

CHAPTER ONE

PHASE IV OVERVIEW

1.0 INTRODUCTION

Since 1989, the Federal Aviation Administration (FAA) Office of Aviation Medicine (AAM) has conducted research related to human factors in aviation maintenance and inspection. The research has been well received by FAA, the scientific community, and the airlines. This research program has sponsored eight workshops on human factors issues in aviation maintenance and inspection. These workshops have been attended by more than 800 participants. The 8th workshop was conducted during this phase of the research program. The theme for this meeting was "Trends and Advances in Aviation Maintenance Operations." The proceedings were distributed in April 1994 and were also included on the second FAA/AAM CD-ROM, produced in May 1994.

Figure 1.1 outlines the research plan for this program. The first phase consisted of extensive investigations of airline maintenance organizations in order to gain a better understanding of the problems/needs of the "real world" of airline maintenance (Shepherd et al., 1991). The second phase developed a number of human performance enhancements based on the findings from Phase I [e.g., the Environmental Control System (ECS) Tutor, NDI Simulation, etc.] (FAA/AAM & GSC, 1993a). The third phase continued the investigations and demonstrations of various human performance enhancements. Examples are the FAA/AAM CD-ROM #1, improved workcards for inspection, and the Performance Enhancement System (PENS) for Aviation Safety Inspectors (ASIs). The third phase also began evaluating the effects of the research program outputs (ECS Tutor evaluations) (FAA/AAM & GSC, 1993b; FAA/AAM & GSC, in press). The current phase (Phase IV) also continued with investigations, demonstrations, and evaluations. Phase IV also included fielding of research results. Feedback to all stages of the research program is provided by industry adoption of the research products. All products, procedures, and ideas that have been generated contribute to the continued safety and improvement of operational efficiency through improved human performance.

Figure 1.1 The Research Program

AN ONGOING RESEARCH & DEVELOPMENT PROGRAM



As with the other reports from this research program, this volume begins with a sincere thanks to and acknowledgement of the many government and industry personnel who continue to cooperate with the research team. As the work continues the number of contributors (FAA entities, air carriers, and consortiums of industry groups) has grown beyond a reasonable size to individually list all those who have provided guidance and cooperation.

The remainder of this chapter describes each chapter in this report.

1.1 PENS FIELD EVALUATION (Chapter Two)

Chapter Two reports on the Performance Enhancement System (PENS) field evaluation plan. PENS ([Figure 1.2](#)) is a computer-based tool designed to aid ASIs in performing their oversight duties (FAA/ AAM & GSC, 1993b). For the evaluation, PENS will be fielded in all nine regions of the FAA, using four different portable computers (three pen-based systems, one trackball system). Approximately 36 ASIs will participate in the evaluation, four at each FSDO. Testing the PENS prototype in the field will identify the tools necessary and viable to ASIs and their supervisors.

Figure 1.2 Performance Enhancement System (PENS)



1.2 DESIGN OF PORTABLE COMPUTER-BASED WORKCARDS FOR AIRCRAFT INSPECTION (Chapter Three)

Chapter Three discusses a computer-based workcard system developed during Phase IV, using a portable computer and hypertext software. This system was based on the improved paper-based workcard developed in Phase III (FAA/AAM & GSC, 1993b). Eight tasks were implemented on the computer-based system (five A-checks and three C-checks). Results from tests performed during Phase IV show that the computer-based system is better than the paper-based system, even though the computer-based system could benefit from improved hardware.

1.3 ERGONOMIC AUDIT FOR VISUAL INSPECTION OF AIRCRAFT (Chapter Four)

In order for airlines to determine which human factors interventions are most urgently needed in their own operations, an ergonomics audit was developed to help evaluate potential human/machine mismatches in any inspection task. Chapter Four discusses this audit which contains a method of choosing tasks to be audited, an audit checklist, and computer program evaluating checklist response against national and international standards to produce an audit report. An evaluation conducted in Phase IV showed that while the audit program is no substitute for a detailed ergonomics analysis, it is a useful tool for identifying error-prone situations. Chapter Four Appendix is an example output from the program.

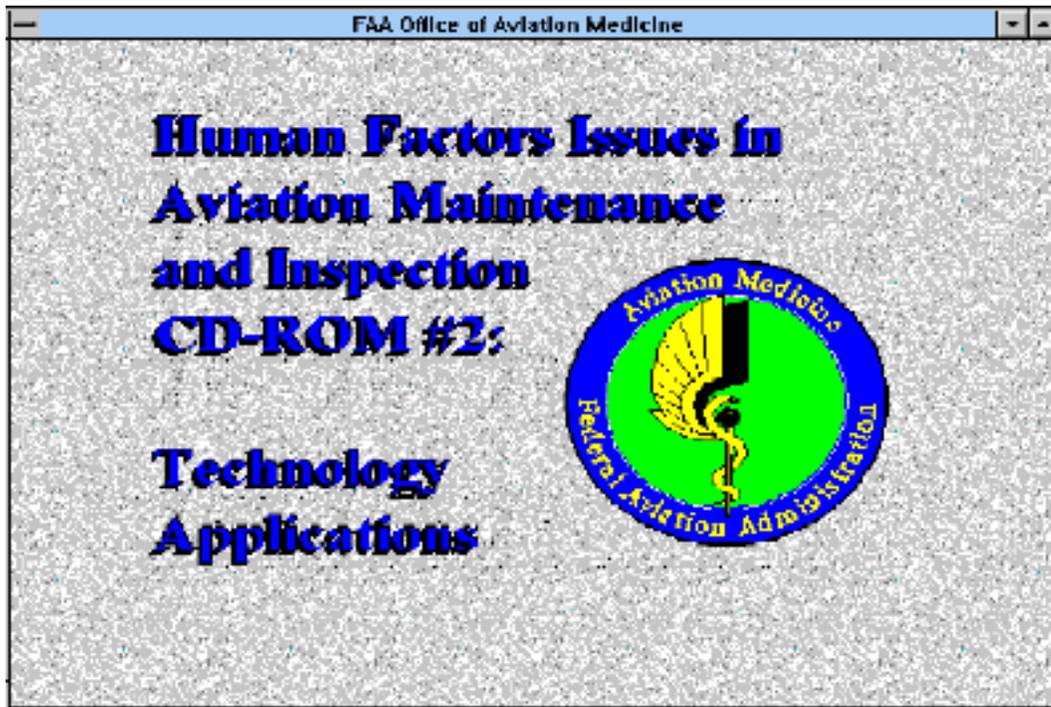
1.4 INVESTIGATION OF ERGONOMIC FACTORS RELATED TO POSTURE AND FATIGUE IN THE INSPECTION ENVIRONMENT (Chapter Five)

Chapter Five reports on an investigation of ergonomic factors which may cause increased inspector stress, fatigue and workload, particularly restrictive spaces that cause extreme postures. Phase III developed a methodology for studying the effects of these restrictive spaces on inspector fatigue (FAA/AAM & GSC, 1993b). Phase IV evaluated these effects using a set of four tasks from the C-check of a DC-9. Inspectors were observed and tests were taken to measure fatigue, postural discomfort and workload. The results showed that the same tasks have the greatest impact on the inspector. Based on this evaluation, a posture/fatigue module has been developed and integrated into the ergonomic audit program (Chapter Four). Also several improvements/ interventions were implemented at the partner airline to reduce the effects of restrictive spaces.

1.5 HYPERMEDIA INFORMATION SYSTEM (Chapter Six)

Phase IV continued to expand the Hypermedia Information System (HIS). Research during Phase IV continued to make the tools generic and enhance their functionality. The current HIS contains eight conference proceedings and three phase reports. It also contains one complete training simulation (ECS Tutor) as well as a computer-based workcard system and an ergonomics audit for inspection. The HIS also contains the Performance Enhancement System (PENS). Two new libraries used in conjunction with PENS were added: one contains the Federal Aviation Regulations; the other, the Inspector's Airworthiness Handbook. This edition of the HIS was released on a CD-ROM ([Figure 1.3](#)) in May 1994.

Figure 1.3. Human Factors Issues in Aviation Maintenance and Inspection, CD-ROM#2



1.6 CORRELATES OF INDIVIDUAL DIFFERENCES IN NONDESTRUCTIVE INSPECTION PERFORMANCE (Chapter Seven)

A previous report reviewed literature related to differences in inspectors' NDI proficiency (FAA/AAM & GSC, 1993b; FAA/AAM & GSC, in press). Several variables were identified which would appear potentially relevant to NDI inspector selection and/or proficiency:

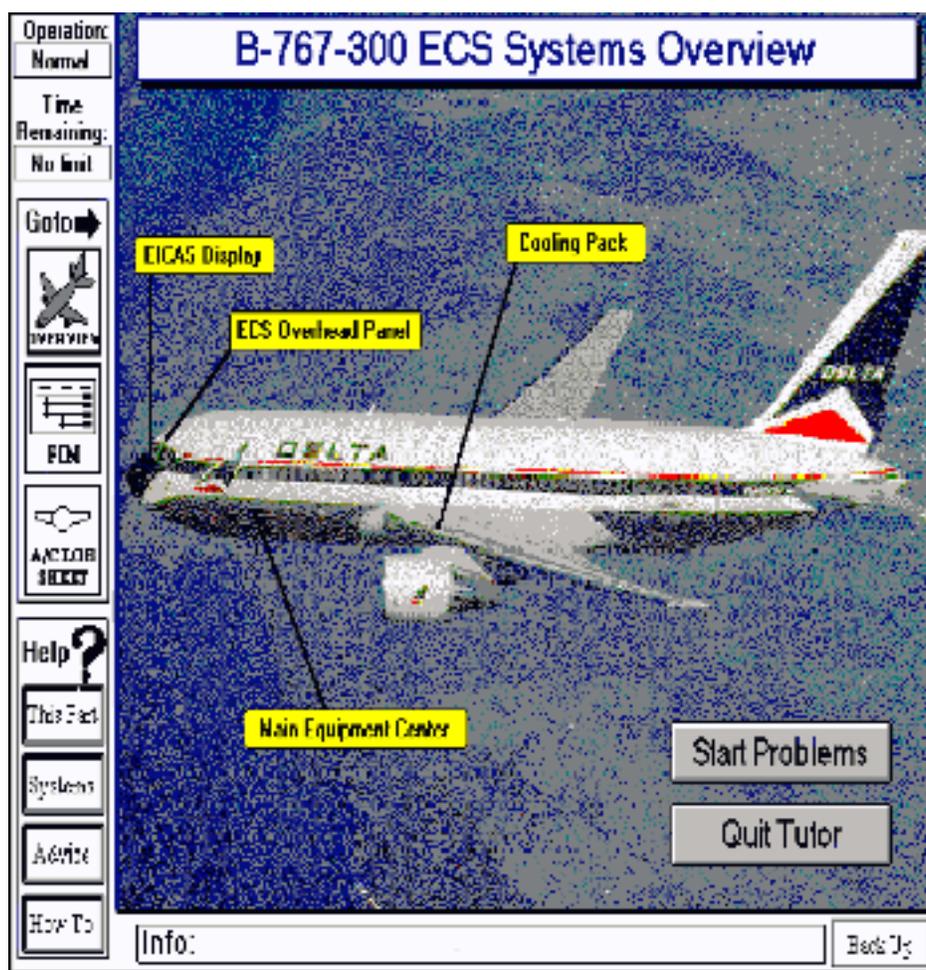
- Boredom Susceptibility
- Concentration/Attentiveness/ Distractibility
- Extroversion/Impulsivity
- Motivation/Perseverance
- Decision Making/Judgement
- Mechanical/Electronics Aptitude
- Need for Autonomy

The goal of Phase IV research was to determine the relationship between selected tests and measures derived from the above category and performance on an NDI task. Research also investigated possible performance changes from sustained performance during a simulated one-day shift and interactive effects between performance changes and the variables identified above. Chapter Seven reports on the findings of this research.

1.7 RESULTS OF THE ENVIRONMENTAL CONTROL SYSTEM TUTOR EXPERIMENT AT CLAYTON STATE COLLEGE (Chapter Eight)

Chapter Eight describes an investigation to determine the effect of an Intelligent Help Agent (IHA) on the effectiveness of computer-based training. The training system used was the Environmental Control System (ECS) Tutor, a simulation-based trainer developed in previous phases of this research (Figure 1.4). Subjects used the ECS Tutor either with or without an error-driven IHA. No significant difference in performance was found between the two groups. Other findings are also discussed in the chapter.

Figure 1.4 ECS Tutor



1.8 RELIABILITY IN AIRCRAFT INSPECTION: UK AND USA PERSPECTIVES (Chapter Nine)

The CAA and the FAA co-sponsored an investigation of reliability in aircraft inspection in the United Kingdom (UK) and the United States of America (USA). Aircraft inspection sites in both countries were visited with an analysis made of the overall inspection/maintenance system and of larger floor operations. Similarities were more common than differences due to the technical specification of the tasks, regulatory similarities, and skill and motivation of inspectors. Larger differences in nondestructive testing (NDT) were observed due to a difference in emphasis between the two countries. The USA emphasized rule-based performance; the UK, knowledge-based. Chapter Nine documents the similarities and differences and offers recommendations.

1.9 GUIDELINES FOR DESIGNING AND IMPLEMENTING COMPUTER-BASED TRAINING FOR AVIATION MAINTENANCE (Chapter Ten)

Chapter Ten is a bibliographic overview of selected issues in designing computer-based training (CBT) systems. Issues such as instructional design, information presentation formats, screen design and layout, and hardware are covered. Over 60 references are included.

1.10 FUTURE PLANS

Capitalizing on a research team of scientists and engineers from industry, government and academia, the research program will continue to develop and implement tools and procedures for human performance enhancement. Future phases will increase field studies of research results. The program will also continue to conduct research with partners in both industry and government. All research efforts will continue to emphasize the measurable impact of the research program on increasing maintenance effectiveness and efficiency with resultant cost control.

1.11 REFERENCES

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