CHAPTER 1
PHASE VI OVERVIEW

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1.1 INTRODUCTION

Secretary Peña's Safety Summit held in 1995 has resulted in the Department of Transportation's Aviation Safety Action Plan - "Zero Accidents". This has brought a new level of awareness and focus to applying Human Factors approaches to reducing human errors and developing methods and tools that allow cost savings without compromising safety. The airline industry is showing a great responsiveness in applying human factors methodologies to the maintenance environment. Maintenance Resource Management (MRM) or Technician Resource Management (TRM) using CRM-Human Factors concepts is being viewed favorably by many airlines. Continental Airline's Crew Coordination Concepts (CCC) program for its maintenance personnel is an example of this effort. Airlines are trying to control and reduce "Human Error" and are moving away from "blame the technician" approach to using structured methods to identify the root cause of the errors. The Maintenance Error Decision Aid (MEDA) developed by Boeing in cooperation with the Federal Aviation Administration (FAA) and various airlines is an example of this approach. With human error being the # 1 cause of aviation incidents, it is evident that applying Human Factors principles to aviation is the best option for the U.S. Air Transport System to continue to maintain and improve its impressive record of air safety.

The Office of Aviation Medicine (AAM) has conducted Human Factors-related research in Aviation Maintenance since 1989. The research ranges from basic scientific experimentation in laboratories to applied studies in airline working environments. The philosophy of this research program has been that "good science" must be the basis for "good practice" and the research conducted must have demonstrable benefits to the Aviation Industry. For this to happen, the end user of the research must be involved in all stages of the research. As such, the researchers in this program have actively sought input from airlines and FAA organizations to define, develop and evaluate the research initiatives.

There has been a strong emphasis on transitioning the research products to the industry. For example one major air carrier is using maintenance workcards that have been re-designed as part of the research. The FAA Flight Standards Service (AFS) is currently planning a large scale deployment of an operational portable computing system called OASIS (On-line Aviation Safety Inspection System). OASIS was an offshoot of the pen-computing job aid developed as part of this research program. These and other research products and procedures generated by the research program have continued to demonstrate the effectiveness of using Human Factors principles in the Aviation Maintenance.

The research program has so far conducted 10 workshops on Human Factors in Maintenance and Inspection attended by over 1000 industry participants. In seven years, the research program has generated over 200 technical reports, journal articles, and presentations at industry meetings. Four CD-ROMS have been published so far and distributed to over 3000 recipients. A homepage has also been established on the world wide web of the Internet to disseminate Human Factors Information to the aviation community.

This report describes the research activities performed during Phase VI of the research program. Research was conducted in a broad spectrum of areas including application of advanced technologies to aviation maintenance, application of CRM concepts in maintenance and inspection, investigation into automation error and ground damage incidents, investigating human performance issues and developing job aids, investigating and developing digital documentation techniques for efficient communication, visual inspection studies, evaluation of Simplified English, and developing methodology to create "advanced certification" for AMTs. Each of the research activities will be described briefly in the following sections of this introductory chapter.

1.1.1 Multi-media based Training System for Regulatory Documents (Chapter 2)

In this phase, the System for Training Aviation Regulations (STAR) progressed from a prototype (in Phase V) to an application supporting three learning environments. The learning environments are the Overview, Scenario, and the Resources. STAR is designed to be an instructional companion to the FAA Part 147 course on Aviation Maintenance Regulations. It uses multi-media technology and case-based story telling techniques to motivate interest and promote understanding of aviation regulations. The chapter describes the theoretical basis of STAR, the learning environments, and the evaluative studies performed to test the validity of this approach.

1.1.2 Computer-based System for Aircraft Maintenance Team Training (Chapter 3)

Team training attempts to improve teamwork by facilitating better communication, decision-making, and problem-solving skills in team members. As computer-based technologies get cheaper, application of these advanced technologies to imparting team training concepts is very desirable. This chapter describes the development of a computer-based team training software called the "Aircraft Maintenance Team Training (AMTT)". AMTT has been designed to train AMTs in basic team skills. It uses multi-media presentations including full motion videos, animations, pictures, and audio to explain team training concepts to the student. It also has an "instructors" module that allows a training instructor to analyze the performance of the student using the pre- and post-training data collected by the software.

1.1.3 Team Situation Awareness in Aircraft Maintenance (Chapter 4)

Situation Awareness (SA) had been limited to the study of pilots and air traffic controllers and found to have a tremendous impact in these areas. However, an enhanced understanding of how maintenance personnel manage resources and maintain an awareness of all aspects of a given maintenance task has the potential to reduce and/or mitigate human error in maintenance. The project studied the situation awareness training requirements of maintenance teams. This chapter presents a description of the situation awareness requirements for aircraft maintenance teams, analyzes how SA needs are currently being met in a typical maintenance environment, and establishes the concepts and requirements for training Team SA in the maintenance domain.

1.1.4 Job Aiding for FAA and Industry (Chapter 5)

Human-centered job aids help the aviation industry to improve performance without reducing safety. This chapter describes the three job aids developed as part of this effort, one was a fully operational system for conducting audits for the Coordinating Agency for Supplier Evaluation (CASE), the second was a job aid for the FAA Aviation Safety Inspectors to use the Job Task Analyses (JTA) information, and the third was a prototype system for the Civil Aeromedical Institute (CAMI) to collect and distribute data on alcohol and drug test results.

1.1.5 Pen-Computer based Non-routine Write-up System (Chapter 6)

Pen-computer based non-routine cards promise the benefits of less handwriting, standardization of language, improved readability, better access to maintenance information, automated routing of information for scheduling repairs, and improved database to support planning and analysis. This chapter describes the development of a prototype non-routine write-up system and a pilot study conducted to test its effectiveness.

1.1.6 Error Reporting System for Maintenance Facilities (Chapter 7)

Many error reporting systems are in use by different departments in an airline. However, these systems are rarely used together to analyze the system as a whole. This holistic approach is important because there could be common causes for errors across the different maintenance areas. The research effort analyzed five classes of errors from reporting systems for Ground Damage Incidents (GDI), On the Job Injuries (OJI), and Paperwork Errors. The chapter describes this analysis and the development of an "Unified Incident Reporting System" for Maintenance.

1.1.7 Electronic Ergonomics Audit System for Maintenance and Inspection (Chapter 8)

The purpose of this project was to integrate a variety of ergonomic audit tools into a comprehensive package to cover both maintenance and inspection tasks. Issues such as interface usability, expert system support for analyses, and provisions for printing and generating reports were considered. The chapter reports the development of this tool and also describes its capabilities.

1.1.8 Advanced Technology Applications (Chapter 9)

Advanced technology can help maintenance and inspection (M&I) technicians as well as the aviation safety inspectors (ASI's) to achieve the twin goals of safety and productivity. This was demonstrated by the Performance Enhancement System (PENS) which used pen-computer technology. This technology was developed and evaluated in Phase V of the research project.. The project described in this chapter focused on the following areas: (1) Development and evaluation of an improved display prototype, (2) Evaluation of documentation output options for PENS, and 3) Evaluation of specific advanced technologies. These areas were selected because they matched the Flight Standards Service (AFS) requirements for recording and accessing data.

1.1.9 Visual and NDI Inspection Research (Chapter 10)

The National Aging Aircraft Research Program (NAARP) of the FAA Technical Center has identified visual inspection and non-destructive inspection (NDI) as two of the specific research areas. This chapter describes research activities performed at the Aging Aircraft Non-destructive Inspection Center (AANC). Two studies were performed, one to help conduct and analyze the Visual Inspection Research Program (VIRP) benchmark study at the AANC and the second was an enhanced visual inspection evaluation in which a "Maglight" flashlight was evaluated. The chapter also reports a summary of a quantitative comparison of recent NDI reliability studies performed by the FAA and the CAA (UK).

1.1.10 Study on Automation Related Errors in Maintenance and Inspection (Chapter 11)

Modern test equipment for maintenance is getting increasingly complex and poses a potential for novel forms of errors alongside the promised benefits of higher productivity. This chapter reviews the progress of automation in the maintenance and inspection hangar, provides a method for taking automation decisions, and presents a simple procedure to help system designers and buyers to foresee and mitigate automation-related errors.

1.1.11 Field Evaluation of Simplified English (Chapter 12)

The Air Transport Association (ATA) and the Aerospace Industries Association of America (AIAA) have emphasized the use of "Simplified English (SE)" for technical documentation. Most major aircraft manufacturers now use SE in their documentation. However, the impact of this restricted language on AMTs had not been directly measured so far. This chapter describes the results of the study conducted to determine whether SE enhances comprehension of workcards by AMTs.

1.1.12 Study of Advanced Certification for AMTs (Chapter 13)

The Aviation Rulemaking Advisory Committee (ARAC) Part 65 Working Group has been reviewing FAR Part 65. This process began in 1989 and is now in the final stages. The committee's final recommendations have resulted in the draft of a proposed new Part 66 - certification: Aviation Maintenance Technicians and Aviation Repair Specialists, completed in December 1995. This chapter describes the second phase of a study undertaken as an extension of the Part 65 review work. The first phase of the study (Phase V progress report) focused on the need for an industry-directed, independent system. The second phase study addressed the process for developing certification standards of aviation maintenance specialists. The chapter reports the key findings and recommendations for an Aviation Repair Specialists (ARS-I) training, qualification, and certification process.