HUMAN FACTORS IN THE YEAR 2000

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I would like to welcome you this morning to this Sixth Meeting on Human Factors in Aircraft Maintenance and Inspection. This welcome is extended on behalf of the Office of Aviation Medicine in the Federal Aviation Administration. By the comments we have received at the Office of Aviation Medicine, these meetings have been quite successful. Attendance has been good; interesting presentations have been given, and useful recommendations have been generated. As I review the program for this meeting, I can see that the standards set in previous meetings certainly will be met over the next two days.

The mandate for today's meeting is to peek into the future. We want to project, to the extent that we can, a decade from now. What will aviation be like? What maintenance will be required for the aircraft of the year 2000? What problems will be faced by those responsible for aviation maintenance? What will be the most important human factors problems faced by the industry in the coming decade?

The path that aviation will travel in the next ten years will be decided by many factors. One, of course, is industry. Developments leading to new aircraft, to new construction methods, to new test equipment, and to new maintenance technology all will be of great importance.

In this march to the future, we should not ignore the role to be played by the public. The public's willingness to accept new systems, whether this acceptance is based on subjective preference, economic reasons, or perceptions of safety, will be important.

Finally, we come to the Federal Aviation Administration. The FAA certainly will be a player in determining the progress of American aviation. I would like to talk a bit today about the FAA and our view concerning the proper involvement of the agency in the events of the next ten years. To do so, I will speak from the perspective of the Office of Aviation Medicine since, as you know, my experience has been in this office.

Before we move to the future, I would like to discuss the past briefly and describe the mandate of the FAA. Certainly everyone at this meeting knows that the Federal Aviation Administration, as it is now called, was established through the Federal Aviation Act, passed by Congress and approved by the President on the 23rd of August 1958 (Figure 1). An event which served as a driving force for passage of this Act was the collision of two airliners over the Grand Canyon in 1956. This collision dramatically called attention to the need for improved safety in commercial aviation. As you can see, "safety" is noted clearly as an objective of the Act. Everyone knows this. However, fewer people know that another purpose of the Act, and a responsibility of the FAA, is "to provide for the . . . . promotion of civil aviation." The FAA is directed to use its resources to best foster the development and safety of civil aviation.

THE FEDERAL AVIATION ACT
(1958)

- to provide for the safe and efficient use of the airspace;

- to provide for the regulation and promotion of civil aviation in such a manner as to foster its development and safety.

Figure 1

It is important that those of you in the industry, as well as the general public, understand that the FAA does much more for aviation than just pass regulations and then enforce them. The regulations are important, of course, since they serve to ensure that a high level of safety is achieved in both commercial and private aviation. But the passage of regulations by no means represents the sum of our activities. Much of what we do falls more under our mandate "to promote civil aviation." Perhaps this can be illustrated through our approach to the topic of **human factors**.

The Office of Aviation Medicine defines "human factors" broadly. This term might well be viewed as including all of the human activities within aviation systems. We are not alone here. The early attention given by those working in the field of human factors to control and display problems has been broadened to include a wide range of human activities. Meetings of the Human Factors Society now include presentations on topics such as aging, consumer preferences, use of prosthetics, and many others. Human factors is a broad discipline.

Figure 2 presents my definition of the elements of "human factors." As you can see, human factors encompasses all aspects of the individual and the environment that affect performance and/or well being. The first item, and one that we give considerable attention to in the Office of Aviation Medicine, is the health of a person. We are interested in health status, whether this status represents a permanent condition or is a function of the operation of some environmental stress agent. The next item concerns the performance capabilities of the person. Here we are interested in basic capacities, certainly, but generally more interested in performance capabilities after appropriate training for whatever the task. The next item of concern is the transitory state of the person. This refers to the person's condition of the moment as it might be affected by recent or on-going drug use, by emotional stress, by financial problems, or any other element that might degrade ability to perform. Finally, human factors examines the task demands and the individual's response. We find that the qualities making a person a good Air Traffic Controller may not be the same as those that make a good pilot.

MAJOR ELEMENTS IN HUMAN FACTORS

- Health

  Natural state/Environmental influences

- Performance Capabilities

  Inherent capacity

  Effects of training

- Transitory Condition

Effects of drugs, emotional stress, etc.

- Task Demands

  Man-machine relationships/Job suitability

Figure 2

Aviation medicine in the Federal Aviation Administration covers a broad spectrum of medical, behavioral, and human factors science. Figure 3 illustrates the organizational structure of the Office of Aviation Medicine and depicts the major program responsibilities. The left line of organizational elements, those reporting through the Deputy Federal Air Surgeon, are activities conducted at FAA Headquarters in Washington, DC. Activities on the right are those conducted at the Civil Aeromedical Institute in Oklahoma City, an operating element within the Office of Aviation Medicine. Not depicted here is Regional Office structure of the Office of Aviation Medicine's nine regional offices reporting to the Federal Air Surgeon through the Deputy Federal Air Surgeon. Staff at the regional offices administer Office of Aviation Medicine programs at the local level.

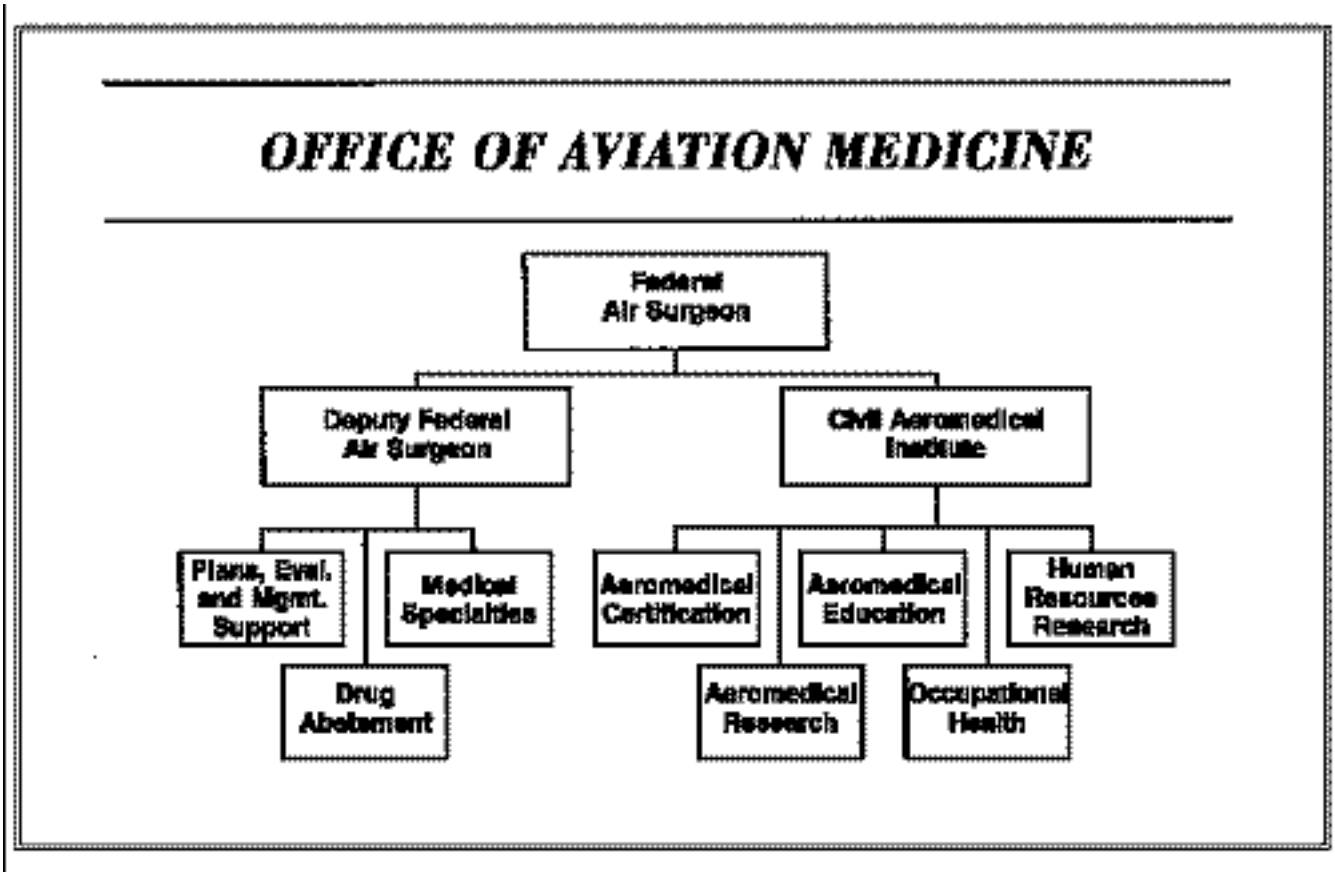

Figure 3

When one thinks of aviation medicine within the FAA, probably the activity that comes to mind most readily is that of medical certification of pilots. Most certification activities are carried out at the Civil Aeromedical Institute in Oklahoma City. As you can see, however, aeromedical certification, while a very important part of our work, is but one of a number of activities. The Medical Specialties Division at Headquarters includes, in addition to medical certification related to appeals to the Federal Air Surgeon, medical rulemaking, limited research, psychiatry, accident investigation, and occupational health. One part of our research program, directed by Dr. William Shepherd, and managed out of the Medical Specialties Division, addresses the human factors issues in aircraft maintenance. This began as a response to our concerns over the safety of the aging aircraft fleet, but now has broadened into a consideration of a range of human factors issues in aircraft maintenance and inspection. This is the program that supports the meeting we are attending today.

The work that is being done at Headquarters and at the Office of Aviation Medicine's principal research arm, the Civil Aeromedical Institute, contains a mixture of basic and applied research. Much of the research being done, even though it might address the population of pilots primarily, has potential application through the entire aviation workforce. Studies of the process of aging, for example, are concerned at the moment with the validity of the "Age 60" retirement rule for air carrier pilots. However, as the age of our maintenance workers increases, this aging research could be of considerable value as we examine ways to sustain this workforce and maintain high levels of proficiency. In short, we are not concerned just with the problems of pilots. Our studies hopefully will produce information that can be applied profitably to problems of all workers in aviation.

One of the most important activities at the Office of Aviation Medicine is central to our responsibility to ensure safety in aviation. We are responsible for the aeromedical certification of all civilian pilots. There are over 700,000 active civilian pilots in the United States. They, along with those applying for student pilot licenses, must be medically fit and must be granted certification by the FAA. Designated Aviation Medical Examiners, about 5,600 private physicians, perform almost 500,000 required medical examinations each year. The central screening facility at the Civil Aeromedical Institute is responsible for collecting, processing, adjudicating, investigating, and analyzing the medical data originated during this certification process.

The paperwork generated to support medical certification is tremendous. To minimize delays, efforts are underway to modernize this process and to automate the collection of data, the transmission of information, and the total processing operation. While we are concerned with making the process as rapid as we can, we also are concerned with the number of errors committed by our medical examiners. A new system is being designed which will electronically transfer certification information and should streamline the flow of data between key components of the system. Computer terminals will be used in the Aviation Medical Examiners' offices to record, edit, and transmit examination data directly to CAMI for processing.

As I am describing our problems with data management in the certification process, I am sure that I am striking a chord with many of you. I know that the management of maintenance data has been an on-going problem for years and that some innovative work is being done now as you look toward more automated solutions that will allow you to have the right information at the right place at the right time. Our certification procedures may well benefit in days to come from the work you are doing on automation today.

Another research effort, which I've already mentioned, is studying the relation of accidents to age with a view to assessing the "Age 60 Rule" under which persons at this age are prohibited from serving as airline pilots. The FAA regulation is based on the concept that older pilots are more likely than younger pilots to suffer medical incapacitation and performance degradation that would adversely affect aviation safety. The reason for applying an inflexible age rule is that there are no known ways to reliably predict the onset of performance problems. An on-going study at CAMI is investigating aging and pilot performance and, to a certain extent, medical problems. This study is following two lines. First, an examination is being made of existing data bases. Three historical data bases are being consolidated into one research data base. Analyses of these data will address the relationship between age, experience, and accidents; will improve upon prior methodologies used in this research; and will address the differences between recreational and professional pilots. The second line of examination is an attempt to identify a test battery that might be used to assess performance capabilities.

The findings of our studies on the aging process certainly will apply to more groups than simply pilots. Will there be modest but significant declines in the performance of senior inspectors and mechanics as they approach age 60? While I do not propose that we establish an "Age 60 Rule" or medical certification for maintenance personnel, information concerning the performance effects of aging can be used beneficially as we determine the best manner in which to use all segments of the aviation workforce.

Other work being done through the Office of Aviation Medicine hits on an issue of obvious importance to all work groups. This is the matter of substance abuse, whether abuse of alcohol or other drugs. An alcohol study being conducted now at the Civil Aeromedical Institute is examining the influence of four alcohol-related conditions on pilot performance. The conditions include three minimal blood alcohol concentrations. These are .04 percent, .027 percent, and .013 percent. All very low levels. The fourth condition is looking at the phenomenon known as "hangover." If the data indicate that performance is compromised at low blood alcohol levels and/or during hangover periods, more stringent guidelines may be needed for pilots, air traffic controllers, and systems maintenance personnel. If degradation in performance is not found, a more reliable data base to support current rules concerning alcohol use will have been established. In any event, information from this research will be used to develop educational programs for pilots, air traffic controllers, and other safety personnel.

The FAA also is on the front line in the war against the use of illicit drugs. We now have an industry-wide anti-drug program in effect in aviation. Figure 4 shows the results obtained through this program in calendar year 1990. Of well over 200,000 tests administered, 966, or 4/10th of one percent, were positive. About half of these positives were detected in pre-employment tests. Applicants testing positive were not hired for safety-sensitive positions. By the beginning of 1991, approximately 340,000 aviation employees were subject to the drug testing program. These include pilots, mechanics, flight attendants, airport security screening personnel, flight engineers, and aircraft dispatchers. This obviously has become a major program and it will grow larger. Through Congressional action, the Omnibus Transportation Employee Testing Act of 1991 has placed new responsibilities on the FAA. In addition to codifying authority for current drug testing regulations, this new legislation requires that the FAA prescribe regulations for alcohol testing in the air carrier industry by October 28, 1992. We are working on meeting this Congressional mandate.

The Office of Aviation Medicine program of most interest to you in the audience today is our **Aircraft Maintenance Human Factors Program**. As you well know, various human factors issues in aircraft maintenance and inspection are under study. These include training, the work environment, use of job performance aids, and organizational factors. One of the primary products of this program will be a *Handbook of Human Factors* to provide guidance for maintenance personnel and others concerned with this process.

FAA DRUG ABATEMENT PROGRAM

1990

- 230,621 tests administered
- 966 positives
  - 46 percent in pre-employment tests

1991

- 340,000 employees subject to testing

Findings

- Drug use is low (0.4 percent)
- Most used: marijuana and cocaine

Figure 4

The programs I have just described are but part of the activities of the Office of Aviation Medicine. We have other important activities in occupational health, aeromedical education, human resources research, aeromedical research and accident investigation. All of these program areas touch on human factors issues inasmuch as they all are concerned with the human element and with ways to make the performance of aviation personnel safer and more effective. In each of these programs we are generating new information to better understand the performance of aviation personnel and to allow them to do their jobs better. As noted in the beginning, the goals of the FAA are to ensure safety in aviation operations and to promote civil aviation. The information we are developing supports both of these goals.

Where will human factors, as we have defined it, be a decade from now? Hopefully, human factors research will help tell us how to manage aviation operations carrying many more people than is the case today; how to develop a maintenance workforce to deal with the very advanced technologies that will exist in aviation in the year 2000; how to ensure that aircraft capable of carrying 600 or more passengers are being operated and maintained by personnel who are medically and psychologically fit for this tremendous responsibility. To achieve this program, we must understand our problems today and we must begin programs to overcome these problems. This meeting is a noteworthy step toward our goals for the year 2000. I wish you a very productive and successful meeting. Thank you.