CHAPTER 1
PHASE REPORT SUMMARY AND PROGRAM REVIEW

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1.1 PROGRAM PERSPECTIVE

Nineteen ninety-eight marks the completion of ten years of the formal existence of the Federal Aviation Administration (FAA) Office of Aviation Medicine research program on human factors in aviation maintenance. Since the inception of the program, in the Fall of 1988, the program has generated 10 phase reports, some in multiple volumes, over 400 technical reports (see bibliography at www//http://hfskyway.com), hundreds of conference presentations, three editions of the *Human Factors Guide for Aviation Maintenance*, and 12 Symposium that have attracted nearly 3000 participants. The annual FAA Human Factors in Aviation Maintenance CD-ROM, produced since 1993, has become the primary source of human factors information for the aviation maintenance community worldwide. Distribution of the 1998 CD-ROM shall exceed 4000. Finally, the website for the FAA Human Factors in Aviation Maintenance (hfskyway.com) has been accessed over 1.5 million times since 1996; and, the site had been accessed an average of 100,000 times per month since the beginning of 1998.

The success of the research program is attributed to numerous factors. Table 1.1 lists the factors that contribute to the success. First, and foremost, the program's research and development tasks are customer driven. The customers include a wide variety of entities including, but not limited to, the following: the FAA Flight Standards Service, the Office of Aviation Medicine, the National Transportation Safety Board, the airline industry, the Air Transport Association, the repair stations, the maintenance supplier industry, aircraft and component manufacturers, aviation maintenance technician schools, universities, and the general aviation maintenance community. The research is driven by requirements and ideas specified by these customers.

Table 1.1. Contributing Causes for Success of FAA Maintenance Human Factors Research Program

Customer Driven
Adaptive to Dynamic Safety Issues
Active Industry Participation
Multi-Disciplinary Research Team
Pragmatic Approach
Wide-scale Information Dissemination

A second factor contributing to the success of the research program is the manner in which research tasks are adapted to immediately meet the ever-changing safety requirements of the industry. As an example, recent accidents have placed focus on FAA and airline oversight of repair stations. Therefore, in 1998, the research program conducted an in-depth review of training and qualifications of repair station personnel (Goldsby, 1998). Additional repair stations studies are currently in progress. Another example of responsiveness to changing safety needs and customer requirements is the Performance Enhancement Systems (PENS), now called the On-Line Aviation Safety Inspection System (OASIS). Back in 1993, the research program developed PENS in response to the FAA requirement and strategic plan to empower inspection personnel with improved technology for airline oversight. OASIS has evolved to an FAA-wide system for all Aviation Safety Inspectors.

The industry has taken a very active role in the research activities, which is a third factor contributing to the success of the program. Most of the research activities have an active industry partner. The industry has provided not only guidance but also full-scale participation and numerous services in-kind, including but not limited to, air travel.

The research team, for the past ten years, has included a multi-disciplinary group of researchers with an ideal mix of industry experience and academic credentials. University researcher participants have combined sound scientific principals applied to pragmatic aviation maintenance topics. The team includes experienced psychologists, engineers, educators, lawyers, Airframe and Powerplant Technicians, and pilots. This diverse mix ensures that all aspects of aviation maintenance human factors is considered.

A fifth, and very important ingredient for success, is the extremely pragmatic focus of the program. The research team has endeavored successfully to cooperate with FAA and industry to identify real-world opportunities to improve human performance in maintenance. The legacy of results, over the past decade, demonstrates the pragmatic approach.

Finally, the research program publishes and disseminates results to the industry. The list of technical publications, CD-ROMS, and website information, described above, clearly demonstrates the commitment to getting the research results to the users. This phase report, distributed on the annual CD-ROM and the Websites, is yet another example of such information dissemination.

1.2 PHASE REPORT SUMMARY

This year's Phase report runs the gamut, from human factors training projects to the design of maintenance documentation to a study of norms in the aircraft maintenance workplace. This year the team concentrated on the evaluation of selected human factors interventions. The evaluations look at training for situation awareness, assessment of ground damage interventions, and evaluation of formats for maintenance documentation. As usual, the CD-ROM and full-text website are also deliverables.

1.2.1 Evaluation of Team Situation Awareness

Chapter 2 describes the evaluation of classroom training for situation awareness. This topic was once reserved to such operational environments as the fighter jet or airliner cockpit to the air traffic control room. Now it has been revamped and applied to the aviation maintenance workplace. A training course was developed and evaluated with a partner airline. The course focused on five topics including the following: shared mental models, verbalization of decisions, shift meetings and teamwork, feedback, and general situation awareness. The training evaluation was based on delivery of approximately 12 hours of Situation Awareness Training presented to 72 participants from nine different locations of a major airline. All participants also received a basic Maintenance Resource Management class as a prerequisite to the Situation Awareness class. A course outline and post training questionnaire are included in Chapter 2.

Chapter 2 shows the results of measures related to value and usefulness of the training, pre and post training attitudes, and changes in behavior in job performance. Results showed that the students rated most aspects of the training to be valuable, identifying class discussions and case studies as the most desirable instructional method. The pre and post training attitudinal measures suggested that the course would have a positive affect on each individuals situation awareness. The questionnaires, administered one month after training, suggested that course material did transfer to job performance.

1.2.2 Develop Line-Oriented Human Factors Training for Maintenance

Chapter 3, entitled "Line-oriented Human Factors Training: MRMIII," looks at Maintenance Resource Management (MRM) training compared to Crew Resource Management (CRM) training. The purpose of the comparison is to speculate how MRM is likely to evolve. The authors emphasize the importance of training for communication and for teamwork. Using a map for the "categories of learning," the authors show how the instructional delivery methods vary from lecture, for conveyance of basic information, to the use of discussing simulation and gaming to ensure "higher order learning." Evolving MRM training, therefore, must become simulation-oriented not unlike the line-oriented flight training (LOFT) that is a final stage of CRM training for pilots. The chapter offers a variety of alternative considerations for advanced MRM training.

1.2.3 Distance Education for Maintenance Resource Management

Chapter 4 also addresses training; however, the focus is on applying web-based technology for distance education. The Gore Commission (Final Report to President Clinton by the White House Commission on Aviation Safety and Security, http://www.aviationcommission.dot.gov) encouraged the FAA to capitalize on advanced technology to improve aviation safety. The chapter describes distance education as an "instructional approach where people engage in educational activities without having to be at the site where the instruction is occurring."

This chapter describes the system called Safe Maintenance in Aviation Resource Training Center (SMART). It is an exemplary infrastructure for on-line computer-base training that uses the World Wide Web. Located at http://www.hfskyway.com, the SMART prototype provides a virtual classroom, including such features as the following: on-line registration, a calendar, videos, chat groups, a Federal Aviation Regulations (FAR) glossary, an archive of documents, on-line testing, and a means for students to include material in the on-line archive. This chapter also describes the variety of instructional alternatives that shall soon emerge as web-based distance education.

1.2.4 Evaluation of Ground Damage Interventions

Chapter 5 describes aircraft ground damage, which costs the world's airlines as much as twenty billion US dollars a year. The Chapter begins by describing the impact, causes, and historical research associated with aircraft ground damage. The authors report their efforts to quantify the effectiveness of human factors interventions in ground reduction at one airline. Further, they present standardized means to establish a methodology for "analysis of incidents, deriving interventions and measuring the effectiveness of interventions that can be used by other airlines and for other human error outcomes."

Chapter 5 offers a classification system of active failures, or hazard patterns, that characterize most ground damage accidents. The chapter also offers a summary of interventions used at the participating airline and a safe practices checklist to minimize ground damage.

1.2.5 A Study of AMT Norms and Work Habits

Chapter 6 describes a study of the "Norms and Work Habits" of aviation maintenance technicians. The research looked at social factors affecting human error in maintenance. " Norms are socially accepted workplace procedures that do not necessarily conform to company written procedures. They are implicit work rates by definition. Norms are unwritten procedures. Thus a study of unwritten procedures was a particular challenge. The chapter describes how norms are reinforced by such factors as on-the-job training or time pressures to complete a given maintenance task.

The Chapter offers the results of a questionnaire-based study conducted in cooperation with Transport Canada. The questionnaire was designed to assess worker attitudes regarding workplace norms. The 138 questionnaire respondents in the study were involved in a human factors training course delivered in Canada. While the researchers did not claim that the report was a definitive study on norms there were some interesting results. First, respondents felt that norms had a positive, not negative, impact on safety. Respondents felt that many "standard operating procedures" do not reflect the reality of the maintenance workplace. Respondents also felt that they were not negatively pressured by existing norms. Managers were more likely to admit that they follow norms, mostly due to the pressure to "get the aircraft out." While such interesting data emerged, the chapter authors emphasized the mere questionnaire data is not sufficient to make significant conclusions and recommendations regarding norms. The authors recommend a more substantive study including extensive workplace observation and interviews.

1.2.6 Enhancing Safety with Advanced Training Models

Chapter 7 focuses on building a framework for understanding and improving inspection performance. Models are often used to ensure a complete understanding of a domain before computer-based training is developed. The researchers, therefore, first review the literature associated with training for inspection. Secondly, the researchers describe human inspection performance using an engineering model. Finally, the chapter describes an Automated System of Self Instruction for Specialized Training (ASSIST). The ASSIST system characteristics are described and prototype computer-based training screen displays are presented. A detailed development plan is included.

1.2.7 Evaluation of Documentation Formats

Chapter 8 reports on the evaluation of documentation formats at a participating airline partner. The chapter describes a documentation design job aid then includes evaluative information from airline users of the job aid. A formal experiment was conducted to measure the difference between the same document presented in two different formats. One format followed the airlines conventional layout, the second format used the Documentation Design Aid (DDA). The DDA was previously developed, by this research program, as a job aid highlighting application of simplified English. The study showed that there were fewer interpretation errors on the redesigned document. Further, the chapter reports that the revised document shows measurable improvement in comprehension and reduced reading time.

1.2.8 The NTSB Maintenance Accident Report Online Archive and CD

Chapter 9 describes the production process to convert 24 National Transportation Safety Board (NTSB) hard copy documents into a digital database for inclusion on the FAA's annual CD-ROM and on the hfskyway.com website. Of course the end product has greater value than the report on how the work was accomplished. The chapter is interesting because it shows that conversion of primary source hardcopy or microfiche documents to fully searchable electronic documentation presents numerous challenges. This project was undertaken at the request of the NTSB, as an attempt to provide a research database for maintenance-related accidents.

1.2.9 Wireless technology: Delivering Technical Information to Line Maintenance Mechanics

Chapter 10 describes a field study of the application of wireless technology for delivery of technical manuals for airline line maintenance. The study had two purposes: to evaluate human factors aspects of wireless equipment and to assess the feasibility of such devices in the flight line environment. The chapter describes the evaluation reporting that both radio frequency and portable data terminals are suited to flight line access of technical manuals.

1.3 OTHER REPORTS

Four of the reports published by the research program for 1997-1998 were written to stand alone and are not included herein. These reports had an audience with an immediate need . Therefore, they were distributed in low volume hard copy. These reports shall be available on the 1999 CD-ROM. The reports shall also be available on the hfskyway.com website during 1998.

1.3.1 AMT/AMT-T Curriculum: An Alternative Method of Compliance with Federal Aviation Regulation Proposed Part 66

The first "stand-alone" report was written by Charles W. White of Aviation Technical Training and Consulting, and Michael J. Kroes of Purdue University. The report, used as a supplement to the FAA workshop on FAR 66, presents a proposed curriculum matched to expected regulatory changes. The report also contains presentation slides and handouts from the three workshops conducted by the researchers.

1.3.2 Learning from our Mistakes: A Review of Maintenance Error Investigation and Analysis Systems

The second report was written by David Marx. It is an excellent summary of the various aviation maintenance error reporting systems that have emerged and evolved since 1994. While not endorsing any of the reporting systems, the strengths and weaknesses of each system are detailed.

1.3.3 Comparative Study of Personnel Qualifications & Training at Aviation Maintenance Facilities

The third report was written by Raymond Goldsby and Galaxy Scientific Corporation. In this report the researcher does an insightful review of personnel training and qualifications comparing airlines to repair stations. He finds that manufacturers and large airlines offer the very best training. He also contends that the FAA and the entire industry should "take serious and rapid action toward raising the standards for maintenance training and qualifications, especially the minimum standards."

The information for the report was gleaned through numerous site visits, telephone discussions, and questionnaires. The researcher, having over 30 years of airline maintenance experience, was able to collect an immense amount of data throughout all levels of the industry. The chapter, therefore, details the regulatory requirements, reports on the current status of training throughout the industry, and ends with a set of summary concerns and suggestions for action. Of particular interest are the many frank comments from managers, aviation maintenance technicians, and other personnel from manufacturers, airlines, and repair status.

1.3.4 Advisory Circular for MRM and Prototype MRM Training Program

The fourth stand-alone report is a draft Advisory Circular regarding training programs for Maintenance Resource Management. The author, Ben Sian, builds on various systems developed throughout the industry, especially those in which Dr. Michelle Robertson has worked. The report is clearly an excellent reference source for MRM training guidance.

1.4 SUMMARY

This phase report and the associated three reports serve to document a large portion of the maintenance human factors research conducted in 1997 by FAA Office of Aviation Medicine. The research and development activities in progress for 1998 and planned for 1999 shall continue to seek pragmatic results working with industry and government partners.