

Chapter One

Phase III Overview

1.1 SUMMARY

This is Volume I (of II) of the Phase Three report of the Office of Aviation Medicine research program on Human Factors in Aviation Maintenance and Inspection. The research program has matured since it began in 1989. [Figure 1.1](#) shows that the research program has fully transitioned to the final stages of Implementation/Evaluation. The government and the aviation industry have begun to embrace and adopt the products of the research program. These products and research results are described herein.

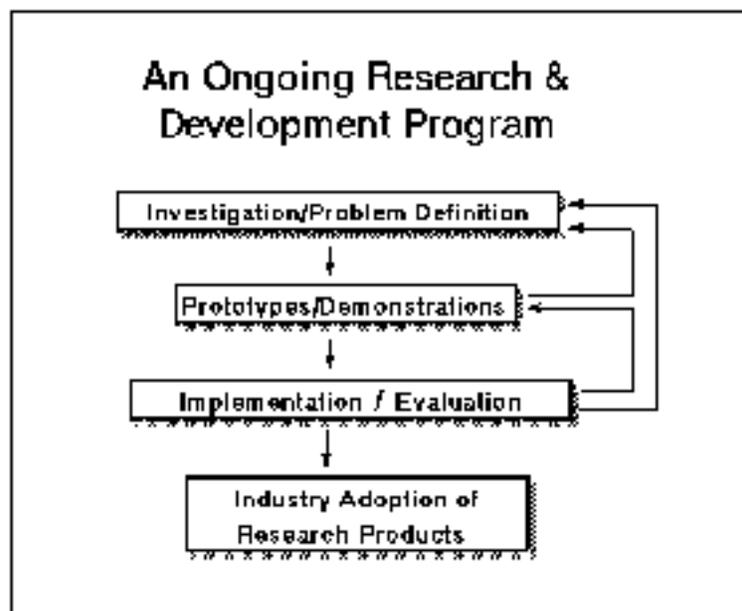


Figure 1 The Research Program

The success of this research and development program is founded on the principle that "good science" must be the basis for "good practice." However, basic scientific research must not be confined to the laboratory - end users must be involved in all stages of the research. This research attributes its success to the active participation of end users. Those participants include the [FAA](#) Flight Standards Service; industry consortiums like the U.S. and International Air Transport Association and the Aviation Technician Education Council; individual airlines like Delta, Continental, USAir, Northwest, United, and others; and labor representatives like the International Association of Machinists. Under such guidance the various members of the research team have been able to develop, implement, and evaluate human-centered maintenance performance enhancements.

Each chapter contained in this volume addresses an aspect of performance enhancement. The research program recognizes that outputs must have a focus on safety and on cost control. Our current air transportation system is safe and all trends show increasing reliability and safety. The safety must continue in concert with cost control. Cost control means working smarter, reducing errors, reducing flight delays or cancelations, and generally improving the overall efficiency and effectiveness of the human in the total aviation maintenance system.

1.2 AN AIRLINE EVALUATION OF ADVANCED TECHNOLOGY TRAINING (Chapter Two)

During Phase I and II of the Aviation Medicine Human Factors in Aviation Maintenance and Inspection research program, training was a key research topic. A key product of the initial phases was advanced technology computer-based training for technicians. The focus of training is the Boeing 767-300 environmental control system (ECS). The training system includes an operational simulation of the [ECS](#) and a robust method of tracking student performance and providing advice and feedback.

This third phase of the research had the goal of evaluating the instructional effectiveness in an airline training setting. A formal evaluation was conducted comparing individualized student computer-based training (CBT) versus instructor-lead [CBT](#). Results of the experiment are reported in this section. The results should be helpful to training personnel as they make decisions regarding the best application of instructional technology.

1.3 IMPROVING PERFORMANCE WITH BETTER INFORMATION CONTROL (Chapter Three)

The Performance Enhancement System (PENS) is being designed for the 2600 Aviation Safety Inspectors (ASIs) of the [FAA](#) Flight Standard Service. [PENS](#) capitalizes on advanced technology software and hardware to improve the collection, storage, analysis, and distribution of field data. [Chapter Three](#) describes the requirements analysis, early design and evaluation of a variety of hand held portable computer systems.

1.4 PERFORMANCE IN INSPECTION TASKS (Chapter Four)

Aviation maintenance requires the highest quality assurance. Thus, continuing inspection is a critical component of quality. This chapter describes an example of the laboratory research underway to identify characteristics of personnel best suited to inspection-oriented jobs.

The chapter reviews over twenty-five years of Department of Defense literature related to personnel and inspection.

1.5 ERGONOMIC FACTORS AFFECTING POSTURE AND FATIGUE (Chapter Five)

Aviation maintenance tasks require the technician to bend over, squat, and perform a variety of anatomical contortions. Such forced changes in posture lead to fatigue, back and limb soreness, and perhaps, error. This chapter, first, reviews the research literature related to such topics as the following: restrictive space factors, stress, and fatigue. Second, the chapter presents a plan to identify aviation maintenance tasks that are likely to force unnatural posture and, thus, increase the likelihood of fatigue and resultant error. Ultimately this research will prescribe a program to identify maintenance tasks where posture demands are beyond that at which a human can perform safe and reliable work performance. The research will offer ways to improve human performance under such conditions.

1.6 AN EVALUATION OF THE AIRCRAFT MAINTENANCE VISUAL ENVIRONMENT (Chapter Six)

Visual inspection accounts for 90% of all inspection activity. Therefore there is a high value in research that will improve the inspection visual environment. This study used a visual environment evaluation at the facilities of an airline partner to develop a general methodology for recommending the correct equipment. Ambient illumination must be supplemented by both portable area lighting and personal light sources to achieve the necessary illumination levels. The importance of a glare-free visual environment that makes use of surface reflectance is stressed. The developed methodology used task analysis data, lighting evaluations, input from inspectors and the evaluation of light sources to specify better equipment and visual surroundings.

1.7 A REDESIGN OF MAINTENANCE WORK CONTROL CARDS (Chapter Seven)

Aircraft maintenance and inspection is often driven by workcards. They present a detailed and organized ordering of the subtasks necessary to complete a job. This chapter describes an effort to improve the method in which workcards are designed and presented to the aviation maintenance technician.

As part of this project new workcards were designed for A-check and C-check on DC-9 aircraft. The results of an airline evaluation are reported. Not only does this chapter propose specific design solutions, but it also provides a highly generic methodology for design of quality technical documentation, both written and digital.

1.8 TRAINING FOR VISUAL INSPECTION (Chapter Eight)

During previous phases of the research a computer-based simulation was built for laboratory research on training for visual inspection. This chapter summarizes the results of laboratory experiments and offers concrete examples of the necessary components of a training program for visual inspection.

This chapter reports on the status of visual inspection in airlines, aircraft manufacturers, and other non-aviation maintenance environments. The chapter describes training alternatives such as part-task, whole-task, adaptive, active, on-the-job, and computer-based training for visual inspection. The chapter also describes training and inspection feedback that is likely to improve technician performance in visual inspection.

1.9 CONTINUING RESEARCH

Phase III, Volume II will be published about four months after this volume. The next volume will place increasing importance on the measurable impact of the research on human performance enhancement. The aviation industry is struggling through increasingly difficult financial hardships. Research programs must continue to improve the "bottom line" by providing procedures and products that improve maintenance efficiency. That will remain a highest priority of this program

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