

# Human Factors Issues in Maintenance Publication Design



Dr. Katrina Ricci

Senior Research Psychologist

NAVAIR Orlando, Training Systems Division

Katrina.Ricci@Navy.Mil

# Naval Aviation Class A Flight Mishap Rates

776 aircraft  
destroyed in  
1950

## Impact of Engineering & Administrative Controls:

Naval Aviation Safety Center (Now NSC)

Naval Aviation Maintenance Program

Fleet Replacement Squadron Concept

NATOPS Program

Squadron Safety Program

System Safety Designs

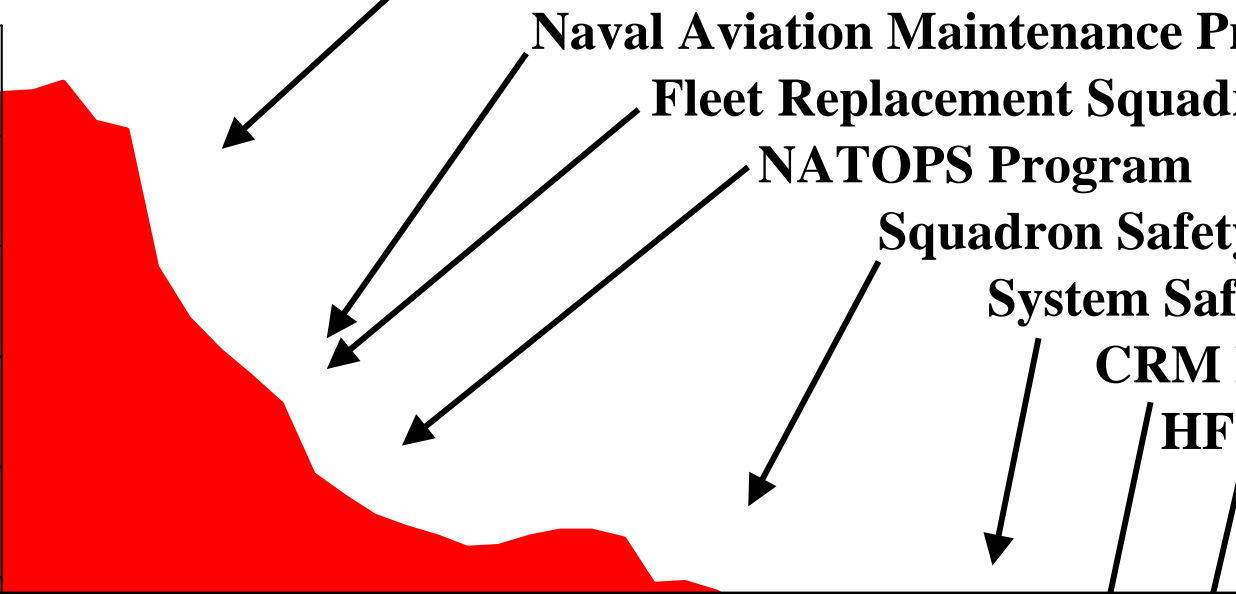
CRM Program

HF Reviews

Climate Surveys

Class A FMs / 100,000 Flight Hours

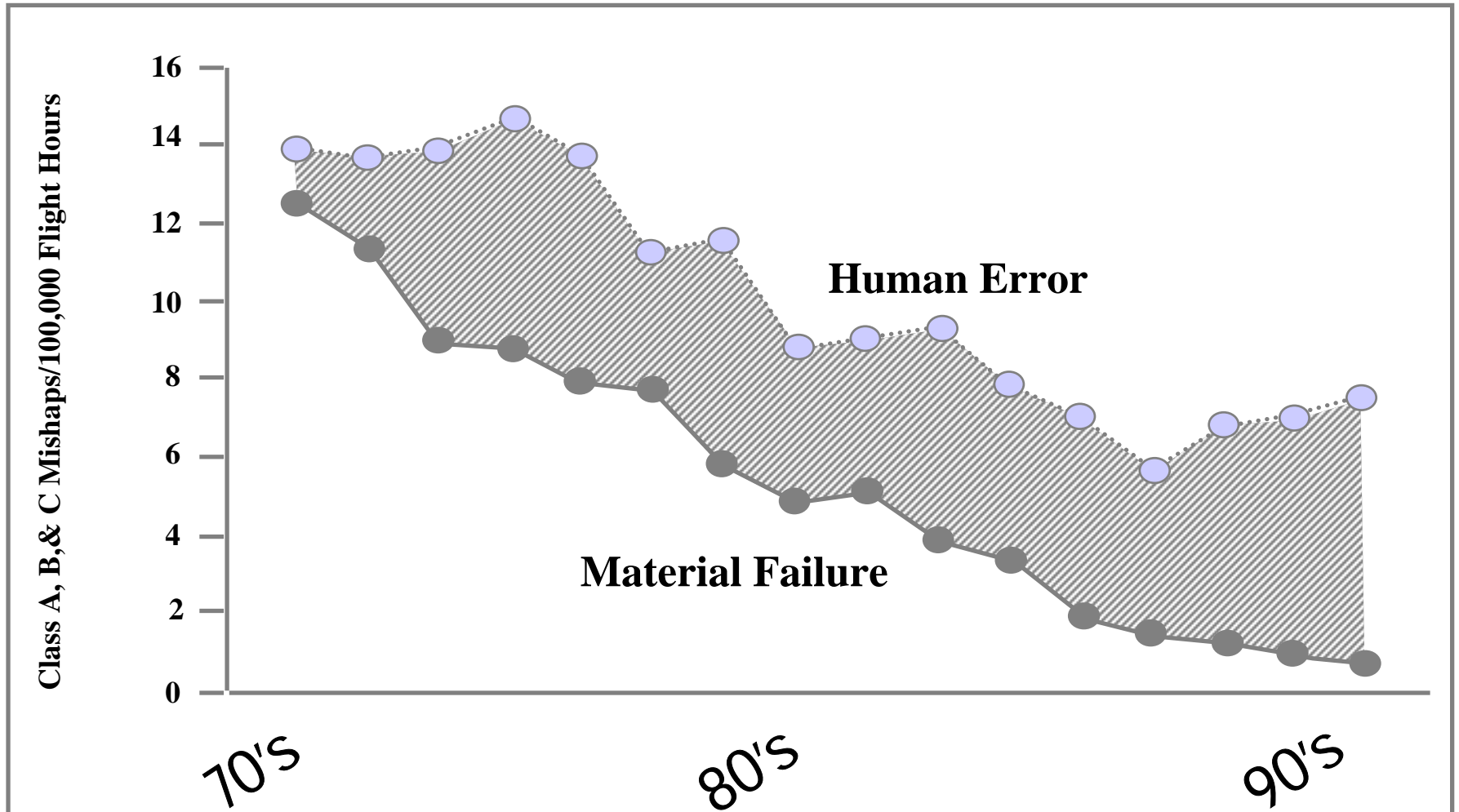
60  
50  
40  
30  
20  
10



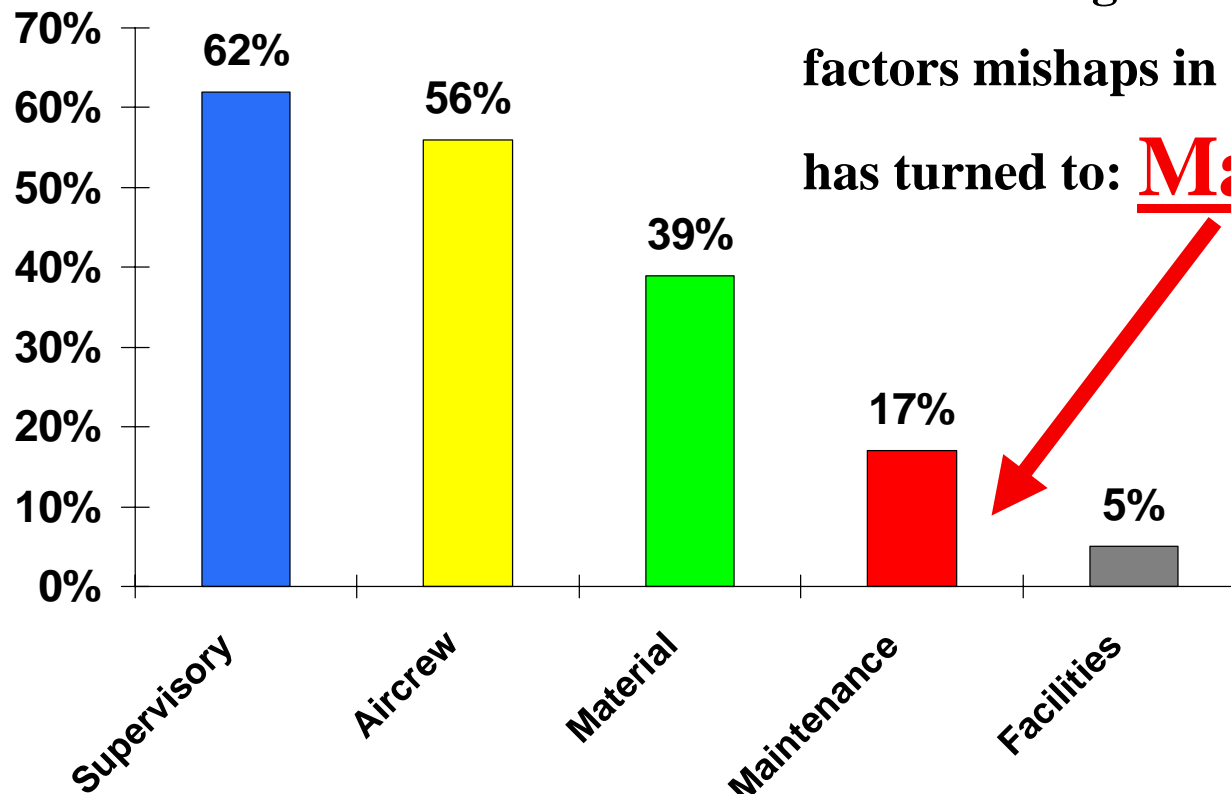
Total Cost of Naval Aviation Mishaps Last  
FY was nearly \$700 Million w/33 Fatalities

31 aircraft  
destroyed in  
2002

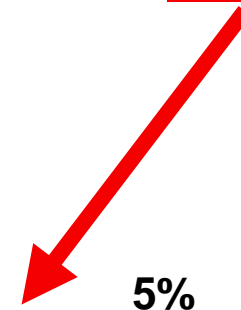
# Engineering & Administrative Controls have Impacted Hardware Reliability, but....



# Mishap Data Analysis Focus: Naval Aviation Class A FM Causal Factors

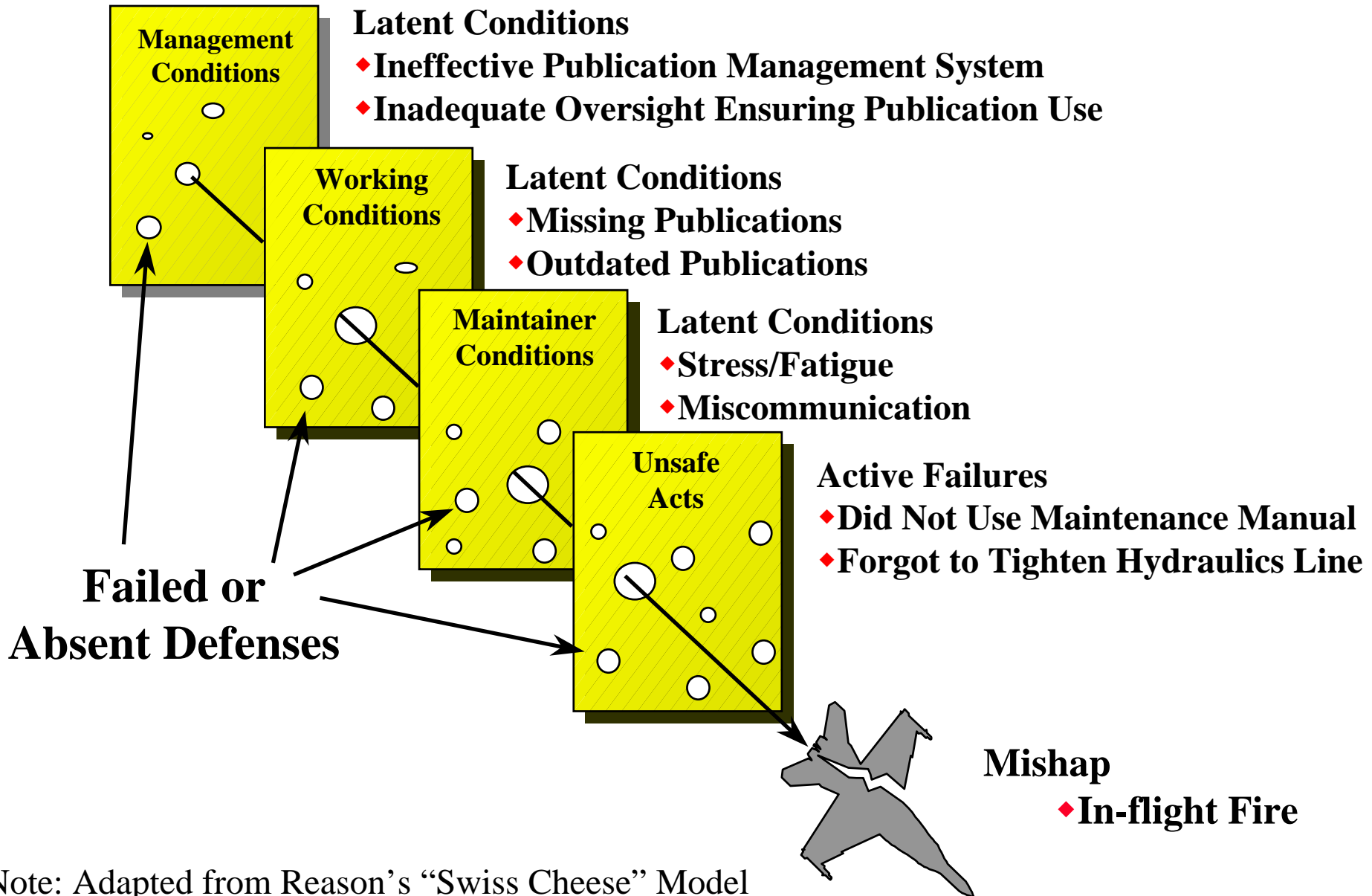


Initial emphasis on “Pilot Error,”  
but to reach goal of cutting human  
factors mishaps in half the focus  
has turned to: **Maintenance**



# Human Factors Analysis & Classification System

## *Maintenance Extension*



Note: Adapted from Reason's "Swiss Cheese" Model

# **Preliminary HFACS-ME Analysis of All FY 90-02 Maintenance Mishaps**

- 294 of all Naval Aviation Maintenance Mishaps Involved a Publications Problem (28%)
  - 168 Involved Process/Procedure Deficiencies (16%), some common examples include:
    - Missing procedural step and/or steps out of sequence
    - Inadequate procedure for inspection, troubleshooting, etc.
    - Procedures do not include hazard and risk warnings
  - 158 Involved Documentation Deficiencies (15%), some common examples include:
    - Technical data is wrong and/or missing (e.g. torque values)
    - Part number, diagrams, etc. are inaccurate and/or missing
    - Inspection criteria inadequate, missing, and/or inaccurate

# Maintenance Mishaps Involving Publications Activity Breakout

- Inspection 31%
- Installation 23%
- Troubleshoot 10%
- Servicing 08%
- Repair 05%
- Removal 04%
- Assembly 04%



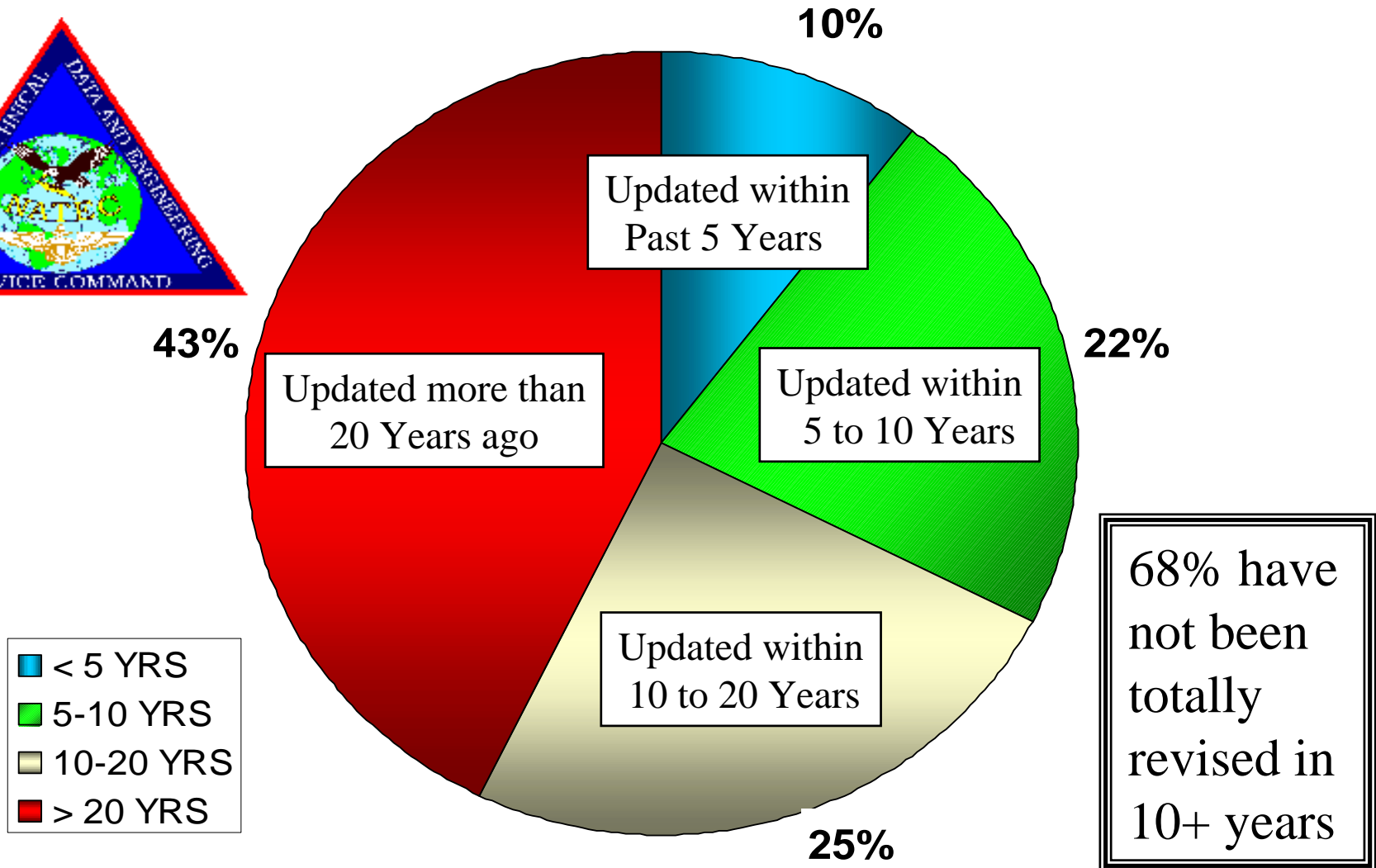
# E6A Illustrated Parts Diagram Deficiency vs. Aircrew Glove



**IPD Wins Hands Down!**

# Naval Aviation Technical Manual Status

(As of 6/14/00)





# NATEC Technical Manual Status

*As of 20 DEC 01*

## ■ Outstanding Actions

- 2,761 Interim Rapid Action Changes (IRACs)
- 18,780 Tech Pub Deficiency Reports  
(including 218 CAT I)
- 5,683 Publications require update

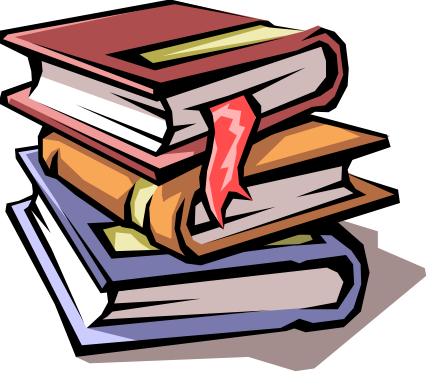
# TPDs in Naval Aviation Maintenance Mishaps Involved a Publications Problem

	#	%
Technical data is inaccurate or not established	134	46
Maintenance procedures unclear, incomplete or out of sequence	93	32
Inspection procedures are inadequate or not established	54	18
Hazards/Warnings not included in maintenance procedures	13	4

(n=294)

# **Long-Term Strategic Initiative: Interactive Electronic Technical Manuals**

- **IETM Working Group**
  - **Working group est. November 2001**
  - **Navy Safety Center in the loop**
  - **Purpose: Eliminate/minimize stovepipe implementations**
  - **Program by Program review of digital implementations**
- **IETM Standard Viewer for Naval Aviation**
  - **Competitively procure an IETM viewer for Navy; Plan approved by PDASN(RDA)**

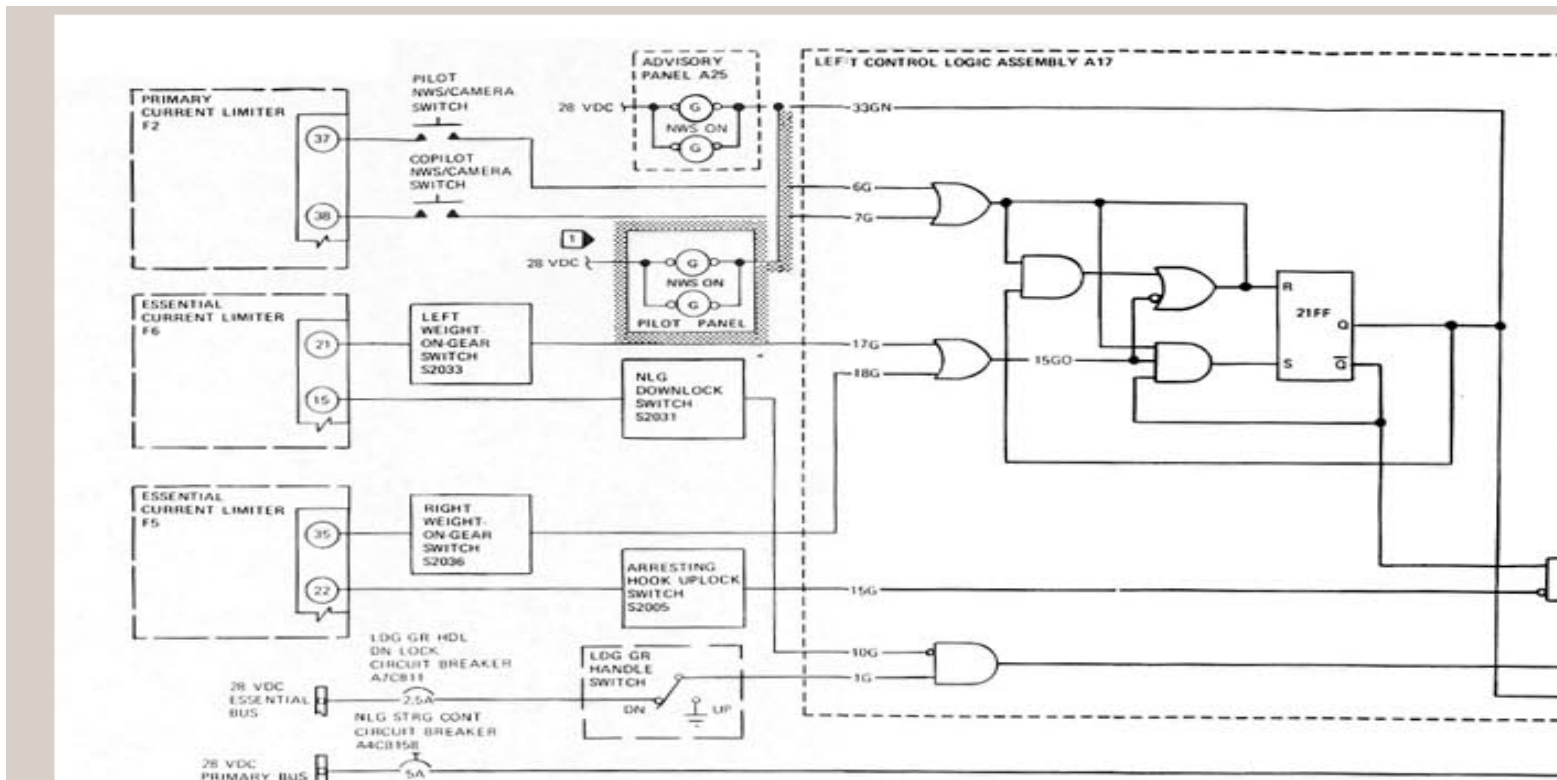


## **Electronic Technical Documentation: Potential Opportunities and Pitfalls**

- **Conversion of traditionally paper-based technical documentation to electronic format**
- **Current state of technology**
  - Most presently converted documentation exists as scanned *pdf* files
  - Current technologies lack sound human centric design principles, intelligent tutoring capabilities, user testing, and accepted mobility
- **Electronic manuals can be tedious to use**
  - Lowers efficiency and effectiveness of mechanics
- **Little guidance exists to maximize the potential of electronic technical documentation (and what guidance that does exist is often ignored!)**

# Scanned Static Displays

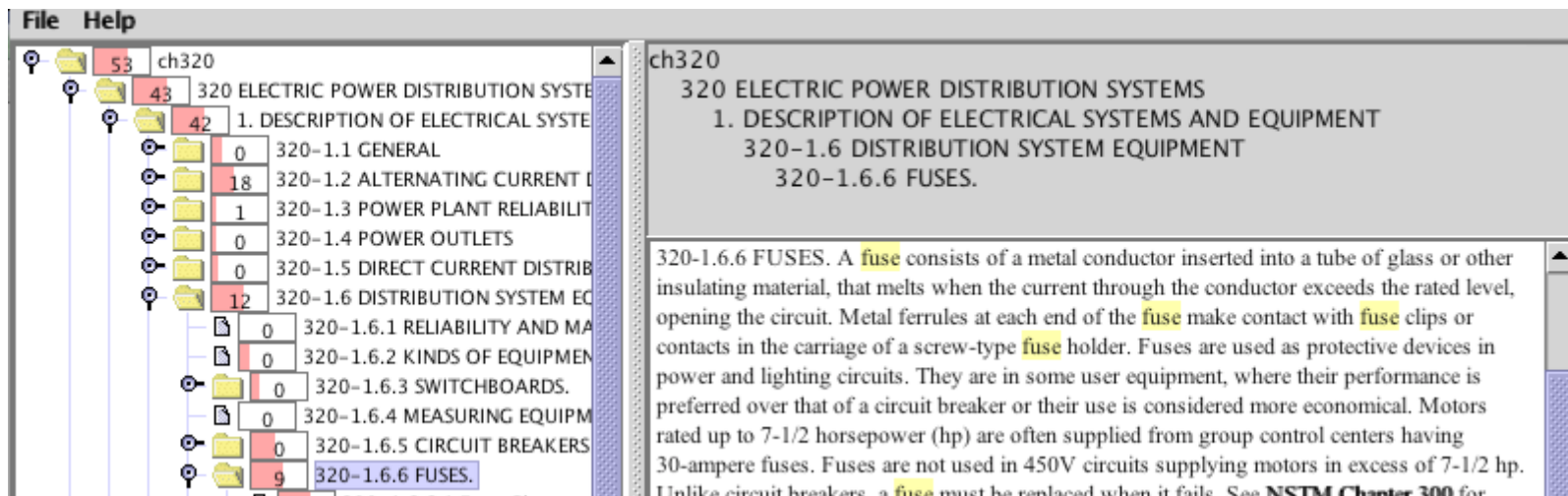
- No interaction
- High memory load for user
- Difficulty navigating and keeping track





# Human Factors Guidance: Search/Navigation

- **User's require:**
  - “Breadcrumbs” or history paths between procedures and illustrations
  - More active linking between text and illustrations
- **Avoid potential to get lost in “hyperspace”**



# Human Factors Guidance: Portability and Operability



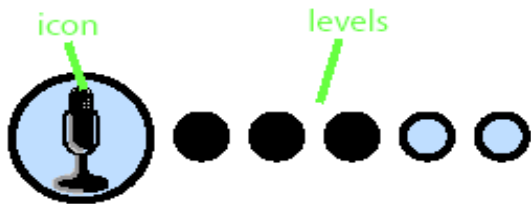
- **Wearable/Mobile Displays**

- Permits point of use access to technical publications and technical information
- Supports circumstances warranting primarily hands-free operation
- Requires users tend to wear special gear and may inhibit fine motor operations
- Lighting is variable, and may make readability an issue in some settings



# Human Factors Guidance: Provide for Optimized HSI

- **Graphical User Interfaces (GUIs)**
  - Leave enough white space to tolerate user errors
  - Include status indicators that the system is working, cues for user action, acknowledgements, etc.
- **Typography**
  - Reserve use of all caps for headlines or emphasis
  - Increase text sizes to accommodate resolution increase
  - Point size alone is not the only indicator is sizing text
  - Consider phrase-sensitive spacing



# *Questions?*



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