
- Maintenance Resource Management (Human Factors in Aircraft Maintenance Systems)
Gear Problem turned into fuel starvation

“Events always speak louder than Human Factors specialists”
“Events always speak louder than Human Factors specialists”
“Events always speak louder than Human Factors specialists”
Top eight maintenance problems listed in order of occurrence:
(Graber & Marx)

1. Incorrect installation of components
2. The fitting of wrong parts
3. Electrical wiring discrepancies (including cross-connections)
4. Loose objects (tools, etc.....) left in aircraft
5. Inadequate lubrication
6. Cowplings, access panels and fairings not secured
7. Fuel/oil caps and refuel panels not secured
8. Landing gear ground lock pins not removed before departures
FEDERAL AVIATION ADMINISTRATION

#1 REASON AVIATION MECHANICS GET THEMSELVES IN TO TROUBLE?

Failure to follow procedures!
Understanding Errors –

Question and answer time!

In other words-I can have some fun!
?? OPEN QUESTION ??

What is Human Error?
HUMAN ERROR

The \textit{unintentional act} of performing a task

- incorrectly - or failing to perform a task, which

- can \textit{potentially degrade the system}. 
What causes Human Error?

Actually two big hitter’s in the aviation world
TYPES OF HUMAN ERROR

1. **Error of omission:**
   Failure to do a task or procedure step
   (simply just didn’t do it)

2. **Error of commission:**
   Incorrect performance of a task (thinking one thing but doing something else)
FEDERAL AVIATION ADMINISTRATION

ERRORS OF OMISSION

- Omissions account for nearly 60% of all recorded maintenance lapses in major airlines.*

THE NUT AND BOLT EXAMPLE

• How many ways are there to disassemble the nuts from this bolt?

• Over 40,000 ways of going wrong in reassembly

• (excluding omissions)
CONSEQUENCES OF HUMAN ERROR

• Little or no effect
• Physical damage to equipment
• Personal injury
• Catastrophic event
FEDERAL AVIATION ADMINISTRATION

CONSEQUENCE OF HUMAN ERROR

Intentional Act
"TO ERROR IS HUMAN"

• To make errors is a natural part of being human…

  • In fact, it is the basis of learning,
    • most of what we have learned has been a result of “trial and error”.
HUMAN ERRORS CAN HAPPEN ANYWHERE ANYTIME

Because we...

- Perform actions
- Read and interpret data
- Make critical decisions
THEREFORE

• We can not eliminate *Human Error*

• Instead, we must learn to *MANAGE* it!
OVERALL, WE HAVE LEARNED TO MANAGE ERRORS FAIRLY EFFECTIVELY

- Maintenance Inspection - Buy backs, RII’s,
- Detailed Procedures
- Checklists
- Erasers On Pencils
- Spill Check - Spell Check

We can still do better!
What is the Greatest Hazard to Aircraft?

Gravity

Humans
Simply Put...

- Aside from gravity itself, the greatest hazard facing modern aircraft comes from people.
Can you provide examples of Human Factor issues that you have witnessed with your Jobs?

Proprietary graphic used with expressed permission of Lufthansa Technical Training (www.ltthf.com)
Factors Line up to Cause an Event – Like Swiss Cheese

Some holes are active
Worker
Fatigue

Poor Training
Tooling

Bad Lighting

Some holes Are latent
Mgmt

People
Environment
Actions
Resources
FEDERAL AVIATION ADMINISTRATION

• ANYBODY EVER HEARD OF A CHAIN OF EVENTS?

GOOD – IT IS ANOTHER WAY OF LOOKING AT THIS!
Chain of Events

- Multiple contributing causes that can lead to an accident.
  - Fatigue
  - Tooling
  - Bad Lighting
  - Poor Training

Accident
Preventing any event could prevent the accident

Management → Break the Chain of Events! → Crew

Maintenance

If we can break the chain the accident doesn’t happen!
Consequences

Nobody Broke the Chain!

Little or no effect

Personal injury - ?

*Equipment damage* - ?

Catastrophic event - ?
THE DIRTY DOZEN

LACK OF RESOURCES
LACK OF COMMUNICATION

ASSERTIVENESS
DISTRACTION

NORMS
FATIGUE

LACK OF AWARENESS
LACK OF TEAMWORK

PRESSURE
COMPLACENCY

LACK OF KNOWLEDGE
STRESS
Dirty Dozen

- **Lack of Communication**
  - A lack of clear direct statements and good, active listening skills.

- **Complacency**
  - Self-satisfaction accompanied by a loss of awareness of the dangers.

- **Lack of Knowledge**
  - Lack of experience or training in the task at hand.

- **Distraction**
  - Draw one’s attention away, mental emotional, confusion or disturbance.
Dirty Dozen

- **Lack of Teamwork**
  - Lack of working together to achieve a common goal

- **Fatigue**
  - Weariness from labor or exertion, nervous exhaustion, temporary loss of power to respond

- **Lack of Resources**
  - Failure to use or acquire the appropriate tools, equipment, information and procedures for the task at hand

- **Pressure**
  - Pushing for something in spite of opposing odds, creating a sense of urgency or haste
Dirty Dozen

• **Lack of Assertiveness**
  • A lack of positive communication of one’s ideas, wants and needs.
  To Speak Up

• **Stress**
  • Mental, emotional or physical tension, strain, or distress.

• **Lack of Awareness**
  • Failure to be alert or vigilant in observing.

• **Norms**
  • The commonly accepted practice of working routine jobs without the manual.
CONCLUSION

• Human error is typically unintentional
• Omissions = 60%
• Swiss Cheese / Chain of Events
• Breaking the Chain
• The Dirty Dozen
• 80% of all Aviation Accidents = Human Error
Conclusion

- FAA has the leaders and team to support & promote maintenance human factor initiatives
- Human Factors is basically how we interact with stuff
- You don’t want to be on the other end of an event
- Deal with the issues up front
Conclusion

• Technicians must be made aware of, and STAY AWARE of how Active and Latent errors can occur.

• Error reporting/investigation systems have the potential to reduce error.
  • ASAP, Internal Reporting Programs, MEDA, Etc.

• Greatest HAZARD TO AVIATION?

• Web Sites - http://hfskyway.faa.gov
  www.hf.faa.gov/opsmanual
Closing Comments

• I hope that you have enjoyed this presentation.

• Your commitment to quality can be contagious.

• Please, go spread this information at your places of work.

John.j.hiles@faa.gov