

HUMAN FACTORS IN AIRCRAFT MAINTENANCE

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1.0 INTRODUCTION

The aviation maintenance technician has a key, and often unheralded, responsibility for the availability of airworthy aircraft for efficient, reliable, and safe operation. Related to the FAA Aging Aircraft Program is the research program mandated by the Aviation Safety Research Act of 1988. This research program, which focuses on the Human Factor in Aircraft Maintenance, is conducted by the Office of Aviation Medicine. A jointly developed National Plan for Aviation Human Factors has identified major areas for research. They include Air Traffic Control, Flight Deck, Flight-Deck Integration, and Maintenance - of which Aircraft Maintenance is the subject of this meeting.

2.0 HUMAN FACTORS

We are all aware of the important role of human factors in the field of aviation. I wonder if anyone has ever compared the billions of dollars we spend each year in advancing our technological knowledge, to that spent advancing our understanding of human factors. Better still what percent of the money spent in applying advanced technology is spent in the application of human factor principles?

Human factor means many things to many people. The meaning can be related to a person's environment or their position. There is a different perception of the definition, value, and application of human factors in the arenas shown in [Figure 1](#).

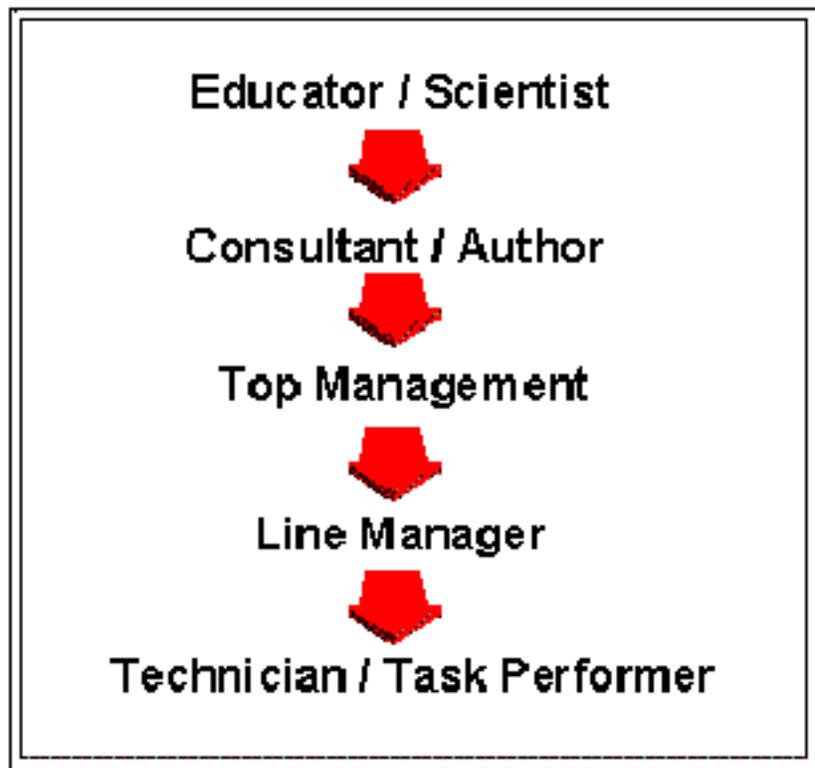


Figure 1 Human Factors Arenas

The Educator/Scientist is engaged in developing a better understanding of the basic principles of human factors and their application. The Consultant/Author is engaged in dissemination and communication of human factor information. Top management makes the decisions relating to the policy and support of human factors and the importance attached thereto. The line manager provides direction and assurance that established policy is implemented. The technician, or performer of the task, is often considered the primary focus for application of human factor principles and the bottom line is to enhance performance at this level.

All too often, we concentrate intently on the individual and the immediate task ([Figure 2](#)). Each group relates to and engages in one-on-one communication with the Technician/Task Performer and endeavors to enhance the influence of human factors through this link. We ignore or do not integrate the other important influences that have a major effect upon the increased efficiency we look for through the application of human factor principles. Two of the other influences I am thinking about are motivation and leadership which tie all of these elements together.

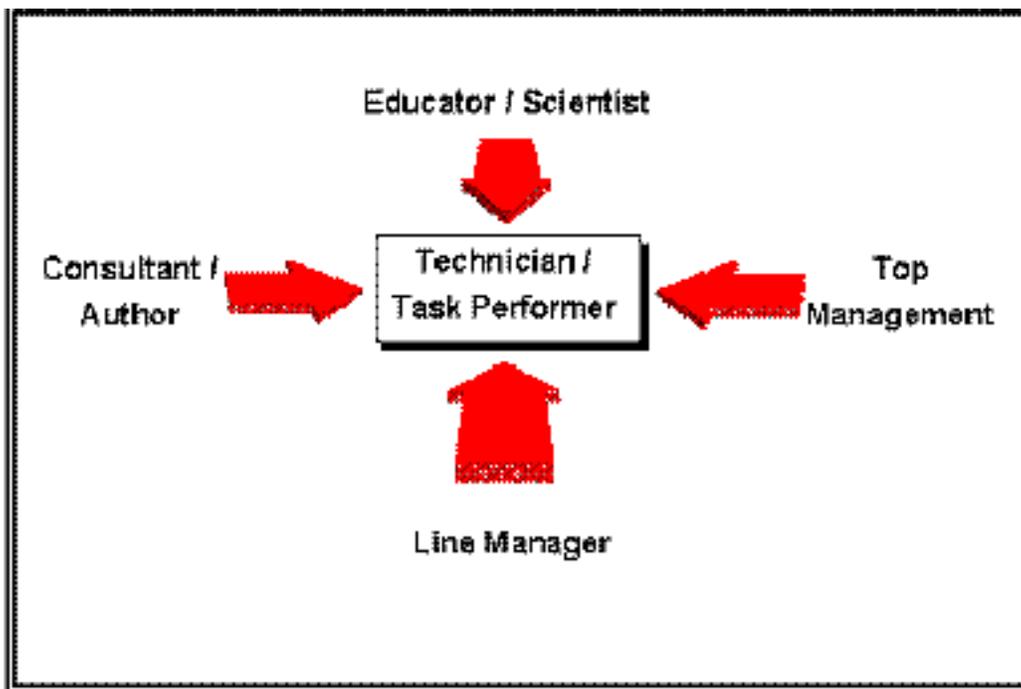


Figure 2 Concentration on the Task

Although in each of the above groups there is some interface directly with the worker, the major influence does not come directly but follows a sequential path from the top to the bottom. It is in this chain of command and communications, as shown in [Figure 1](#), that the elements of motivation and leadership play their most important role.

Forty years ago, this month in fact, at Wright-Patterson AFB, I was first made aware of the importance of human performance in aircraft operations. The thinking at that time was "KEEP THE MAN IN THE LOOP" ([Figure 3](#)). At that time, data on aircraft accident investigations assigned pilot error as the cause in some 65% of all accidents - not so different from the percent of human error contribution to aircraft accidents today. Many years later, discussing this with the then FAA Administrator, he stated "if the pilot causes 65% of all accidents, then we should look at how to get the pilot out of the loop to reduce aircraft accidents".

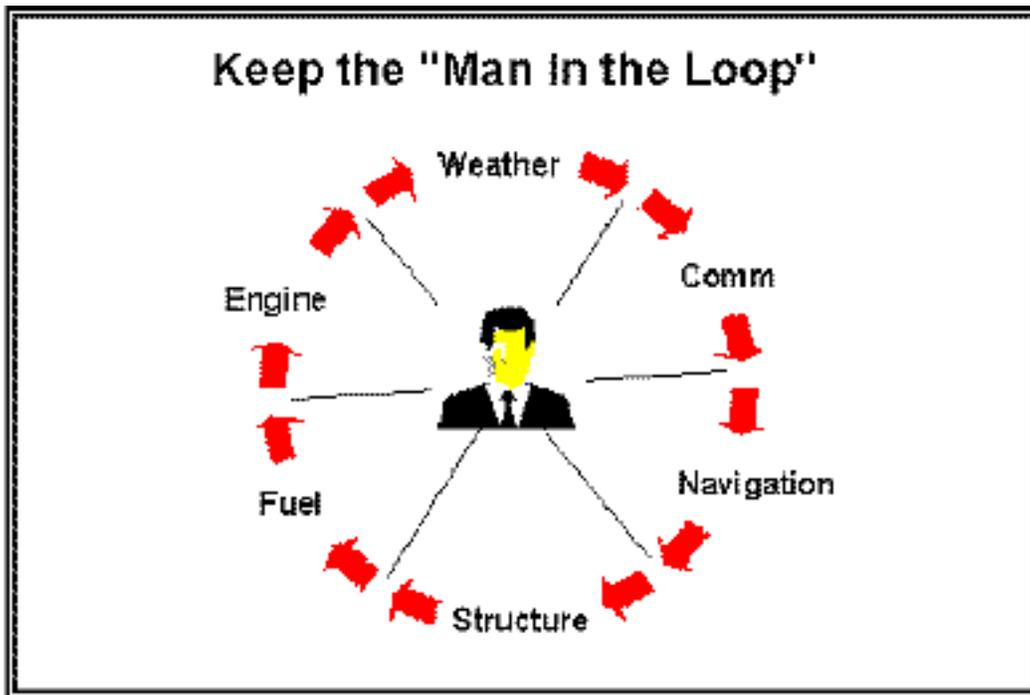


Figure 3 The 'Man in the Loop'

Regardless of the problems or failures with engines, weather, structures, fuel, navigation, or communications - the then listed primary causes of aircraft accidents - man was there as the last or final fail-safe element of safety. Today, when we look at the Aloha and Iowa City accidents we see that after material failures occurred the human element in the system was the fail-safe component of last resort. There is no question that the "pilot in the loop" saved the day.

There appears, however, to be a dichotomy. We say the human is responsible for 65% or greater of the accidents, yet, the human is the most important and last safety element in the system. Just what is and what should be the role of the human in the system?

Aircraft flight operational experience provides an insight as to how the role of the human has changed quite dramatically. The first transoceanic aircraft had a flight deck-crew of five. There was the pilot, copilot, navigator, radio operator, and flight engineer. Today we fly the Boeing 747-400, our largest transport aircraft, with a flight-deck crew of two. Needless to say, there has been considerable human factor effort expended in the reduction of the crew size and the functions performed by crew members. We should build on this experience with crew members and apply the knowledge we have learned to aircraft technicians.

This brings up the question of just how we determine what the role of the human in the aviation maintenance system is. Maybe we should start with the original design and approval of the aircraft. The FAA chairs a Maintenance Review Board (MRB) for each new vehicle. For example, the Boeing 777 MRB is just starting to meet. This is where the manufacturer, airlines, component manufacturers, and the FAA address the maintenance program to be approved by the FAA before the aircraft can be fully certified and operated. The operator of the aircraft must establish a maintenance program for their particular operation and it must be consistent with the Approved Maintenance Manuals resulting from the MRB action. Human factor input should we made at this initial discussion of the maintenance programs for the new aircraft.

Many of the research activities that will be reported on at this workshop are directly related to the human factor issues and principles. Research teams have spent thousands of hours at maintenance sites and in airline training facilities talking with industry experts. They have learned much about airline maintenance and the human factors involved. Also, the airline maintenance partners in this research have a much better understanding of human factors issues. As I reviewed the list of attendees and look at this audience it is clear that you represent a cross-section of the scientists, managers, consultants, and workers I mentioned earlier as the principals involved in this process.

The Office of Aviation Medicine research program develops scientific theory and solid principles as well as practical guidelines for improved aircraft maintenance. The program has facilitated very effective communications among airlines, government, and the scientific community through different vehicles such as this workshop.

The research projects underway are vital to the development and application of improved principles and practices that will enhance our aircraft maintenance programs in numerous ways.

I am very excited about the innovations taking place in the development of computer hardware and software as it is applied to enhanced concepts of computer-based training. Real world problems such as the design and use of job cards, improved environment for inspections, and similar tasks are being identified and new and more efficient solutions are being found.

Human performance in inspection, critical to the airworthiness of the aircraft in our aviation fleet, is a major area of study.

"Hypermedia" and "hypertext" are new words that identify a new and exciting technology. I am delighted that we will have a hypermedia product distributed at this workshop.

New management philosophies and management styles are included in the research effort and will be covered along with presentations on high technology "Job Aids".

3.0 SUMMARY

We are faced with the problem of enhancing human performance and efficiency in the design, manufacture, operation, and maintenance of our aircraft and the system in which they operate. Defining the role where technology can best be utilized, and applying that technology so human performance can be enhanced are both related to the research to be reported at this workshop.

We are all aware that research and development by its basic nature is an investment in the future. This meeting is indicative of the Federal commitment to that investment. The "hands on" applied research direction that Dr. William T. Shepherd has given this program, the airline participation, the technical expertise brought to bear, with the corporate commitment clearly evident, all speak well of the positive impact that can be expected in the future.

It is very obvious that the members of this audience are true research partners and not just the customer of the research results. With the guidance, expertise, and enthusiasm of this multi-disciplinary team, I am confident that you will enhance the efficiency and effectiveness of the key element in the aviation maintenance system - the performance of the aviation maintenance technician.