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# Human Factors Guide for Aviation Maintenance (1998)

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### CHAPTER 3

Workplace Safety *Describes the major hazards associated with industrial workplaces and the steps maintenance supervisors and planners can take to mitigate the hazards*

### CHAPTER 4

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### CHAPTER 5

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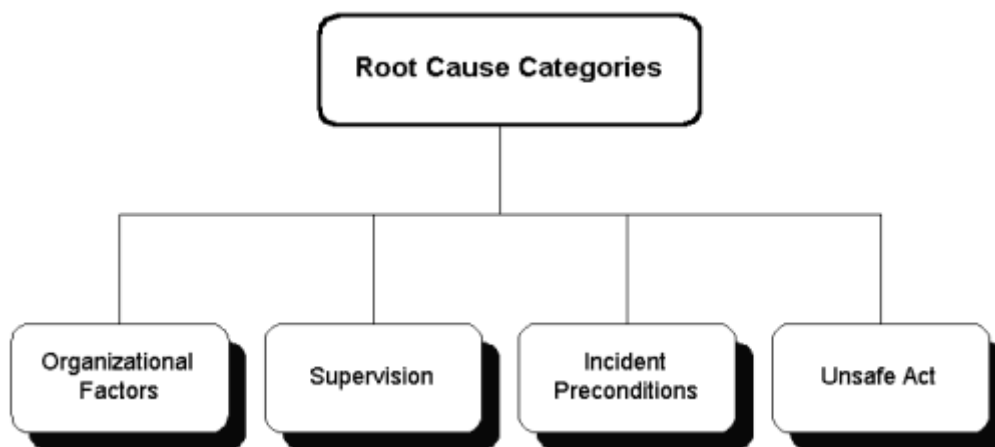
## GUIDE TO THE *GUIDE*

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.

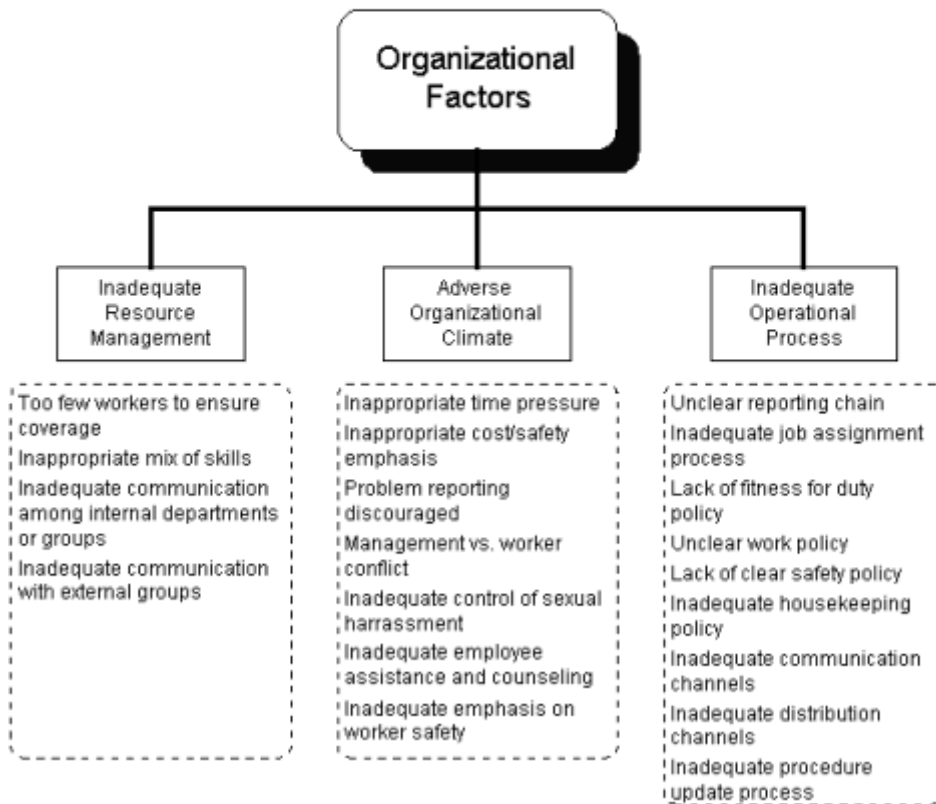
**Figure 1: Root Cause Categories**



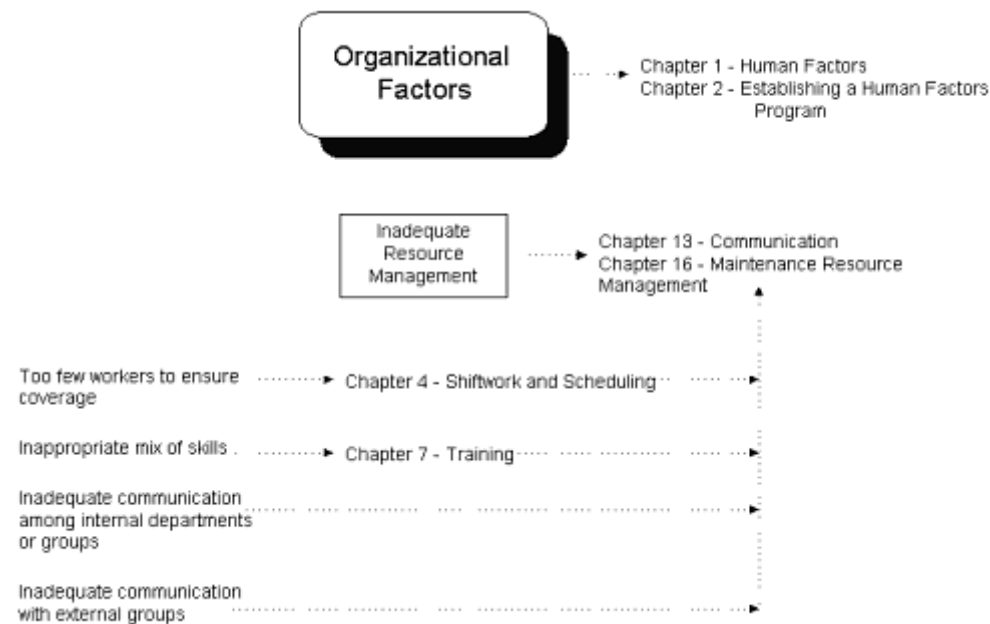
**Figure 2: Maintenance Incident Root Cause Classification Framework**

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# Maintenance Incident Root Cause Classification Framework

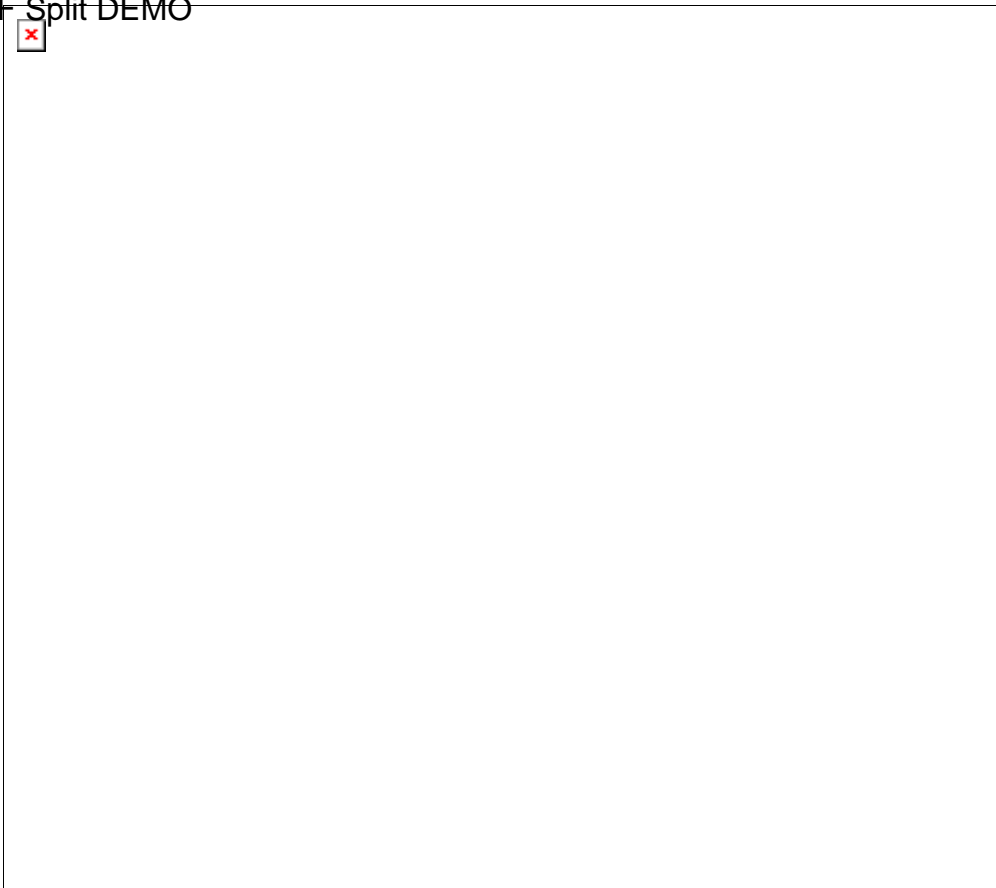


**Figure 3: Inadequate Resource Management**



**Figure 4: Adverse Organizational Climate**

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**Figure 5: Inadequate Operational Process**

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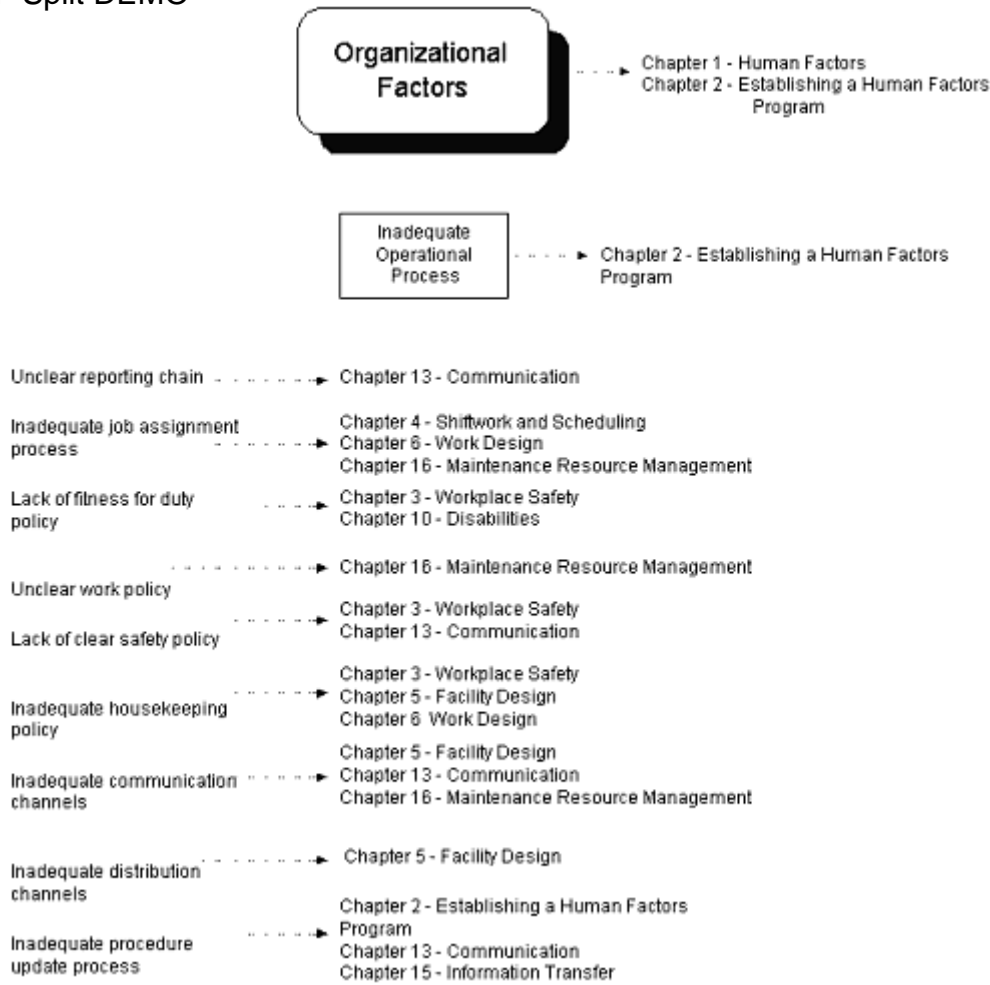
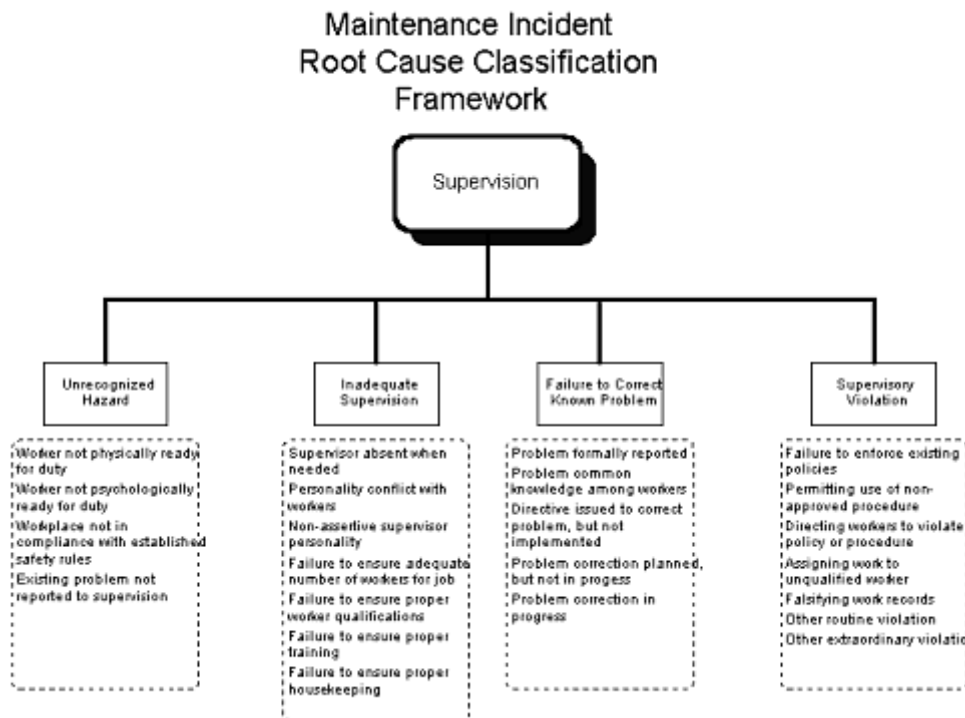


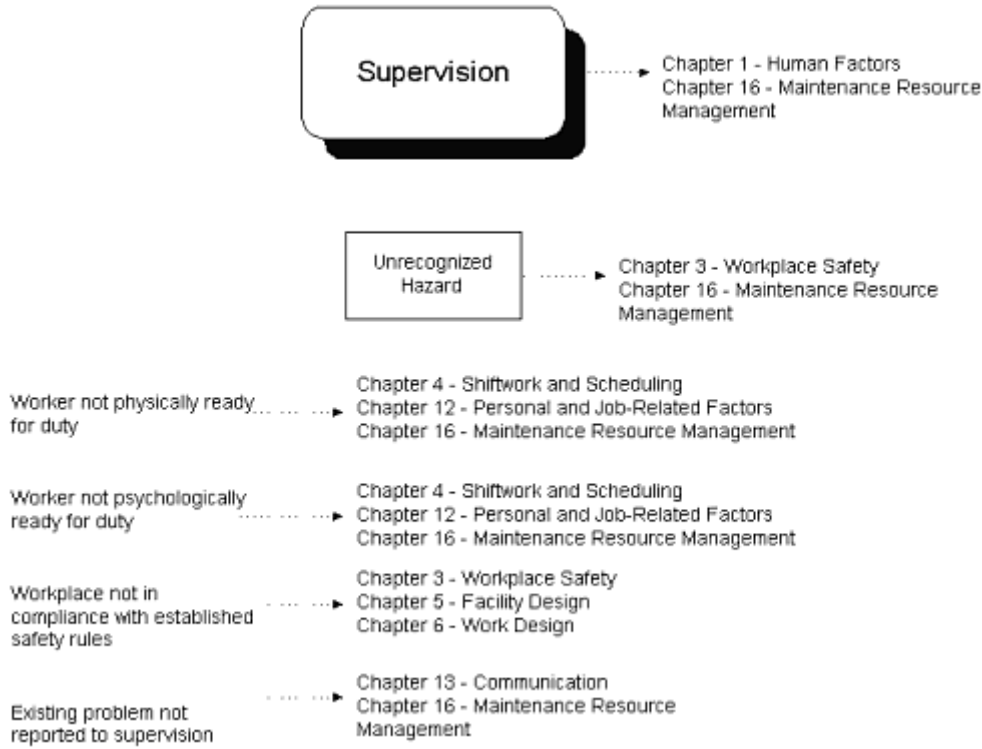
Figure 6: Supervision





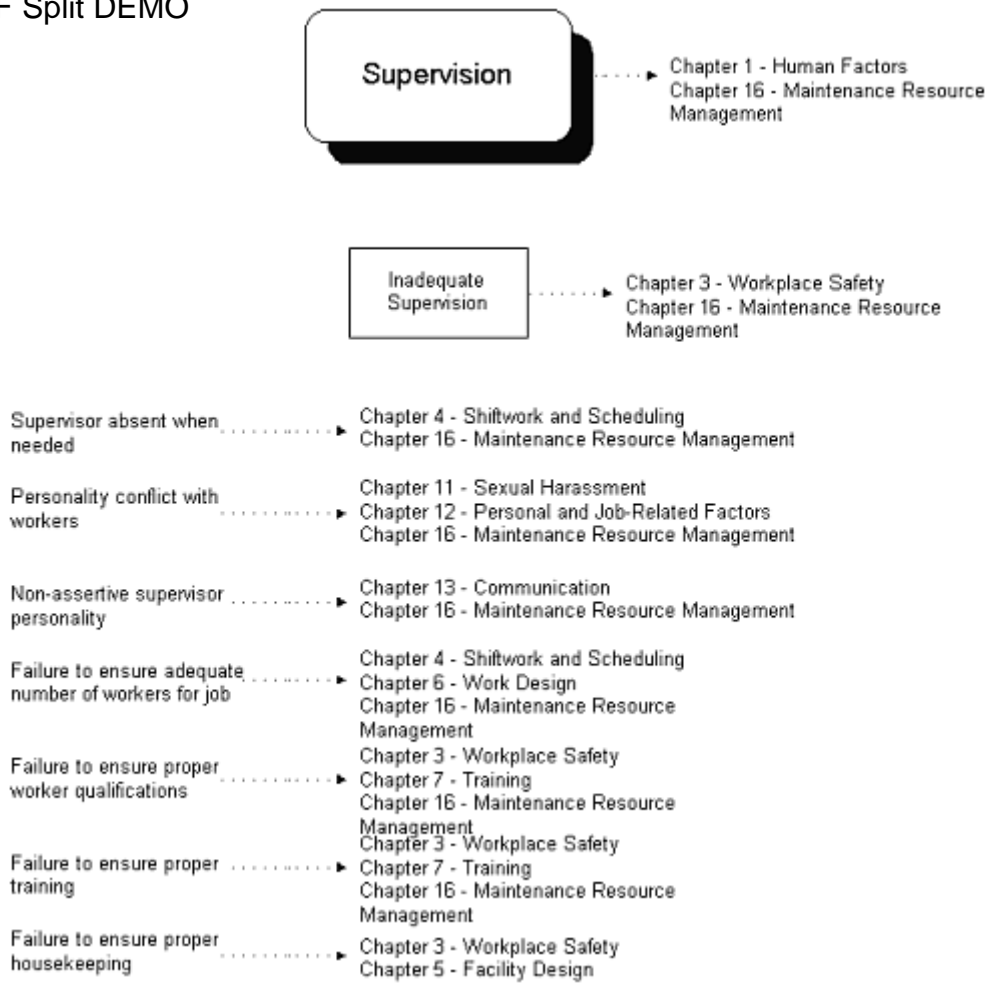
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**Figure 7: Unrecognized Hazard**

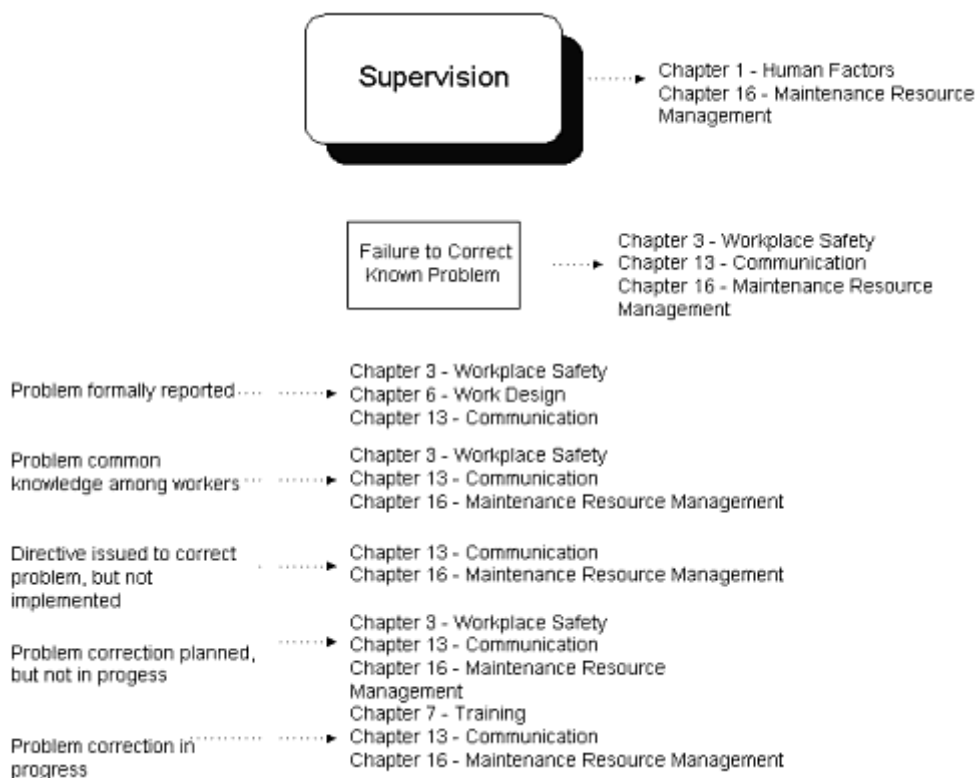


**Figure 8: Inadequate Supervision**

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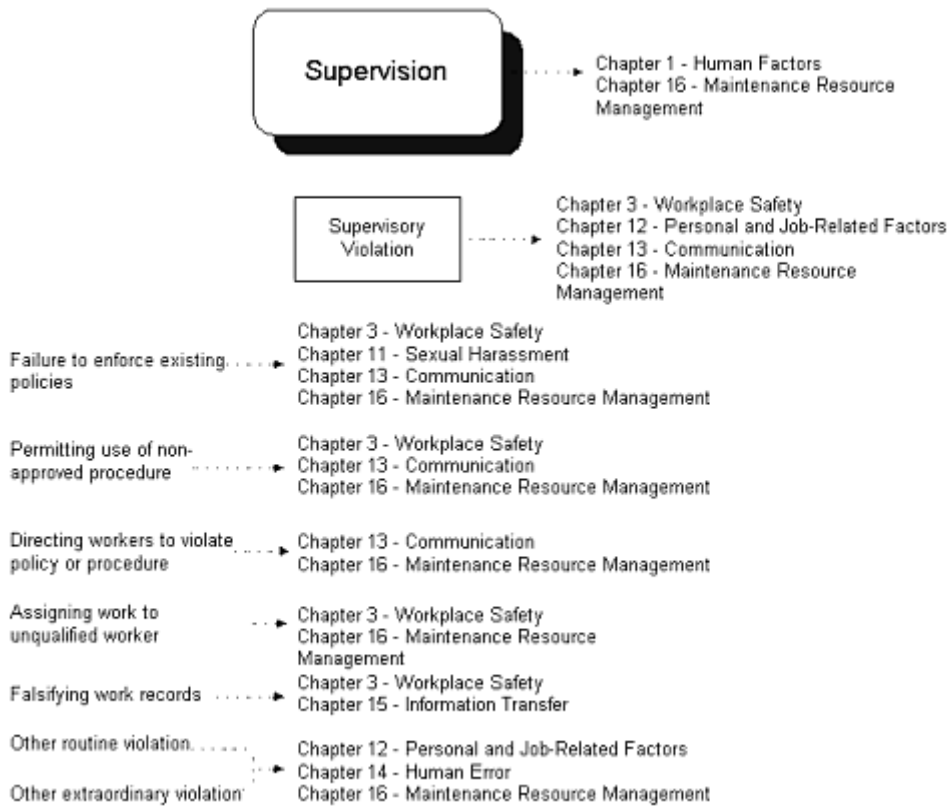


**Figure 9: Failure to Correct Known Problem**



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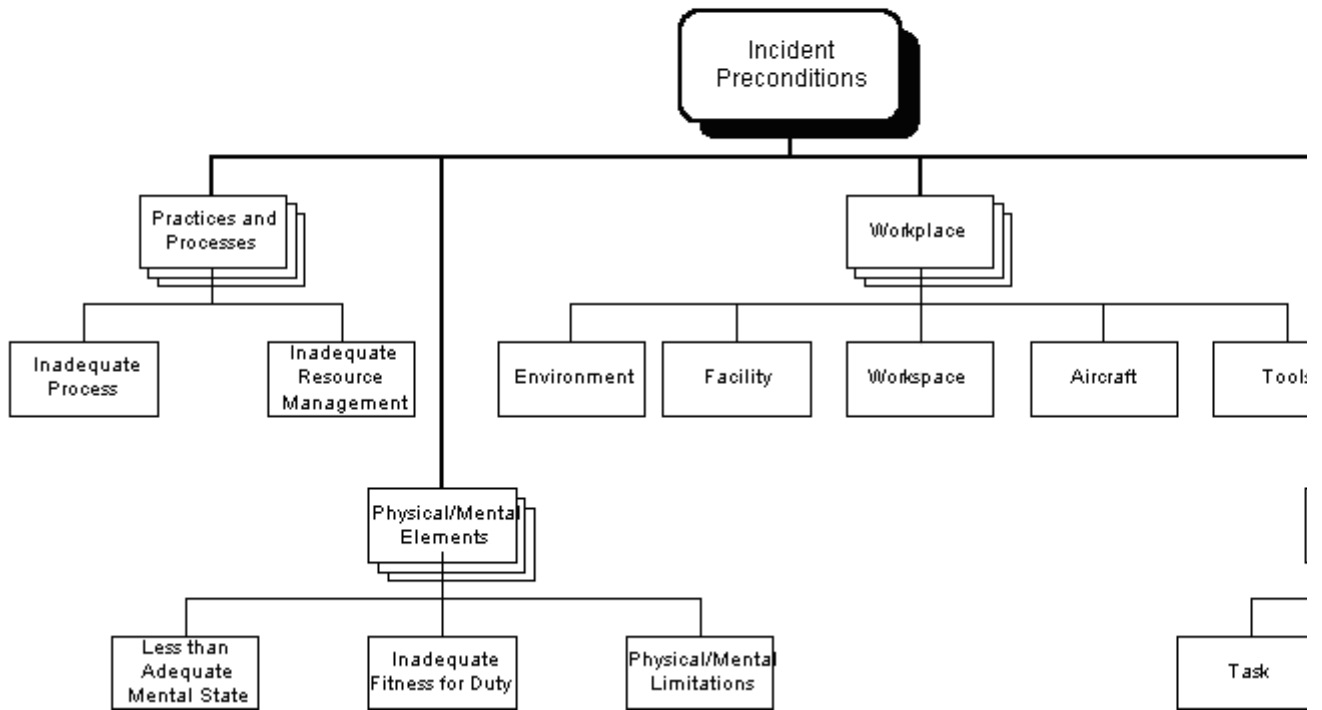
**Figure 10: Supervisory Violation**



**Figure 11: Incident Preconditions**

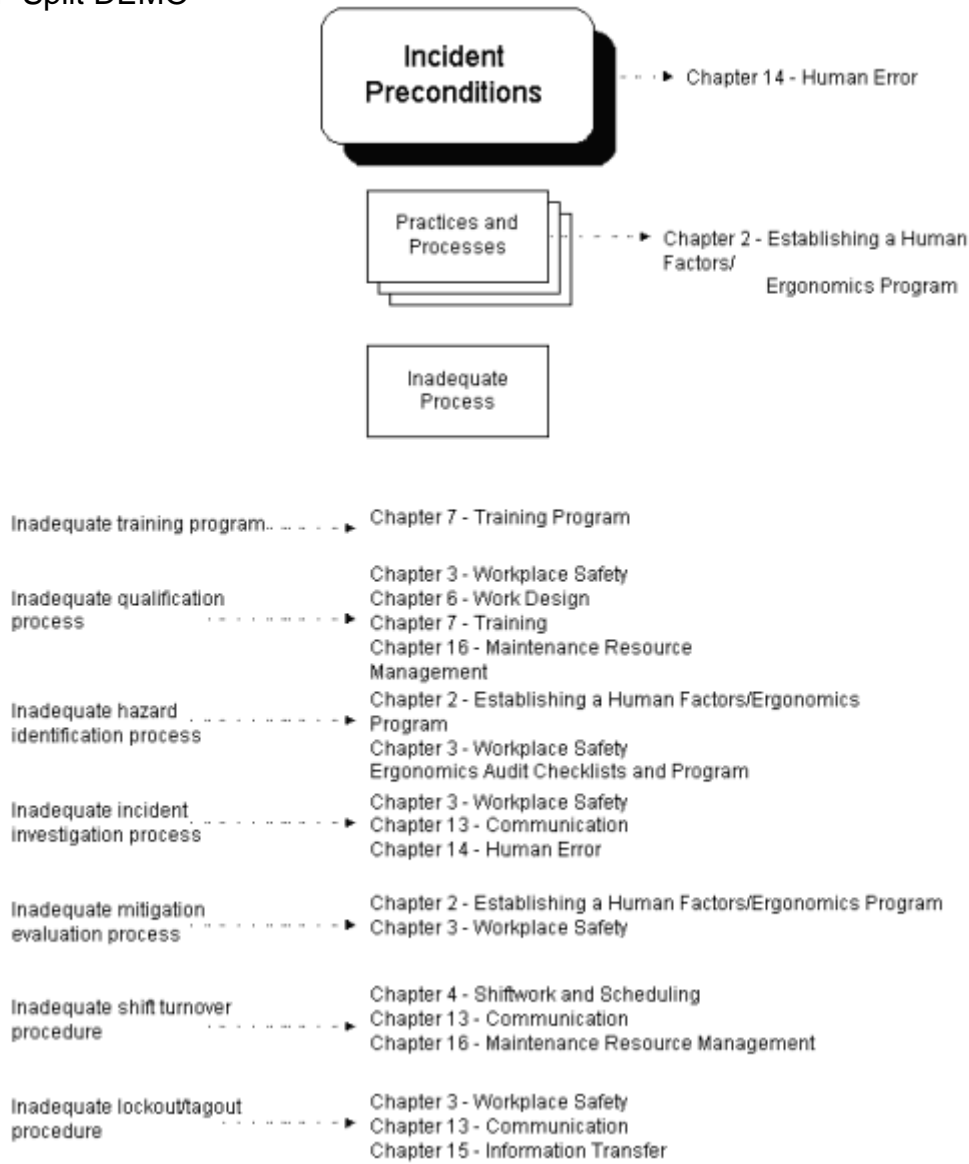
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### Maintenance Incident Root Cause Classification Framework



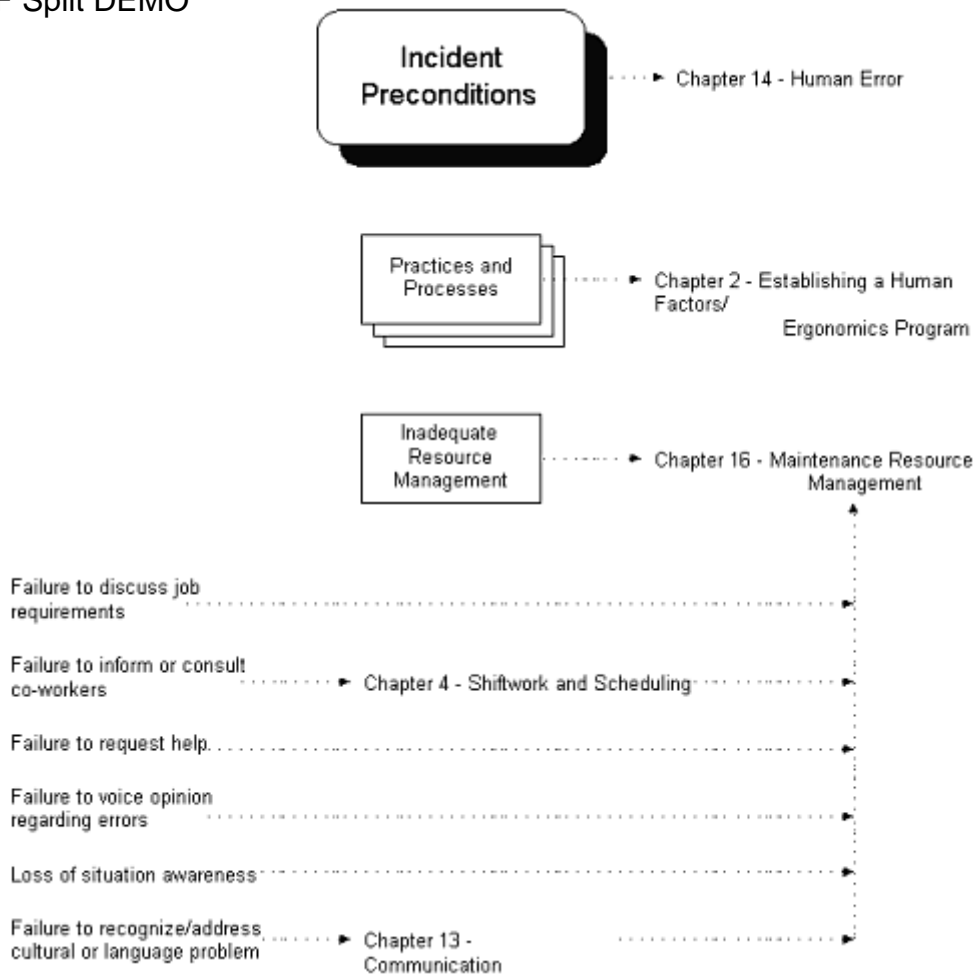
**Figure 12: Inadequate Process**

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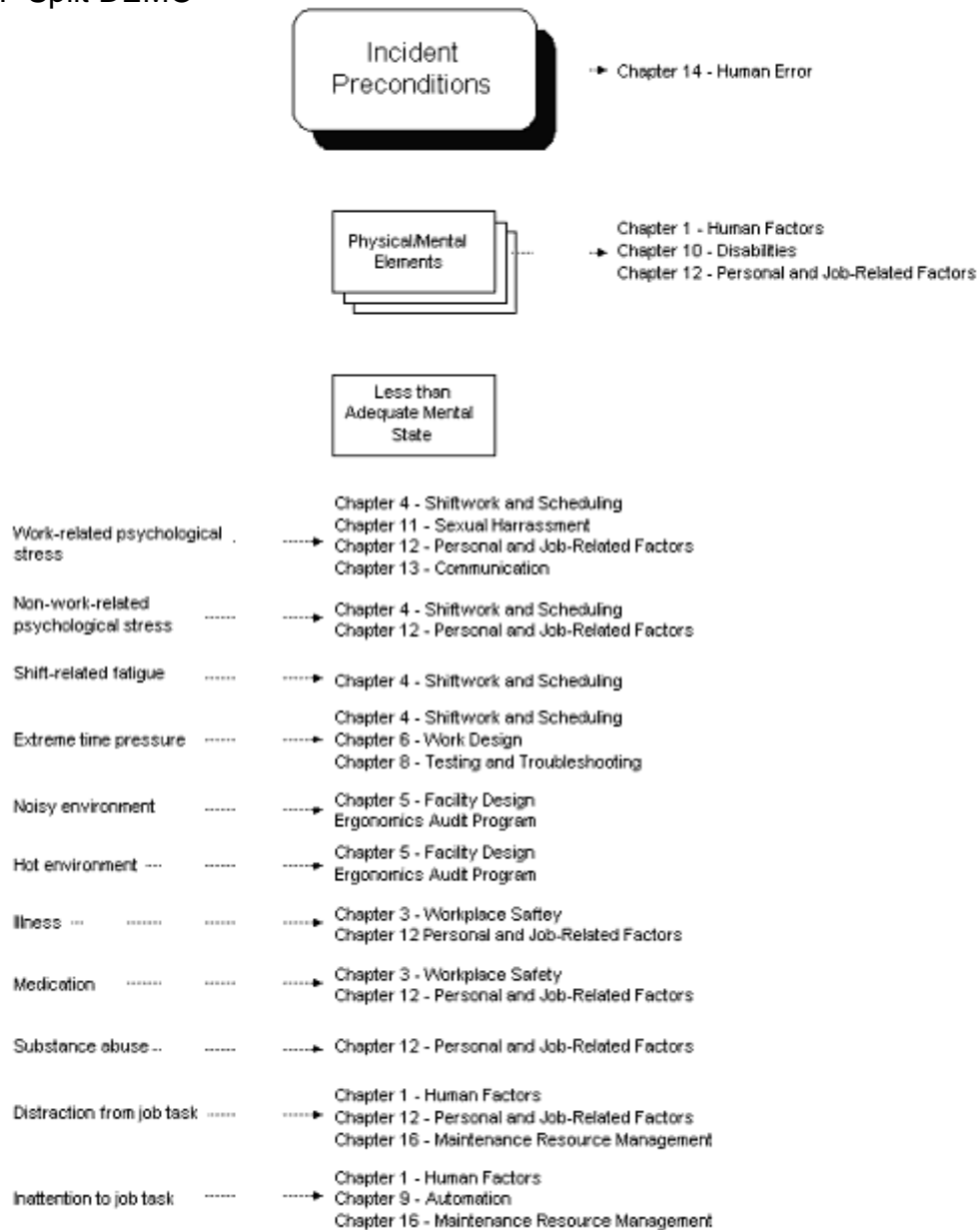
**Figure 13: Inadequate Resource Management**

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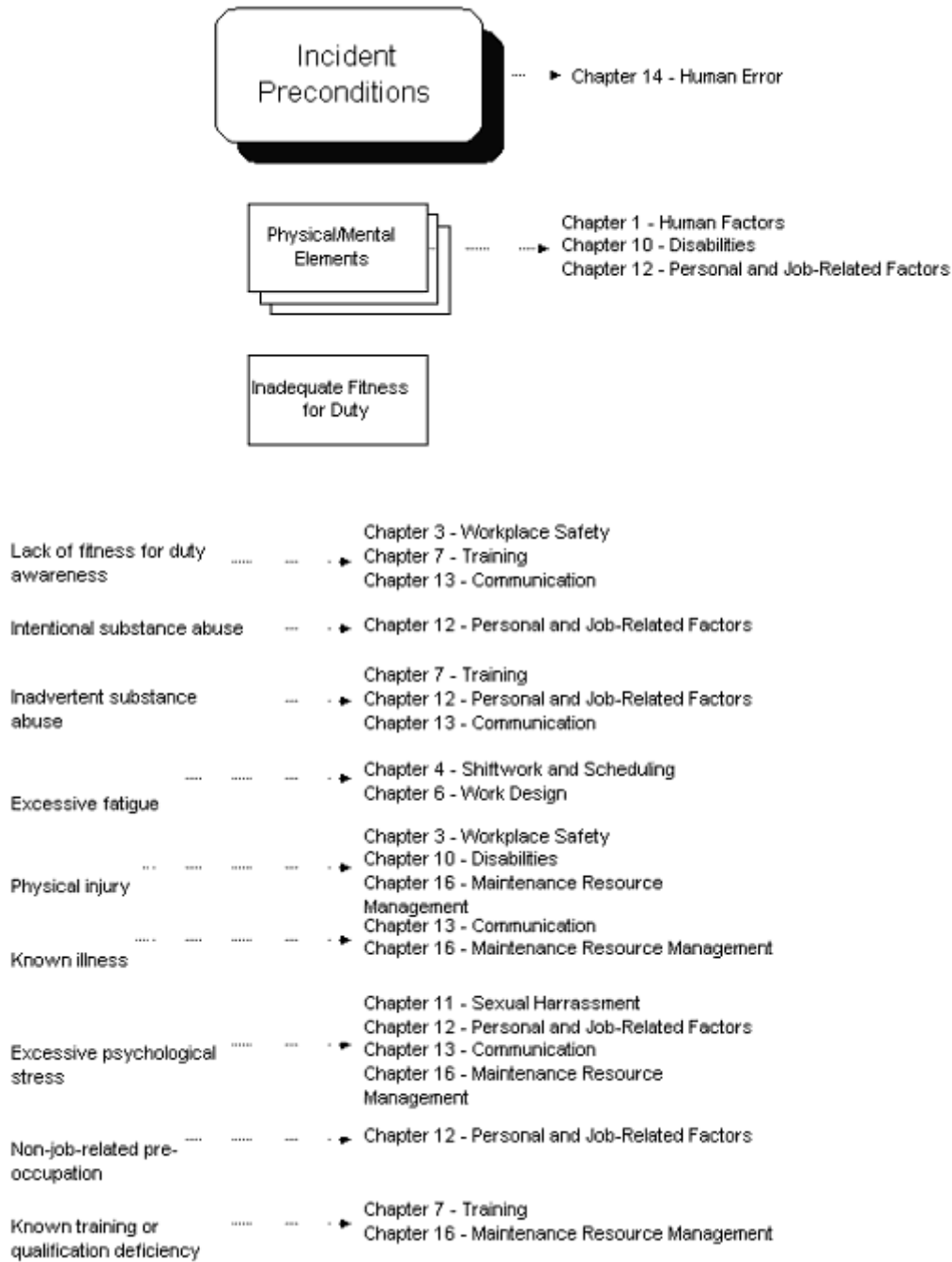
**Figure 14: Less than Adequate Mental State**

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**Figure 15: Inadequate Fitness for Duty**

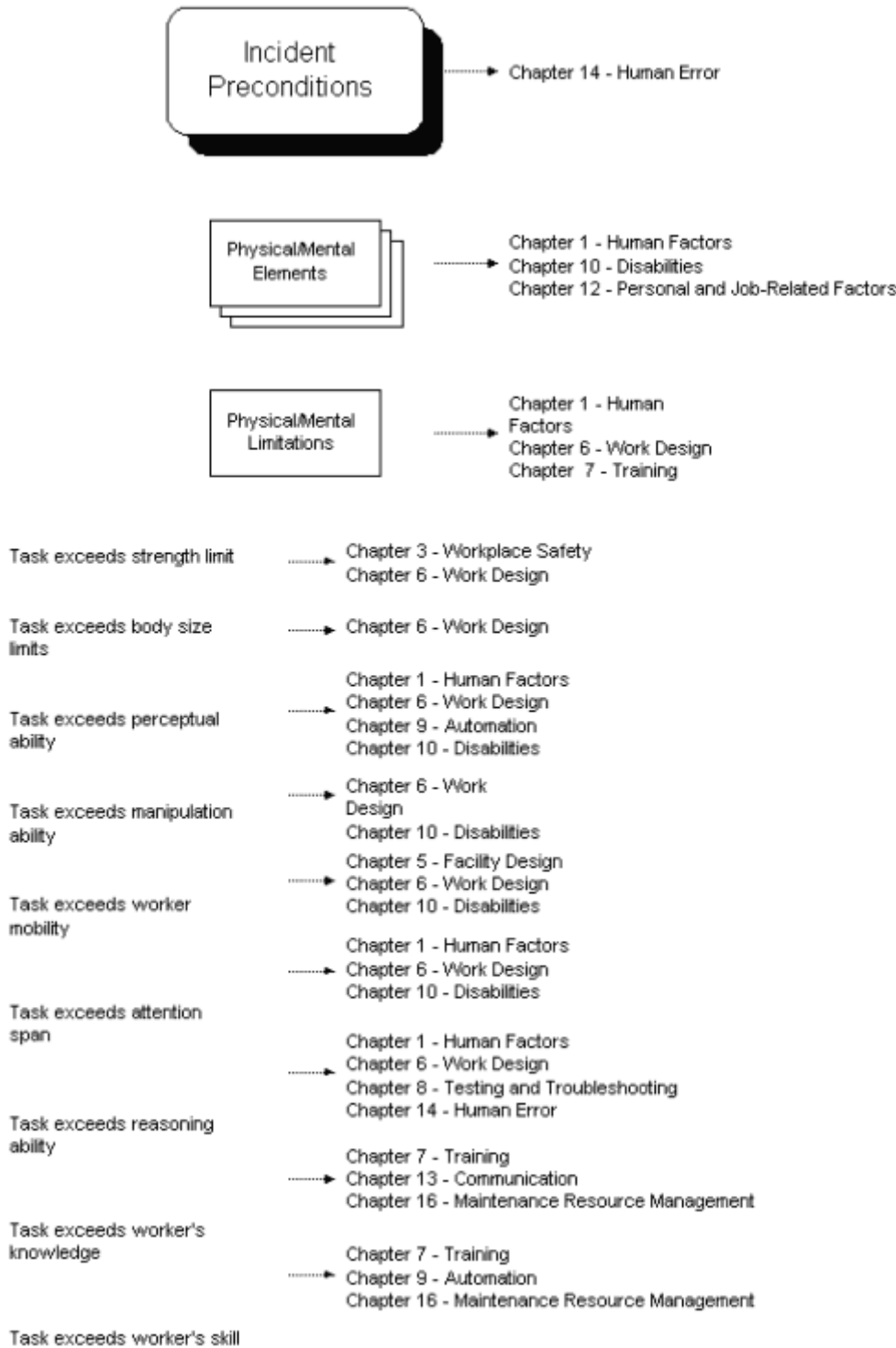
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**Figure 16: Physical/Mental Limitations**

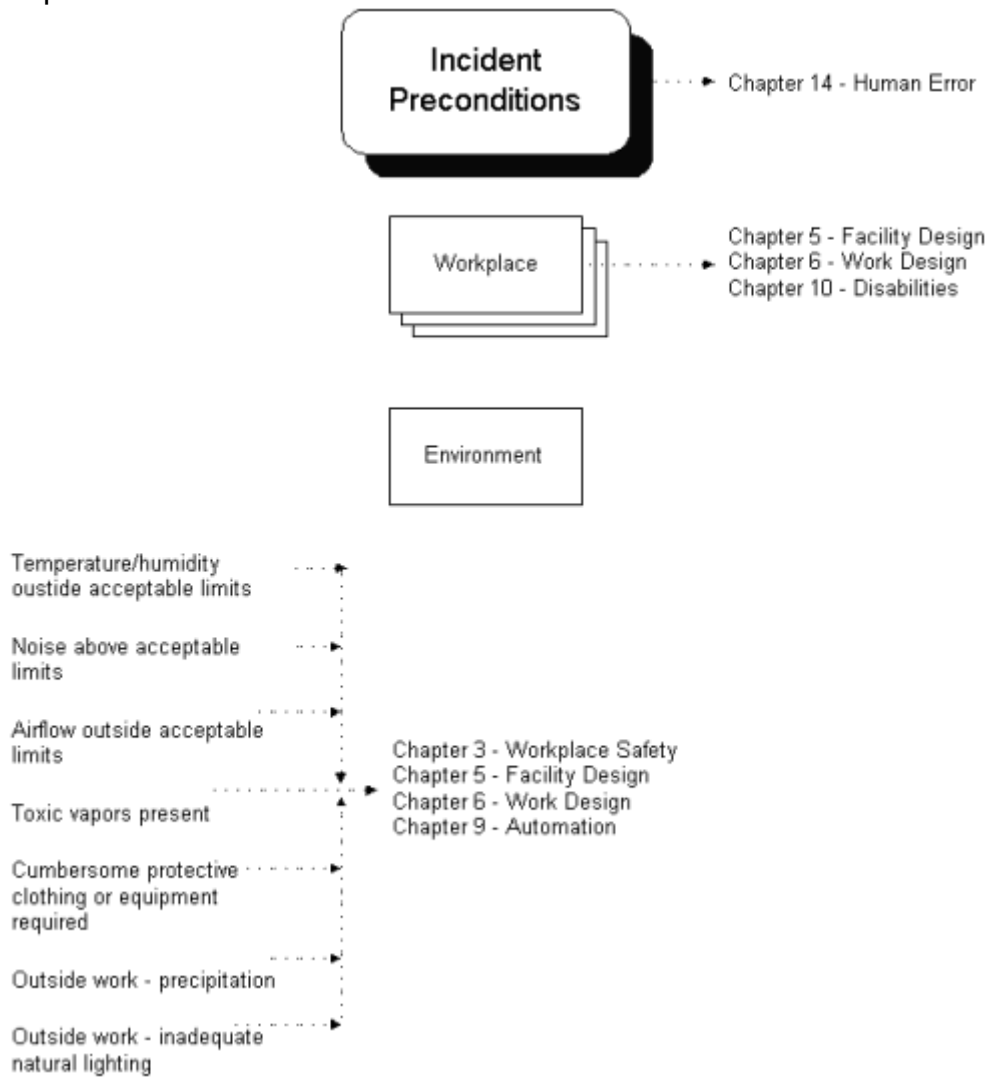


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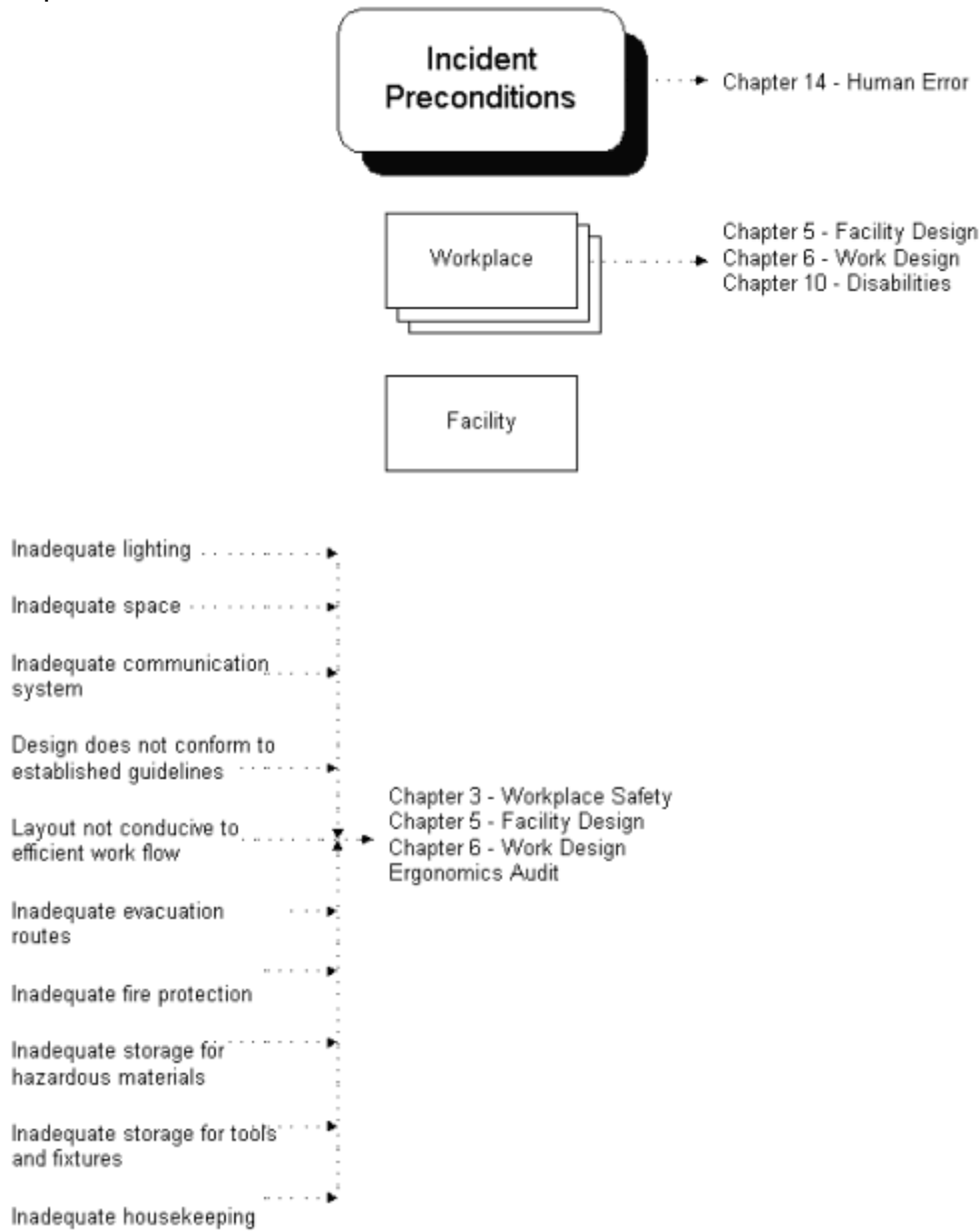
**Figure 17: Environment**

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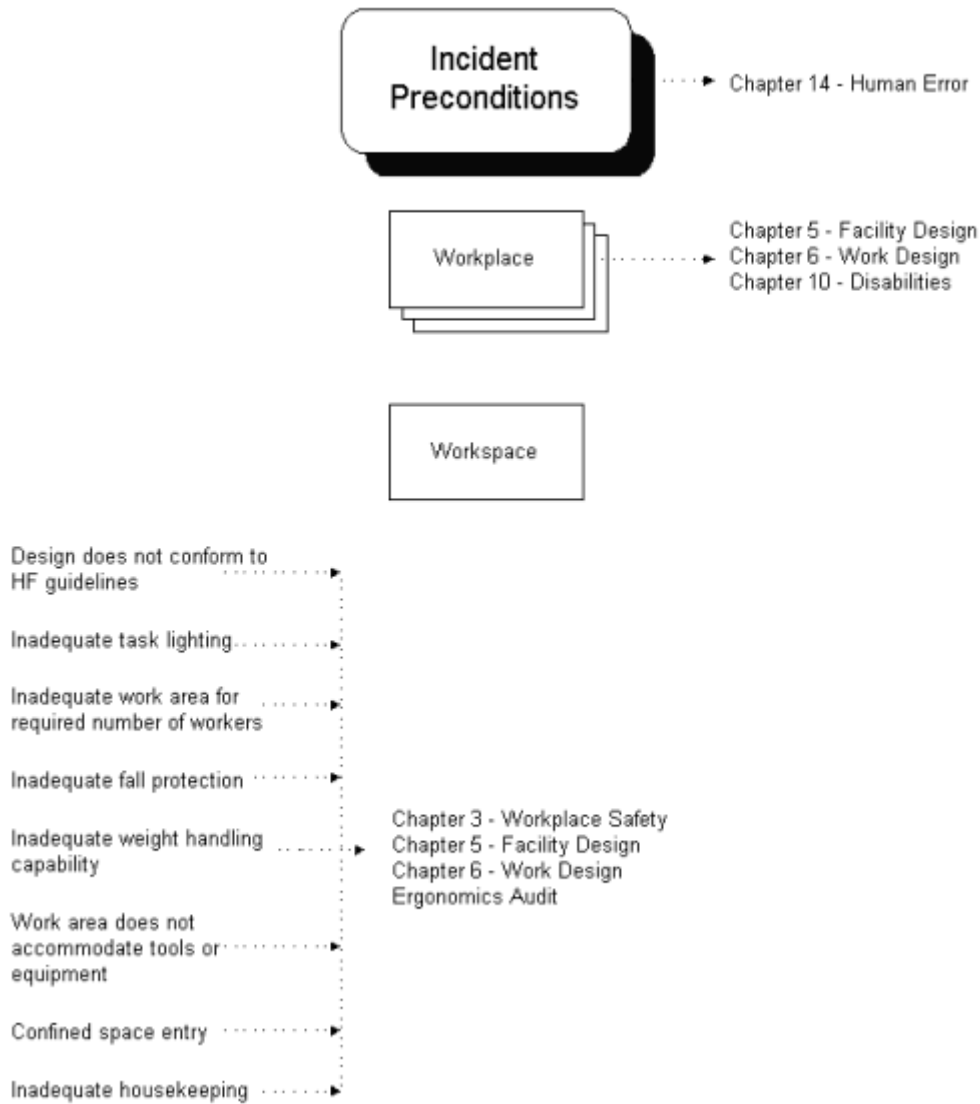
**Figure 18: Facility**

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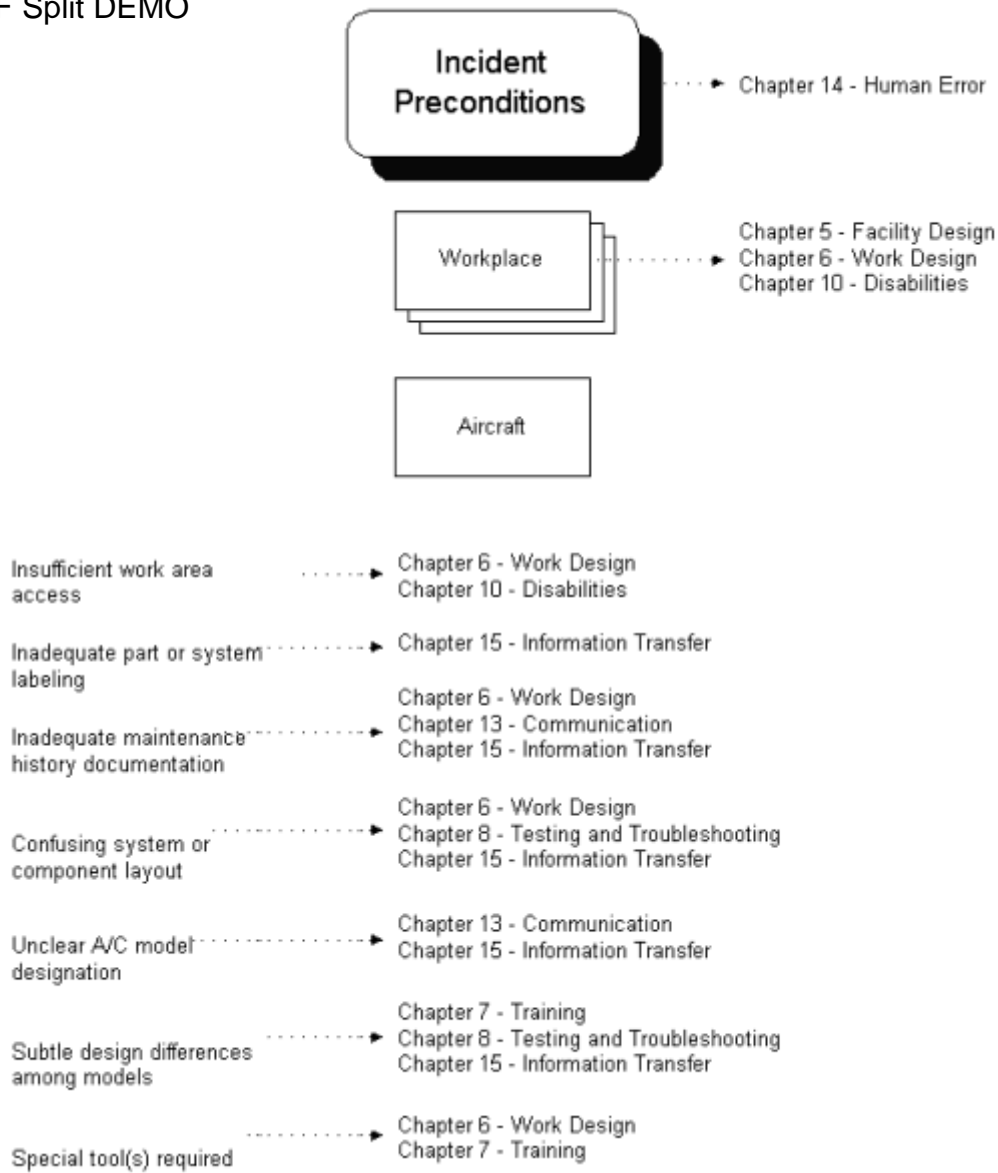
**Figure 19: Workspace**

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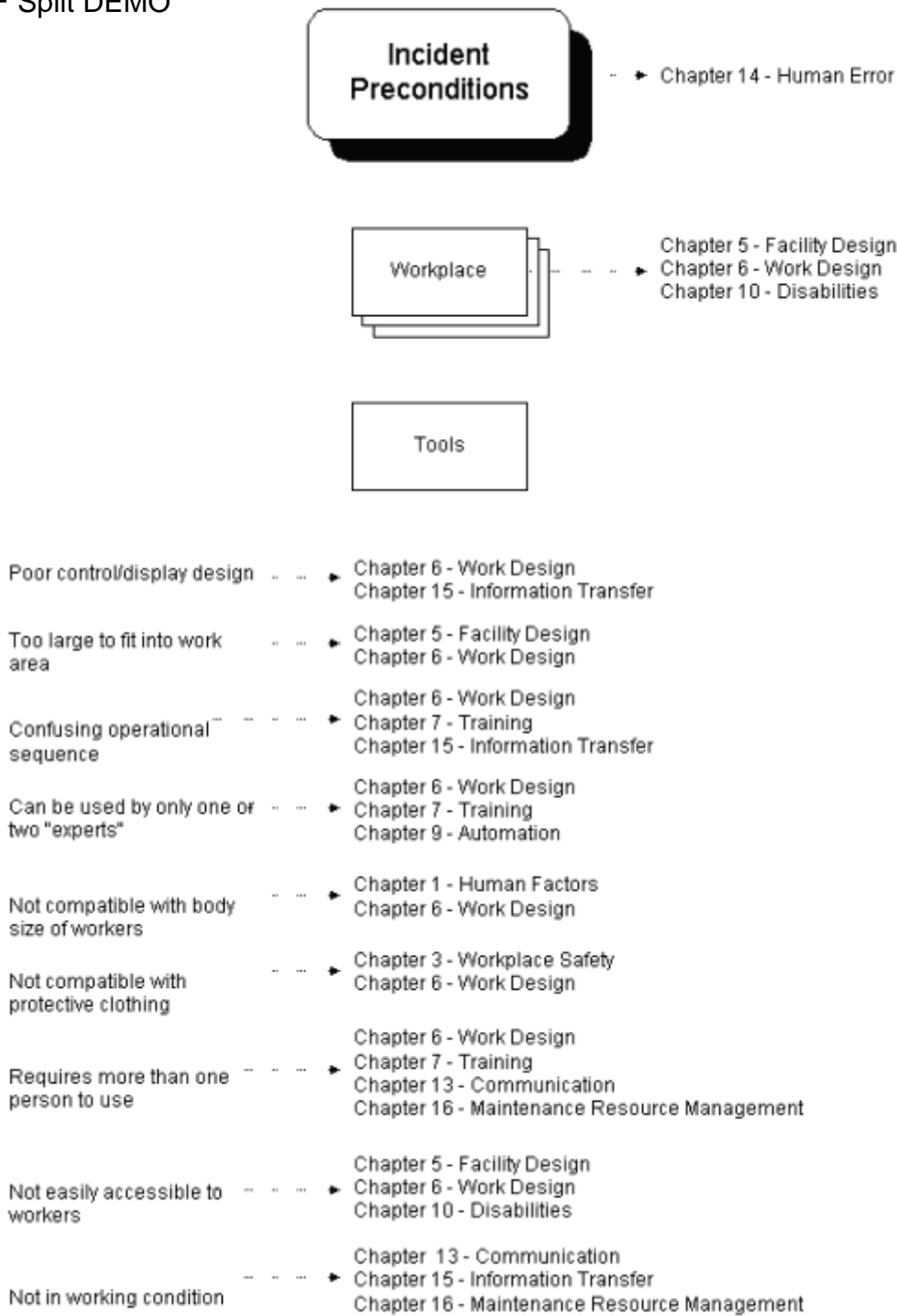
**Figure 20: Aircraft**

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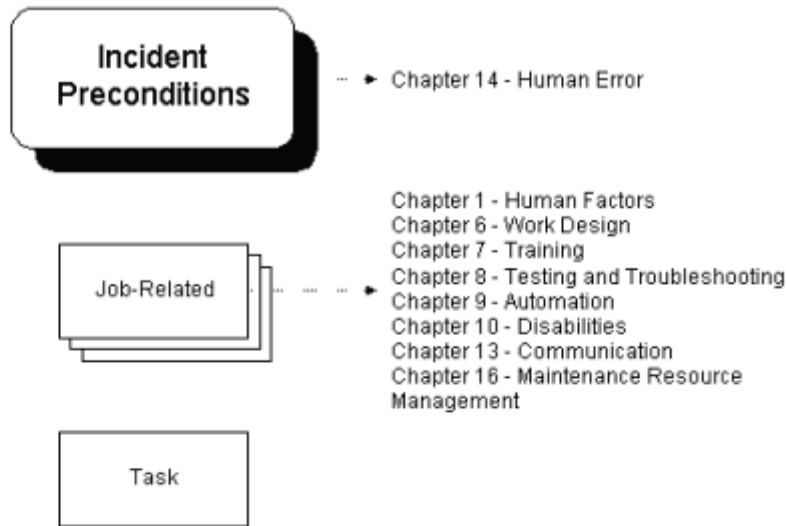
**Figure 21: Tools**

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**Figure 22: Task**

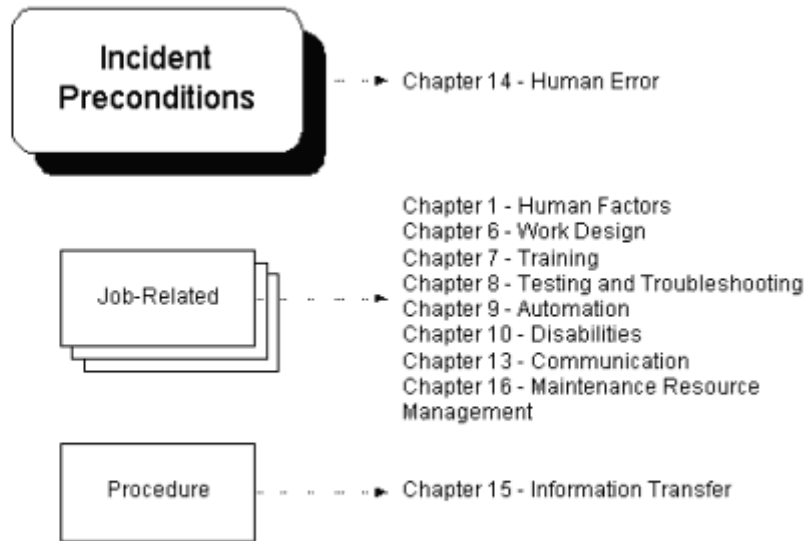
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|  |         |   |
|--|---------|---|
| Requires extended monitoring or vigilance      | .. .. ▶ | Chapter 1 - Human Factors<br>Chapter 6 - Work Design  |
| Requires frequent simple, repetitive actions   | .. .. ▶ | Chapter 6 - Work Design<br>Chapter 9 - Automation   |
| Extremely complex with multiple sub-tasks      | .. .. ▶ | Chapter 6 - Work Design<br>Chapter 7 - Training<br>Chapter 16 - Maintenance Resource Management   |
| Contains subtle differences from similar tasks | .. .. ▶ | Chapter 6 - Work Design<br>Chapter 7 - Training   |
| Extends over more than one shift               | .. .. ▶ | Chapter 4 - Shiftwork and Scheduling<br>Chapter 6 - Work Design<br>Chapter 13 - Communication<br>Chapter 16 - Maintenance Resource Management |
| Requires parallel tasks among multiple workers | .. .. ▶ | Chapter 6 - Work Design<br>Chapter 13 - Communication<br>Chapter 16 - Maintenance Resource Management   |
| Critical failure points are not obvious        | .. .. ▶ | Chapter 7 - Training<br>Chapter 8 - Testing and Troubleshooting<br>Chapter 15 - Information Transfer  |
| New task, not previously performed             | .. .. ▶ | Chapter 6 - Work Design<br>Chapter 7 - Training   |

**Figure 23: Procedure**

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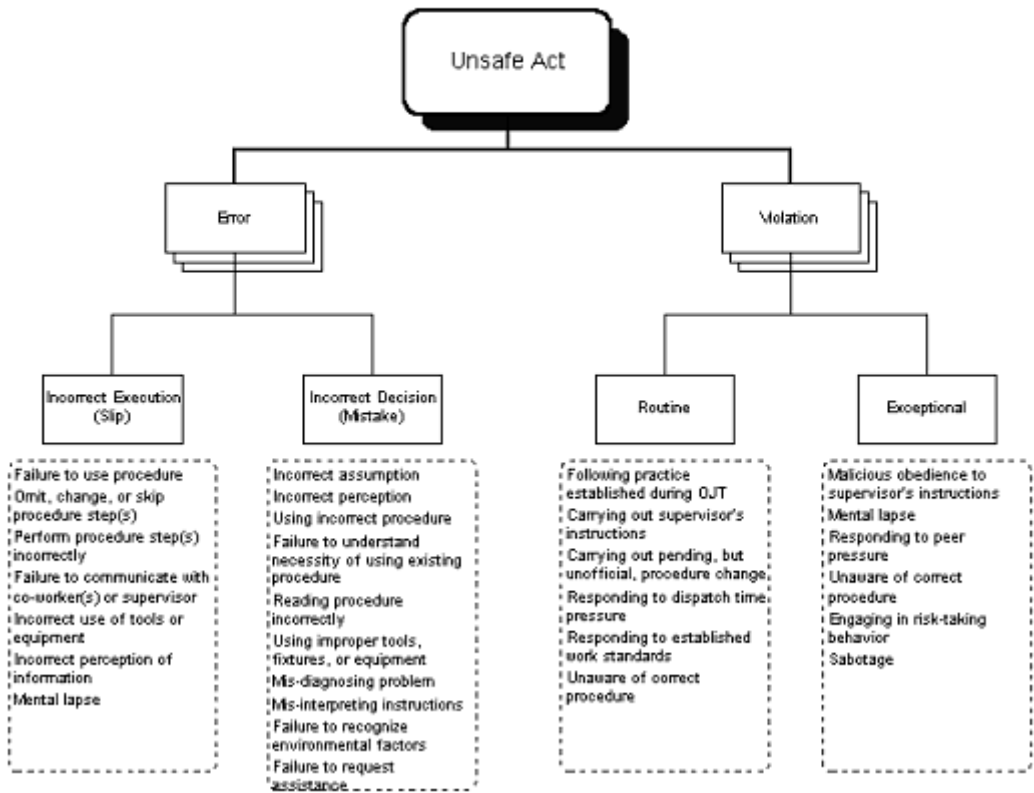
|  |   |
|--|---|
| Inadequate or improper sequencing of tasks           | Chapter 6 - Work Design<br>Chapter 15 - Information Transfer  |
| Layout and format do not conform to HF guidelines    | Chapter 15 - Information Transfer<br>Documentation Design Aid   |
| Terminology is confusing and difficult to understand | Chapter 13 - Communication<br>Chapter 15 - Information Transfer<br>Documentation Design Aid               |
| Requires transcription or mental arithmetic          | Chapter 6 - Work Design<br>Chapter 7 - Training   |
| Not written in worker's first language               | Chapter 6 - Work Design<br>Chapter 13 - Communication   |
| Not updated to latest revision                       | Chapter 13 - Communication<br>Chapter 15 - Information Transfer<br>Documentation Design Aid               |
| Not correct  | Chapter 7 - Training<br>Chapter 15 - Information Transfer<br>Chapter 16 - Maintenance Resource Management |
| First time to be used since last update              | Chapter 7 - Training<br>Chapter 16 - Maintenance Resource Management                                      |

**Figure 24: Unsafe Act**



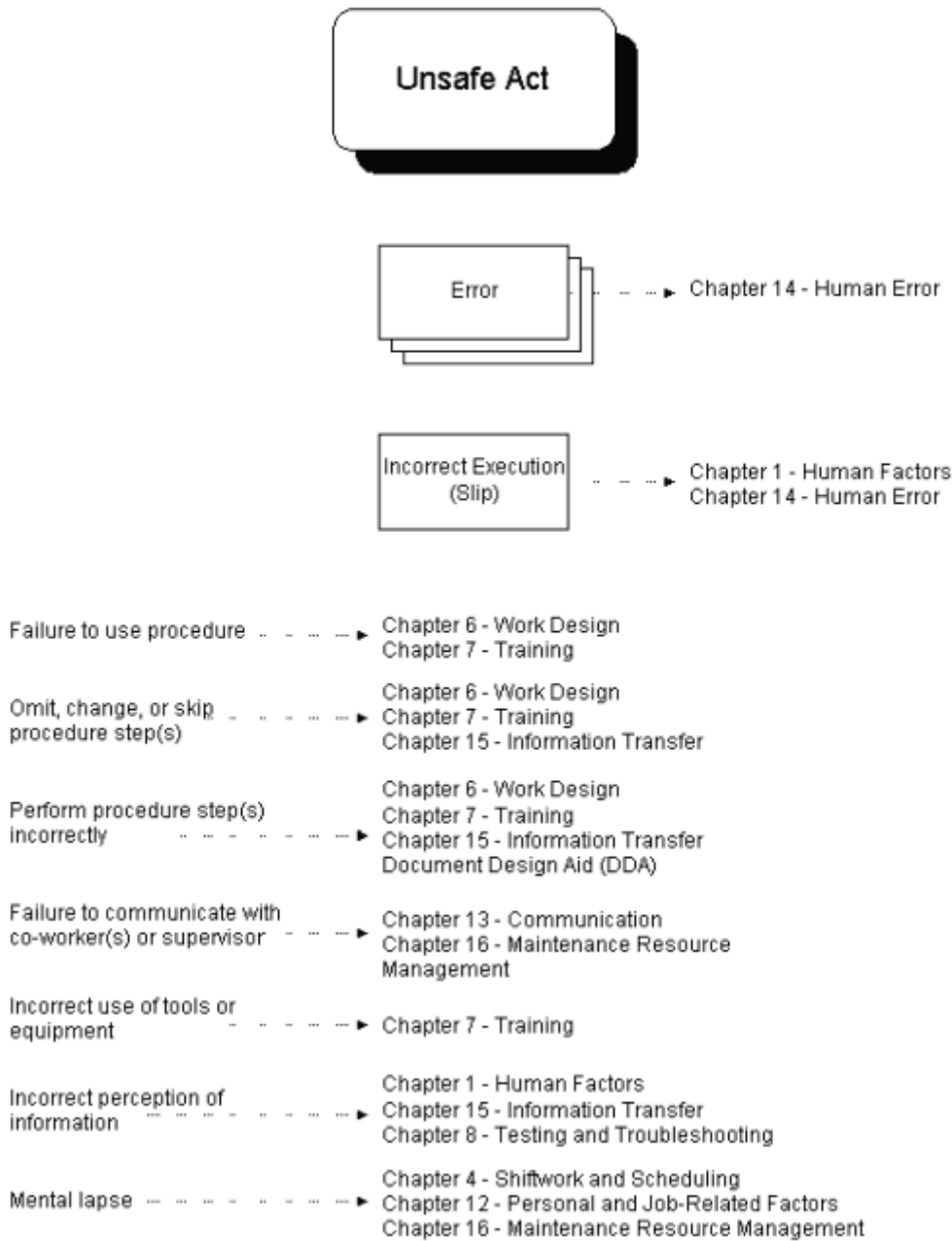
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### Maintenance Incident Root Cause Classification Framework



**Figure 25: Incorrect Execution (Slip)**

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**Figure 26: Incorrect Decision (Mistake)**

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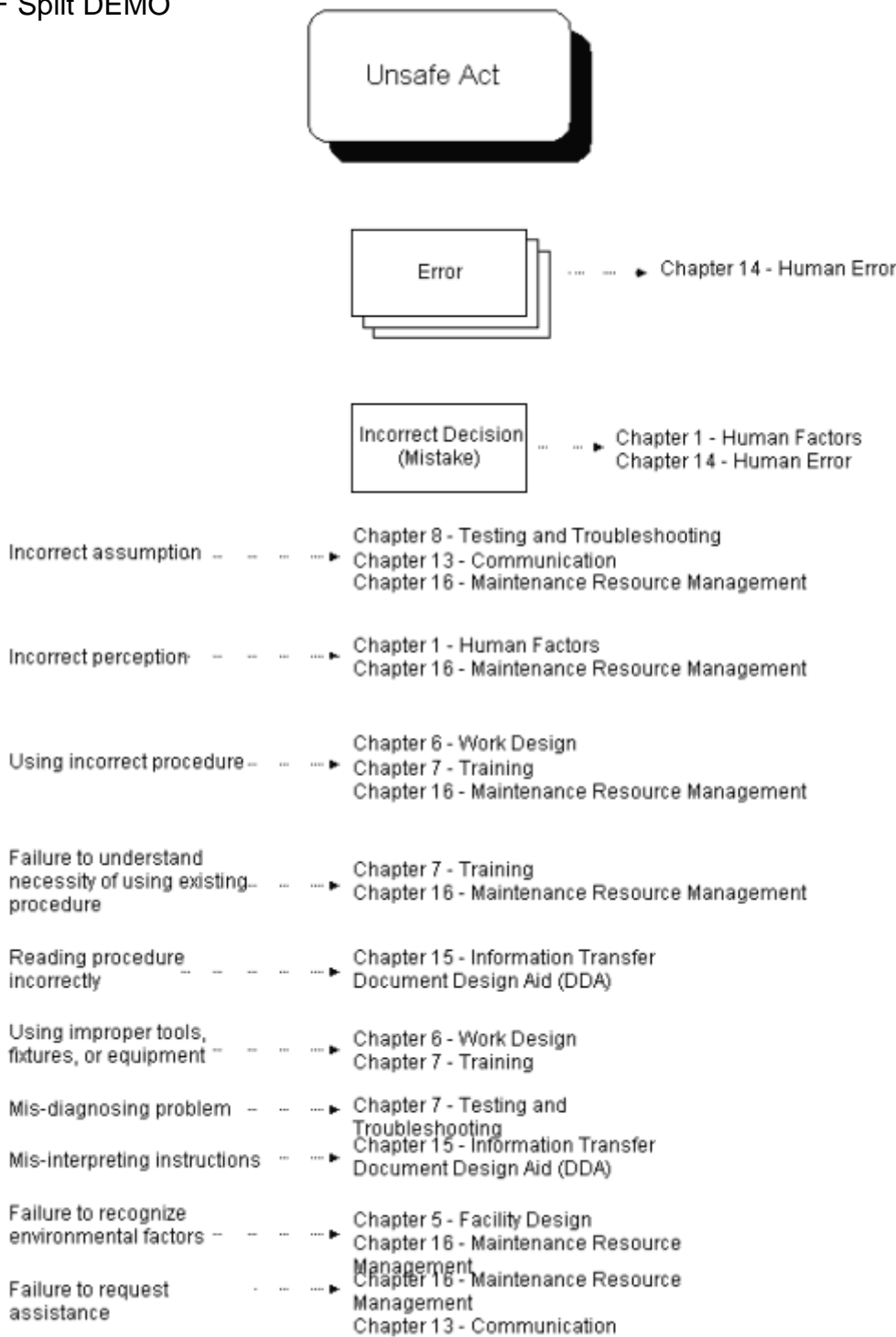
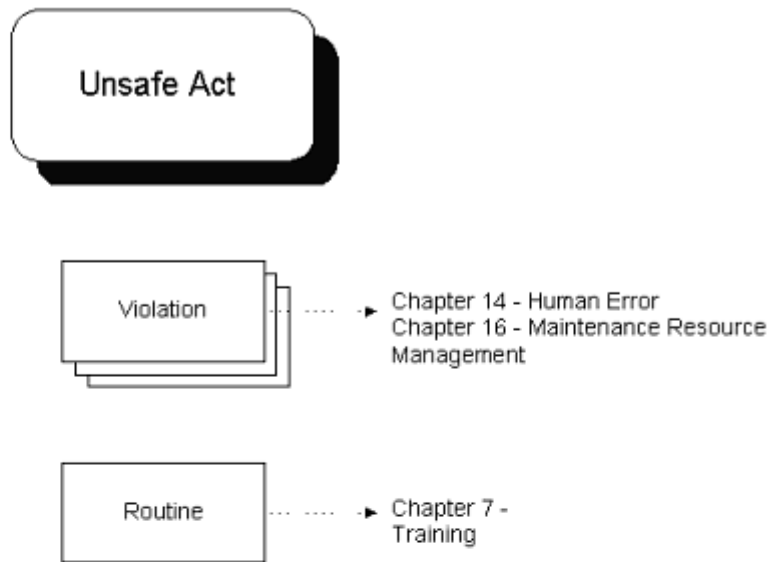


Figure 27: Routine

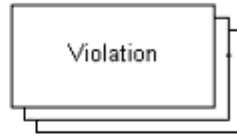
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- Following practice ..... Chapter 7 - Training  
established during OJT
- Carrying out supervisor's ..... Chapter 6 - Work Design  
instructions ..... Chapter 13 - Communication
- Carrying out pending, but ..... Chapter 13 - Communication  
unofficial, procedure change ..... Chapter 15 - Information Transfer
- Responding to dispatch time ..... Chapter 6 - Work Design  
pressure ..... Chapter 14 - Human Error
- Responding to established ..... Chapter 6 - Work Design  
work standards ..... Chapter 7 - Training
- Unaware of correct ..... Chapter 7 - Training  
procedure ..... Chapter 16 - Maintenance Resource  
Management

**Figure 28: Exceptional**

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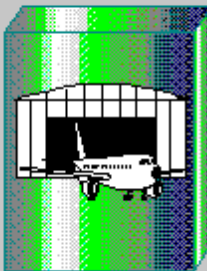
Chapter 14 - Human Error  
Chapter 16 - Maintenance Resource Management



- Malicious obedience to supervisor's instructions ..... → Chapter 3 - Workplace Safety  
Chapter 12 - Personal and Job-Related Factors  
Chapter 13 - Communication  
Chapter 1 - Human Factors
- Mental lapse ..... → Chapter 4 - Shiftwork and Scheduling  
Chapter 6 - Work Design  
Chapter 9 - Automation  
Chapter 12 - Personal and Job-Related Factors  
Chapter 16 - Maintenance Resource Management
- Responding to peer pressure ..... → Chapter 12 - Personal and Job-Related Factors  
Chapter 16 - Maintenance Resource Management
- Unaware of correct procedure ..... → Chapter 7 - Training
- Engaging in risk-taking behavior ..... → Chapter 12 - Personal and Job-Related Factors  
Chapter 16 - Maintenance Resource Management
- Sabotage ..... → Chapter 3 - Workplace Safety  
Chapter 12 - Personal and Job-Related Factors

## FOREWORD

### Foreword



**Author:** William T. Shepherd

**Quote:** " ... operational attention to human factors can raise efficiency, effectiveness, and safety in aviation environments. That translates to cost control and continuing safety. "

The term "human factors" conjures many and varied definitions in the aviation industry. Traditional activities like cockpit design, crew resource management, and team "sensitivity" discussions are often characterized as aviation human factors. However, those activities constitute only a small percentage of aviation-related human factors.

Human factors is the study of the human as a central part of any system. Human factors identifies the capabilities and limitations of humans and, then, adapts the human or the system components accordingly. The science of Human Factors can quantify human performance with measures like time, units of work, safety, error, and, sometimes, attitudinal change. Such measures help to design or modify systems for optimal human performance. Therefore, operational attention to human factors can raise efficiency, effectiveness, and safety in aviation environments. That translates to cost control and continuing safety.

*"Give me a human factors reference that I can understand and use."*

Industry participants involved with the Office of Aviation Medicine's Human Factors in Aviation Maintenance research program have asked for practical human factors guidance that can be used on the shop floor. Maintenance managers cannot call in the company Ergonomist or an outside consultant every time an apparent human factors issue arises. Instead, managers want a Guide that can provide ready reference and information either to make a decision or to elicit additional help.

*The Human Factors Guide for Aviation Maintenance* is designed to be used in aviation maintenance environments. The *Guide* is written for maintenance management, but it contains information and guidance that can be used by people with various responsibilities within maintenance organizations. The *Guide* addresses traditional human factors topics, such as workplace design, safety, etc., as well as at least two topics not typically considered within the scope of traditional human factors. These two topical areas, sexual harassment and personal/job-related factors, are included at the request of industry representatives. While not traditional human factors topics, these two subject areas are known to affect (dramatically, in some cases) the ability of people to work safely and efficiently. In this regard, we believe it is appropriate to address them in a Guide concerned primarily with performance-related issues.

The contents of each chapter are based on laboratory research and best practices in aviation and other industries. The chapters are all written in a straight-forward, readable format. For readers requiring greater detail, additional references are always provided.

### Chapter Layout

All chapters have the same layout. With this design the user can easily become familiar with the

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*Guide* and always know what kind of information is available. Each chapter stands alone, with its own table of contents, index, and list of references. Each chapter includes the following sections:

**Introduction:** This section is a quick overview of the chapter explaining why the chapter is included and what's in it.

**Background:** This section contains more details about the topic than the introduction. In most cases this section provides a perspective of how the topic chapter emerged as an important topic to be included in the *Guide*.

**Issues and Problems:** The most common or severe performance issues related to the chapter's topic are explained in this section. For example, the Aloha Airlines accident made it very clear that training and adherence to procedures is a critical component of the overall "safety chain."

**Regulatory Requirements:** Since aviation maintenance and industry in general is driven by regulations, this section is important. When there are specific regulatory requirements related to the chapter's topic they are stated very explicitly .

**Concepts:** This sections contains straight-forward explanations of the basic principles affecting the chapter topic. In most cases, concepts are related to aviation maintenance examples.

**Methods:** The human factors methods applicable to the chapter are included here.

**Reader Tasks:** Often, there are human factors-related tasks that can be performed by maintenance management. This section describes such tasks and also suggests the kind of tasks that require the help of internal or external human factors professionals.

**Guidelines:** This section is a straight-forward listing of suggested guidelines appropriate to the chapter's topic. Guidelines are tied to the Reader Tasks described in the preceding section. This tends to be the most direct and informative section of each chapter.

**Further Reading:** The *Guide* presents information that has been derived and condensed from many services. This section provides a list of documents, books videotapes, etc., that readers can consult for detailed discussion of the topics addressed in the chapter.

**Where to Get Help:** This section is like a Human Factors Yellow Pages.

**Example Scenarios:** The scenarios presented in each chapter represent some typical kinds of human factors tasks that one can expect to encounter in the workplace. For each scenario, we describe how the issues raised in the scenario can be resolved.

**References:** The *Guide* is written to avoid scientific, engineering, and psychological jargon. The authors of the *Guide* went to the literature to derive the important facts and converted them to practical information. This section provides the primary scientific and/or regulatory references for further information.

### Credit to the authors/developers

Design, writing, and production of a practical guideline for human factors in aviation maintenance is a monumental task. It requires true expertise to explain complex issues in a straight-forward manner. A multi-disciplinary team created the *Guide*. Many aviation industry and government representatives selected the initial 12 chapters and created a list for future editions.

William Shepherd and Jean Watson, FAA Office of Aviation Medicine, identified the industry need for the *Guide* and obtained the FAA commitment to embark on and continue the significant work of creating and supporting the *Guide*. The primary author of *The Human Factors Guide for Aviation Maintenance* is Michael Maddox, of Sisyphus Associates. Other contributing authors are Colin Drury, State University of New York at Buffalo; James Burnette, Ergonomist; and Lawrence Rifkind, Georgia State University.

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The project was headed by Galaxy Scientific Corporation, which provided selection and coordination of authors, editorial support, graphics design, and development of all digital multimedia for the *Electronic Guide*. Galaxy personnel included Suzanne Morgan, Sheldon Kohn, Kiki Widjaja, Julie Jones, Donna Clemons, and William Johnson. Joel Dickerson, Dickerson Design, provided assistance with the graphical design. The project's foundation and initial planning were done by James Parker from BioTechnology, Inc. Numerous industry personnel and human factors professionals have provided essential reviews and guidance to ensure the quality of this document.

The 1996 revision project added Chapters 13, 14, and 15 authored by Lawrence Rifkind, Georgia State University; James Reason, University of Manchester, UK; Michael Maddox, Sisyphus Associates; and Prasad Prabhu, Galaxy Scientific.

The 1998 revision project was headed by Galaxy Scientific Corporation, with Michael Maddox of Sisyphus Associates as editor. Michelle Robertson of the University of Southern California authored Chapter 16 on MRM, and Terrell Chandler of Galaxy Scientific rewrote Chapter 7 on Training. Galaxy personnel included William Johnson, Julie Jones, Terrell Chandler, Phyllis King, Paul Uzee, Linda Mangis, Veronica Danley, Heather Barker-Church, Ben Sian, and Charlena Kunkler.