

MEETING OBJECTIVES

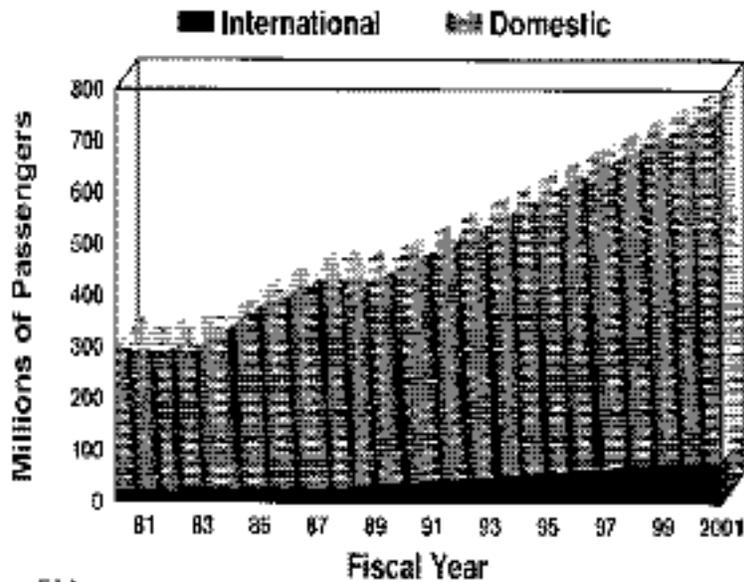
*William T. Shepherd, Ph.D.
Office of Aviation Medicine
Federal Aviation Administration*

The objective of our present meeting is to define the issues and problems likely to be faced by air carrier maintenance during the coming decade and beyond. To do this we must look into the future, never an easy task. An examination of trends in maintenance today and the external forces which tend to shape maintenance should, nonetheless, present us some picture of the world of maintenance a decade hence. In doing this, we must look at the directions of U.S. air carrier maintenance and must also consider foreign maintenance. We know that use of foreign repair stations by U.S. carriers is increasing steadily. After these reviews, by connecting our examination of current trends with forecasts for the year 2000, we should be able to anticipate problems that may occur during the next decade. The development of insight into these potential problems increases the likelihood that real solutions can be identified before the problems become severe.

Industry Growth

The current and projected growth in U.S. commercial aviation is perhaps the most important variable affecting air carrier maintenance. Growth in commercial aviation has been impressive, to say the least. The growth curves presented in [Figure 1](#), covering the two decades from 1981 to 2001, show almost a tripling of the number of people flying. With the number of passengers carried growing at this rate, the industry must make a number of changes in its structure to accommodate this growth. Maintenance certainly is included in these changes.

U.S. COMMERCIAL AIR CARRIERS SCHEDULED PASSENGER ENPLANEMENTS



Source: FAA

Figure 1

Regional and commuter air carriers appear to be growing at an even more rapid rate than the majors. In 1981, less than 20 million passengers were carried, as shown in [Figure 2](#). By the year 2001, this number will have grown to more than 70 million. Here we are looking at an industry increase by a factor of four or five. This should be an item of concern for us. Where will the people come from to operate this system? Where will the airplanes come from? Is the industry capable of handling this growth? Can proper maintenance of this growing aircraft fleet be assured?

U.S. REGIONALS/COMMUTERS SCHEDULED PASSENGER ENPLANEMENTS

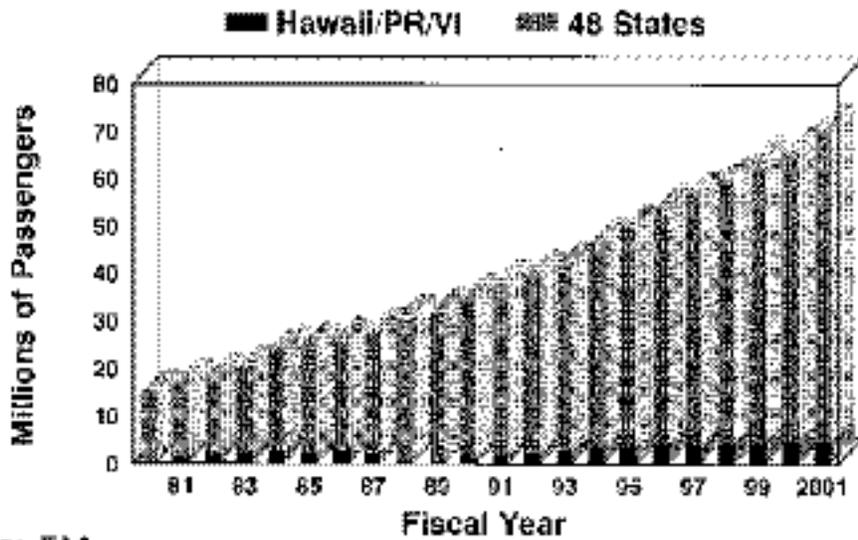


Figure 2

Maintenance Expenses

The growth in air carrier operations over the coming decade will bring a corresponding increase in maintenance expenses. [Figure 3](#) shows that maintenance costs now represent about 12 percent of all air carrier operating expenses. This 12 percent cost item represents over \$8 billion dollars per year and, significantly, is a growing item. The percentage of air carrier operating costs devoted to maintenance is growing at approximately the rate of one-half percent per year at this time. While one-half percent per year does not seem like that much, it is one-half percent of a very large number. While we may not be able to predict the rate of increase with complete precision, we do know that air carrier maintenance expenses are going to increase. Reasons why maintenance will take a larger part of the air carrier operation's budget include costs of maintaining an aging fleet as well as those required for the introduction of a new technology fleet. In any event, the cost of maintenance will be significant.

U.S. AIR CARRIER EXPENSES

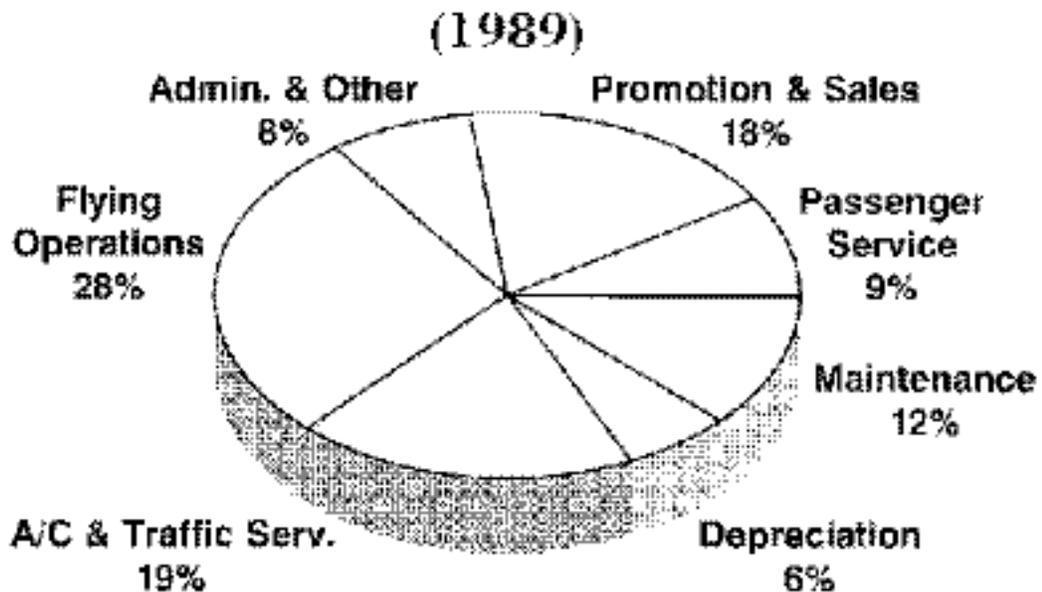


Figure 3

Trends Affecting Maintenance Practices

A number of trends which can be identified at this time will affect air carrier maintenance in the future. One is aircraft size. Boeing is studying an aircraft capable of carrying 650 or more passengers. This is an impressive airplane and appears, from its design sketch in *Aviation Week & Space Technology*, to resemble a double-deck 747. Consider the possibility that, some years from now, several of these new aircraft should arrive for a heavy maintenance check at the same time. The demand on an operator's maintenance resources would indeed be severe.

Another trend, well underway, which will affect future maintenance is the movement toward advanced avionics. More and more aircraft now incorporate the "glass cockpit" design. In the not too distant future, all aircraft operated by the majors will have glass cockpits, with this technology beginning to spread to the airplanes of the commuters and regionals. Maintenance for glass cockpit systems, as opposed to the older round dials of earlier aircraft, requires new skills and new maintenance philosophies.

Use of new materials is another factor affecting maintenance. Here I am thinking particularly of the use of composite materials such as carbon fibers, aramid fibers, and fiberglass in the construction of new aircraft. Composite materials are already being used in the structures of the Boeing 757 and 767, as well as the AirBus A-310. This trend toward composite materials can be found in military aircraft as well as in civilian airliners. For instance, in the F/A-18 aircraft, composite materials account for 10 percent of the structural weight and 50 percent of the surface area. Finally, insight into the extent to which composite materials can be used is found in the Voyager aircraft, which completed its non-stop circumnavigation of the Earth several years ago. This airplane, shown in [Figure 4](#), uses approximately 90 percent graphite fiber materials. While we might not see such extensive use of composites in air carrier airplanes in the next few years, this does illustrate the direction in which aircraft construction is moving.

THE VOYAGER AIRCRAFT

(90% From Graphite Fibers)

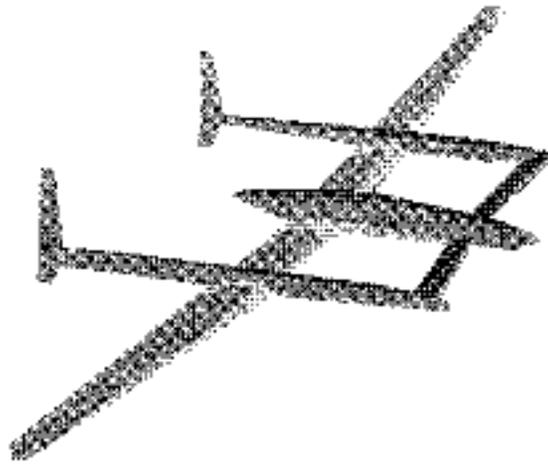


Figure 4

Changes are taking place in the national workforce and in the maintenance industry which, when combined, will have considerable influence on air carrier maintenance. The first of these is purely a demographic issue. In the decade ahead, there simply will not be enough people in the age groups typically drawn on for entry-level maintenance technicians. Projections from birth rates of recent years tell us that there will be a significant drop in the numbers of potential mechanics. In addition, there will be considerable competition for that small group of people from other industries, such as electronic companies, which require technicians with comparable skills.

The skill requirements for technicians in the coming decade will increase, which complicates the personnel availability issue. The fact that the industry will be using new materials, high-tech flight deck avionics, increased automation in flight systems, and other changes means that a higher level of qualification will be required of the future technician. Individuals with marginal high school records will find it difficult to enter the maintenance profession.

Another factor affecting maintenance in the future is that there likely will be a merging of specialties. We will see fewer technicians skilled in only one area as, for example, hydraulics. Airbus, for instance, is working toward a workforce in which technicians are capable of working on any part of the airplane. They are blending the requirements for maintenance technicians and avionics technicians into a single specialty. For a number of reasons, including economics, this seems to be a reasonable goal for the industry. The increased level of qualification means, however, that a real increase in training time will be necessary. Under these conditions, entry into air carrier maintenance will be even more difficult for those individuals who apply and do not have the necessary basic training in reading and mathematics.

A better appreciation of the problems to be faced in air carrier maintenance can be achieved through a more detailed look at changes anticipated in the U.S. labor force. [Figure 5](#) shows projected growth for four age groups by the year 2000, using 1988 data as a base. Anticipated growth for two groups, the 16 - 24 year age group and the 25 - 34 year age group, is negative. They show a decline in the number of people available in the year 2000 as candidates for positions in the maintenance industry. These age groups, of course, are where essentially all entry-level personnel are found. Figure 5 also illustrates the extent to which the American workforce is aging. The age group showing the largest growth during this period is that between ages 35 and 54. When one considers workers in their 50's, you are looking at people approaching retirement. These individuals may not be as amenable to the changing work requirements in maintenance as will those in the younger age groups.

GROWTH OF U.S. LABOR FORCE

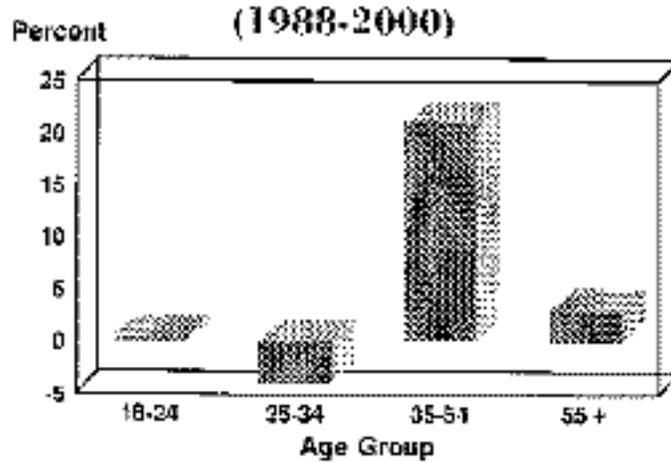


Figure 5

Figure 6 shows that the predicted growth in the American workforce in the decade of the 90's is about twice as great for women as for men. There will be twice as many women as men entering the workforce in the decade ahead. More and more, women represent a potential group to consider for entry into the maintenance workforce. There are growing numbers of women in this workforce now and they are performing quite capably, with some excellent examples in military aviation maintenance. This is one segment of the American workforce that must be drawn on if we are to deal with expected personnel shortages.

CHANGING CHARACTER OF THE WORKFORCE

(1988-2000)

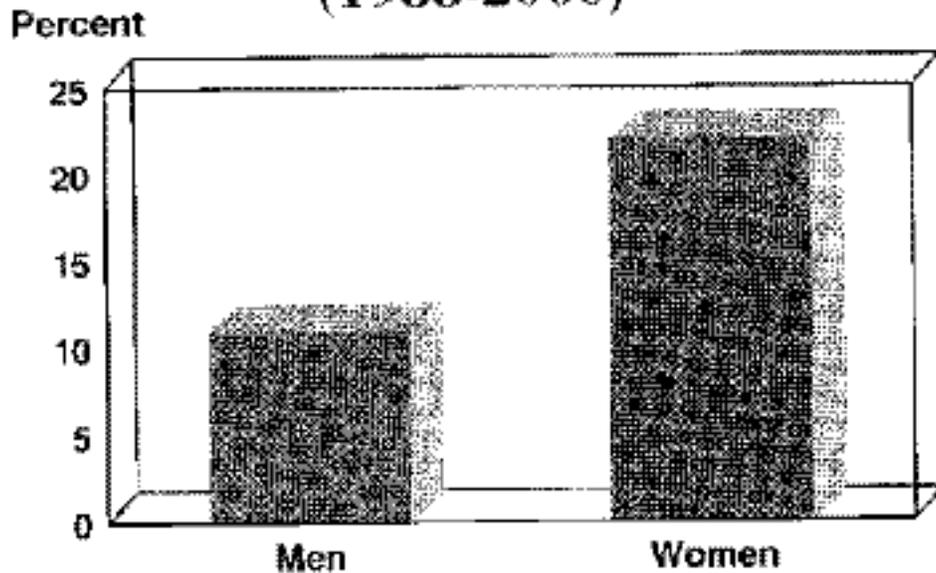


Figure 6

The workforce in the coming decade also will change in its ethnic character. During this period, we expect to see negative growth in the caucasian workforce, as shown in [Figure 7](#). There will be fewer white males seeking positions in air carrier maintenance. There will be growth in the Black and Hispanic workforces so we can anticipate these groups to be participants as maintenance technicians of the future.

CHANGING ETHNIC CHARACTER OF THE WORKFORCE

(1988-2000)

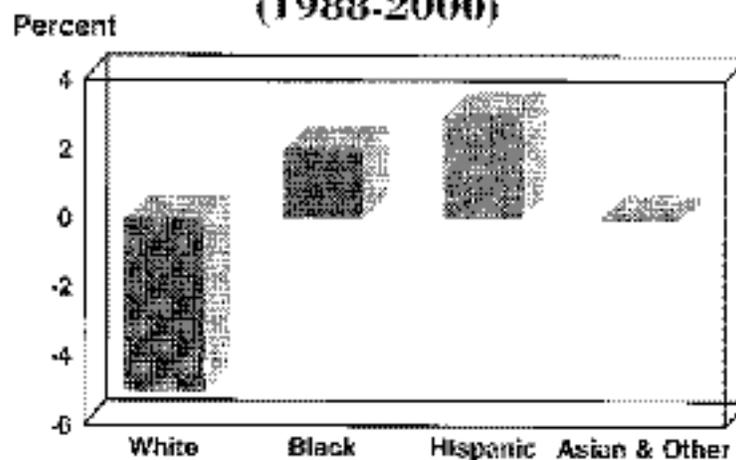


Figure 7

Conclusions

As we look toward the year 2000, several conclusions can be drawn concerning air carrier maintenance and the forces that will shape this industry. Some of the more important are:

- Air carrier maintenance will experience significant growth. Current projections call for at least a 60 percent growth in commercial aviation between the years 1990 and 2000. Air carrier maintenance will need to grow at least as rapidly.
- Automation and new materials may change the nature of maintenance. The age of the glass cockpit is upon us. The use of composite materials in aircraft structures is increasing each year.
- Personnel shortages are likely. Projections call for an actual decrease in the number of potential aviation maintenance technician candidates below 35 years of age.
- Training must keep pace with new work requirements. The new technologies to be incorporated in aircraft of the coming decade will require a high level of understanding and proficiency in electronics, computer sciences, materials technology, and other skills not so important in maintaining the previous generation of aircraft.

The assembled group at our meeting today represents the best expertise available in air carrier maintenance. Your deliberations will be of great value as we all work toward the development of solutions for the issues I have just described. Thank you.