

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



230 4263
R425 410

150N
221 CST

UAL312
90A
321 420

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**



Federal Aviation
Administration

FEDERAL AVIATION ADMINISTRATION

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!



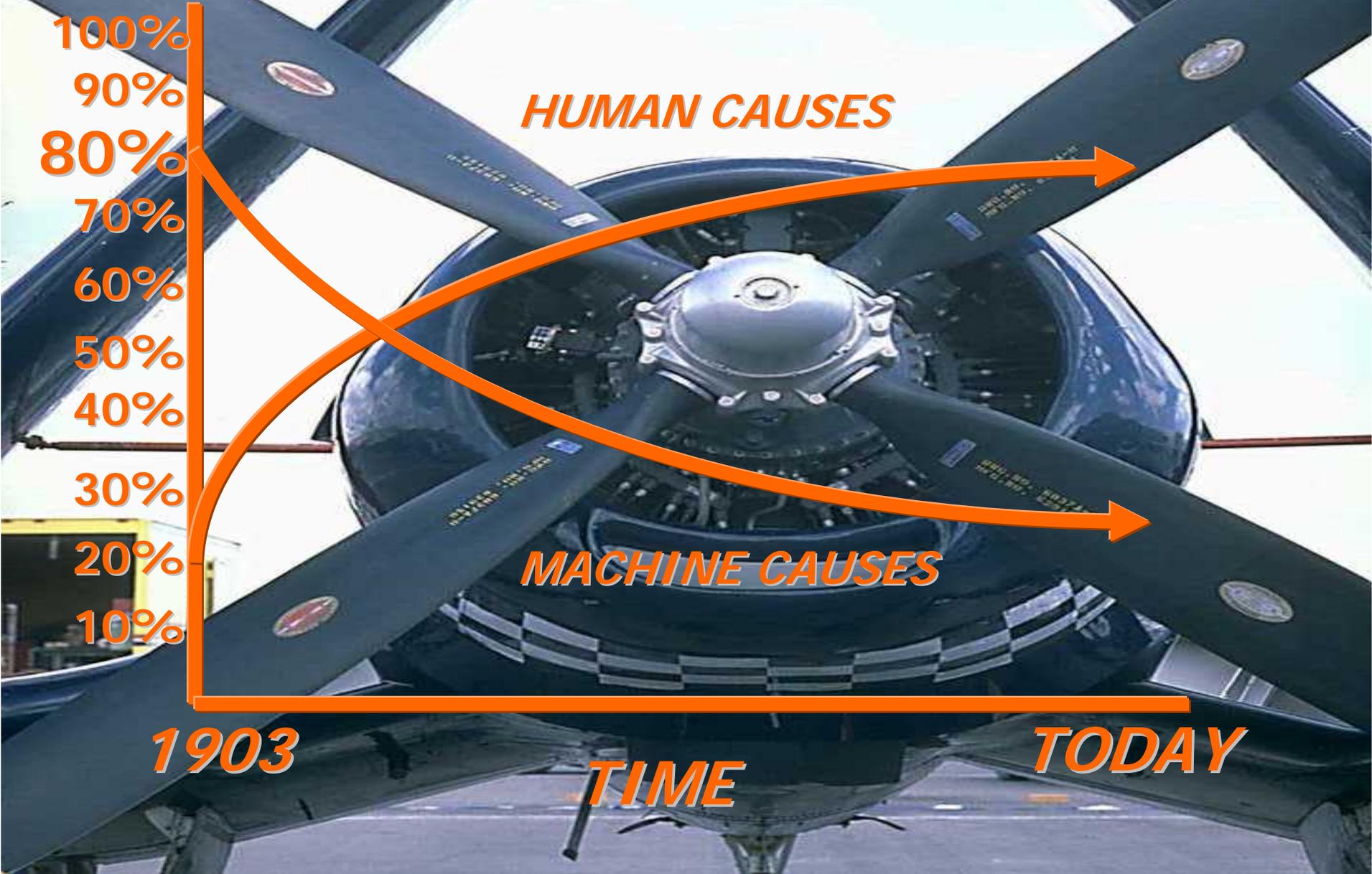
ARE YOU READY?

- This is a somewhat interactive presentation...

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



AVIATION ACCIDENTS



FEDERAL AVIATION ADMINISTRATION

- So what is this stuff called Maintenance Human Factors ?



FEDERAL AVIATION ADMINISTRATION

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

**People
Environment
Actions
Resources**



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

Environment

Physical Environment

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

People
Environment
Actions
Resources



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**

**People
Environment
Actions
Resources**



Good Human Factors

Ensuring continuing safety and efficiency

by- **paying attention to issues**

surrounding human performance.

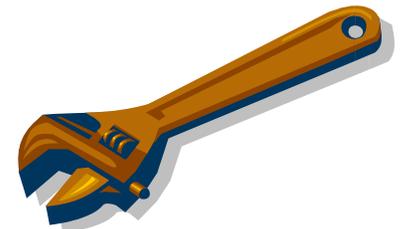
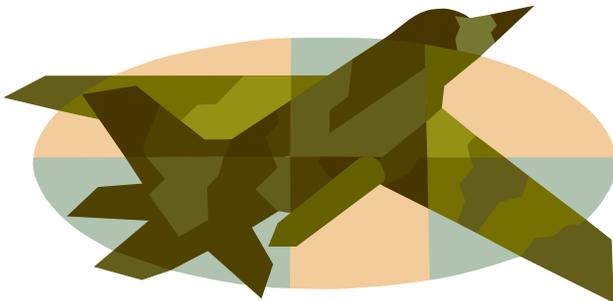


FEDERAL AVIATION ADMINISTRATION

Good Human Factors Practices

Should also -

- Put emphasis on human beings –
 - and how the design of products influences how people interact with them.



FEDERAL AVIATION ADMINISTRATION

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?



FEDERAL AVIATION ADMINISTRATION

HUMAN FACTORS

Designing systems to fit people

- Aircraft
- Automobiles
- Computer Work Stations
- Safety Features



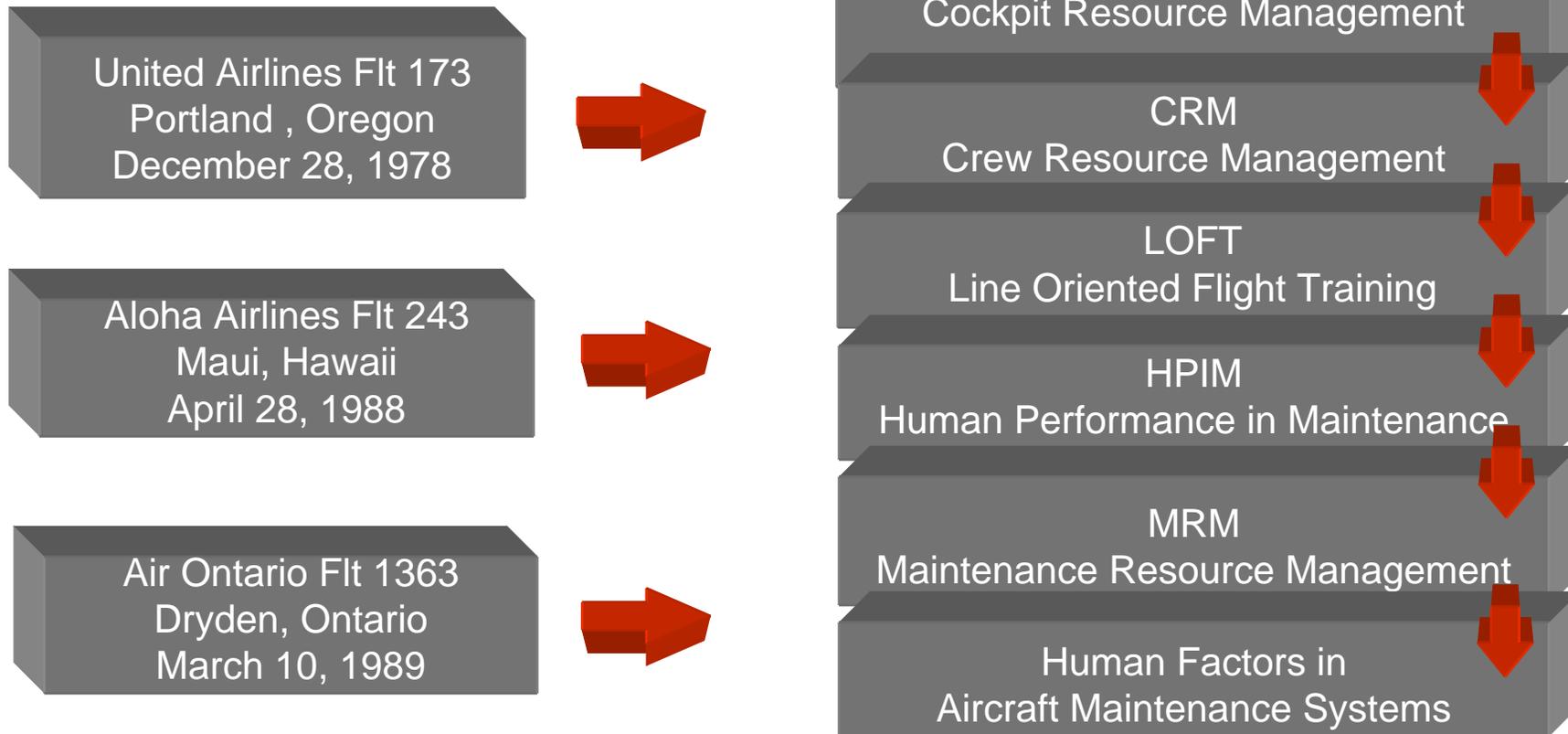


FEDERAL AVIATION ADMINISTRATION



History of Human Factors Training

- The information below represents events that led to the development of Human Factors in the airline industry.



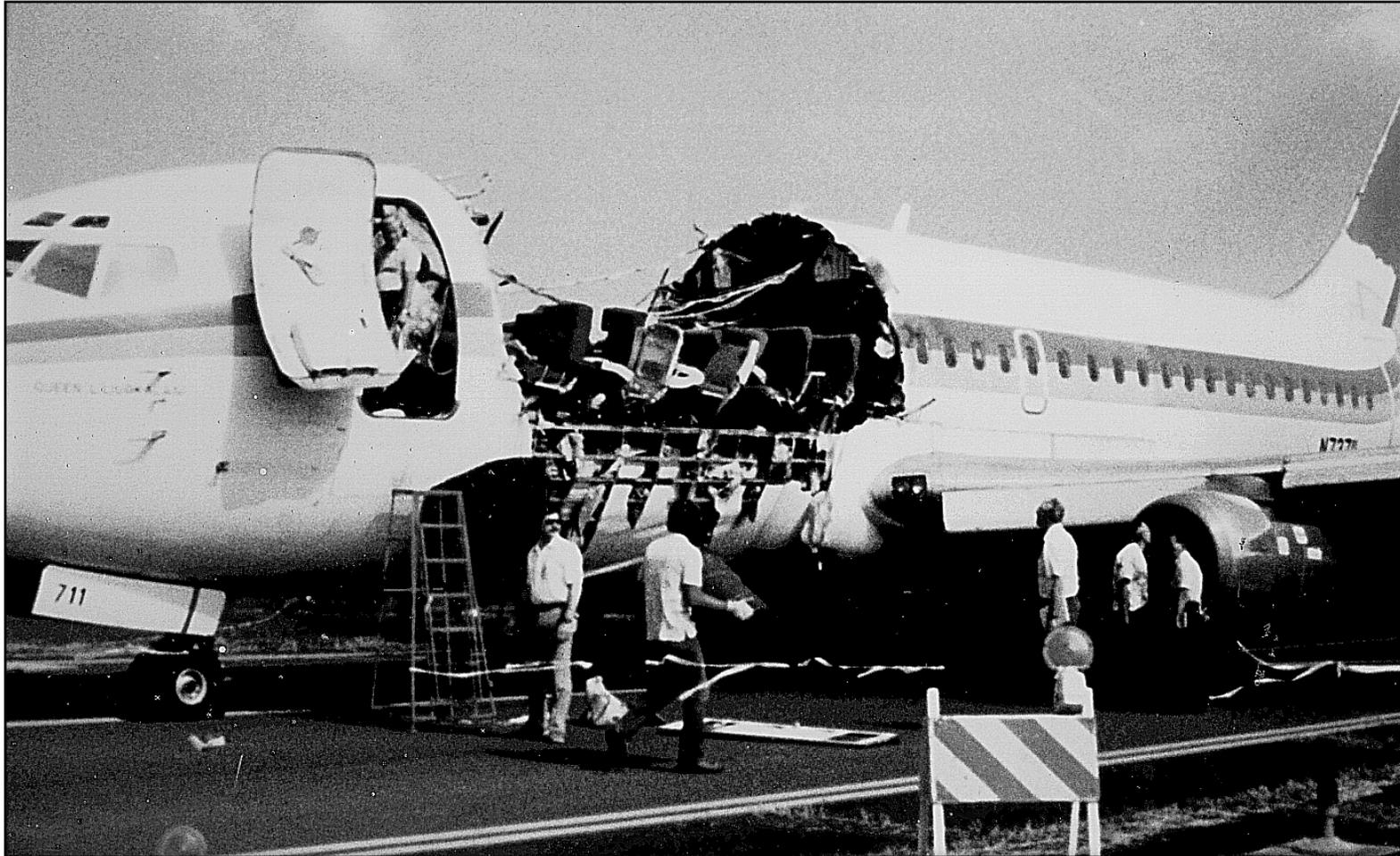
FEDERAL AVIATION ADMINISTRATION

PORTLAND

Gear Problem turned into fuel starvation



“Events always speak louder than Human Factors specialists”



“Events always speak louder than Human Factors specialists”

FEDERAL AVIATION ADMINISTRATION

“Events always speak louder than Human Factors specialists”



FEDERAL AVIATION ADMINISTRATION

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. Cowlings, 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!

FEDERAL AVIATION ADMINISTRATION

Understanding Errors –

Question and answer time!

In other words-
I can have
some fun!



FEDERAL AVIATION ADMINISTRATION

?? OPEN QUESTION ??

What is Human Error?



FEDERAL AVIATION ADMINISTRATION

HUMAN ERROR

The *unintentional act* of performing a task

- *incorrectly - or failing to perform a task*, which
- can *potentially degrade the system.*



FEDERAL AVIATION ADMINISTRATION

?? OPEN QUESTION ??

What causes Human Error?

Actually two big hitter's in the aviation world



FEDERAL AVIATION ADMINISTRATION

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

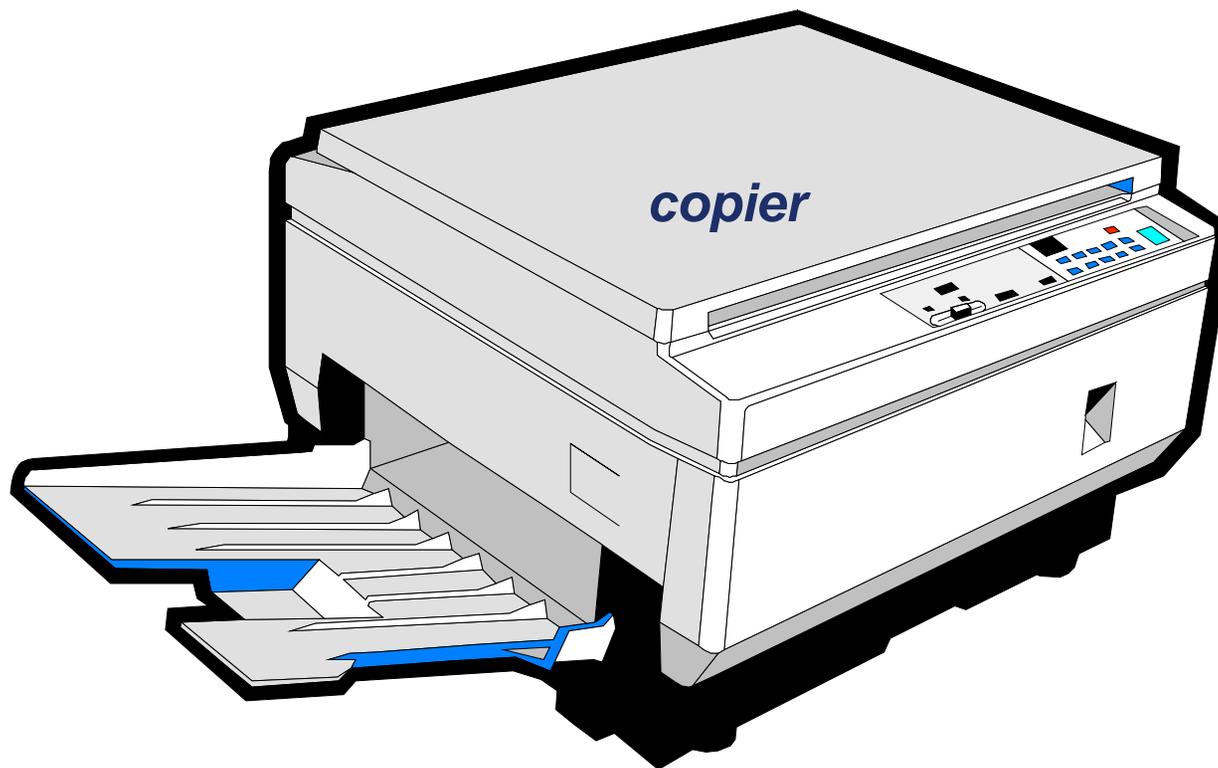
- **Omissions** account for nearly **60%** of all recorded maintenance lapses in major airlines.*

* Reason J. *Comprehensive Error Management in Aircraft Engineering: A Managers Guide*. London, Heathrow: British Airways Engineering.



FEDERAL AVIATION ADMINISTRATION

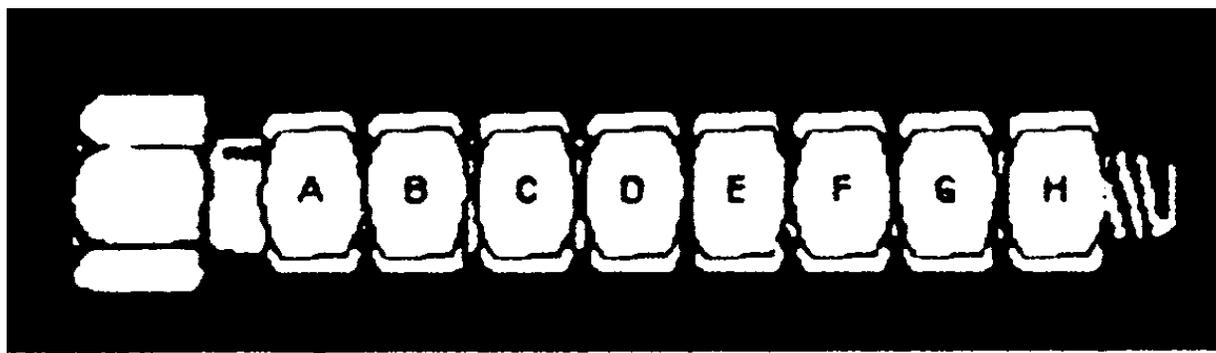
ERROR PRONE TASK



FEDERAL AVIATION ADMINISTRATION

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)**



FEDERAL AVIATION ADMINISTRATION

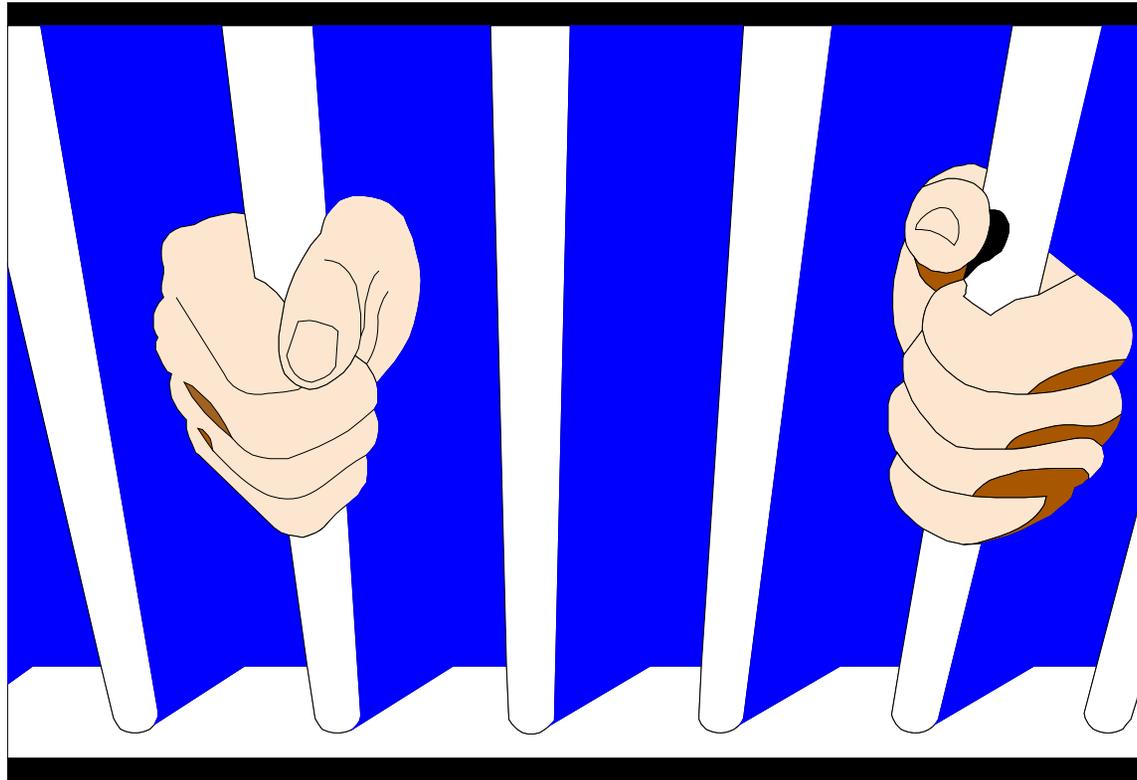
CONSEQUENCES OF HUMAN ERROR

- Little or no effect
- Physical damage to equipment
- Personal injury
- Catastrophic event



FEDERAL AVIATION ADMINISTRATION

CONSEQUENCE OF HUMAN ERROR



Intentional Act

FEDERAL AVIATION ADMINISTRATION

“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”*.



FEDERAL AVIATION ADMINISTRATION

***HUMAN ERRORS
CAN HAPPEN
ANYWHERE ANYTIME***

Because we...

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



FEDERAL AVIATION ADMINISTRATION

THEREFORE

- We can not eliminate *Human Error*
- Instead, we must learn to *MANAGE* it !



FEDERAL AVIATION ADMINISTRATION

OVERALL, WE HAVE LEARNED TO MANAGE ERRORS FAIRLY EFFECTIVELY

- Maintenance Inspection - Buy backs, RII's,
- Detailed Procedures
- Checklists
- Erasers On Pencils
- Spill ~~C~~hec - Spell Check

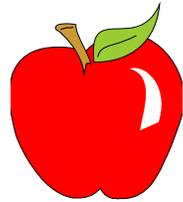
We can still do better!



FEDERAL AVIATION ADMINISTRATION

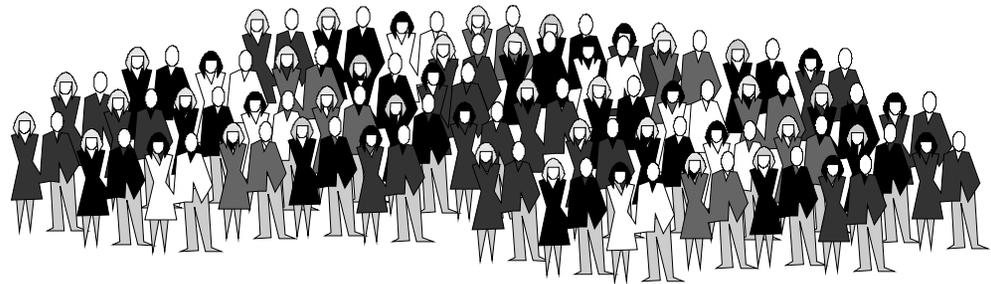
What is the Greatest Hazard to Aircraft ?

Gravity



THEN

Humans



FEDERAL AVIATION ADMINISTRATION

Simply Put...

- Aside from gravity itself, the greatest hazard facing modern aircraft comes from people.

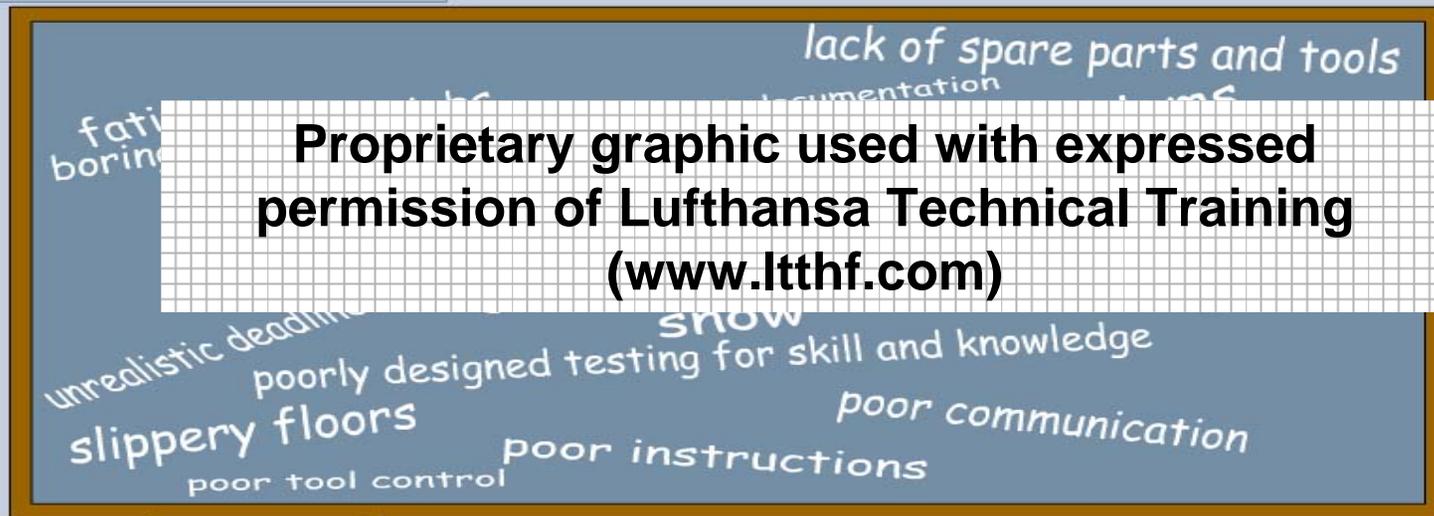
HUMANS



FEDERAL AVIATION ADMINISTRATION

Can you provide examples of Human Factor issues that you have witnessed with your Jobs?

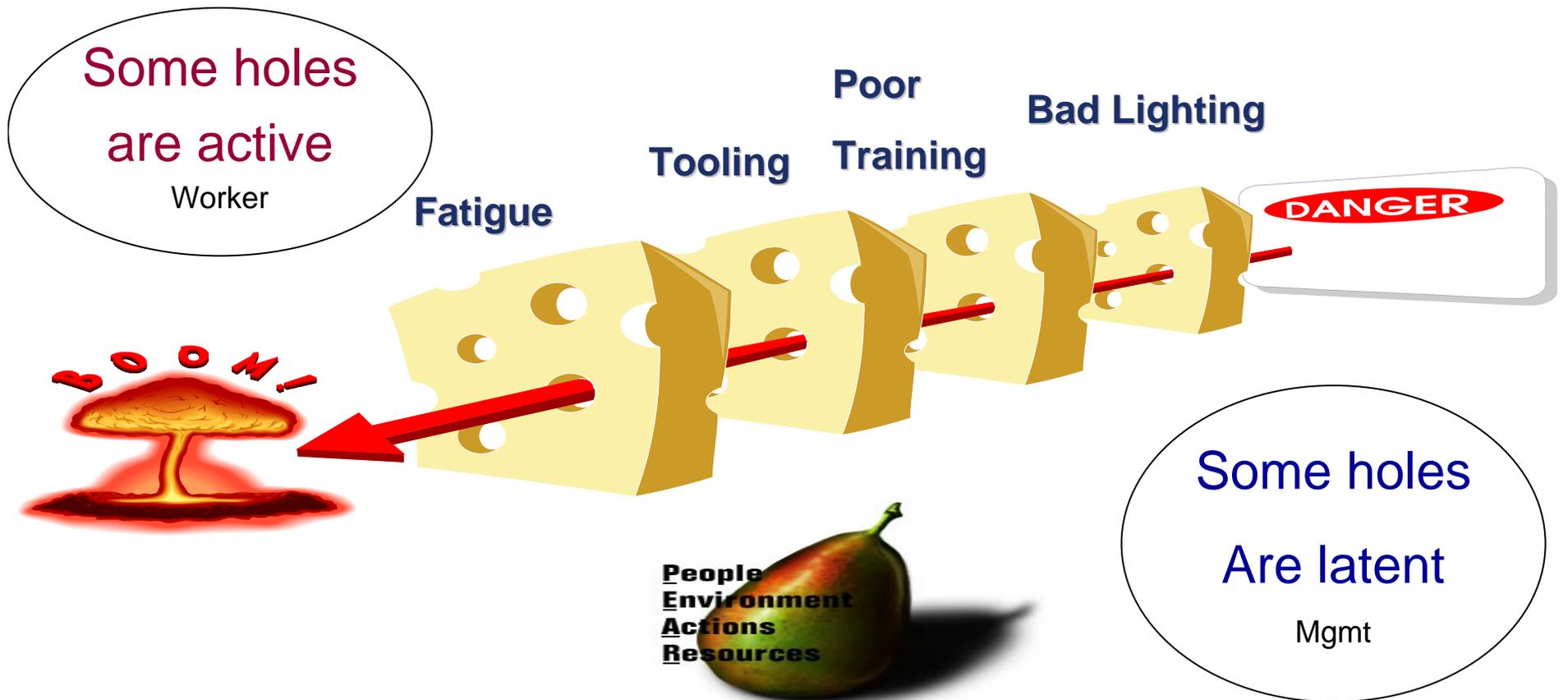
HUMAN FACTORS



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

FEDERAL AVIATION ADMINISTRATION

Factors Line up to Cause an Event – Like Swiss Cheese



FEDERAL AVIATION ADMINISTRATION

- ANYBODY EVER HEARD OF A CHAIN OF EVENTS?

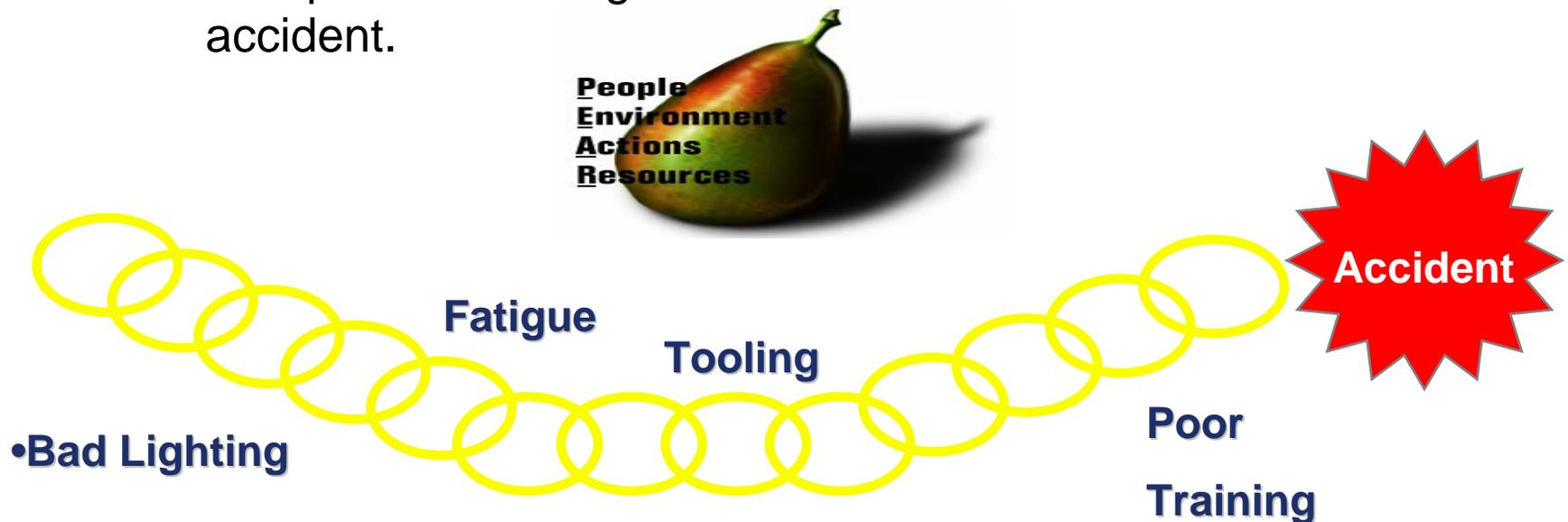


GOOD – IT IS ANOTHER WAY OF LOOKING AT THIS!

FEDERAL AVIATION ADMINISTRATION

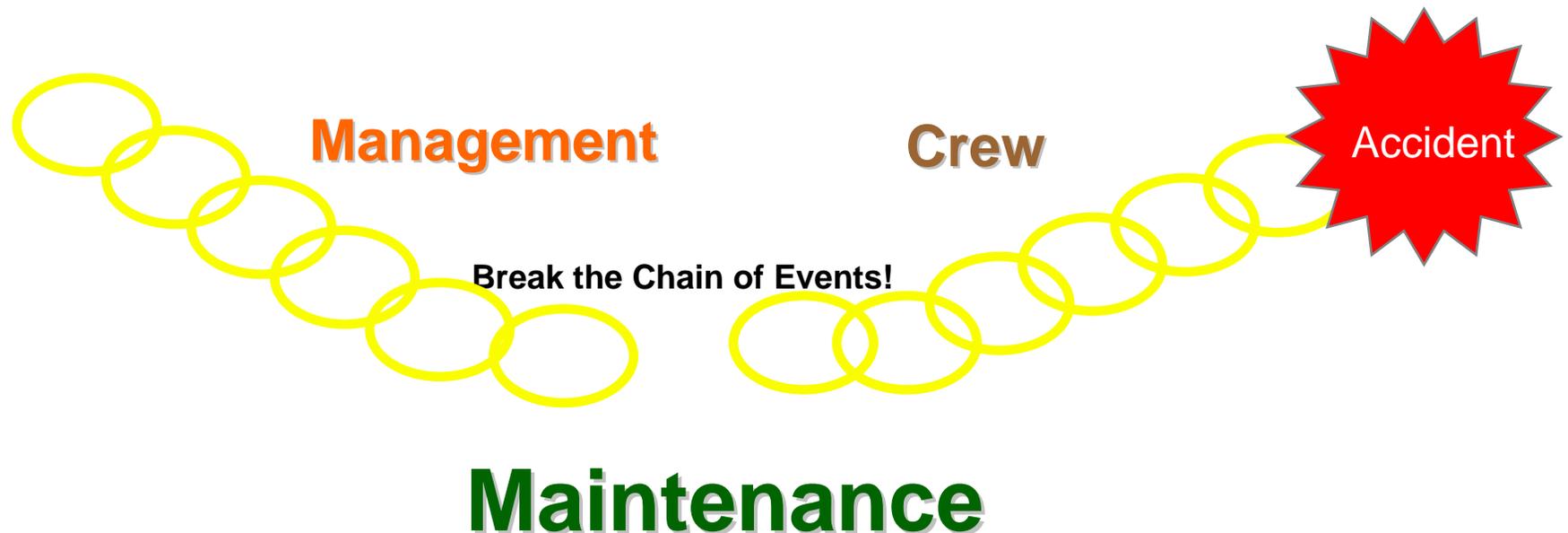
Chain of Events

- Multiple contributing causes that can lead to an accident.



FEDERAL AVIATION ADMINISTRATION

Preventing any event could prevent the accident



If we can *break the chain* the accident doesn't happen!

FEDERAL AVIATION ADMINISTRATION

Consequences

Nobody Broke the Chain!

Little or no effect

Personal injury - ?

Equipment damage - ?

Catastrophic event - ?



FEDERAL AVIATION ADMINISTRATION

THE DIRTY DOZEN

LACK OF RESOURCES

LACK OF COMMUNICATION

ASSERTIVENESS

DISTRACTION

NORMS

FATIGUE

LACK OF TEAMWORK

LACK OF AWARENESS

LACK OF KNOWLEDGE

PRESSURE

COMPLACENCY

STRESS

FEDERAL AVIATION ADMINISTRATION

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.

FEDERAL AVIATION ADMINISTRATION

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



FEDERAL AVIATION ADMINISTRATION

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.

FEDERAL AVIATION ADMINISTRATION

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



FEDERAL AVIATION ADMINISTRATION

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



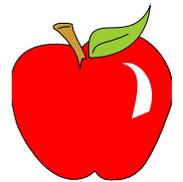
FEDERAL AVIATION ADMINISTRATION

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

Gravity

**Then
US**



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

John Hiles

ICT FSDO Presentation
10/31/2006



Federal Aviation
Administration

