Most aviation maintenance tasks are well-defined and bounded. They are described by explicit procedures, work cards, and instruction manuals. Certain job characteristics, however, are implicit and diffuse, permeating every aspect of the aviation maintenance workplace. Human factors is one of these overreaching elements. During initial and recurrent training, through each workday, throughout a maintainer's career, various human factors elements come into play and affect their job performance.

One purpose of this Guide is to serve as a training resource and an everyday reference for those human factors elements that are most important in daily work situations. Fortunately, most maintenance tasks are completed in a competent, timely, and safe manner. Certainly, that is the goal of all aviation maintenance organizations. Barriers, both physical and procedural, are intentionally put into place to prevent maintenance errors and to isolate maintenance workers and the flying public from the effects of errors. This Guide contains concepts, methods, data, and reference sources that can help define, monitor, and maintain such barriers.

The purpose of this section is to use the graphical categorization scheme below as a troubleshooting guide to determine the human-factors-related root-causes of an incident investigation. To move from general root-causes to specific root-causes click on a box where the cursor turns into a hand. Once you have identified the most probable human-factors-related root-causes of an incident, click on the chapter number associated with the root cause to open the chapter.

**Figure 1: Root Cause Categories**

**Figure 2: Maintenance Incident Root Cause Classification Framework**
Maintenance Incident Root Cause Classification Framework

Organizational Factors

- Inadequate Resource Management
  - Too few workers to ensure coverage
  - Inappropriate mix of skills
  - Inadequate communication among internal departments or groups
  - Inadequate communication with external groups

- Adverse Organizational Climate
  - Inappropriate time pressure
  - Inappropriate cost/safety emphasis
  - Problem reporting discouraged
  - Management vs. worker conflict
  - Inadequate control of sexual harassment
  - Inadequate employee assistance and counseling
  - Inadequate emphasis on worker safety

- Inadequate Operational Process
  - Unclear reporting chain
  - Inadequate job assignment process
  - Lack of fitness for duty policy
  - Unclear work policy
  - Lack of clear safety policy
  - Inadequate housekeeping policy
  - Inadequate communication channels
  - Inadequate distribution channels
  - Inadequate procedure update process

Figure 3: Inadequate Resource Management
Figure 4: Adverse Organizational Climate

- Inadequate Resource Management
  - Chapter 13 - Communication
  - Chapter 16 - Maintenance Resource Management

-Too few workers to ensure coverage
  - Chapter 4 - Shiftwork and Scheduling

-Inappropriate mix of skills
  - Chapter 7 - Training

-Inadequate communication among internal departments or groups

-Inadequate communication with external groups

Organizational Factors

- Chapter 1 - Human Factors
  - Chapter 2 - Establishing a Human Factors Program

Adverse Organizational Climate

- Chapter 2 - Establishing a Human Factors Program

- Inappropriate time pressure
  - Chapter 4 - Shiftwork and Scheduling

- Inappropriate cost/safety emphasis
  - Chapter 3 - Workplace Safety

- Problem reporting discouraged
  - Chapter 13 - Communication

- Management vs. worker conflict
  - Chapter 16 - Maintenance Resource Management

- Inadequate control of sexual harassment
  - Chapter 11 - Sexual Harassment

- Inadequate employee assistance and counseling
  - Chapter 12 - Personal and Job-Related Factors

- Inadequate emphasis on worker safety
  - Chapter 1 - Human Factors
  - Chapter 3 - Workplace Safety
Figure 5: Inadequate Operational Process

- Organizational Factors
  - Inadequate Operational Process
    - Chapter 1 - Human Factors
    - Chapter 2 - Establishing a Human Factors Program

- Unclear reporting chain
  - Chapter 13 - Communication

- Inadequate job assignment process
  - Chapter 4 - Shiftwork and Scheduling
  - Chapter 5 - Work Design
  - Chapter 6 - Maintenance Resource Management

- Lack of fitness for duty policy
  - Chapter 3 - Workplace Safety
  - Chapter 10 - Disabilities

- Unclear work policy
  - Chapter 16 - Maintenance Resource Management

- Lack of clear safety policy
  - Chapter 3 - Workplace Safety
  - Chapter 15 - Communication

- Inadequate housekeeping policy
  - Chapter 3 - Workplace Safety
  - Chapter 5 - Facility Design
  - Chapter 9 - Work Design

- Inadequate communication channels
  - Chapter 13 - Communication
  - Chapter 16 - Maintenance Resource Management

- Inadequate distribution channels
  - Chapter 5 - Facility Design

- Inadequate procedure update process
  - Chapter 2 - Establishing a Human Factors Program
  - Chapter 13 - Communication
  - Chapter 16 - Information Transfer

Figure 6: Supervision
Figure 7: Unrecognized Hazard

Unrecognized Hazard
- Worker not physically ready for duty
- Worker not psychologically ready for duty
- Workplace not in compliance with established safety rules
- Existing problem not reported to supervision

Supervision
- Chapter 1 - Human Factors
- Chapter 16 - Maintenance Resource Management

Unrecognized Hazard
- Chapter 3 - Workplace Safety
- Chapter 16 - Maintenance Resource Management

Worker not physically ready for duty
- Chapter 4 - Shiftwork and Scheduling
- Chapter 12 - Personal and Job-Related Factors
- Chapter 16 - Maintenance Resource Management

Worker not psychologically ready for duty
- Chapter 4 - Shiftwork and Scheduling
- Chapter 12 - Personal and Job-Related Factors
- Chapter 16 - Maintenance Resource Management

Workplace not in compliance with established safety rules
- Chapter 3 - Workplace Safety
- Chapter 5 - Facility Design
- Chapter 6 - Work Design

Existing problem not reported to supervision
- Chapter 13 - Communication
- Chapter 16 - Maintenance Resource Management

Figure 8: Inadequate Supervision

Inadequate Supervision
- Supervisor absent when needed
- Supervisor subject to conflict with workers
- Non-supervisory supervisor personality
- Failure to ensure adequate number of workers for job
- Failure to ensure proper worker qualifications
- Failure to ensure proper training
- Failure to ensure proper housekeeping

Failure to Correct Known Problem
- Problem commonly known among workers
- Directive issued to correct problem, but not implemented
- Problem correction planned, but not in progress
- Problem correction in progress

Supervisory Violation
- Failure to enforce existing policies
- Permitting use of non-approved procedure
- Directing workers to violate policy or procedure
- Assigning work to unqualified worker
- Failing to verify work records
- Other routine violations
- Other extraordinary violations
Figure 9: Failure to Correct Known Problem
Figure 10: Supervisory Violation
Figure 11: Incident Preconditions
Figure 12: Inadequate Process
Figure 13: Inadequate Resource Management
Figure 14: Less than Adequate Mental State
Figure 15: Inadequate Fitness for Duty
Figure 16: Physical/Mental Limitations
Figure 17: Environment
Figure 18: Facility

Incident Preconditions

Workplace

Chapter 5 - Facility Design
Chapter 6 - Work Design
Chapter 10 - Disabilities

Environment

Temperature/humidity outside acceptable limits
Noise above acceptable limits
Airflow outside acceptable limits
Toxic vapors present
Cumbersome protective clothing or equipment required
Outside work - precipitation
Outside work - inadequate natural lighting

Chapter 3 - Workplace Safety
Chapter 5 - Facility Design
Chapter 6 - Work Design
Chapter 9 - Automation
Figure 19: Workspace

Inadequate lighting

Inadequate space

Inadequate communication system

Design does not conform to established guidelines

Layout not conducive to efficient work flow

Inadequate evacuation routes

Inadequate fire protection

Inadequate storage for hazardous materials

Inadequate storage for tools and fixtures

Inadequate housekeeping

Chapter 3 - Workplace Safety
Chapter 5 - Facility Design
Chapter 6 - Work Design
Chapter 10 - Disabilities

Chapter 14 - Human Error
Design does not conform to HF guidelines
Inadequate task lighting
Inadequate work area for required number of workers
Inadequate fall protection
Inadequate weight handling capability
Work area does not accommodate tools or equipment
Confined space entry
Inadequate housekeeping

Figure 20: Aircraft
Figure 21: Tools
Figure 22: Task
Figure 23: Procedure

- Incident Preconditions
  - Chapter 14 - Human Error
  - Chapter 1 - Human Factors
  - Chapter 6 - Work Design
  - Chapter 7 - Training
  - Chapter 8 - Testing and Troubleshooting
  - Chapter 9 - Automation
  - Chapter 10 - Disabilities
  - Chapter 13 - Communication
  - Chapter 16 - Maintenance Resource Management

- Job-Related
  - Requires extended monitoring or vigilance
    - Chapter 1 - Human Factors
    - Chapter 6 - Work Design
  - Requires frequent simple, repetitive actions
    - Chapter 6 - Work Design
    - Chapter 9 - Automation
  - Extremely complex with multiple sub-tasks
    - Chapter 6 - Work Design
    - Chapter 7 - Training
    - Chapter 16 - Maintenance Resource Management
  - Contains subtle differences from similar tasks
    - Chapter 5 - Work Design
    - Chapter 7 - Training
  - Extends over more than one shift
    - Chapter 4 - Shiftwork and Scheduling
    - Chapter 5 - Work Design
    - Chapter 13 - Communication
    - Chapter 16 - Maintenance Resource Management
  - Requires parallel tasks among multiple workers
    - Chapter 5 - Work Design
    - Chapter 13 - Communication
    - Chapter 16 - Maintenance Resource Management
  - Critical failure points are not obvious
    - Chapter 7 - Training
  - New task, not previously performed
    - Chapter 5 - Work Design
    - Chapter 7 - Training
**Figure 24: Unsafe Act**

- Incident Preconditions
- Chapter 14: Human Error

- Job-Related
- Chapter 1: Human Factors
- Chapter 6: Work Design
- Chapter 7: Training
- Chapter 9: Automation
- Chapter 10: Disabilities
- Chapter 13: Communication
- Chapter 16: Maintenance Resource Management

- Procedure
- Chapter 15: Information Transfer

- Inadequate or improper sequencing of tasks
  - Chapter 6: Work Design
  - Chapter 15: Information Transfer

- Layout and format do not conform to HF guidelines
  - Chapter 15: Information Transfer
  - Documentation Design Aid

- Terminology is confusing and difficult to understand
  - Chapter 13: Communication
  - Chapter 15: Information Transfer
  - Documentation Design Aid

- Requires transcription or mental arithmetic
  - Chapter 6: Work Design
  - Chapter 7: Training

- Not written in worker's first language
  - Chapter 6: Work Design
  - Chapter 13: Communication

- Not updated to latest revision
  - Chapter 13: Communication
  - Chapter 15: Information Transfer
  - Documentation Design Aid

- Not correct
  - Chapter 7: Training
  - Chapter 15: Information Transfer
  - Chapter 16: Maintenance Resource Management

- Firsttime to be used since last update
  - Chapter 7: Training
  - Chapter 18: Maintenance Resource Management
Maintenance Incident Root Cause Classification Framework

Unsafe Act

Error

Incorrect Execution (Slip)
- Failure to use procedure
- Omit, change, or skip procedure step(s)
- Perform procedure step(s) incorrectly
- Failure to communicate with co-worker(s) or supervisor
- Incorrect use of tools or equipment
- Incorrect perception of information
- Mental lapse

Incorrect Decision (Mistake)
- Incorrect assumption
- Incorrect perception
- Using incorrect procedure
- Failure to understand necessity of using existing procedure
- Reading procedure incorrectly
- Using improper tools, fixtures, or equipment
- Mis-diagnosing problem
- Mis-interpreting instructions
- Failure to recognize environmental factors
- Failure to request assistance

Violation

Routine

Exceptional

Following practice established during OJT
- Carrying out supervisor’s instructions
- Carrying out pending, but unofficial, procedure change
- Responding to dispatch time pressure
- Responding to established work standards
- Unaware of correct procedure

Malicious obedience to supervisor’s instructions
- Mental lapse
- Responding to peer pressure
- Unaware of correct procedure
- Engaging in risk-taking behavior
- Sabotage

Figure 25: Incorrect Execution (Slip)
Figure 26: Incorrect Decision (Mistake)
Figure 27: Routine
Figure 28: Exceptional
Unsafe Act

Violation

Chapter 14 - Human Error
Chapter 16 - Maintenance Resource Management

Exceptional

Malicious obedience to supervisor's instructions

Chapter 3 - Workplace Safety
Chapter 12 - Personal and Job-Related Factors
Chapter 13 - Communication
Chapter 1 - Human Factors
Chapter 4 - Shiftwork and Scheduling
Chapter 6 - Work Design
Chapter 9 - Automation
Chapter 12 - Personal and Job-Related Factors
Chapter 16 - Maintenance Resource Management

Mental lapse

Chapter 12 - Personal and Job-Related Factors
Chapter 16 - Maintenance Resource Management

Responding to peer pressure

Chapter 7 - Training

Unaware of correct procedure

Chapter 12 - Personal and Job-Related Factors
Chapter 16 - Maintenance Resource Management

Engaging in risk-taking behavior

Chapter 3 - Workplace Safety
Chapter 12 - Personal and Job-Related Factors

Sabotage