Appendix A: Meeting Presentations

THE CHANGING WORKFORCE TO THE YEAR 2000

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The Office of Employment Projections within the Bureau of Labor Statistics (BLS) is the office responsible for all forecasting work in BLS. Our work is in two parts. First, we develop detailed projections of the labor force and of industry and occupational employment. Second, we prepare widely used vocational guidance materials including the *Occupational Outlook Handbook* and the *Occupational Outlook Quarterly*. The audience for our work is varied and includes high school and college students, guidance counselors, education and training program planners, people interested in recruiting and retention, as well as other Government agencies.

Our work began after World War II in order to develop data to assist returning veterans reentering the workforce. Our projections generally cover 10 to 15 years. The projections reviewed today have a base year 1988 and are projected to the year 2000. We currently are revising these projections and soon will be looking at the projection period 1990-2005. Projections are revised every two years in order to monitor technological changes, changes in the way business is conducted, demographic changes, as well as correcting any mistakes. Looking into the future is not easy and our goal is not to be perfect. Rather, we strive for our projections to be generally in the proper direction and in the correct order of magnitude. We feel that we generally meet this goal.

The work of the Office of Employment Projections uses four closely integrated models covering (1) labor force, (2) aggregate economic activity, (3) industry employment, and (4) occupational employment. The last model covers occupational employment for several hundred occupations and industries. In this, we produce an industry occupational employment matrix with which we can provide detailed data on occupations in a particular industry, both current and projected. One can look at an occupation and see the industry distribution of employment both in the base year as well as in the target year. We normally produce three alternatives based on different assumptions concerning gross national product, unemployment, population growth, and labor force growth. Today's review is based on a moderate set of assumptions. This provides projections that we feel are most likely to occur.

The first step in our work is to develop estimates of the labor force, defined as those at work and looking for work. People who have become discouraged in their job search and quit looking are not considered. For the purposes of this presentation, I will present data for the most recent 12 year period, years 1976 to 1988, as well as for the projection period, years 1988 to 2000.

Figure 1 shows that over the 1976 to 1988 period, some 26,000,000 people entered the labor force, an increase of 27 percent. Our projection for the 1988 to 2000 year period calls for an increase of 19,000,000 persons, a 16 percent rise. This projected slowing in the growth of the labor force reflects slower population growth stemming from the decline in the birth rate in the 1960's and 1970's. It also reflects a projected slower growth rate in women's labor force participation rates, an issue to be discussed later.

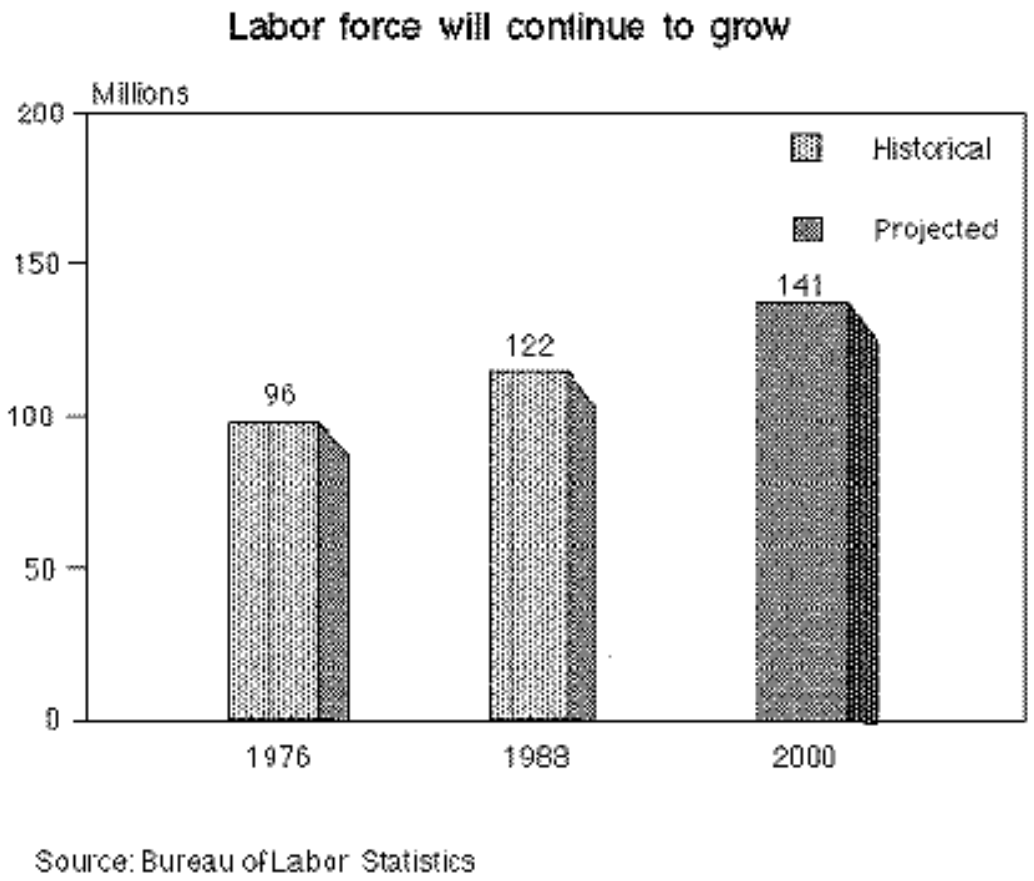
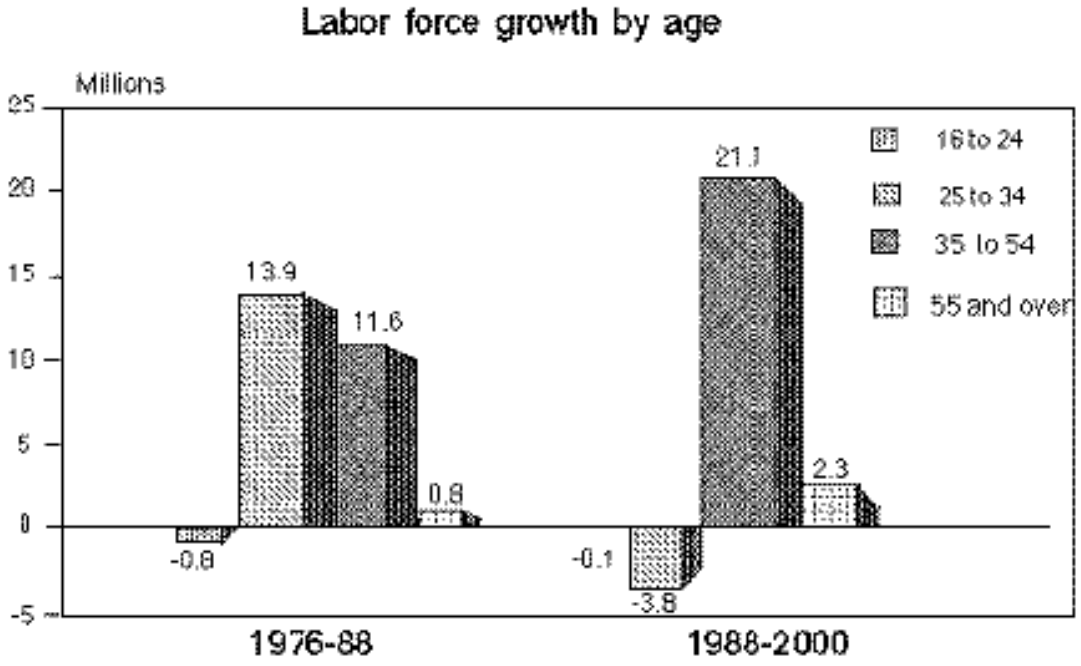


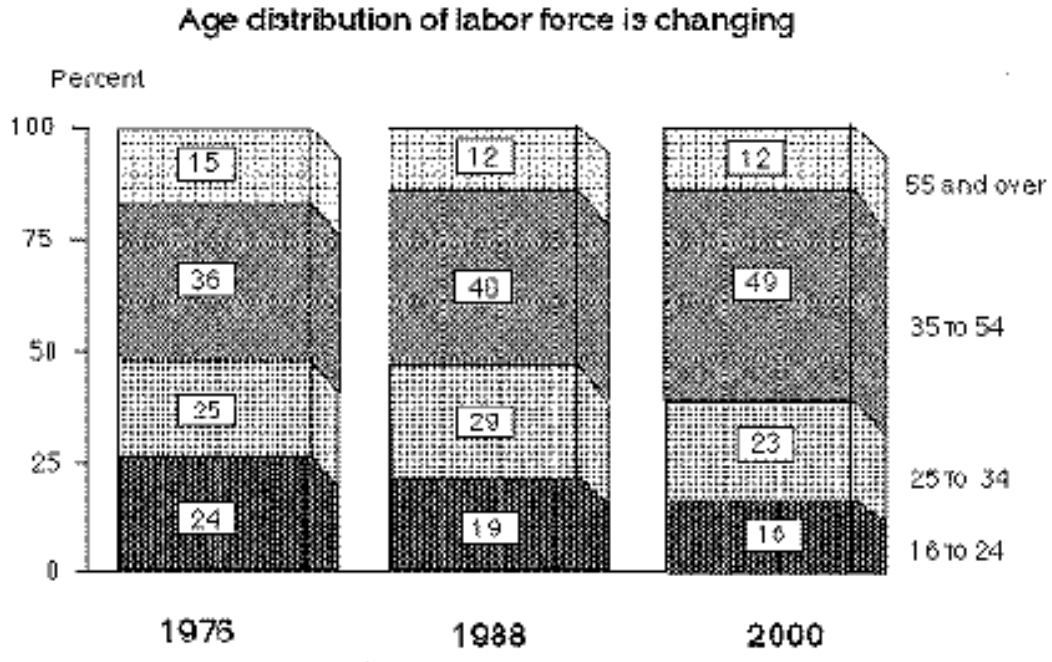
Figure 1

An examination of projected labor force growth by age to the year 2000 shows some changes of particular interest to those working in aviation maintenance. Figure 2 shows the age projections for four major age groups. The 16-24 year old labor force, the group representing potential entrants to training programs in aircraft maintenance, shows a slight decline in size over the projected period. The 25-34 year age group, which grew by nearly 14,000,000 from 1976 to 1988 will drop nearly 4,000,000 between 1988 and 2000, again reflecting the declining birth rates of the 1960's. As shown in Figure 3, almost all the growth will occur among those 35-54 years in age. This is the group that includes the "baby boom" generation.



Source : Bureau of Labor Statistics

Figure 2



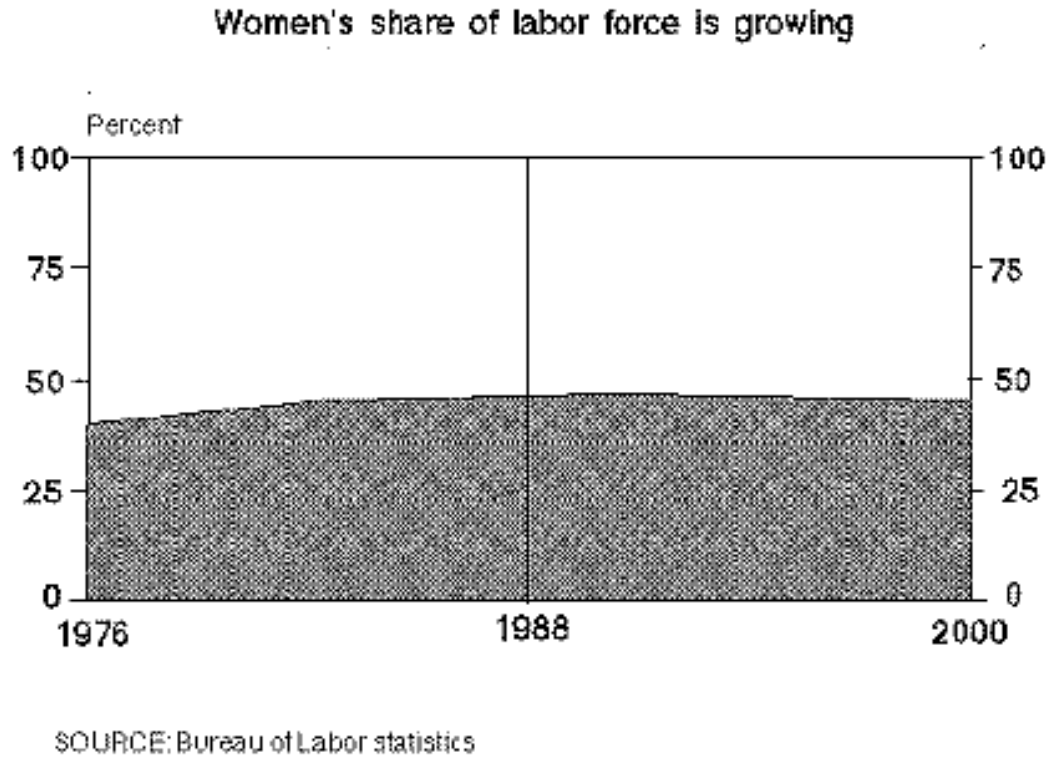
Source: Bureau of Labor Statistics

Figure 3

The changing patterns of growth for different age groups over the next decade necessarily will produce a different age distribution in the workforce. The 55 and over share of the labor force is projected to remain the same as in 1988, halting its earlier decline. The baby boom generation will be 35-54 years in the year 2000 and will account for almost one-half of the year 2000 labor force. Both the 25-34 year group and the 16-24 year group will decline in terms of their share in the total labor force.

Rates of labor force growth are projected to drop for both men and women. As was the case in the 1976 to 1988 period, labor force growth for women will be greater than for men, as shown in Figure 4. The participation rate for women will increase by about 22 percent over the projected period. The greater labor force growth for women means that their proportionate share of the labor force will continue to increase, as indicated in Figure 5. Women's share of the labor force increased from 40 percent in 1976 to 45 percent in 1988. This increase is projected to continue, reaching about 47 percent in the year 2000.

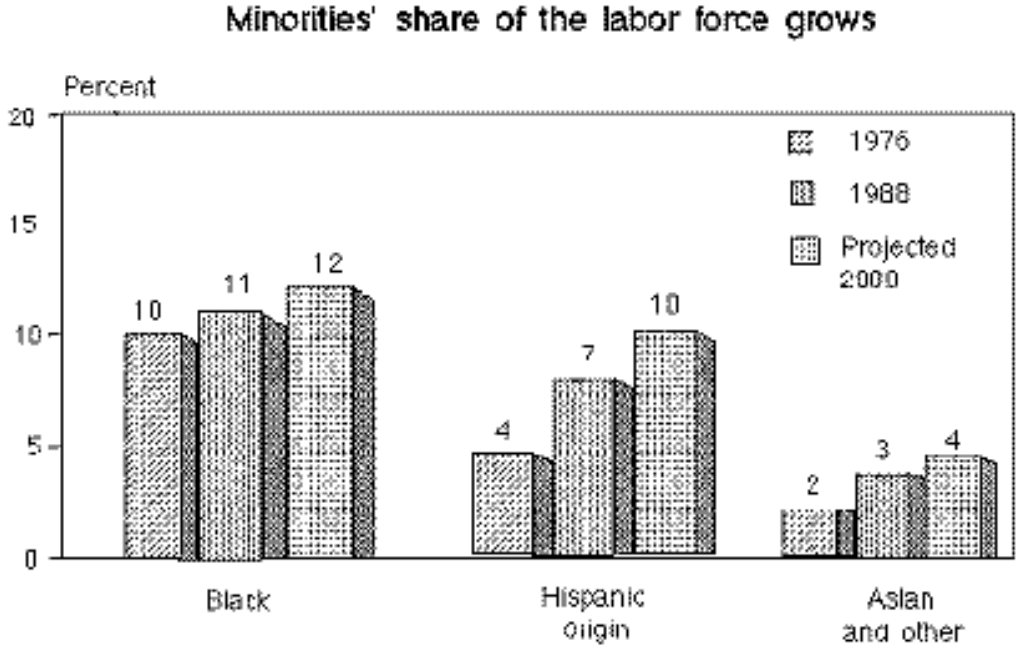
Figure 4



SOURCE: Bureau of Labor statistics

Figure 5

The labor force also is changing in terms of race and ethnic background. Figure 6 shows the distribution of minority groups in the labor force in 1976 and 1988, and projected for the year 2000. Over this period, blacks have been and will continue to be the largest minority group. The hispanic share, however, will grow faster than other groups due both to their higher birth rate and to immigration. The new immigration law may moderate this somewhat, but the growth rate for hispanics will continue to be a significant factor in the changing workforce.



SOURCE: Bureau of Statistics

Figure 6

Who will be coming into the labor force? Of the 141,000,000 in the labor force in 2000, 43,000,000 will not have been there in 1988. These are entrants to the labor force over the projected period. Figure 7 shows that 23,000,000 of the 43,000,000 labor force entrants, about 55 percent, will be needed to replace those leaving the labor force. For most occupations, even for many rapidly growing occupations, replacements needed to take the place of those who leave for all reasons -- transfers, deaths, retirements, family responsibilities, school -- exceeds the number of openings generated from growth. The remaining 19,000,000 represent net growth of the labor force over the projected period. So even though 43,000,000 people are going to be at work or looking for work, only 19,000,000 will represent an expansion of the labor force.

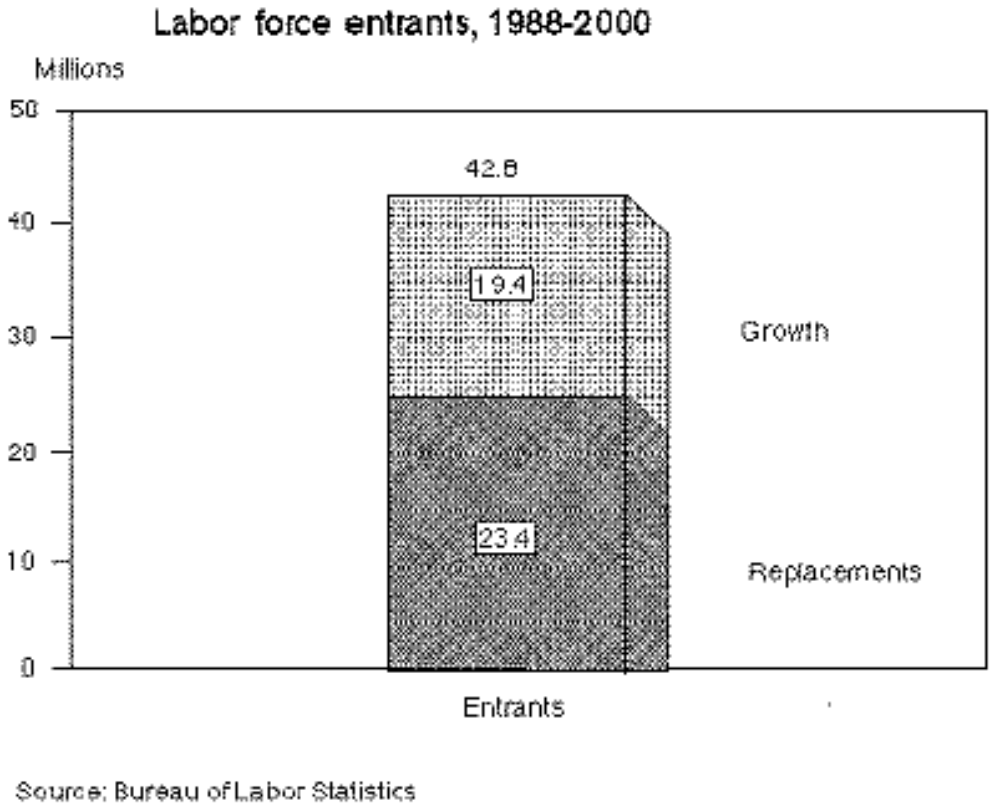


Figure 7

The characteristics of the group representing growth, rather than replacement, for the 1988-2000 period are interesting. Women will account for over 12,000,000 or about 60 percent, of these entrants. Slightly over 10,000,000 of the new workers, or just over 50 percent, will be from minority groups. So we see the expansion of the labor force being fueled to a considerable extent by the addition of women and minorities.

The data presented to this point describe the present labor force and changes projected for the coming decade. Now I will turn to a subject of more direct relevance, the air transportation industry and the aviation maintenance occupation. The air transportation industry, in terms of employment, grew 72 percent over the earlier period from 1976 to 1988. We are projecting this industry to grow only 29 percent over the 1988 to 2000 period. The reason for this slowdown in employment growth rests with rising productivity. The rate of increase in industry output will be almost twice as fast as the rate of employment change over the coming period.

Table 1 summarizes some of the characteristics of the aviation maintenance occupation and reflects some of the data we have developed. As you can see, those working in this occupation are predominantly white males. The annual separation rate for employees is seven percent. This is low in comparison to the average for all occupations. A meaningful comparison can be made with the broad occupational group containing precision, production, craft, and repair occupations, which also contains aircraft mechanics. In this group, consisting of highly skilled repairers, construction craft workers, and other precision metal workers such as tool and dye makers, the separation rate in 1986 was 15 percent. This comparison indicates that aviation maintenance is a rather stable occupation, with workers exhibiting a strong attachment to their chosen career.

Table 1
Characteristics of Aircraft Mechanics

Women	2.6%
Blacks	9.2%
Hispanics	7.5%
Separation rate	7.0%
AGE DISTRIBUTION	
16 - 29	31.3%
30 -49	50.7%
50 +	18.0%
MEDIAN AGE	36.2 yrs
OCCUPATIONAL TENURE	
Median	9.4 yrs
3 or fewer years	22.9%
4 - 9 years	28.5%
10 - 19 years	16.2%
20 +	32.5%

Source: Bureau of Labor Statistics

The problem that aviation maintenance will face in the years ahead is highlighted in the next section of Table 1, the age distribution. Almost one out of five aircraft maintenance personnel is age 50 or older. You can imagine the kind of turnover this occupation will have over the next decade. This will come not only from retirements but also from increased mortality and disability.

The aviation maintenance workforce is quite experienced. The median time on the job is almost ten years, and one-third of these mechanics have been on the job for 20 or more years. This just confirms what you already suspect: The loss of experience and skills is likely to be relatively dramatic over the next decade.

I would now like to summarize the data we have developed for the aviation maintenance occupation. Table 2 shows that wage and salary employment in 1988 is 122,000, projected to grow by about 20,000 by the year 2000. Most of this growth will be in the air carriers. The 2000 or so self employed workers are projected to show little if any change by 2000. The self employed generally are found in operations such as small repair shops where the person classifies himself as self-employed.

Table 2

Supply / Demand

1988			2000		
Tota Empl	W & S	S/E	Total Empl	W & S	S/E
124K	122K	2K	144K	142K	2K

Total new jobs: 20,000 or 1,677/yr.

Separation rate: 7%

134,000 x .07 = 9,380 replacements anually

Total demand = 9,380 + 1,667 = 11,047 entrants each year over the 1988-2000 period.

Training completions: 2,221

Source: Bureau of Labor Statistics

Adding the two employment categories yields a total employment change of about 20,000. This is approximately a 16 percent change, which is about average for all occupations. However, we will use the seven percent separation rate identified in 1986 for this occupation and apply it to the average number of employees (134,000) over the 12 year period. The total annual demand for employees then can be calculated as the number of new jobs per year plus the replacements needed each year. This shows an average annual requirement of 11,047 entrants each year over the 1988-2000 period. Data from surveys of training schools conducted by the Department of Education show a little over 2,000 training completions each year. Although this number seems a bit low, it represents the only data we have. If all of our input data are reasonably accurate, our analysis shows an occupational imbalance of roughly 9,000 a year. However, one must recognize that this is a national projection for an occupation in which there are many local labor markets. So there might be a real shortage in New England while, at the same time, a glut in the Southwest states, or vice versa.

The last item for discussion concerns compensation of aircraft mechanics. Compensation certainly is one variable that impacts the availability of workers. It also is one that can be manipulated in the event of a labor shortage. For this reason, a comparison of different but similar occupations can provide useful information. Table 3 compares the weekly earnings for aircraft mechanics with three other occupational groups. The first comparison is with all workers. The second is with electrical and electronics technicians, a group that possibly draws some qualified technicians from the field of aviation maintenance. The third comparison is with workers in the broad category of precision production, craft, and repair occupations. Aircraft mechanics represent a subgroup within this grouping. The data in Table 3 show that compensation for aircraft mechanics compares favorably with technicians in other classifications. However, the rate of growth of compensation for aircraft mechanics over the period of 1983 to 1989 is not as rapid.

Table 3

Median Weekly Earnings

Year	Aircraft Mechanics	All Workers	E & E Technican	Precision Prod., Craft & Repair
1983	$ 468	$ 313	$ 409	$ 377
1984	$ 476	$ 326	$ 420	$ 384
1985	$ 491	$ 343	$ 426	$ 397
1986	$ 505	$ 353	$ 477	$ 408
1987	$ 510	$ 373	$ 491	$ 419
1988	$ 519	$ 385	$ 496	$ 430
1989	$ 532	$ 399	$ 512	$ 454
% Change	13.7 %	27.5%	25.2%	20.4%

Source: Bureau of Labor Statistics

In conclusion, the data we have developed show that aviation maintenance is a stable occupation with modest turnover. However, the labor force is aging and may have problems in replacing workers during the next decade. Finally, I would like to note that the Office of Employment Projections of the U.S. Department of Labor is continually acquiring new information and upgrading its assessments of the national workforce and of specific occupations. If there are questions in the future concerning your labor force for which we might have useful information, please contact us. We will do whatever we can to help.

ORGANIZATIONAL FACTORS IN THE ENHANCEMENT OF AVIATION MAINTENANCE

Major General Albert G. Rogers, USAF (Ret)
Integrated Engineering Services

The impact of organizational factors on human performance is a matter which generally does not receive the attention it merits. Yet, the structure of the organization within which a person works can make a real difference in the productivity of that individual. Certainly, there is evidence that this is true in aviation maintenance. In any endeavor, however, the important feature is the personal involvement each employee has with the organization and the manner in which the organization encourages and supports this involvement.

The fundamental issue with any organization is the extent to which it has a centralized structure. Is it centralized or is it decentralized? This is an important distinction, one which definitely affects the quality of performance of employees.

Many characteristics of an organization are established as a result of the extent of centralization or decentralization. Each of these characteristics has some impact on the role and performance of employees. To illustrate, I would like to list some of the most important characteristics of each type of organization. Table 1 shows some of the key features of a centralized organization. I will comment briefly on those items in Table 1 which illustrate the way in which a centralized organization works.

A centralized organization does macromeasurement and macroanalysis. As an example of macromeasurement, consider the national measure of unemployment, which currently is in the order of 5.7 percent. This unemployment index tells the young, black, 22-year old in the District of Columbia, where the unemployment rate for his group is 29 percent, very little about work in the United States. That is macromeasurement.

Table 1
Characteristics of a Centralized Organization

- Macromeasurement
- Macroanalysis
- Lack of *definable,* common goals and standards
- No personal stake in the action
- Leadership, authority, decisions, only at the top
- Nameless, faceless "control" functions
- "<u>One</u>" of something
- People work for the system

For macroanalysis, I offer as an example a measure of merit called "issue effectiveness" used by the Air Force Logistics Command. This measure shows, for all the items that people ask for, how frequently the Logistics Command responded in the time allowed. This is a nice measure of effectiveness which comes to about 99.8 percent year after year. The problem is that this measure includes writing paper, pencils, and paper towels, as well as an $830,000 electronic black box that allows an F-16 aircraft to deliver weapons precisely. Obviously, the global groupings within this effectiveness measure greatly reduce the usefulness of the measure.

A centralized organization typically does not have a common definable goal. U.S. auto manufacturers are centralized. The production line worker, who does much the same assembly work year after year, would have great difficulty in describing the common definable goal of his organization. This same worker also perceives himself as having little if any personal stake in the action. He has very limited involvement in the successes and failures of the organization.

A key feature of a centralized organization, from a worker's point of view, is its leadership structure. A centralized organization has a few people at the top. These are to proverbial "they" or "him" or whatever. This leadership is seen as a faceless authority which makes decisions and exercises control functions. The leadership appears as a disembodied voice on the telephone, supported by nice written procedures. Most important, centralized organizations have one of something. When you have only one, it is almost impossible to judge it. Is it tall or short? Is it fast or slow? There is no way to tell. For example, there was no way to evaluate the U.S. Postal Service some years ago. Now, with the advent of Federal Express, Purolator, UPS, and others, the public can make realistic evaluations.

Finally, in a centralized organization, people work for the system. There is an inflexible, established system to which people come and go. Whoever comes and goes, there is little change in the way the organization appears to the employees within it.

Now consider the decentralized organization. Here there is competition, with at least two of something. While we may not want to have two U.S. Postal Services, or two General Motors, one can make micro-comparisons by forming subsets within the organization. Here we would have like sets of resources doing like kinds of activities with like kinds of goals. In such a situation, one can compare the different resources along any number of dimensions. Typically, when there are three of something, one does very well; one does about average; and one brings the average of the three. This will be true even though the goals and standards established for each of these subsets might be the same.

In a decentralized organization, employees will be personally tied to the product to a greater extent than with a centralized organization. They also will have many levels of leadership, with responsibility for decisions that are made at several levels. The names and faces of those leaders making the decisions are known. Also, the system works for the people. The system is there to supplement and support their own personal efforts. They are not a slave to that system. Finally, there is a singleness of purpose. Personal goals and organizational goals match to a far greater extent than in a centralized facility.

Improvements in Aviation Maintenance

The observations concerning centralized versus decentralized organizations suggest ways in which organizational factors might be manipulated to improve the quality of aviation maintenance. This improvement can be made through organization and through leadership. Typically, we do not thing of an organization as facilitating the function of leadership. We generally take the organizational structure which is in place and then worry about the functions in that organization. What we need to do is review the organizational structure to determine if it facilitates advantageous leadership.

Any organization can be evaluated in terms of certain characteristics of that organization. To facilitate our discussion, we may characterize an organization in terms of five "P's" which describe it. These five are:

- People
- Purpose
- Pride
- Professionalism
- Product

The people within an organization consist of employees and managers, recognizing that these categories are not necessarily mutually exclusive. We will focus on managers for a moment and consider how management necessarily must provide leadership. We will accept the definition that a leader is "a person who by force of example, talents or qualities of leadership, plays a directing role, wields commanding influence or has a following in any sphere of activity or thought . . ." In more specific terms, our thesis is that a leader in an organization must recognize the five "P's" just described and must be able to deal with each. In particular, he must recognize that management of people is most important and that people are fundamentally different from things.

One of the real challenges of leadership is to achieve a common purpose for both an organization and its employees. Leaders must get employees to transcend their individual purposes to get into sufficient harmony with the fundamental purpose of the organization so that they fully support its goals. Such leadership, however, requires an organizational structure that supports the leadership and does not stifle it. In an example from the Air Force Tactical Air Command, to be provided later, this type of organization will be described.

Closely allied with common purpose is the matter of pride. Pride is the bedfellow of quality, if you will, and is something one feels inside. Good leaders understand pride and know how to appeal to it. More important, they provide a climate that produces pride.

Pride breeds professionalism. Professionalism is important. How willing are you to leave your new $40,000 automobile for repair at a garage where the things you see lying around include food wrappers, old tin cans, a few wrenches, and an open tool box with grease all over it? Would you leave your car their? Professionalism implies norms of behavior based on self discipline and commitment. Further, professionalism is based on standards that are never compromised. Leaders recognize the need for these standards and understand that excellent standards equal an excellent organization.

The discussion to this point has centered on people but one must recognize that in any organization there is a product. Indeed, the raison d'^etre of any organization is its product or output. This is true for those in both the private and public sectors. In either case, there must be an orientation toward output and a focus on productivity. The employees within the organization must be able to relate to the product of that organization.

The organizational features represented by the five "P's" discussed above are important as determinants of organizational effectiveness and efficiency. A case study will illustrate the manner in which changes in organizational structure, based on consideration of these features, can have a positive impact on organizational productivity.

A Case Study in Organizational Structure

The Air Force Tactical Air Command (TAC) in the year 1978 was a large organization operating from 29 different bases in the United States. TAC consisted of 34 wings, each operating 72 aircraft. Maintenance was a major activity, with some 48,000 people employed in direct maintenance support.

TAC at that time was a well-structured organization, centralized on a wing-wide basis. It had been so for nearly ten years. The typical flight line had somewhere between 1800 and 3500 maintenance people. All work priority and assignments for these technicians came from Job Control through a dispatch communications system. Job Control was a centralized organization and control system. They knew the big picture; they could work the priority; they could work the sequence. In this system, only a generalist crew chief was on the flight line; all other maintenance people were in "shops." A fleet of vehicles carried dispatched specialists from the shop to the job aircraft and towed dispatched support equipment. In this system, the dispatched technician frequently did not take the correct technical data. Also, he might find he was not the proper technician for the job once he arrived at the airplane.

A centralized organization called Plans and Scheduling controlled much of daily life. All preplanned maintenance and flying activity was done by a central scheduling office. While there were three separate flying squadrons, any Wing pilot flew any Wing aircraft.

There were both hidden and obvious signs of trouble in 1978. A major problem was that the existing organization was not the war-time organization. In the event of a national emergency and deployment, a maintenance force would assembled by selecting a certain number of these people, a certain number of those people, and so on. This is analogous to a football team such as Alabama having all of its guards practice in one place, its tackles in another, and its backs in still another. Then, on Saturday you say to Coach Bryant, "Bear, take two of these, take two of those, take one of those, and likewise until you have a full team. Then go out and win the game." Obviously, the Coach would look at you like you were crazy. Yet, this is exactly how we planned to form combat maintenance teams.

There were other signs of trouble. Pilots were exiting the Air Force at an alarming rate. Experienced maintenance technicians also were leaving. Certainly caused in some measure by the fact that they were treated like second-class citizens. Stress was high and people were unhappy.

What was the effect of working under the conditions I just described? Let's examine the performance of this organization over a ten-year period. Figure 1 shows the percent change in utilization rates for all TAC fighter aircraft from 1969 to 1978. The baseline represents what history and experience had told us was necessary. That is, each one of the 72 airplanes in a Wing had to fly about 18 times a month for a total of about 25 hours to provide appropriate training for the fighter pilot and necessary air-to-ground and air-to-air work. The curves of Figure 1 show that from 1969, when TAC's centralized system was introduced, to 1978 there was a continuing and dramatic decrease in organizational productivity. Aircraft that had averaged 23 Sorties per month in 1969 now were averaging 11.5.

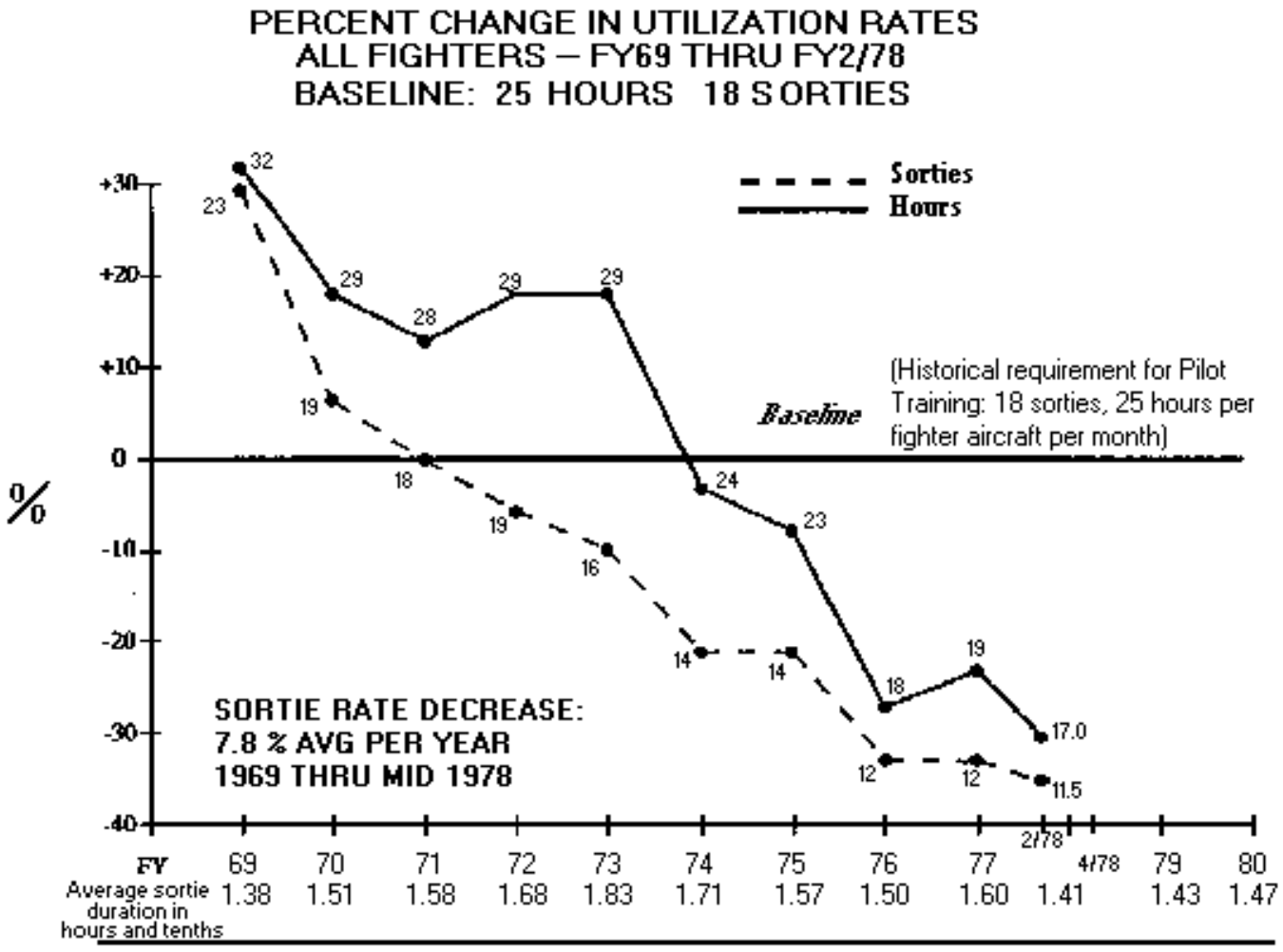


Figure 1 Percent decrease in TAC utilization rates FY69 through FY2/78. By fiscal year, this is the average number of sorties and hours flown by each fighter aircraft per month. This is a pure measure of production output.

The Combat Oriented Maintenance Organization

We in TAC recognized by 1978 that something had to be done or we would simply go out of business. A number of changes were made, some of which were immediate while others evolved over time. First, a decision was made to focus on the mission. This meant that TAC units would practice together, during peacetime garrison training, just like they were going to fight. When TAC deployed for a European exercise, a "team" would be sent, and this team would be those units that had trained together in the U.S.

Another decision was to move to a more decentralized leadership structure. There would be several levels of leadership, with authority and responsibility at each level. No longer would there be a faceless function like "Job Control." Leadership, with appropriate authority and responsibility, would be provided by individuals at levels where the leadership was needed.

A number of other changes were made in organizational structure and in personnel management. Goals and standards were established, a fixed number of Sorties per month was set as a requirement for each authorized airplane. Procedures were established to foster competition among different working groups. Ways were considered to develop a feeling of asset ownership for each of the working groups. Focus was shifted strictly toward output. The output here clearly was number of Sorties. The final decision at this point was that the new program must reward the strong and be able to identify the weak members, i.e., those who could not meet the new goals and standards.

The plans made in 1978 paid particular attention to the individual -- the maintenance technician -- in the reorganization. Unity of purpose was considered essential between individual and organizational goals. Each member of the team must be personally affected by the team's success or failure. For self motivation, individuals must identify with and be tied to the product. Also, individuals must be allowed a measure of independence, with avenues available to emerge from the crowd while, at the same time, remaining a team member.

From the plans just described emerged a new organization called the Combat Oriented Maintenance Organization. As a first step, the 72 airplanes in a Wing were assigned to three separate 24 airplane squadrons. All maintenance people then were divided among these three squadrons. Members of each squadron then chose a particular color to identify the assets of that squadron. If green was the color chosen, green stripes were painted on the 24 airplanes; green scarves were used by the squadron's fighter pilots; and maintenance technicians wore green hats. In effect, we said "Okay, you're the green guys."

From that time on, only green-hatted mechanics worked on green-tailed airplanes. If there are no green-tailed airplanes in commission and you're a green scarf pilot, you don't fly. As a means of aiding the "ownership" issue for mechanics, each squadron was assigned its own ground support equipment. In addition a crew chief and pilot were assigned to each aircraft, with their names painted on the canopy rails. All measures were taken to foster feelings of ownership and identification.

The function of the unit known as "Job Control" was changed dramatically and renamed. This unit no longer told individual mechanics when to work on which airplane. The unit became a status keeping organization so that the Wing Commander could review overall status of the Wing. Direction and control of squadron maintenance now was moved to the squadron level. Each squadron was given the common goal -- 18 Sorties, 25 flight hours per month for every authorized airplane. Against this goal, each squadron could set its own schedule. Headquarters would not establish the schedule but instead would simply track the squadron against its schedule. The only real requirement was that the Sortie goals be achieved. Of course, various things can happen in any given month, so the real requirement was that squadrons meet these goals on an average basis through the year. Nevertheless, the goals had to be met.

Proper oversight of squadron output was maintained. Score was kept on the number of Sorties produced. These scores also deliberately were made common knowledge. At the gate to the base, there were signs identifying each squadron by color and showing "Sortie goal for the month" and "Sortie status to date." The status of squadron competition was well known.

Many steps were taken to encourage feelings of personal identification with the unit. When squadrons deployed in overseas training exercises, units maintained their identity. "Green mechanics" continued to work on "green airplanes." During these periods of deployment, competition continued among the different squadrons as well as with the enemy forces.

Although the sense of identification and the competition were very important variables, other changes were made. For one, maintenance technicians were treated better. We began to treat them like they were first-class citizens. Decent work and break facilities were built for each squadron. Air conditioning and proper heating units were installed in work areas. At work, maintenance crews and air crews began to live together in the same facilities. In addition to providing improved living quarters for maintenance technicians, this arrangement did much to develop a better understanding and closer rapport between flight crews and maintenance teams.

An important element in our initial planning was that superior performance should be recognized. To acknowledge outstanding maintenance technicians, we established an array of awards for different maintenance categories. At each base in Tactical Air Command, a Maintenance Awards Banquet is held once a year. In the maintenance complex, there is a "Maintenance Hall of Fame," which is a nicely appointed room with a solid walnut trophy case. In this case there is a sculpture of an Aviation Maintenance Technician with a listing of the continuing award winners year by year. This room is open to all who wish to see the names of those honored for their contributions to Air Force maintenance.

The Results -- Maintenance Improvements

The results of the changes made in maintenance organizational structure and operations in the Tactical Air Command can now be reviewed for the 12 year period from 1978 to 1990. Inasmuch as many changes were introduced through time, results will not be immediate but must be considered as the changes took effect.

Figure 2 shows changes in Sorties, our most important product. In 1978, we were flying about 14.1 Sorties per airplane per month. We then set a goal of 18 per month. However, a new airplane was introduced around this time, the F-16, which has a dual role of air-to-air and air-to-ground. This meant more flying time was necessary to keep a pilot proficient so we changed the goal to 20 Sorties per month. By 1983, we had achieved this goal. Now why does it run somewhat above 20 in all subsequent years? This simply shows the effect of competition. When questioned, squadron members say "If you're worth your salt, you don't want to be second." Thus they always come in a bit over 20.

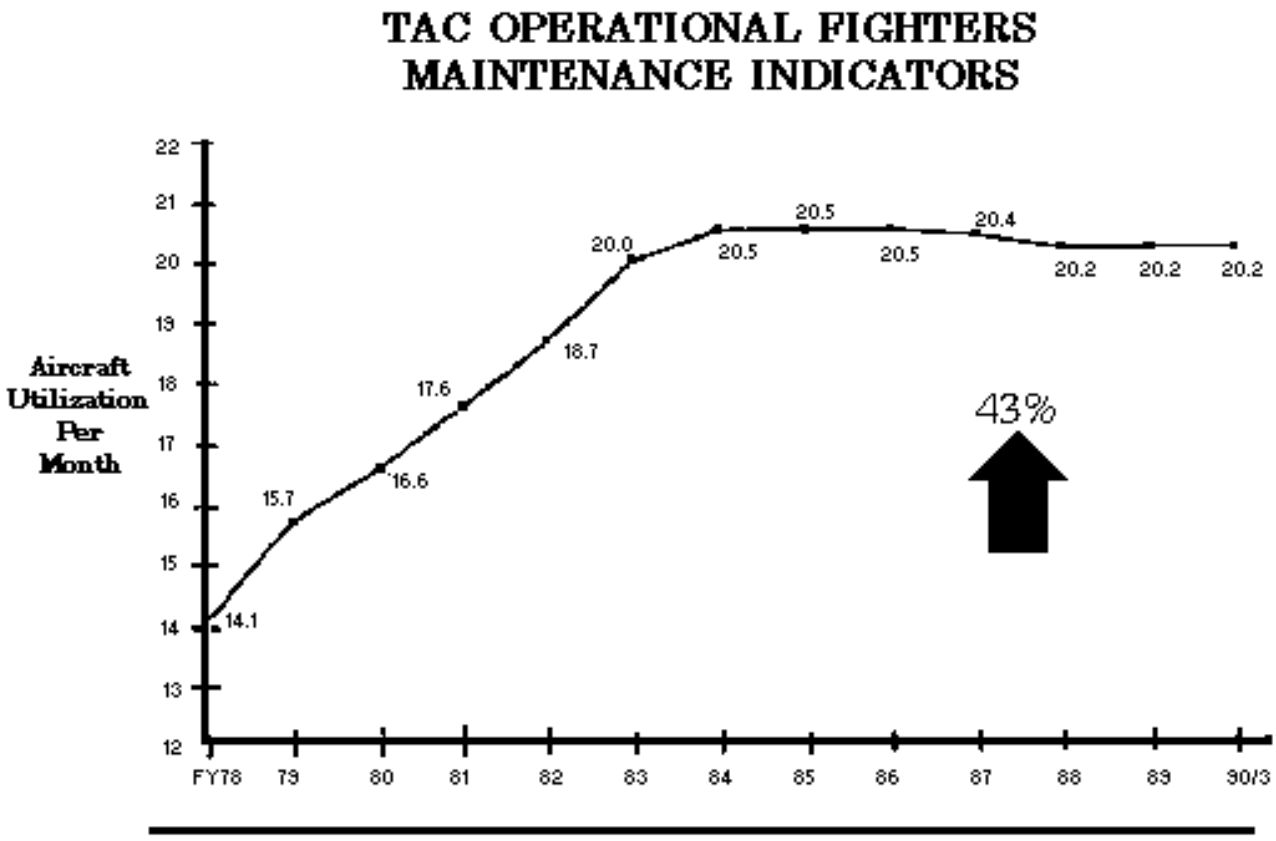


Figure 2 Utilization Rate. This is a quantity indicator showing the average number of sorties flown per month per authorized aircraft. Twenty was the described goal, thus production remains at that level.

Another indicator of maintenance effectiveness is aircraft readiness. How many airplanes are ready to do their mission and fight on any given day? Figure 3 shows that in 1978 only slightly over one-half of our airplanes were ready to fight, as measured daily. By the mid-1980's, aircraft readiness had risen to the mid 80 percent. This is about as high as one is going to achieve because these data include scheduled as well as unscheduled maintenance. In any case, the data do show about a 60 percent increase in produce quality.

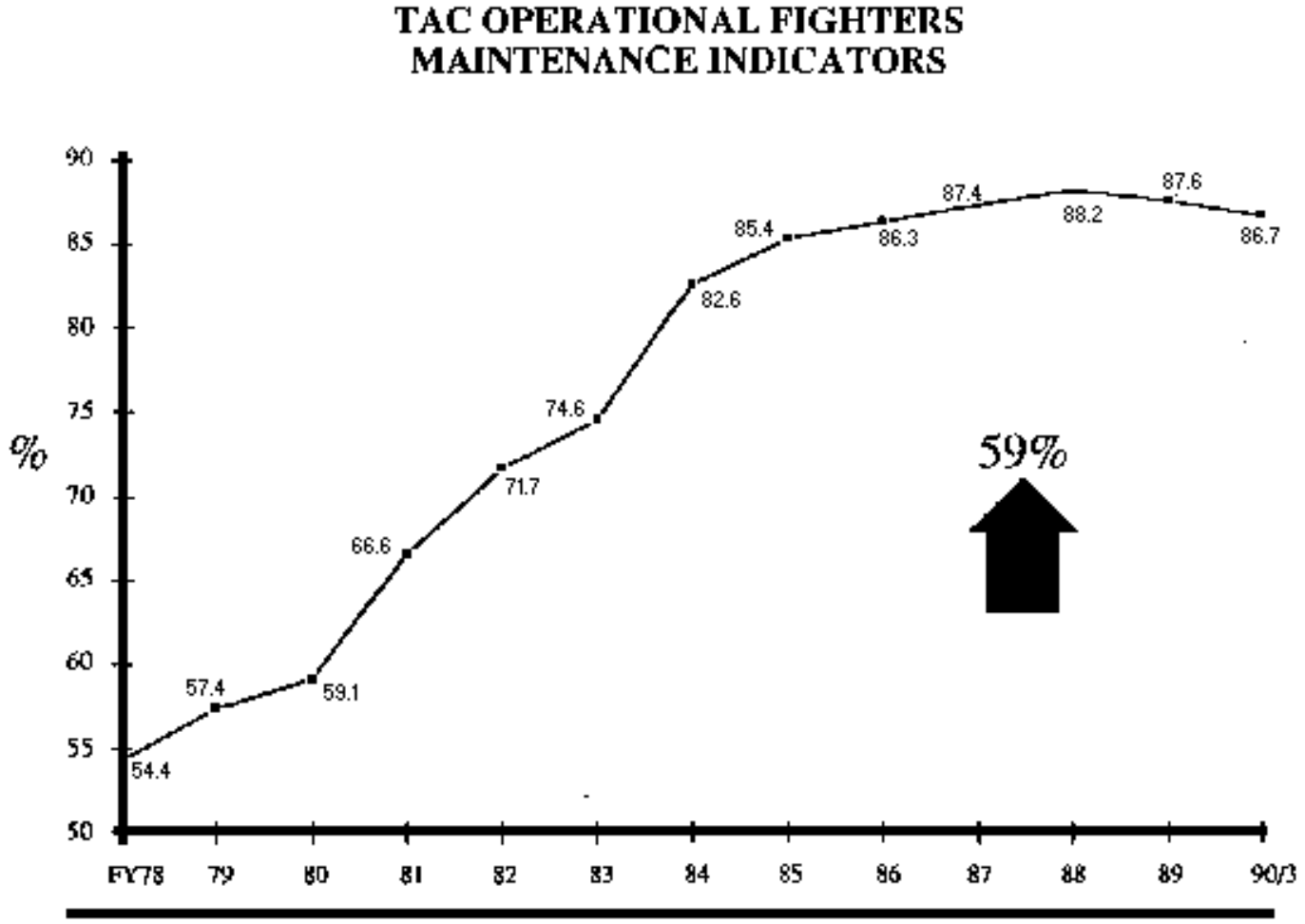


Figure 3 Mission Capable Rate. This is a quality indicator and describes the average percentage of aircraft over a 24 hour day that can fly and do some portion of its mission.

Figure 4 presents an additional indicator of maintenance output. This figure shows the percentage of landing aircraft that must be repaired and which are repaired within eight hours of landing. In wartime, this would show the number of airplanes requiring repair that could return to the fight on that same day. In 1978, some 30 percent of our airplanes were fixed within eight hours. By the late 1980's, this number had risen to over 80 percent, or a 158 percent improvement.

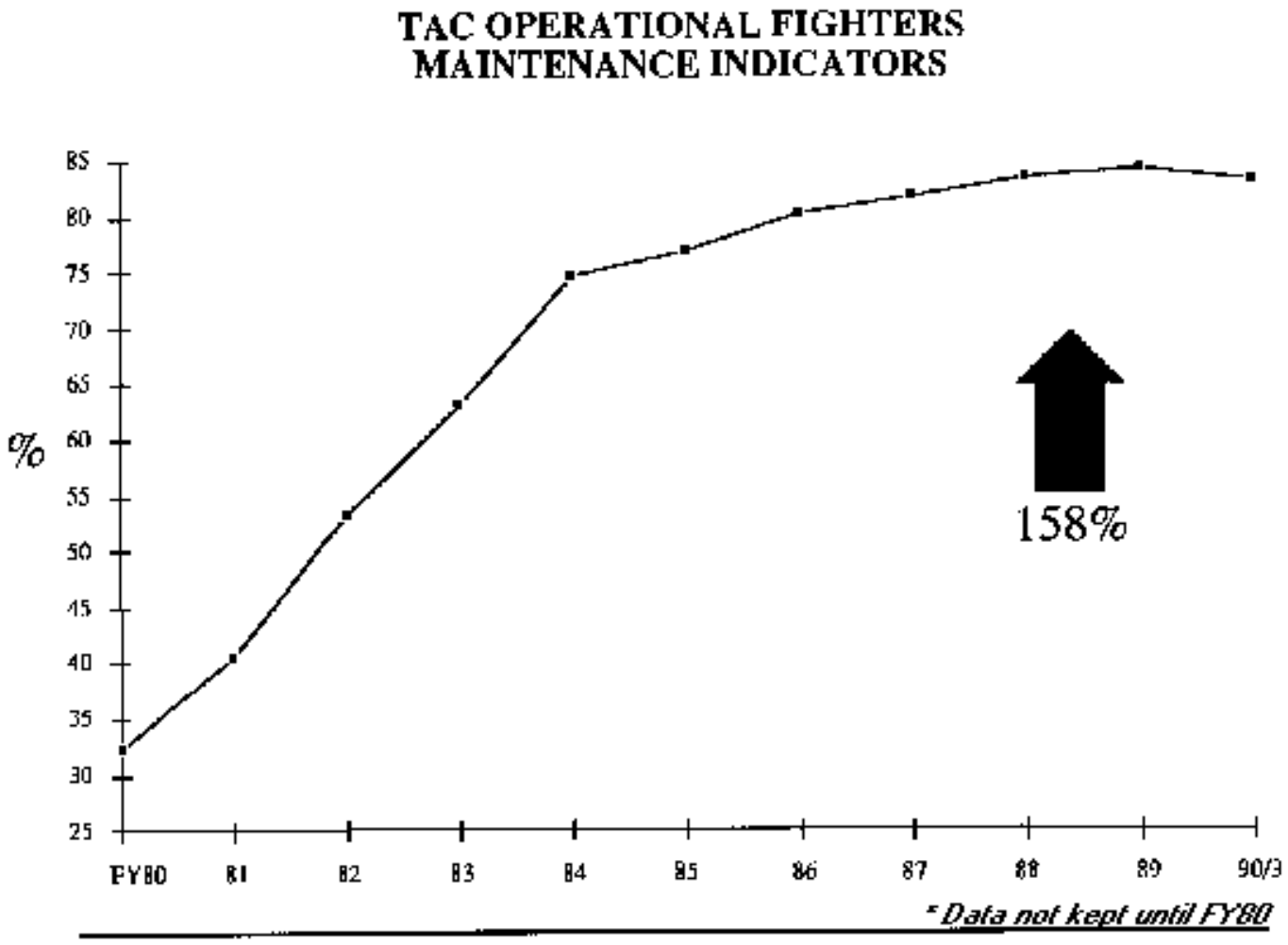


Figure 4 Fix Rate (At 8 Hrs). This is a critical indicator of quantity. It is the percenage of landing aircraft which must be repaired, that are repaired within eight hours of landing.

The extent to which flight schedules are met is a measure of merit for maintenance. In TAC, a flight schedule is published by noon each Friday for the forthcoming week. This schedule shows aircraft tail number and take-off time. If an airplane leaves within 15 minutes of the scheduled time, it is considered on-time performance. In 1978, about 75 percent of our airplanes flew as scheduled. This implies considerable turmoil on the flight line trying to get airplanes ready to go. By the late 1980's, on-time departures had improved to over 90 percent. This shows a real improvement in discipline in flight line maintenance activities.

Conclusions

The changes made in 1978 by the Tactical Air Command resulted in a number of improvements in its maintenance program. Most important was in production. As shown earlier, the number of Sorties flown increased and more airplanes were available each day in a ready status. The fix rate over eight hours improved and more flights left on schedule.

The improvements noted in maintenance effectiveness were not achieved easily or without cost. For the first two years, there was great reluctance to change. After all, we were dealing with systems and a "way of life" that had been in place for many years. To overcome this reluctance, literally thousands of maintenance training courses were given, any of which involved presentations by senior personnel, including the four star General in command of Tactical Air Command.

We also found that training required separate attention. Any time training goals are placed in direct competition with production goals, training comes in second. For this reason, we took training responsibilities away from the squadrons and centralized training, drawing on each of the squadrons for training instructors.

In all, however, we judge our program to be a success. Reenlistments are up and there is evidence everywhere of pride in the organization. The quality of our output has improved and the aircraft accident/incident rate has decreased. All of these indicators point to Tactical Air Command as a more effective and efficient organization.

There are several conclusions to be drawn concerning organizational change and its possible impact on organizational performance. The conclusions we have reached are:

- The significance of organizational factors is not fully understood and frequently may be underestimated. The experiment conducted at Tactical Air Command indicates organizational factors can be very important for the performance of the organization.
- Organizational structure can facilitate or can stifle the functioning of leadership. For many activities, leadership at the hands on level is most effective and is encouraged by a decentralized structure.
- The human factors of organization are mostly generic and are not unique to a specific endeavor.
- The challenge to leadership is how to structure an organization to enhance the necessary generic human factors and consequently to improve organizational output. The efforts described at Tactical Air Command are not a prescription, just one example of how this can be done.

ISSUES IN WORKFORCE PRODUCTIVITY

James Diffley
Manager, Maintenance Administration
Delta Air Lines, Inc.

The founder of Delta Air Lines stated, in the 1930's, that the philosophy of Delta was "to manage a company that makes a profit and treats its employees fairly." Through the years, Delta has maintained this philosophy. Doing so in recent years has not been a simple matter, particularly in light of the significant growth we have experienced. In March of 1987, just before our acquisition of Western Airlines, we had slightly more than 4,000 people working in maintenance. Now our maintenance workforce consists of about 7,600 employees. With a workforce of this size, developing procedures to ensure that each employee is treated fairly and works productively represents a real challenge. Today I would like to review some of the issues we face and the procedures we are using to deal with matters of personnel management and employee productivity.

Selection

The first step in developing an effective workforce is through proper selection procedures. Selection procedures for maintenance technicians have been given considerable attention at Delta in recent years. From 1964 to 1988, I personally hired every mechanic at Delta. However, this can be very time consuming and eventually overwhelming. Selection at any major airline must be handled through a systematic program administered by a qualified department.

The Delta selection process is strict. We now accept three out of every 100 people who apply for a job as an aircraft mechanic. The screening process focuses on basic skills, including reading and mathematics. Since aircraft manufacturers now prepare maintenance manuals for the eighth to ninth grade reading level, we screen for a reading skill slightly higher than that. For math, we screen simply for an ability to work with basic high school mathematics and certainly do not require an understanding of calculus. For whatever reason in our educational process, we find that many applicants simply do not have the requisite language and mathematics skills.

Our selection process also attempts to evaluate the attitudes of applicants. We look for mature and self-disciplined people who want to learn and who are cooperative. In short, we look for people who will do the right thing simply because it's right. Of course, it is difficult to make such an assessment during a short interview period. In our screening, we use mechanics on loan to the Employment Office for the preliminary screening. Final decisions are made by managers, drawing on screening information with assistance from psychological consulting services.

Our strict screening provides us with a very productive maintenance workforce with little turnover. We lose less than one-half of one percent a year. We have approximately 100 mechanics retire each year and another 100 who are promoted to other positions. Promotion, in fact, is a key factor in personnel change for the maintenance workforce. At Delta, we practice promotion from within. If a supervisory or administrative job is open, the position is filled from someone within the maintenance group. This provides opportunities for workers and helps in maintaining the stability of our workforce.

Responsibility

Delta gives the individual mechanic virtually complete responsibility for his/her work. This approach is not taken by all major air carriers. In many operations, the lead mechanic or the foreman evaluates problems with an airplane and then gives continuing instructions to the mechanics. We do not believe in that approach. We feel that the individual mechanic should have the responsibility. If he has problems, of course, he can get help immediately.

Maintenance technicians are encouraged to think of aircraft or aircraft systems as "my unit." Technicians are given reports from Engineering that describe the liability of their unit and indicate areas where problems are being experienced. Technicians are encouraged to work with our engineers to determine best repair approaches, but in the end the technician is responsible for accomplishing the repair. The individual A&P mechanic in line maintenance must sign the aircraft logbook. His name goes on the log saying that this airplane is airworthy. This certainly makes him identify with that airplane and bear full responsibility for the quality of any repairs.

Pay and Benefits

An important factor in attracting and keeping good mechanics is a competitive wage structure. The wage scale does not have to be highest in the industry but it does have to be competitive. Employees respond to good wages but wages alone are not sufficient to ensure employee satisfaction and productivity.

The wage scale at Delta is supported by an excellent benefits program. These benefits were put into place after long planning and are designed to promote employee security. We believe that a feeling of personal security is essential for job success. Under our insurance program, an employee and his/her family are covered from the first day the employee starts to work. Here, security and employment begin together. Likewise, our retirement program stresses security. We do not encourage early retirement. We value our senior employees and the experience they have. We also find that senior employees are important in passing on good company attitudes and work approaches to newer members of the workforce. Without these senior employees, we would have great difficulty in teaching 3,000 new people how to think and work our way.

Training

The Delta Airlines training program is designed to ensure that every line mechanic is confident that he can handle any maintenance problem when a Delta plane rolls up to the gate. Each line mechanic is given a minimum of 60 to 80 hours of familiarization training on each aircraft type that operates in his city. In addition, mechanics receive a great deal of specialized training.

Our training staff consists principally of volunteer mechanics. When we have a new aircraft training program, we normally have about 150 mechanics volunteer to participate in the training program. Of these, we select about 25 to 30 who are given a two week program in methods of instruction. Mechanics who show an aptitude for teaching are then sent to the aircraft manufacturer for five to six weeks of factory training on that particular airplane. When these mechanics return to Delta, they contribute to the development of Delta's training manuals for that aircraft and teach the aircraft to our other mechanics.

For our two most recent aircraft, our approach has been to give training to small groups of mechanics, with one week of classroom training followed by one week of on-the-job training. For specific systems, we use a mix of formal and on-the-job training. For example, a small class of mechanics might spend two hours going through the manuals for door rigging. Following this, instructors will take them to the airplane where they actually rig the door. Similarly, the next night they might run through the paperwork and manuals related to an engine change and then actually change an engine. In all, we have about 40 hours of classroom training and about 40 hours of on-the-job training. At the completion of this program, we will have trained some 500 to 800 mechanics on a particular airplane. The volunteer mechanics/instructors then will return to the city which is their normal base and will be well prepared to handle that airplane as it serves their city. In addition we now have some 500 to 600 mechanics scattered throughout our cities who have taught in a new aircraft training program.

Participation by aircraft mechanics in this type of training program has career benefits. Such participation allows others to see that one has the initiative and talent to succeed in management. This is a chance to be seen by higher management. Many of our current managers and general managers, including the current Vice President of Maintenance, served in this program at an earlier time.

At this time we are placing emphasis on avionics training for mechanics in line maintenance. To provide a sound basis for our avionics work, A&P mechanics are not allowed to transfer into line maintenance without a minimum of 750 hours of electrical and electronics study. Most A&P technical schools devote about 300 hours to these topics. This means that mechanics, on their own, must obtain about another 450 hours of study covering topics such as AC and DC circuits, linear devices, digital systems, microprocessors, and electronic troubleshooting. With this background, a mechanic can now be taught avionics, which is our responsibility. This program, which we feel is working well even though it is new, gives the technician sufficient electronic knowledge so that he can learn avionics skills and be confident and prepared when an advanced aircraft such as the Boeing 757 or 767 rolls up to the gate.

Job Security

An indispensable element in workforce productivity is a feeling of job security on the part of employees. At Delta, we do a number of things to produce this sense of security. Most important is the fact that in its 61 year history the airline has never laid off a mechanic. This was true even during the time of the 1974 oil embargo when we were forced to reduce our flying by 20 percent because we faced a comparable cut back in aviation fuel. Even though we grounded part of our fleet, we did not lay off a single mechanic. In fact, we did not lay off any employees. True, many of these employees had to work at different jobs during these difficult times, but they all kept their jobs. The sense of security they now possess certainly is grounded in historical precedent.

Another dimension of job security is the belief by employees that they will not be subject to arbitrary action by management. In our system, only the Senior Vice President of Personnel has the authority to fire an employee. Foremen cannot do it; even the Vice President of Maintenance cannot do it. In the event of a problem an employee can be suspended and action initiated that might ultimately lead to termination. However, termination itself, whether for mechanic or pilot, must be approved at the Senior Vice President level.

When we have an employee with disciplinary problems, we deal with the issue first through a counseling program designed to encourage him/her to overcome their problems. If this does not appear to work, a letter is sent that discusses the problem and the need for immediate improvement in work. The last step is to put the employee on probation. If this step is not successful, then action leading to ultimate termination is started. However, as you can see, every possible opportunity is given an employee to improve before disciplinary action is taken. Employees have no fear of abrupt and arbitrary action.

The relationship of employees to management is supported by an "open door" policy. An employee who is unhappy about something and wants to discuss it can talk to anyone in the company. Indeed, employees are encouraged to do this. If a mechanic has a problem, we try to have him work it out with the supervisor first. If this doesn't work, the employee is free to take the discussion to the next highest level or, ultimately, to the level he feels necessary. In practice, our open door policy works and is a useful system for maintaining high employee morale.

Summary

Many variables contribute to an effective maintenance workforce. I have described those that Delta Airlines considers particularly important. All of these variables are structured to create a climate of approval. We want employees with positive attitudes who feel good about themselves and their work. Creating this climate of approval, with the positive attitudes that result, is most important in developing and maintaining an effective maintenance workforce with a high level of productivity.

PROFESSIONALISM FOR AVIATION MAINTENANCE?

William O'Brien
General Aviation Staff
Federal Aviation Administration

Good afternoon. I would like to ask two "questions" on the very important subject of "Professionalism and the Aviation Maintenance Industry."

I raise these questions not as a representative of the Federal Aviation Administration, but as an airframe and powerplant mechanic with 23 years of experience. Hopefully exploring solutions to these questions during our time here today will give us something to think about and maybe, just maybe, offer a new course of action.

The first question is:

> *Should the aviation maintenance occupation be considered as a "Professional" career field by the United States Government, the aviation industry, and the flying public?*

Before I answer, let's look at the word "Professional." The word has more "feeling" to it than substance, and I bet everyone here can give me their definition of the word.

As a mechanic I always thought I knew what it meant to be an aviation maintenance "professional."

In the 1960's I thought to be a professional mechanic you had to be so good at what you did that other people knew it. They, your peers, told you that you were professional!

In the lean years of the 1970's, to be a professional in aircraft maintenance meant that if you had a full time job, your paycheck told you that you were professional.

In the 80's I thought that if you worked for the Government, carried a briefcase to the office, did inspections on air carriers and repair stations, and drove a Government car, the kind of job you had told you that you were professional! I was wrong ..... for twenty years.

To find the right answer I tried to look at this question of professionalism objectively. I started by examining the "root" of the word professionalism which is Professional.

Webster's New World Dictionary defines the word "Professional" as "one who is engaged in, or worthy of, the high standards of a profession."

For me to understand this definition a little bit better, I next looked up the definition of the words "Standard" and "Profession."

Webster's definition of the word "Standard" means: Standard: applies to some measure or principle which things of the same class are compared in order to determine their quality or value.

Webster's defines the word "Profession" as a vocation or occupation requiring advanced education and training and involving intellectual skills such as medicine, law, theology, engineering, teaching, etc.

We now have a framework by which to judge if the aviation maintenance community should be recognized as a "professional" career field.

Being Irish, I often work backwards to solve a problem so I would like to examine the last definition first, by asking: Can the aviation mechanic's duties and responsibilities meet the Webster's definition of the word "profession?"

I think I can get you all to agree that an aviation maintenance career can meet the first part of the definition for profession ... Can it be called an occupation? ---- Occupation is something that occupies someone's time. Yes, I think most aircraft owners and operators would definitely say that aviation maintenance occupies someone's time. The maintenance bill for their aircraft can be submitted as proof.

The next part of the definition for Profession is: vocation requiring advance education, training, and involving intellectual skills such as medicine, law, engineering, teaching, etc.

I am sure all of us here would agree that professional occupations such as doctors, lawyers, and engineers require a college degree. And all of us would have to agree that a college degree is universally considered as evidence of receiving advanced training.

Since many aviation mechanics do not have a college education, this seems to forever ban all aviation mechanics from being recognized as a true professional according to our definition of the term.

Not so. The definition of the word "profession" speaks only to "advance education or training." This does not necessarily mean that it must be from a college or university. However, since a college degree is the "professional norm," then to be fair and objective we should make any comparisons of the number of hours of training in non-college training to the number of hours of training received in a college or university.

Let's begin by examining the number of hours needed to graduate from a four year college. The average number of credit hours for a college degree program is 126. This means a student must attend 42-three credit hour classes. With 40 hours of instruction per class times 42 classes, a college student must complete a total classroom instructional time of 1,680 hours in order to graduate.

A student in an FAA Part 147 Aviation Maintenance Technician school must complete a minimum of 1,900 hours of instruction covering 41 highly technical subject areas. The average Part 147 school schedule is 2,200 hours, enough time for a master's degree.

If an applicant wanted to take the FAA mechanic examination for airframe and powerplant based on "practical experience" he or she would have to show an FAA Safety Inspector a minimum total of 4,800 hours working on airframes and powerplants. In both cases, Part 147 qualified and practical experience qualified, the applicant must pass three written tests. Once the tests are successfully passed the applicant must take the oral and practical tests. These O&P tests usually take two eight-hour days to complete.

I am sure my explanation will satisfy anyone's doubts that the advance education and training requirements the FAA demands of mechanic applicants compare favorably with those requirements for a four year college degree and therefore satisfy the advance education and training requirements in the definition of the word "profession."

Some would argue that doctors, lawyers, engineers, and teachers must pass State Boards to be accredited. True. But applicants for the FAA mechanic certificates must pass Federal examinations. And when they pass, they are issued a mechanic **certificate.**

Now let's look at the definition of the first word, "Standards," which applies to some measure or principle which things of the same class are compared in order to determine their quality or value.

The Federal Aviation Administration sets the standards for mechanics in two Federal Aviation Regulation (FAR) Parts. FAR Part 65 sets the standards for mechanic certification, and their duties and responsibilities. FAR Part 43 sets the standards of performance to which a mechanic must perform those duties.

Therefore -- Do you agree that 60,000+ active aviation mechanics should be recognized as a professional "individuals" by the United States Government, the aviation industry and the public?

Do you agree?....I don't! I do not agree because aviation mechanics do not meet all the requirements to qualify to be called a professional according to the definitions in Webster's New World Dictionary.

The definition for professional states that one who is engaged in, or worthy of the "high" standards of a profession.

Is aviation maintenance career a profession ----- yes! Is aviation maintenance "professional" .... no! Because there are not high standards to be met!

The Federal Aviation Administration by the Federal Aviation Act of 1958 is empowered by law to set only minimum standards. All 50 states set minimum standards for doctors, lawyers, engineers, and teachers. Why are these occupations considered a professional career field and not us? Because these career fields are supported by state and national organizations that set "high standards" for their members.

Sadly, in the last 64 years of United States civilian aviation, there is no recognized national aviation maintenance organization that has set the higher standards or provided a means to meet those standards.

To present this paper has not been easy for me. Remember, I am an airframe and powerplant mechanic. I apologize if I have offended any of the thousands of "professional aviation mechanics" whose own individual high standards of conduct are above reproach. But I gave you the facts as I see them.

Now it is time for my second question:

Do you really want to raise the standards for the maintenance profession to a professional level?

Do you want to put in the time, the money, the sweat and tears to change the status of mechanics from semi-skilled to professional?

If you do, may I offer you some recommendations.

1. First, create a National Organization to set professional standards and to develop procedures for aviation technicians to meet those standards. This organization must be recognized by the Government and supported, but not controlled by, all segments of the aviation industry.

Why? Individual maintenance industry representatives and organizations rarely talk to one another because each tends to focus on a narrow segment of the maintenance community. A national organization will provide the means to bring many groups together for a common goal.

2. Delete the 18 month and 30 month practical experience requirement for the airframe and powerplant mechanic's rating from FAR Part 65.77 experience requirements. This will make a graduation certificate from an approved school the only requirement to take the mechanic's examination. Classroom training in all 41 aviation subject areas will ensure the same minimum standard for all new mechanics.

Why? Twenty years ago the military was supplying the civilian sector with mechanics who had a background in all types of aviation maintenance. In the last 10 years the trend in the military has been to limit training by having the soldier, sailor or airman specialize in one or two subject areas.

When these individuals leave the military their overall level of aviation knowledge is small. Most are married with a family and they need a job immediately so they apply for an FAA mechanic certificate based on their military occupational specialty (MOS). The FAA signs them off to take the mechanic's test based on the MOS Codes and the DD 214 forms. These forms and codes are vague and hard to verify because the applicant's supervisor usually has been transferred to some other base. We have to trust them when they say they worked the required time in the MOS. Some have lied to us.

Yes, these same individuals still have to take the FAA test. That creates no great barrier. There are many diploma mill schools in Tennessee, Texas, and California that, for a fee, will "guarantee" that you will have your mechanic certificate in a week or your money back. They can boldly make that guarantee because they teach the test question by question, courtesy of the Freedom of Information Act.

After passing the FAA written exams the diploma mill students seek out "easy" mechanic examiners who will issue a mechanic certificate and enter the system the next day. By removing the practical experience requirements this will remove any chance safety will be compromised and the standard will be raised.

3. Raise the standard level of math and reading skill requirements at all FAA Part 147 Aviation Technician Schools.

Why? Air carriers tell me that they must rewrite the aircraft maintenance manuals to a 9th and 10th grade level so the mechanics can understand how to perform a task.

A strong math background is essential for the understanding of electronics, and electronics is now the name of the game in aviation.

4. Retire the word "Mechanic" with honor.

Why? In your mind's eye give me a one word description of the word "mechanic." Instead of professional, able, smart, and capable, I bet the majority of you thought of these words first: dirty, greasy, or dumb. Since the word has such negative connotations, especially when dealing with the younger generation, I recommend that we change it to Aircraft Technician. This more professional sounding term will attract the students now in primary and secondary schools to our profession.

5. Have the industry support Part 147 schools with resources, grants, and by providing instructors to raise the teaching standards.

Why? Because the aviation industry, and the air carriers in particular, should be no less responsible than the rest of private industry.

It is common practice for large and small corporations to supply grants, low cost loans, resources, and even instructors to colleges that supply those same industries with good employees.

The aviation industry must realize that the path to a professional workforce starts in a classroom!

6. The FAA should increase the level of difficulty of the Aviation Technician examination over the next five years.

Why? Because this will force the Part 147 schools to teach the required subjects to a higher knowledge level, to a higher standard, which in turn will produce a better employee for the workforce.

7. Make recurrent training an integral part of the aviation technician career field, and then show recognition for that training.

Why? The Federal Aviation Administration is presently involved in a five year maintenance training program called Airworthiness Management. This program will produce 10 programs, two a year, over the next five years. The programs will cover subjects from regulations to non-destructive inspection. The goal of the program is designed to change attitudes about recurrent training.

The FAA is presently surveying the industry to see if a maintenance proficient award program is needed and wanted by the industry.

The awards program is not designed to be a give-away program. Each mechanic, repairman or student must meet certain "standards."

In closing, I would be most interested in hearing your comments or suggestions on how to raise the aviation mechanic's trade to qualify as a professional occupation. I would also like to leave you with my 1990's definition of the word professionalism: Professionalism is an attitude that affects one's behavior in a positive way. I hope that my attitude about creating higher standards for mechanics will affect your behavior towards this most important enterprise in a positive way.

TRAINING ESTABLISHMENT PERSPECTIVE

Richard Ulm Department
Chairman Aviation Maintenance Technology
Embry-Riddle Aeronautical University

The training of aviation maintenance technicians has changed a great deal over the past 30 to 35 years. Aircraft today are quite different and new skills are required of those performing the necessary maintenance. Those of us who are managers of training facilities must see that maintenance technicians can meet the challenges presented by today's aircraft, both the new aircraft coming on-line and the older aircraft being retained in service.

Technician training schools represent the first step in shaping tomorrow's maintenance workforce. We generally have the first opportunity to build the skills needed by an aviation maintenance technician. To illustrate the manner in which we meet our responsibilities, I would like to briefly describe the program and facilities at Embry-Riddle Aeronautical University.

Embry-Riddle is a university in the full sense, covering many fields within aeronautics. Maintenance training is a major specialty in the university. The aviation maintenance training facility is located close to the flight ramp and includes about nine classrooms and eight laboratories, including an engine repair station. We have a separate hangar in which to conduct training and aircraft maintenance, and a separate turbine engine test cell.

Other programs within the university include aerospace engineering, management sciences, and computer science. In maintenance, we have some different goals and motivations that perhaps in some ways set us apart from the other schools. I will describe these as we go along.

The principal goal of our training program at Embry-Riddle is to "train and educate the future leaders and managers in the aerospace maintenance industry." In our Aviation Maintenance Technology program, the core curriculum qualifies an individual for his/her airframe and powerplant license. After this qualification, a student can proceed into a number of other programs, as follows:

- **Associate in Aviation Maintenance Technology.** This is the minimum degree program and requires 72 credit hours.
- **Associate in Science in Aircraft Maintenance.** Requires 93 credit hours.
- **Bachelor of Science in Aviation Maintenance Management.** Requires 150 credit hours.
- **Bachelor of Science in Aviation Technology.** Requires 145 credit hours and can be oriented either toward flight activities or avionics.

We feel that our avionics program leading to the Bachelor of Science degree in Aviation Technology is possibly tops in the industry and find that our graduates are in great demand.

Table 1 shows the curriculum for the Associate Degree program which provides the airframe and powerplant certificate. Within this program are a number of academic courses such as college level math, English, speech, computer programming, and history. Notice that there is very little left in the curriculum devoted to wood, dope, and fabric materials. Now our attention is turning to composites.

Table 1

Aviation Maintenance Technology

Associate Degree Requirements

Semester	Course Number/Title	Credits
FIRST	(General Aeronautics)	
	AMT 101 Applied Science for Aerospace Technicians	2
	AMT102 Aviation Regulations, Records & Documents	2
	AMT 103 Basic Electricity	3
	AMT 104 Aircraft Servicing Procedures	2
	AMT 105 Aviation Material	3
	HU 122 English Composition and Literature I	3
		15
SECOND	(Airframe I)	
	AMT 201 Aircraft Structures & Sheet Metal Fabrication	4
	AMT 202 Nonmetallic Structures	2
	AMT 205 Aircraft Electrical Systems	4
	AMT 206 Hydraulic & Pneumatic Systems	2
	MA 111 College Math for Aviation I	3
		15

THIRD (Airfame II)

AMT 203 Aircraaft Instruments & Communication/Navigation Systems 2

AMT 204 Aircraft Welding, Assembly & Rigging 4

AMT 207 Aircraft Environmental & Fuel Systems 3

AMT 208 Aircraft Landing Gear Systems 3

HU 219 Speech II 3

15

FOURTH (Powerplant I)

AMT 209 Aircraft Reciprocating Engines 3

AMT 210 Aircraft Powerplant Systems 3

AMT 211 Engine Electrical & Ignition Systems 3

AMT 212 Propellers & Propeller Systems 3

CS 109 Introduction to Computer Programming w/BASIC 3

15

FIFTH (Powerplant II)

AMT 213 Engine Installation & Operation 2

AMT 214 Reciprocating Engine Overhaul 4

AMT 215 Turbine Engines & Turbine Engine Systems 6

SS 110 World History OR

SS 120 American History 3

15

TOTAL 75

Other course work is offered to supplement the basic A&P program. For example, we offer 40 hours of training in working with composite materials. We also offer programs in propeller repair and in non-destructive inspection.

To ensure that every student is given every chance to succeed, we offer a number of remedial courses. These are developmental courses to provide basic skills in math, reading, and writing. Attendance in these courses may cause a student to be in school for another semester, making the program six semesters or two years of full-time study. This program would be over 2200 hours.

The Associate in Science degree offers extended academic study, including coursework in economics, physics, management science, and statistics. This program meets requirements for the College of Continuing Education through which Embry-Riddle provides training on a world-wide basis. Many enlisted military technicians begin their training at Embry-Riddle in this manner. They receive an Associate in Science degree which transfers directly to the Bachelor of Science programs if these students elect to continue directly at Embry-Riddle.

We also have a degree program in Aviation Maintenance Management. An individual who earns his A&P certificate can continue in this program and obtain a degree in Aviation Maintenance Management. The coursework is business oriented with an additional aviation maintenance course required on issues of reliability and maintainability. Many students who have completed this program now work for manufacturers in the fields of product support, reliability, and maintainability.

The program of which we are particularly proud is in avionics. The degree conferred is the Bachelor of Science in Aviation Technology. To complete this degree, a student must complete a core program and options in avionics, flight, or maintenance. Table 2 presents the full curriculum for the Aviation Technology program with the avionics option. This table illustrates the comprehensiveness of this program. For example, mathematics training is required to the level of calculus and differential equations. A student who completes this program is very well prepared and can expect a good position in industry.

Table 2

Aviation Technology*

Bachelor of Science Degree Requirements

Semester	Course Number/Title	Credits
FIRST	AMT 101 Physical Mathematics	2
	AMT 102 Aviation Regulations, Records and Documents	2
	AMT 103 Basic Electricity	3
	AMT 104 Aircraft Servicing Procedures	2
	AMT 105 Aviation Material	3
	MA 241 Calculus & Analytical Geometry I	4
		16
SECOND	AMT201 Aircraft Structures & Sheet	

Metal Fabrication 4

AMT 202 Aircraft Wood, Fabric & Finishes 2

AMT 205 Aircraft Electrical Systems 4

AMT 206 Hydraulic & Pneumatic Systems 2

MA 242 Calculus & Analytical Geometry II 4

16

THIRD AMT 203 Aircraft Instruments & Communication/Navigation Systems 2

AMT 204 Aircraft Welding, Assembly & Rigging 4

AMT 207 Aircraft Environmental and Fuel Systems 3

AMT 208 Aircraft Landing Gear Systems 3

HU 122 English Composition & Lit I 3

15

FOURTH AMT 209 Aircraft Reciprocating Engines 3

AMT 210 Aircraft Powerplant Systems 3

AMT 211 Engine Electrical & Ignition Systems 3

AMT 212 Propellers and Propeller Systems 3

CS 210 Scientific Programming 3

15

FIFTH AMT 213 Engine Installation & Operation 2

AMT 214 Reciprocating Engine Overhaul 4

AMT 215 Turbine Engines & Turbine Engine Systems 6

PS 103 Technical Physics 3

HU 123 English Composition & Lit II 3

18

SIXTH EL 106 Direct & Alternating Current Fundamentals & Circuit Analysis 6
MA 245 Applied Technical Mathmatics 3
ET 101 Engineering Graphics 2
PS 101 Basic Chemistry 3
PS 104 Technical Physics 3
17

SEVENTH EL 220 Introduction to Pulse & Digital Circuits w/Lab 4
EL 223 Solid State Fundamentals & Circuit Analysis w/Lab 6
HU 221 Technical Report Writing 3
SS 220 Introduction to Psychology 3
16

EIGHTH EL 225 Advanced Digital Circuits & Systems w/Lab 4
EL 226 Electronic Systems Analysis w/Lab 5
EC 200 An Economic Survey 3
HU 219 Speech 3
HU/SS Elective (300-400 Level) 3
18

NINTH EL 230 Microprocessor Systems w/Lab 3
AV 305 Aircraft Communications and Landing Systems 3
AV 309 Aircraft Pulse Systems 3
AV 339 Avionics Equipment Trouble-shooting & Repair Lab 2
HU 330 Values and Ethics 3

Open Elective (300-400 Level) 3

17

TENTH AV 318 Low Frequency & Area Navigational Systems 3

AV 320 Aircraft Surveillance Systems 3

AV 324 Avionics System Integration & Flight Control 3

AV 325 Long Range Navigation Systems 3

AV 341 Advanced Avionics Equipment Troubleshooting & Repair Lab 2

14

TOTAL 162

**Type 147 AMT/Avionics*

Approximately 350 students complete the Aviation Maintenance Technician program each year. About 60 percent of these continue on in the four-year academic programs. The placement rate for those graduating from all of our degree programs is quite high, almost 100 percent. As noted earlier, there is a particular demand for those who have completed the avionics program. These are highly qualified people and are sought by a number of industries.

Problems

The training establishment faces a number of problems as it tries to provide qualified personnel to support the maintenance requirements of the aviation industry. From my vantage point, the most important of these problems include:

1. **Number of Applicants.** The enrollment in the maintenance programs at Embry-Riddle ten years ago was over 1,000 students. At the present time, we have about 600 students in the different programs. The majority of these are in four-year programs. Our Avionics program is underutilized, having no more than 25 students. You would think that the prospect of a $40,000 job in a short period of time would entice a number of qualified people for programs such as this. Many reasons can be put forth to explain the lack of qualified applicants. One reason certainly rests with industry advertising. We do not do a proper job of telling the rest of the world what's available in aviation maintenance as a career. Also, our academic standards may preclude some people from applying. These standards, however, are an indispensable part of our training effort. We have a 25 percent failure rate in our A&P program. This is atrocious. The basic reason rests with the quality of the applicants for the program. Even though these applicants may be graduates of high school, reading and math skills may be very poor. They cannot read and write at the eighth grade level and this presents a problem for us. We need applicants who have better training in math and science. Until this occurs, attrition will remain a problem. To help students with poor qualifications, we offer a number of remedial courses. Although the intent is good, the results often are not. If a student fails a remedial course twice, he/she must leave the university. This is happening more and more often. Embry-Riddle is considering arranging a program with a community college or a high school to provide additional training in the basic skills. Other high tech industries, also seeking qualified applicants, are doing the same thing. We all are facing a common problem.

2. **Training Materials.** Much of our training materials and training equipment is not appropriate for the high technology world into which a graduate will enter. We want to train people for the equipment that is in the real world. There are many difficulties in doing this. At Embry-Riddle, we do receive some donations of equipment, which can be used for training purposes, from the air carriers. For instance, Boeing donated a 747-400 tape to us, which represents about $1 million worth of software. We also have a Computer-Based Training laboratory which will be of greater and greater value in the future. Nonetheless, our equipment, training materials, courseware and instructor training do not remain apace with industry advances. Industry needs to help with this problem. What about training equipment grants from industry? What about stipends from industry for faculty training? There is precedence for such industry support. For example, the Daytona Beach Community College has a Nissan-supported technician training program which provide automobiles, test equipment, and trained instructors. While we cannot duplicate this approach in 170 technical training programs for aviation maintenance, the industry could do better than is being done now.

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A short video presentation was made at this point to illustrate the equipment currently available at Embry-Riddle Aeronautical University. _____

3. **Regulations for AMT Schools.** The revision of Part 147 of the Federal Aviation Regulations will be completed shortly. This is positive and a genuine step forward. However, there is more to be done. For instance, performance objectives in Part 147 are rather vague. Perhaps the FAA should support another study similar to one done a number of years ago by Dr. Allen in which he documented maintenance performance requirements. A task analysis is needed that will show exactly what a maintenance technician does on the ramp, in the shop, and elsewhere. Training schools then can structure their training programs with more specificity in terms of objectives and of training materials required.

Approximately 20 years passed before the current Part 147 revision was accomplished. This is too long. We need some kind of flexibility within Part 147 that would allow us to review it and make changes to it on a more frequent basis. Only by doing so will we be able to keep up with changing industry technology.

4. **Training Costs.** The training establishment needs to provide more electronics training, more material sciences training, more exposure to NDI, and more work with composite materials. All of this is costly. Perhaps I am talking a semester of additional training. The cost for this might be about $5,000. We realize that the technician needs to know more. The question is "How much more will he be willing to pay?" Should the student pay these costs? Or should the aviation industry view this as the price they must pay for better qualifications and improved performance on the part of technicians provided by the training industry?

5. **Training Standards.** Standards for the training of maintenance technicians must be kept high. A few years ago, American colleges raised academic standards for student athletes. While there were a number of complaints at first, the standards remained and schools adjusted to these higher standards. All of this was for the betterment of sports. As standards are maintained and possibly adjusted upward in maintenance training, it will be for the betterment of our industry. Whatever the problems, we must provide a quality product.

The above problems will not be solved easily or rapidly. We must recognize their existence, however, if we are to develop programs to improve the training of aviation maintenance technicians so that such training keeps pace with the growing requirements and changing technologies in the air carrier industry.

MAJOR AIR CARRIER PRACTICES

Richard Yeatter
Director of Maintenance Training
USAir

Topics within this address deal with issues of recruiting, training, and, in general, the sustenance of the maintenance workforce. These are topics, when discussed, that provide many questions and few answers. Other carriers, the manufacturers, and the FAA see workforce recruiting and training as difficult matters.

Before addressing specific topics in maintenance, we should pause to recognize that our industry reflects the forefront of man's technological achievements. In few other industries have we seen the rapid growth and advancement that we see in aviation. The automation found in today's aviation is required for man to cope safely with the complexities of the aircraft and support systems that we as an industry have produced. This never ending technology process that we conceived, designed, and produce and operate has provided the unique and wonderful world of high speed transportation visible only in man's imagination just a few years ago. However, as this technology advances, the maintenance workforce has inherited a task that grows constantly more complex and difficult. Nonetheless, the mechanic or aircraft technician must function to maintain and support today's new technology aircraft in an effective and efficient way.

Workforce Recruitment

Issues of workforce recruiting and training parallel the advancing technology of our industry. The important matter for maintenance production is a qualified applicant. As we all know, such individuals are harder to find since the World War II generation of aviation maintenance technicians. As we proceeded from the 1950's through the first part of the 1980's, there was a surplus of applicants. At that time, these people required less preparation and training to be effective as maintainers of aircraft fleet types that were less complex than those today. Now, the surplus of technicians is gone and the aircraft are more complex. This means higher training costs and more programs for the airlines to prepare technicians. Schools and colleges both find it difficult to purchase necessary costly training equipment. Faced witht his more complex and expensive environment, what can we do to ensure an adequate supply of skilled technicians?

The first thing we must do is face up to this new technology so that we can increase our productivity. There are a number of things that can be done. One of the first issues we address when we acquire a technician is to ensure that we know what we have. As part of our workforce recruitment program, we now have a formal verification program for licenses, certificates, previous training experience, work history, education, reference checks and even the existence of criminal records. Drugs and drug testing now represent a real world item and must be considered.

Equal employment opportunity and minority and affirmative action programs require compliance. At USAir, we have a process where all available in-house jobs are posted on the Career Opportunity Bulletin circulated through the company. All qualified individuals then have an opportunity to bid on these positions. At the same time, we do U.S. Department of Labor listings, classified ads, inquiries of recruiting services, minority group agencies, and finally we encourage minority employees to refer other qualified applicants.

As we move to a more diverse workforce and acquire aircraft of foreign manufacture, language barriers present daily problems. We have language barriers between different cultures. We also have language issues in dealing with foreign countries. Aircraft and their supporting manuals produced by and purchased from foreign manufacturers bring semantics, intent, and translation considerations. Finally, we have new technical languages and jargon to surmount. A mechanic must learn new acronyms to understand maintenance concepts and to perform new maintenance tasks. Bite checks, TCAs, DADCs, FCCs are part of a new language that grows daily.

Workforce Retention

Once a qualified and effective maintenance workforce has been developed, a company certainly wants to retain it. At this time, at least at USAir, workforce retention is not a difficult problem. We are losing very few of our maintenance workforce. However, this does not mean that workforce retention should not receive appropriate attention.

To foster retention, USAir provides opportunities for inhouse advancement. Many of our mechanics come from Embry-Riddle and other colleges with educational degrees. They would like to advance into management positions. Opportunities for advancement are announced on the Career Opportunity Bulletion. Avenues include progress into technical specialist areas and supervisory categories. Within the past year, about six employees from the Training Department have moved up the career ladder into other positions. One now has become Director of Aircraft Records.

Another factor in retention is maintaining competitive salaries and benefits. While USAir might not be at the top it is certainly right in the top level. We must be certain that we offer all employee benefits that other carriers have. In the future, more companies must realize that in order to be competitive as a company they will have to offer competitive salaries for all employees in skilled areas.

New Initiatives

Under the general topic of "workforce sustenance," I would like to describe a number of new initiatives undertaken by USAir. Recently, as we all know, our industry has come upon slower times as a result of the mid-east crisis, rising fuel costs, and consequently fewer passengers flying. While cutbacks were required in some areas, USAir made no cutbacks in maintenance. One reason, of course, is that if orders for new airplanes are reduced, older airplanes take on more of the work. With older 727's and 737's, it has been necessary to add maintenance tracks in order to keep these airplanes in service. This is encouraging in that, even in slow times, there is still brisk employment for maintenance personnel. However, even with steady employment, we feel new initiatives are required to sustain workforce effectiveness.

An important initiative we have taken is the establishment of management/employee question and answer sessions. Whenever there is a slow down period or a cutback in any part of an organization, employees need to be reassured that their jobs are safe and the company's future is secure. Senior vice presidents have been meeting with employees in these question and answer sessions and, where possible, providing answers during the session. If an answer cannot be given then, it is provided as soon as possible after the session.

The preparation of a monthly newsletter for each major department, such as Customer Services, Flight Attendant Services, and Maintenance, represents another initiative. Coverage in these newsletters is organized largely around personal achievement and recognition of employees within the department. This is part of our program of recognizing that these people are individuals and need to be treated as such. In the newsletter, we let one's fellow employees know good things about individual employees.

In an attempt to promote intra-company communications, we are promoting weekly staff and crew meetings. As has been noted, many time upper management has information which is transferred between companies but is not sent down to lower levels within the company. Everyone is busy and frequently simply does not get around to providing information to employees as they should. We are working hard to improve these management/ employee communications.

We also maintain an Employee Hotline which an employee can use to ask a question or give a suggestion. One person answers these calls, fills out appropriate forms, and then sends the information to the proper department. In Maintenance, I receive two or three of these a week. I must have an answer back to the employee within 15 days. This system seems to be functioning well and is letting employees get answers for questions that can't be answered at their own supervisory level.

Problems

There are many problems which arise each day in a maintenance department. While most of the problems are local, a few stand out as having industry-wide application. However, it is worth noting that a new program instituted by the FAA is helping us to reduce the number of our problems. I am referring to the FAA Self Disclosure Program.

In earlier days, if the FAA conducted an audit of an airline's operations to determine if the airline were in compliance with procedures specified in operating and maintenance manuals, a negative finding could be very expensive. In fact, every leg of a flight operated with an airplane that was not in compliance could cost about $10,000. This expense was an inducement to hide problems rather than acknowledge them.

The FAA's Self Disclosure Program puts audit responsibility on the carrier. The carrier, using a specialized audit team, reviews each functional area described in the aircraft manual, develops a set of findings, and reports these findings to upper management. If, for example, it is found that an AD was missed, the carrier can report this to the FAA and the local Principal Maintenance Inspector (PMI) will deal with it. If he determines the airline has complied at this time with the necessary requirements, and systematic changes have been made to ensure the problem does not recur, the PMI can decide no further action is required. Under this system, people are considerably more willing to come forward and point out potential problem areas. The system also supports an improved working relationship with the FAA.

There are four specific problem areas worthy of mention. These are:

1. **AD's, the "fix all."** Immediately following every major aircraft incident or accident, or so it appears to those of us in industry, an Airworthiness Directive (AD) is issued to fix the problem. When an unfortunate event does happen, everyone recognizes that there is considerable pressure to do something immediately. This pressure comes from Congress, from the news media, and from many other sources.

   The pressures following an aircraft incident or accident are difficult to resist. However, I feel that a better plan would be to slow down enough that proper inputs could be obtained from the regulatory agency, the manufacturers, the operators, and anyone else involved so that the ultimate solution uses a better thinking process. At this time, some solutions imposed are so unrealistic that no one can comply with them. A good example is found in the requirement for portable personal breathing equipment (PPBEs). The AD gave a date by which we had to have this equipment. The problem was that no one could buy it. Manufacturers could not manufacture enough systems by the mandated date. Therefore we could not be in compliance. Again, I feel we need more time to perform proper front end analyses and to develop better solutions that will deal with the problem effectively and, at the same time, not impose unrealistic burdens on our industry.

2. **Training inconsistencies.** Defining training requirements for different aviation activities can be a difficult task and often is not done with any consistency across operators. For example, if our marketing people decide we should begin flight operations across any of the oceans, we need to obtain ETOPS (extended twin-engine over water operations) from the FAA. Training requirements for ETOPS are significant and, we feel, frequently are measured by the pound, the height, or the month. This, I feel, is not the way to do it. I do not believe we can maintain an aircraft in a safe ETOPS condition as determined by the number of days we are going to spend in training. Also, the volume of training documentation, which can be considerable, does not necessarily ensure a safe aircraft. The bottom line is that we need to seek task-oriented, competency-based solutions that can be consistently applied in areas such as ETOPS. The weight of the training manuals, or the height of the stack of manuals, is not a sufficient indication of adequacy of training.

3. **Manufacturing design improvements.** Those of us in maintenance would be appreciative if the designers of space-age aircraft being designed and manufactured today would give more thought to the fact that these machines do some time break and do need components changed. Perhaps they could be designed so that components could be changed more easily. For example, for a DC-9, built in 1965, we can change an engine, run up the new engine, and have the airplane back on line in eight hours. With a modern, state-of-the-art 767, the same engine change takes two eight hour shifts. So, what has high technology done for us here? It has doubled the down time to get that airplane back on line for revenue service.

The above example illustrates the increasing work requirements faced by maintenance technicians as they move to more advanced aircraft. If maintainability could be given a higher priority during initial aircraft design, this might not be the case. Both maintenance personnel and the airlines would benefit.

4. **Communication and cooperation.** The matter of communication and cooperation in our industry, while probably not viewed as a major problem, certainly remains as an issue where we should work together. Meetings such as this, plus those held by PAMA and the ATA, are working toward a common cause and are drawing needed attention to problems in air carrier maintenance. I would like to see even more representatives of the airline operators; the manufacturers of airframes, engines, and components; training institutions; and anyone else interested in this field to get involved. I think the communication and cooperation brought about through these meetings will lead to better maintenance and improved industry productivity.

INDUSTRY AND SCHOOL COOPERATION FOR MAINTENANCE TRAINING

John Harle
Maintenance Training Group
Boeing Commercial Airplanes

The Boeing Company and the North Shore Community recently entered into a partnership program designed to encourage young people to enter the aviation industry. We are trying to build an awareness in these people of the opportunities that exist in aviation. The Boeing program completed a five month pilot effort in the Spring of 1990. On the basis of this pilot program, we can begin to look at strong and weak points as well as the potential of the program for accomplishing its objectives.

The impetus for our program, which we named "Look to the Sky," comes from growing concern over a possible shortage of maintenance technicians in the immediate future. We have heard discussions on both sides of this issue. Some say there will be a shortage. Some say there will not. The problem we are having concerns the basic capabilities of entry-level personnel. They do not have the desired skill levels in math, science, and English. As a basis for our program, we then developed the following problem statement:

> The predicted decline in the technical ability of the American workforce could dramatically affect the aerospace industry in the next 10 to 15 years. To assist in filling the ever growing need for technicians, engineers, and pilots, business and the education community will have to work closely to generate interest in these declining career fields.

The pilot program focused on students at the North Shore Junior High School. We considered working at the elementary school level but decided that some students at that level might not be ready for the program as it was to be presented. Also, if we went to the high school level, we felt that our program might be too late to be effective in guiding these students toward aviation careers. The final event that caused us to choose a junior high school occurred when two teachers from North Shore Junior High School approached us independently and asked if we might be interested in working with them to show their students the careers that are available in aviation.

As we began to prepare our program, we elaborated on our basic goal and developed a listing of program goals. These goals were to:

- Offer opportunities for exploration of aviation fields.
- Encourage emphasis of math, science, and motor skills.
- Stimulate student long-term goals.

- Reduce student drop-out rate.

It is one thing to encourage people; it is another to create opportunities for them. In the past, some have said that the Boeing Company, if it identifies a problem in the local community, will simply give a certain amount of money toward a solution and then walk away. We decided this would not be the case with our program. For example, in addition to encouraging students, we wanted to stimulate the development of long-term goals by showing specific opportunities in aviation, and in maintenance, toward which these goals would lead. The objective was to show students that they can be successful in an aviation career and to illustrate this with specific opportunities.

Having identified a problem, established a target population with which to work, and formulated a finite set of goals, the next step was to consider the structure of the effort. To begin, we decided this definitely would not be an in-out, quick-fix program. This would represent a long-term commitment. The problem we are addressing is difficult and any program to bring about improvement must be administered over a considerable period of time.

As a first step, the Boeing employees toured the North Shore Junior High School and examined classroom facilities that might be used. Next, school staff members were taken on a tour of Boeing Customer Training in order to provide them with a better understanding of Boeing's resources. After these tours, we held a two-day "Team Building" seminar. The purpose of this two-day workshop was to develop a number of activities designed to increase the students' level of comprehension of present day aviation.

The program was split into two parts. These were (1) student tours and (2) student support activities. In the student tours, we attempted to provide genuine insight into aviation at the hands-on level. We wanted students to see what life was like in the noise, feel, and smell around a hangar environment. Student tours lasted for a number of hours and covered many aspects of aviation, including a visit to the factory line where the Boeing 767 and 747 aircraft are assembled. The full list of facilities in the tours included:

- Boeing Customer Training facility
- Alaska Airlines maintenance facility
- Boeing Everett factory
- Boeing Paine Field
- Sea TAC Airport

The second part of our joint program included student support activities and resources. In our pilot program, not every feature of student support could be exploited fully. However, the following listing of the major components within student support shows the scope of the program as we ultimately envision it. Student support includes:

- Career presentations to student classes
- Boeing participation in Aviation Club activities
- Material support
- Aerospace Club support
- Aviation video library
- Aviation curriculum development

The next step following development of a structure for the program was to conduct a pilot effort to see if we appeared to be on the right track. As noted, the pilot program was conducted at the North Shore Junior High School. Forty-eight administrators and teachers at the school and in the school district were involved. On our side, about 12 Boeing employees participated. The program involved 150 students in the 7th, 8th, and 9th grades and lasted for five months.

Since the pilot program concluded in May of this year, objective measures of its performance are not available. However, based on the observations and comments of those involved, we do feel that we have gained valuable insights. One was the perception held by students of aviation technicians. We wanted to determine the "image" of a maintenance technician before a student participated in this program and again afterward.

To begin a discussion, students were asked, "Can anyone offer their perception of a doctor?" I received the usual answers. Students believe that a doctor is professional; he/she drives a very nice car; he/she commands a great salary; he/she has interesting work, etc.

Next we asked about a pilot. Again, responses were very much the same. A pilot is a professional; he drives a very nice automobile; he drives a big 747 airplane; he has a tremendous amount of prestige with all of the passengers; his salary is very good.

Finally, we asked about their perception of an aircraft mechanic. Here the answers were much different. They feel that a mechanic is probably uneducated; he does not get paid well; he has poor career growth; he is the person they see dressed in yellow weather gear driving the tractor that pushes airplanes around the airport.

The above certainly shows, at least based on this one encounter with these students, that the image of the aviation maintenance technician is not good. Certainly, this image will do little to attract these students into this particular occupation. To attract people into an industry, the perception of that industry must be favorable. Perception is extremely important. If we can change the perception students have of maintenance technicians, we will have made a real contribution to the future success of our industry.

At the completion of the pilot program, those involved were asked to provide feedback concerning any aspects of the program. The first comment, and one which we appreciated, was that this program represents "an excellent start." The school staff and Boeing employees both considered the program worthwhile and felt that it should be continued. School employees added that, while the program serves as an opportunity for financial support, they were pleased that it also was providing guidance. They especially appreciated that the program was not just a nameless, faceless endeavor; that there were Boeing employees to talk to on a day-to-day basis about these problems. In all, education managers and school support staff were in agreement that this program represents a positive corporate statement by Boeing. It supports Boeing's goals in terms of citizenship and community involvement.

We also encountered concern that this program was not consistent across the divisions of the Boeing company. In the North Shore school district, some children have parents who work for the Commercial Airplane group. Parents of others work for Computer Services and others for Military Groups. We recognized there was not a large degree of consistency across divisions of our company. We received criticism saying "You came to talk to us about this program, but a year or so ago Boeing Computer Services were here and are doing something similar. You need to talk to each other to avoid this duplication." We are attempting to do so.

School staff members were unclear as to the resources available at Boeing to support this program. Our response covered a number of points. First, we noted that there is a budget supplement to each division to support full-time education managers. The problem here is that they are not funded on a full time basis. They also look at a number of different types of scholarship programs. We believe there needs to be a full time, funded position. The second point is that we recognize the need for a focused effort. The effort must have a central point of control. Under our plan, Resource Administration will act as the introductory focal point for school districts and will serve as the primary resource contact for Education Managers. This administration will spearhead the development of curriculum resource packages for teachers. It also will determine top priority items for which communities require assistance.

We have provided a Boeing Resource Guide. This lists a number of things we have to offer: We have the Aviation Video Library; tours of our various facilities; a speaker bank; a number of community education programs; scholarship information; and materials to aid in curriculum development.

As we proceed on with what we hope will be a growing program, we do not want to keep it within the Boeing Company and North Shore. We hope to share this work with other communities and with other parts of our industry that might benefit from such a program.

I have heard many references being made to an impending crisis in terms of a decline in the skills of people coming to our industry -- perhaps even a shortage of people. The word crisis denotes a problem, something bad and portenous. If you look at the Chinese word for crisis, you will find it is composed of two distinctly different character sets. The first set translates into the word "danger." The second character set translates into the word "opportunity." I would like to leave you with that thought. We are faced more with an opportunity than with a moment of real danger. If we work together in terms of this opportunity, we will be successful in developing an interest in young people in aviation as a career field.

STATE AND AVIATION INDUSTRY TRAINING COOPERATION

Rod Peters
Director, Technical Training
Northwest Airlines

Good afternoon. I am here to describe an example of cooperation between state and industry to improve aviation maintenance training.

The Minnesota Legislature responded to the need for increased numbers of better trained aircraft maintenance technicians by funding a grant through Minnesota Job Skills Partnership. A grant of $500,000 was voted into law for this purpose. It is to be used over two years. Any non-profit educational institution that could form a partnership with aviation business for training of aircraft maintenance technicians was eligible to apply for the money.

The four Minnesota State Technical Colleges that have aviation maintenance training programs formed a consortium to apply for the grant. Northwest Airlines joined with five Twin Cities aviation companies to become the industry half of the partnership. An application was made and granted by the Minnesota Job Skills Partnership.

The object of the program is twofold. To increase the number of quality aviation maintenance technicians (AMTs) available to the aircraft industries and to increase the technical skills of present technicians and personnel. This will be accomplished in six major objectives:

1. **To increase the number of AMTs available to the industry.** Expansion of staff made possible by the grant will increase the number of AMTs that can graduate from the four technical colleges from 220 to more than 600 per year.

   With the growth and changes that have occurred in recent years at Northwest Airlines and within the airline industry, pressure has been put on the corporate and general aviation businesses to keep technicians as the larger air carriers continue to need more. Northwest has been hiring at an increased rate, sometimes 40 per week. Many of these AMTs were graduates of the technical colleges, as well as from corporate and general aviation industries. This has left openings in those areas of the aviation industry which need to be filled; however, there are not enough new A&P AMTs to fill these positions.

2. **To train present and future AMTs in advanced electronics.** An optional 18 credits of Aviation Electronics will be offered to all aviation students at the four technical colleges. This training will also be conducted for a mimimum of 40 present Northwest Airlines A&Ps. Aviation Electronics was developed by the Aviation Advisory Committee, made up of representatives from aviation industry and technical colleges in Minnesota.

Maintenance of modern commercial aircraft (Boeing 757, Boeing 747-400, Airbus 320 or "digital" aircraft) has revealed a gap in training in terms of fundamental knowledge of complex large jet transports and electronics among AMTs working the line. The airline industry's previous reliance on technicians with a Federal Communications Commission license is no longer valid. The FCC license has come to have little relevance to the technology of today's aircraft. The digital aircraft the modern AMT is expected to maintain is a completely integrated set of systems where the mechanical and electrical cannot be separated. Industry's present and future AMTs need electronic training to have the "tools" to productively maintain the new fleet.

3. **To train future AMTs in large jet transport technology** Northwest Airlines will provide aircraft instructors to three technical colleges to conduct training in large jet transport technology. This will be 200 hours (15 credits) of training based on the Boeing 757. Completion of A&P training, or an A&P license, is a prerequisite. It is anticipated 400 trainees will avail themselves of this training.

FAA regulated training (FAR 147) does not address the powerplants or systems found on the new digital cockpit aircraft. Therefore, when A&P AMTs are hired, they must be trained to work on these new generation jet transports. To resolve this problem, or decrease the amount of time newly hired A&P AMTs need to spend in training, Northwest will offer the B757 initial training to A&P students at the technical colleges. This training will take place subsequent to their FAA (FAR 147) training.

4. **To train the highly skilled Northwest Airlines instructors in teaching techniques.** Northwest Airline's 34 Technical Operations aircraft instructors will receive two refresher courses on current teaching techniques. Participants will receive three degree credits for successful completion of both courses.

Northwest and other aviation businesses have their own specialized training programs for their personnel. The major part of Northwest's is advanced training on specific aircraft that are in the Northwest fleet. The technical people teaching these classes are excellent, well-qualified technicians, but they lack training in teaching techniques to maximize the transfer of knowledge from instructor to student. The technical colleges do not have access to the highly-skilled technical people needed to provide this type of training. The resolution is to train the highly-skilled technicians in education techniques to improve the quality of classes and the retention rate of the students.

5. **To train present and future supervisors in supervisory techniques.** Sixty aircraft maintenance supervisors or supervisors-to-be will be trained in supervision techniques. They will attend Zenger-Millers' Frontline Leadership program which is comprised of 23 four-hour modules. Successful completion will give them seven degree credits.

When an industry is in a rapid growth mode and personnel are moving from company to company, or position to position, many personnel are promoted without complete training for the position they assume. This has been happening with AMT supervisors from their pool of AMTs and supervisors from other aircraft industry companies. To assist in resolving this situation, the technical colleges will offer supervisory training to present supervisors and those aspiring to become supervisors.

6. **To upgrade current technical college aviation instructors.** Participating aviation businesses have agreed to provide ten industrial internships over the two-year partnership period to A&P instructors from the technical college system.

The State of Minnesota has set standards of experience that vocational instructors must maintain in their field of expertise. The offering of internships makes it possible for instructors to go back to the workplace and renew their skills, learn the latest techniques, and satisfy their state requirements.

The long-term goal of this program is to help create an environment of cooperation and mutual support bwtween the state's aviation industry and Minnesota's post-secondary educational or non-profit institutions. It is hoped that the partnerships formed through this program will continue to grow and set an example for similar initiatives in other states.

MAINTENANCE PERSONNEL INITIATIVES IN REPAIR STATIONS

Jerry L. Schumacher
Senior Director, Contract Services
Elsinore Aerospace Services

In 1945, the world's population was 2.2 billion people. Ten million people, less than one-half of one percent, flew on the world's scheduled airlines. Now, 45 years later, three million passengers a day, or 1.1 billion people, fly the air routes. Passenger numbers have increased over 100 times since the end of World War II. Given this phenomenal growth rate, 11 percent per year, ICAO estimates that the current carriage of passengers and freight by air will double by the end of the decade; that in the year 2000, 2.2 billion persons, the same number as the world's population in 1945, will be flying as airline passengers. This figure will represent 33 percent of the world population.

Statistics

A. The current aircraft maintenance workforce is 65,000.

B. The current workforce handles 4,100 transport category type aircraft. This amount will double within the next seven years.

C. This means that by 1996 there will be a need for 130,000 aircraft maintenance personnel. This figure does not take into consideration any retirement of the current workforce nor the additional modification work required on the aging fleet. This will require an additional 26,000 mechanics. This all adds up to a total of 91,000 job openings between now and 1996.

D. The Federal Aviation Administration projects that 18,000 A&P tickets will be issued in 1990.

1. Twenty-five percent of these newly licensed mechanics will go on to be engineers or pilots.
2. An additional 20 percent will be lured into other trade industries with the promise of better wages and a more stable work environment.

This leaves us with 10,800 mechanics per year, or 64,800 by 1996. If you are doing your arithmetic, you will see that by 1996 the industry will be short over 25,000 mechanics with a much larger shortage of experienced mechanics.

E. The current A&P school graduate is:

1. 26 years of age

2. Married and/or has two children

3. Is making $13,000 per year and expects to double that when starting as an aircraft mechanic

The competition within the industry for these mechanics is only part of the problem. Other trade industries can offer these graduates better financial incentives; jobs close to home; and less likelihood of lay-offs or furloughs.

In addition to those that are leaving the aircraft industry, there is a shortage of elibible people coming into the industry due to the following:

A. In the United States, over 29 percent of all high school students drop out of school before graduation.

B. In 1990, it will take 53 percent of the high school graduates to fill the needs of all trade industries. However, only 48 percent will go into the trades.

C. By 1996 it is projected that the trades will need 68 percent of the high school graduates, but only 54 percent will go into the trades.

As the demand for personnel increases in the trade industry, it will be even more difficult for the aircraft industry to get and retain the workforce they require.

Questions

So what can or are we doing about this problem? The combination of FAA-approved schools operating under the current FAR's, and the inability of A&P schools to obtain the funds necessary to update their equipment and training aids has caused some of the repair facilities and airlines to step in and start their own schools. Many of them offer courses in sheetmetal, NDT, and use of composites. Others have gone as far as opening a complete FAA-approved A&P school. There are numerous regional Government funded programs that can be utilized for funding potential local residents. One of these programs works well at our facility in Waco, Texas by paying the tuition of applicants attending our aircraft sheetmetal course. Some repair facilities and airlines are fortunate enough to be located near A&P schools. These companies have the perfect opportunity to set up a program that can offer these students paid hands-on experience. In Waco, the local students work for us four hours a day, five days a week, under the supervision of their school instructors. All of these means give the participating facility a natural source of personnel.

Two years ago we realized we needed to do something to get better control of the labor force caused by the ups and downs of the industry, so we started our own Contract Maintenance Personnel business. This business supplies us with a continuous source of qualified maintenance personnel not only for ourselves, but for our customers world-wide who require maintenance personnel on a temporary basis.

Unfortunately, due to the shortages that we are talking about, I feel that our biggest task is yet ahead of us -- the task of safely surviving this shortage. We need to start making a concerted effort to give something back to the industry.

What Can We Do?

Realizing that everybody looks at profits and the spending of money first, you will probably want to know what you can do to help that requires little or no outlay of cash:

A. Attend junior high and high school Career Fairs to promote the aviation industry. Let the young people know that it is still an exciting field with good pay and exceptional benefits.

B. Most large cities have regional occupational programs that are funded by the school districts. These programs normally consist of motivated high school students who are willing to volunteer their time to learn more about a field that they are considering for a career. The programs include some classroom instruction. The students then are placed in businesses that have volunteered their services and facilities to assist these students in getting a head start on their careers. Get involved.

C. All public funded A&P schools desperately need equipment and tools and eagerly accept donations. Items that may be obsolete or not in use by an airline or repair station may be the most modern thing a school has in its inventory. Don't throw it away -- give it away.

D. The recent push by our industry and the FAA to upgrade the current regulations for A&P school certification is a good sign that means we are headed in the right direction. But it still needs a lot of support to make it work for the next generation of aircraft mechanics.

E. Think about the possibility of forming a repair facility organization to help with third party maintenance standards.

F. The raise in starting wages for new mechanics has been a positive sign that will need to continue in order to be competitive with the other trade industries and to encourage people to get into the aircraft maintenance field.

Conclusion

In summation, I would like to say that if we don't want this training and mechanic shortage trend to continue, and if we want to ensure a safer and more productive industry, then we must turn to the people who can help us the most -- and that would be ourselves.

HUMAN FACTORS IN AVIATION MAINTENANCE

Colonel Robert McMeekin, MC, USA
Federal Air Surgeon
Office of Aviation Medicine
Federal Aviation Administration

As we continue this discussion of human factors, it is clear to me that we are seeking ways for each aviation maintenance organization to fashion a better fit between itself and the people who work in it. In these discussions, we expect to see that not only safety, but also productivity, is improved by looking at human factors. Such things as job structure, expectations, and training methods do make a difference in the business of making sure that an aircraft will be where you want it to be and nowhere else.

I look at this in the way a machinist might look at the surface he prepares. If these surfaces are not engineered, built, and maintained properly, he can expect that it will not work for long. A machinist calls this "fit."

Webster's dictionary defines the word "fit" as "to be adapted to an end or . . . to an environment so as to be capable of surviving." Webster goes on to call it more than that: "competent" and "qualified."

I want to talk about this notion of "fit" as it works in the aviation maintenance industry. It seems that in our discussions about human factors we have overlooked the fact that we're talking about physical work. The men and women who perform this work have physical abilities which enable them to do their job.

In addition to making sure that a technician is drug-free, management needs to know that the person is physically capable of doing the job at hand. I am talking about being fit enough to get into a closed-in area to inspect it properly. I am also talking about vision and hearing impairments. The aviation technician workforce, with its bimodal age distribution, is prone to these impairments that often go unnoticed by both the individual and management.

We all know, from our own experience, that to look, feel, and perform our best, we need to have regular physical activity. Fifty-four percent of Americans, however, say that they do not exercise at all and forty-six percent say that they do not exercise regularly. In addition, sixty-three percent of the non-exercisers say they get sufficient exercise while fifty-three percent of the exercisers believe they are not as active as they should be. These figures can be a little confusing. They indicate that there are real gaps between the amount of exercise we need as humans --- the amount we think we need and the amount we actually get. These figures also suggest that the people in your workplace or school are not as fit as they should be to do the type of physical work that aircraft maintenance, in all its forms, requires. There's a good chance that you do not get sufficient exercise. I encourage you to be fit and I encourage you to do what needs to be done to ensure that the people who work with you are also fit.

I want to talk, also, about the need to be in a state of intellectual fitness. We can call this, as Webster does, "unimpaired condition," "soundness," and "readiness" within an organization.

The work we're about is becoming increasingly complex. Aviation maintenance technicians were usually called mechanics, and for good reason: they had a feel for machinery, a set of tools, and were willing to get dirty. Clearly these are not the only skills an AMT needs now.

In September, a "Notice of Proposed Rulemaking" was issued to revise aviation maintenance technician training regulations. These proposed rules will assist you in the industry. Schools will provide advanced training in some fundamental general subjects, such as mathematics and physics, and proportionally reduced training in some obsolescent areas such as fabric repair. There are also some new skill and knowledge areas added to the curriculum. These include areas such as solid state electronics and turbine powerplant service technologies. The proposed rules will introduce requirements in propeller blade and composite structure repair and courses in auxiliary power units or APUs. They will reduce the amount of time used to teach dope and fabric. The FAA's proposed curriculum changes are designed to respond to your needs in certification. If enacted, these rules will ensure that the people who come to your organization will have the knowledge base they need so that they are able to fit in more quickly. More importantly, they will be more fit to do the job. This is not all that is needed, however.

What is needed to satisfy technical requirements may be different from what is needed on the job. In addition to technical skills, the work we expect of technicians requires a new level of communication. People need to work cooperatively when jobs are performed by more than one person. The "lone cowboy" approach simply doesn't work any more. Technicians need to read manuals and document their work in ways prescribed by lawyers who will, hopefully, not be needed to defend them in the future. Thus, the reading and writing skills required of the people who work in your organizations need to be adequate for the task. The required cognitive skills have also increased. People working in Job Performance Aids and Training are familiar with this. Technicians need to be able not only to read an indicator but to interpret its meaning and take appropriate action.

I know many of you express the difficulty of finding enough people who come to the job with the right skills. Some of the presentations yesterday addressed this problem.

So, you may need to take some concrete steps. First, you need to respond to the expected regulatory changes. Become familiar with them and be sure that these changes will produce the type of AMTs you want.

Then, if the people you hire need additional training, you may well need to provide it. So think about your in-house training programs. Think about what AMTs need to know beyond what's provided by the schools and how best to give them that knowledge.

To deal with the expected people shortages, you may need to go outside your organization. You could alert high school students and state employment departments to the existence of the challenging and rewarding careers that are available in the aviation industry. Many of you are more than qualified to deliver this message. It might mean that you encourage your company to take an active role in your community and support football teams, school career days, technical schools and GED programs. Think of this as recruiting -- the sports folks do.

You may want to think about other ways to promote interest in aviation maintenance careers. It's too bad that there is not more space in the National Air and Space Museum in Washington devoted to careers in aviation maintenance. The flying public does not see the AMTs behind the flight attendants and pilots. Most people have only a dim idea of what AMTs do. In a sense, this is a positive, since air travel is as safe as it is, but it also has a negative side. You need to make the public -- primarily students -- more aware so that more good people enter the field. You need to help them find you.

The job of attracting and developing a fit working population may be larger than any one group represented here can handle. We need a lot of good people!

I urge you to create an industry initiative; to increase the public's awareness of the possibilities that exist for people in challenging and rewarding careers in aviation maintenance.

We're going to have to work together, Government and industry, to deal with a whole host of "people" problems ranging from manpower shortages to technician training requirements.

FAA has initiated its part of the process with the proposed rulemaking on training. I think industry can do a tremendous service by increasing the public's awareness of the need for good people and by informing them about the challenging and interesting careers in aviation maintenance. Now is the time to start working on the problem of cultivating a fit and capable AMT workforce for the future.

ISSUES INFLUENCING RECRUITING, TRAINING, AND RETENTION IN THE REGIONAL AIRLINE ENVIRONMENT

William Hinson
Director, Technical Services
Atlantic Southeast Airlines

Quality of maintenance is as important for regional airlines as it is for the major air carriers. Regional airlines, however, face some significant issues and problems in maintenance. The fact that regional airlines have had a measure of success in meeting these problems means to me that they have a story to tell with regard to recruiting technicians, or mechanics as we call them; training them; and keeping them.

In reviewing the problems and programs of regional airlines, I will draw exclusively on the recent experiences of Atlantic Southeast Airlines (ASA). While ASA may be typical of the industry in many dimensions, I cannot claim to speak for all regional airlines. Each company addresses issues associated with its maintenance workforce in its own particular manner. However, while solutions may differ in some measure, the industry certainly faces a number of common problems.

A brief review of this history of Atlantic Southeast Airlines will provide some perspective on our problems and the manner in which we have dealt with them. ASA has had an excellent record of growth in its 12 years history and, as a result, has had to deal with some serious maintenance matters without the luxury of timely planning for them.

A study by Southern Airways in the late 1970's showed that Atlanta stood to gain considerably from deregulation as a market for short-haul connecting flights. When the merger of Southern Airways and North Central Airlines was announced in mid-1978, three Southern employees used this idea as a basis for forming Atlantic Southeast Airlines. As it turns out, the idea was very much right for the time and place. The airline began service on 1 July 1979 with one Twin Otter airplane and one route from Atlanta to Columbus and return. The company was profitable in its first six months and has been profitable since then. This is important because it enabled the founders to follow their marketing plan and to obtain equipment and resources needed to further exploit the market.

Growth of Southeast Atlantic Airlines continued with the acquisition of a different type of airplane, the Bandeirante, in the Fall of 1980; then de Havilland Dash 7's were added in 1982. In 1983, the company acquired Southeastern Airlines to add six more airplanes and additional routes.

An important point in the growth of ASA was the completion of the Delta Connection marketing agreement in 1984. This caused the growth rate to accelerate further. Another type of aircraft was added to the fleet with eight Shorts 360's. By the end of 1986, the growth rate peaked with the opening of a Dallas hub. The company then had twenty-nine airplanes and 240 daily scheduled flights, all accomplished in six and one-half years.

Rapid growth, not only in a regional airline but in any industry, has special problems. In 1987, when I joined the company, virtually every problem in maintaining the aircraft and in keeping aircraft in the air was associated with this rapid growth. The size and expertise of the maintenance organization simply was not able to keep pace with the speed at which airplanes were coming on-board and the amount of time the airplanes were being flown.

The year 1987 began our current period where growth has slowed. We now have begun to solidify market positions, strengthen middle management, create support systems for the maintenance organization, and position the company for the long haul.

In 1987, maintenance problems were severe. We were in a situation where five out of every 100 flights were being cancelled for maintenance. Twenty or more flights out of 100 were being delayed for maintenance. While this could have been viewed as disastrous, we viewed it as an opportunity to bring about improvement. About six months was spent in reviewing the situation to determine exactly what was happening and to work toward meaningful plans for correction. Some of the problems were obvious. There were too few mechanics. We had over fifty airplanes in service and less than 100 mechanics. There was poor supervision, no middle management, no support organization, very poor inventory control, not enough support equipment and tools, and too little hangar space. We were trying to maintain five overnight airplanes in a hangar that was 125' by 150'. This is very bad for morale when it is twenty degrees and raining outside, the night is pitch dark, and mechanics are trying to change an engine with a tent over the wing. Little wonder that our annual mechanic turnover was in excess of forty percent.

After assessing the situation, we decided these were real problems that required real solutions immediately. In the interest of getting things moving, we had some false starts and misdirections. Fortunately, we learned from these mistakes and began moving ahead properly. There was no magic in the solution of our problems. We put a plan together and followed it with a lot of hard work.

The systematic plan of attack we put together was very straightforward. We had to build a hangar; we had to hire management; we had to hire mechanics. Since all of that could not be done at once, we began first with the design and construction of a new hangar. The longest lead time problem was one of acquiring more hangar space. This took about a year and a half longer than I thought it would initially, but it now is serving its purpose well.

Next, we began hiring management. I realize that many people in our industry believe the proper approach is to promote from within. However, when you are talking about an airline only seven years old, you must realize that everyone in maintenance at that time was either fresh from the military or a fresh graduate of an A&P school. We had very few mechanics with extensive experience. So the decision was made to hire key management people. Some mistakes were made initially, but finally we arrived at the proper management structure.

After our hangar construction and management acquisition programs were underway, we began the process of hiring new mechanics. At this time, we noticed a rather amazing thing. Note that as we were building the hangar and "fixing" our inventory system, we were dealing with the two major frustrations of mechanics. These were having to work outside in the cold and not having available parts to fix the airplane. When they could see without a doubt that we were building the hangar and that we were working on the parts situation, a synergy began to develop both with the old and the new mechanics. An immediate manifestation was that the attrition rate started to go down. Mechanics were more committed to our program. Now I would say our attrition rate is probably less than twenty percent.

The next step was to develop a training program. At first, we had no company training program whatsoever. Training was provided by sending mechanics to the aircraft manufacturer for their schooling. In the early days, this was the quickest and best way to accomplish the training. Also, we had negotiated an agreement with the aircraft manufacturer to train, at no cost, four mechanics for every airplane that was delivered. We twisted this meaning a bit to where, since we had twenty airplanes on order, the manufacturer was obliged to train eighty mechanics. On the basis of this twist of contract language, we began shuffling mechanics to the manufacturer's school for their training without waiting for quotas to accumulate with aircraft deliveries.

As the last major step in our plan, we created a dynamic training program. This program is run by the Training Coordinator, an ex-Air Force specialist with thirty years of military experience, and a Training Instructor, a former junior mechanic of ours who had moved up to inspector. Whereas initially we had received a measure of criticism for hiring key people outside, we now had reached a point where we could begin promoting people from within.

In our plan, the key element is "the people." Under this plan, we try in very basic ways to ensure that employees are content and productive. We want to hire enough mechanics so they do not feel overworked and that one person is doing the job of two or three; train them effectively; give them proper tools and equipment; give them needed parts; and finally give them a warm, dry, well-lighted environment in which to work when it is cold, dark, and rainy outside.

Now that we have a good operating program, we come to the issues of recruiting and retention. How do you find good people and keep them? When we needed at first to get fifty or so mechanics onboard in a short period of time, we went around the country to A&P training schools and recruited mechanics. We went to a large number of schools with good reputations and gave our recruiting pitch. When we got the mechanics onboard, we began to get airplanes fixed. However, three or four months later we realized we had a problem. And now, we can say that, for the most part, none of the people hired at first are still with us because of two factors. First, the new mechanics were hired as graduates of schools all over the country. Their roots were spread all over the country. When the opportunity came for a good job closer to home, they moved. Second, these mechanics, as is probably true for all mechanics, want to work on heavy airplanes. When an opportunity came to move to a larger carrier and work on larger airplanes, they took it.

As we recognized what was happening, we revised our recruiting philosophy. We noted there are a number of good A&P schools close to Atlanta and Macon. We now concentrate our recruiting effort at these schools because most of their students are from the local area and are likely to remain there. Another important point is that the school in Americus, Georgia and the school in Ozark, Alabama regularly send classes to look at our hangar, our maintenance operations, our airplanes, and just generally observe night maintenance. We welcome and encourage them to do that. As a result, we receive a lot of applications and hire a number of junior mechanics from these schools.

In the hiring philosophy we developed as a regional airline, we gradually departed from a long-standing company mandate that a "mechanic" had to have an A&P ticket. Since we have a 100 percent buy-back policy for the hangar work area, the mechanic working on the airplane does not have to have an A&P ticket. The inspector signing the paperwork, however, must have one. The supervisor also must have the ticket. This means that we now are able to tap the available local market in terms of special talent. This is where we acquite sheet metal workers, electricians, and avionics technicians. We hire them as mechanics and pay them the same as a junior mechanic or a senior mechanic based on their specialized experience. In this way, we are able to acquire personnel from facilities such as Warner Robbins Air Force Base, where we obtain technicians separating or retiring from active duty, plus some civilians who may wish to change from Federal employment.

We have also worked with local technical schools by identifying our needs. Here we have not specifically addressed A&P tickets but, instead, described our needs for specialized skills. One school, Macon Area Tech, listened to us and then put in an aircraft sheet metal course. Now, in addition to the small number of sheet metal workers they have sent to ASA, they have supplied a larger number to McDonnell-Douglas at Macon Airport. The school has followed up this program with radio commercials using former students. One, which is being played at this time, features a former student who works for McDonnell-Douglas and who is telling everyone "Hey, I went to Macon Area Tech; I became an aircraft sheet metal technician; and now I have a good job at McDonnell-Douglas building parts for the MD-11 airplane." It is a very effective commercial.

Another thing we learned in developing our maintenance force is the value of exit interviews. For the first two and one-half years of our plan, I personally did an exit interview with each person leaving. At first the answers were obvious. They included poor management, no tools, desire to go to larger airlines, low pay, no parts, and no future. Plus we had about fifteen percent of our losses as a result of disciplinary reasons.

The exit interviews now tell us that the situation has changed considerably. Now there are two reasons we lose people. First, they want to go to work for the big airlines. Second, they want to move closer to home. Then, of course, we have the miscellaneous reasons, including two who wanted to quit being airline mechanics so they could indulge their auto racing hobby full time. You cannot compete with those reasons. However, we have noted that, whereas our losses for disciplinary reasons were approximately fifteen percent in earlier years, now they are quite low. This year only two of our departures were caused by disciplinary matters.

Results

Our maintenance plan has been in effect for sufficient time that we now can begin to look at objective measures of performance. These measures provide an indication of the extent to which maintenance effectiveness has improved.

Figure 1 shows that, even though we have entered a period we consider as one of slower growth and consolidation, there remains a measure of continuing growth. The best measure of this growth is the twelve-month average which tends to take out monthly and seasonal variations. On this basis, you can see that we added about twenty scheduled flights per day during this year.

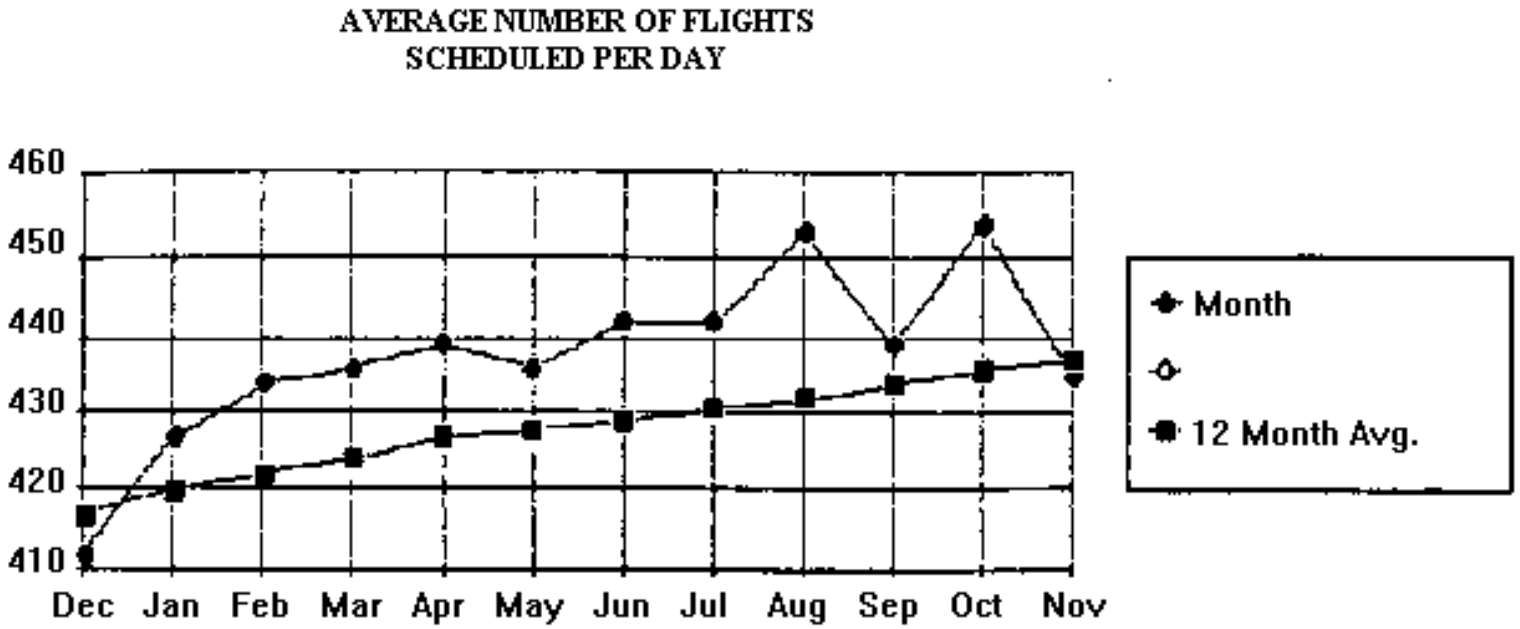

Figure 1

The best indication of maintenance improvement is shown in Figure 2. The twelve-month average for maintenance completion in mid-1988 was 94.5 percent. From a customer service standpoint, this is not good. However, as you can see in Figure 2, the twelve-month average has been steadily improving. At the present time it is almost 98.5 percent, which was our objective for this year.

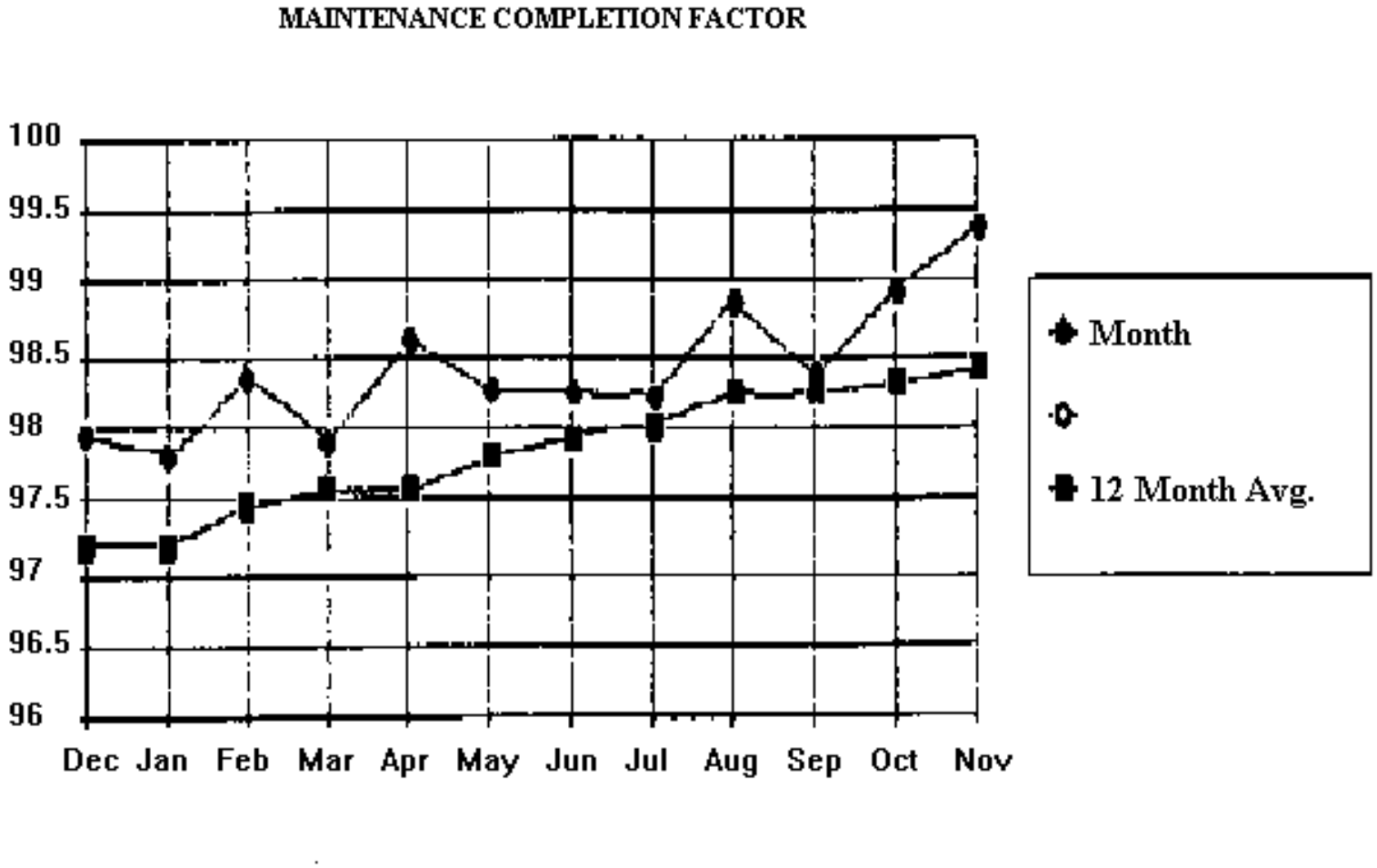

Figure 2

A more direct measure of maintenance performance is provided in Figure 3. This figure presents a synthetic number which shows the combination of maintenance delays and cancellation vs. the total flight schedule. As you can see, the maintenance performance factor, reflecting both delays and cancellations, for November was almost ninety-five percent and the twelve-month average slightly above ninety-two percent. This latter figure means that, on average, less than eight flights in 100 are in any way impacted by maintenance. The nice feature, of course, is that the curve shows a continuing rate of improvement.

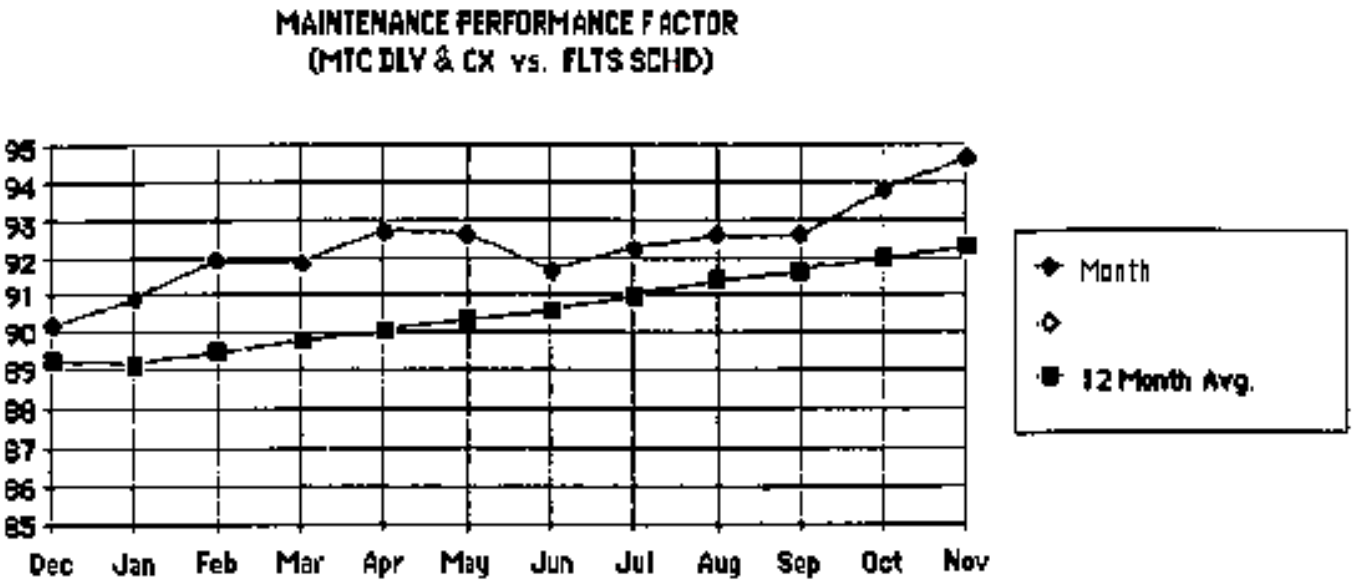

Figure 3

Figure 4 presents our maintenance on-time performance record. As of November, we were averaging almost ninety-four percent on time flights. This means we are not completing flights simply at the expense of running them late. Again, the best feature of this curve is that it shows continuing improvement.

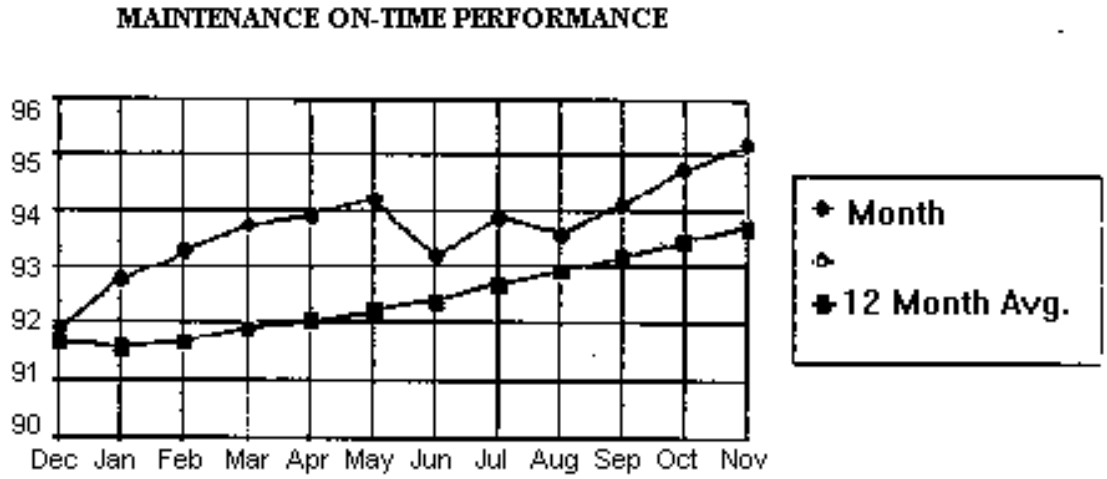

Figure 4

Two additional indices of maintenance performance are shown in the final two figures. Figure 5 presents the number of pilot reports of items requiring maintenance attention received per 1000 flight hours for a specific airplane. These are the total pilot write-ups on the airplane. In easier terms to envision, we are receiving fourteen write-ups for every 100 flight hours. This shows good system reliability and indicates maintenance is dealing with most items before they can come to the attention of a pilot.

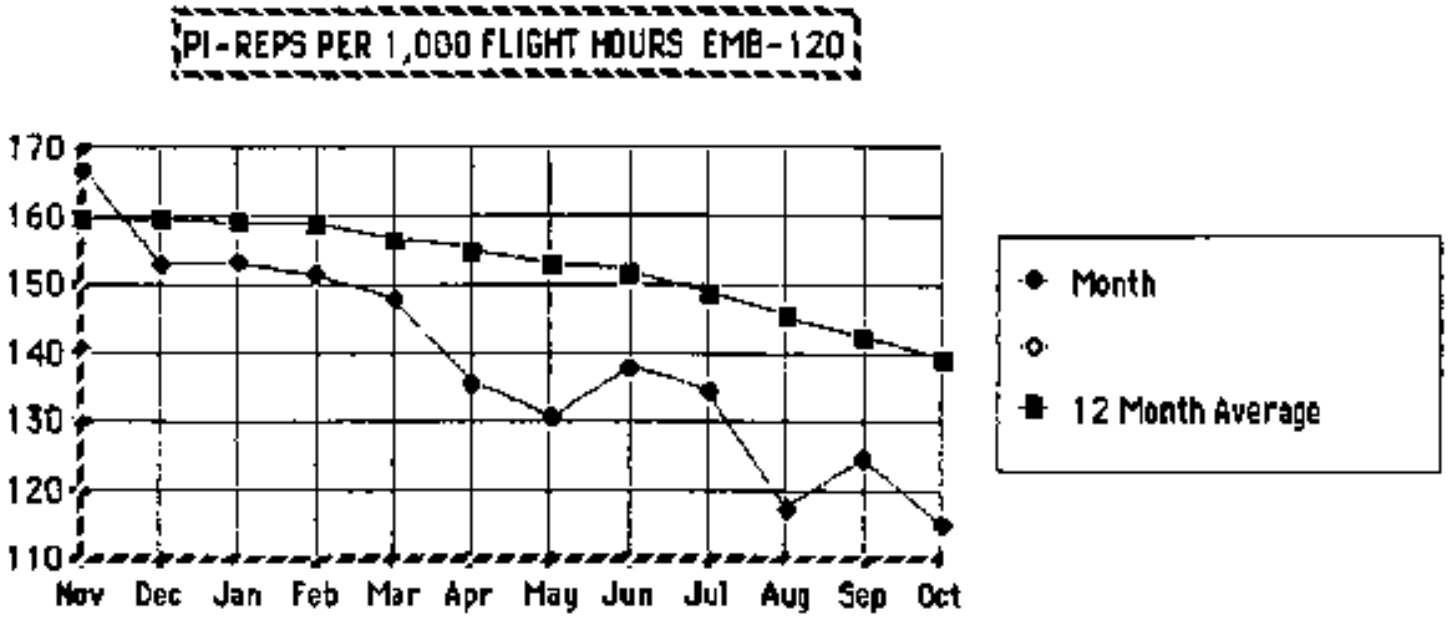

Figure 5

Figure 6 shows the number of unscheduled component removals (UCRs) per 1000 flight hours for the same airplane. Here, more simply, we see 5.5 unscheduled component removals per 100 flight hours in the most recent month. The important feature is that the number of these component removals continues to fall.

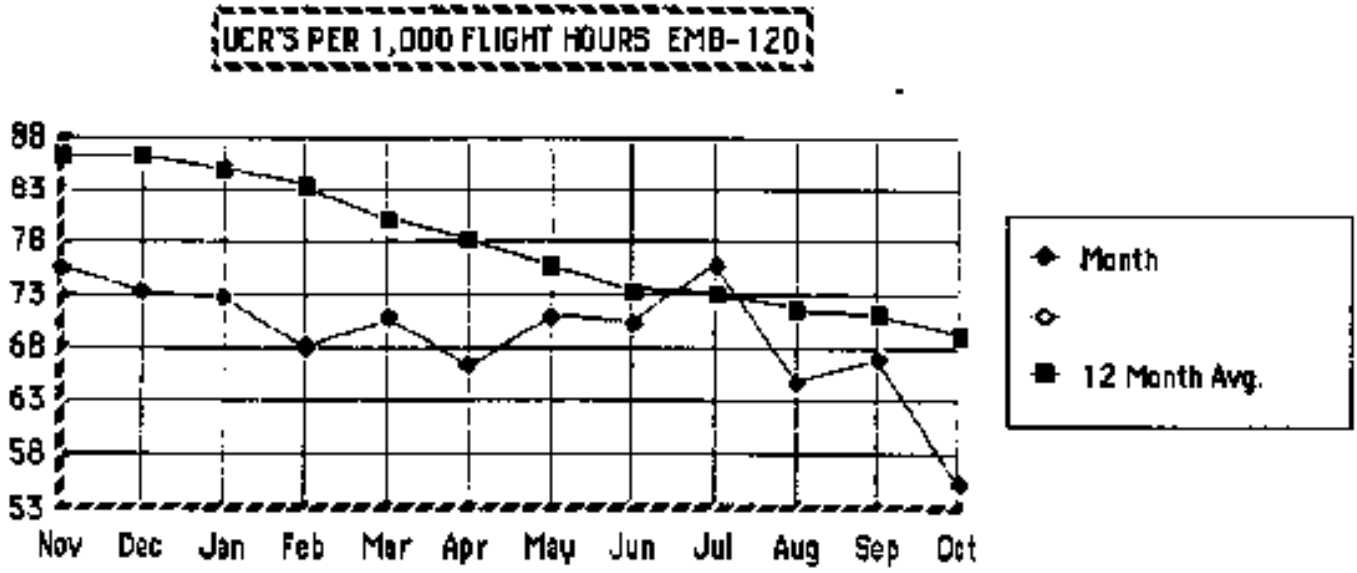

Figure 6

The final gauge of maintenance performance I want to discuss deals with maintenance carry over. These are inspection write ups or mechanic write ups found during a maintenance check or between checks that are not safety of flight items but which need to be fixed. These average about seven per airplane. While we are working to achieve a lower number, this still represents an airplane in good condition.

In conclusion, I believe that from a regional airline's standpoint, it is a cost of doing business to have a strong recruiting program, to have a strong training program, and to address the needs of mechanics for good working conditions and good tools. Then you must accept the fact that there will be a fifteen percent attrition to the large air carriers. You deal with this fact by planning for it. After all, in a very real sense we are the farm clubs for the majors.

I have described the efforts of one airline to build a maintenance workforce and to improve its maintenance program. The procedures I described worked for us. I offer these descriptions in the hope that something here may prove useful for the maintenance programs of other regional airlines.

AVIATION MAINTENANCE PRACTICES AT BRITISH AIRWAYS

Michael Skinner
Manager, Aircraft Training
British Airways

The problems we face in aviation maintenance at British Airways are, interestingly enough, the same problems you face in the United states. However, these problems are tempered somewhat by the fact that they do occur in the United Kingdom, where the culture and climate are similar but not identical to the U.S.

To establish a context for a discussion of air carrier operations in the U.K., I would first like to review a bit of history. If we wish to know where we are and where we are going, then certainly we must know where we came from. Now, if we consider the history of Europe, and particularly that of the United Kingdom, we notice a dramatic change in population growth around or just before 1800, as shown in Figure 1. In the year 1800, population was around 10 million people. In the approximately 200 years since the, population has grown to almost 60 million, an increase of some 500 percent. This rapid growth does not reflect a sudden discovery of sex; rather, it shows the effect of such activities as the covering of sewers and the invention and use of carbolic soap. So the population growth curve does not show a birth rate as much as it does a survival rate. However, the important matter is that labor was available to support the demands of the Industrial Revolution.

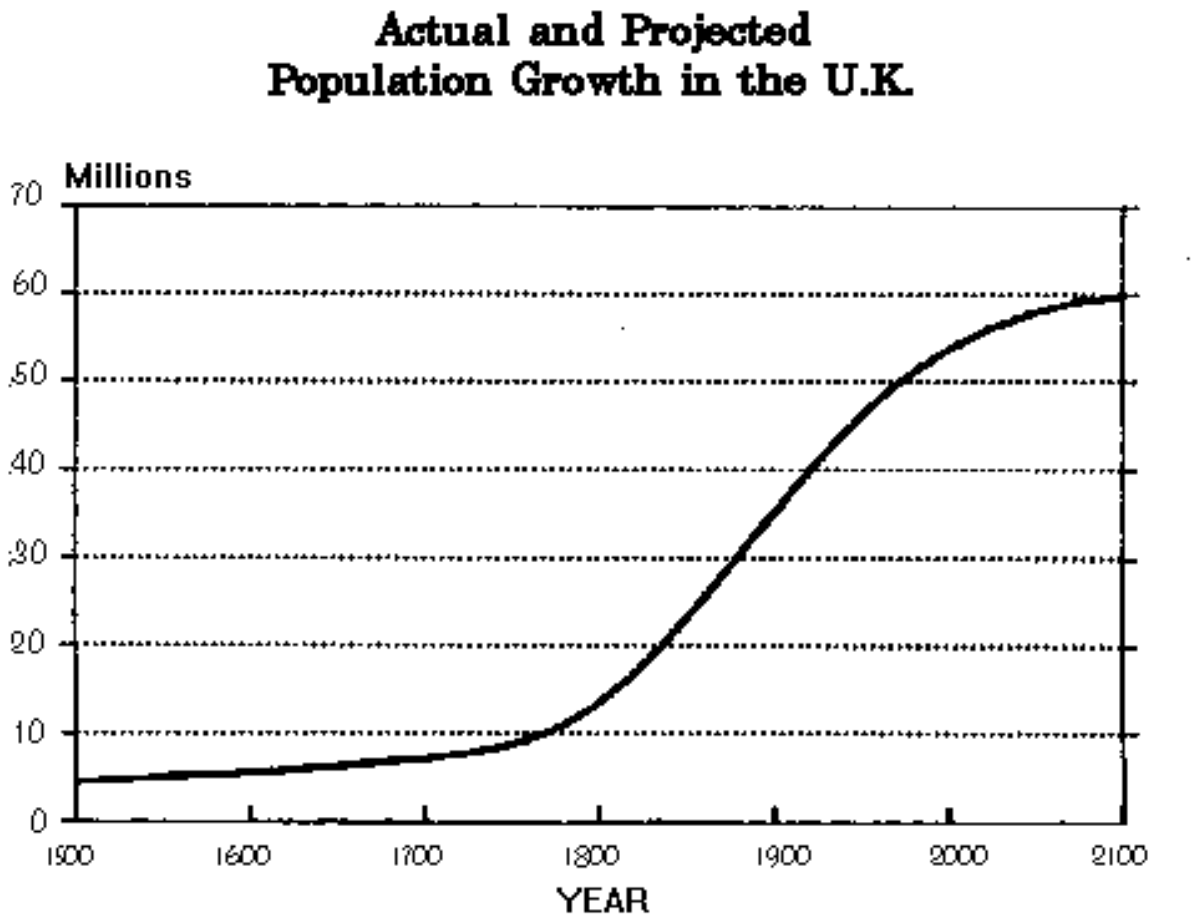

Figure 1

Turning more to present day concerns, Figure 2 shows the population of the European community in millions. The important feature of this figure is that it projects a leveling off of population growth in about 10 years and possibly even a modest decline in population for the decade following the year 2000. The days of an ever increasing labor force may soon be over. This may be especially true for the European community since population growth projections show the EC trailing well behind growth for other major industrial countries such as Japan and the United States.

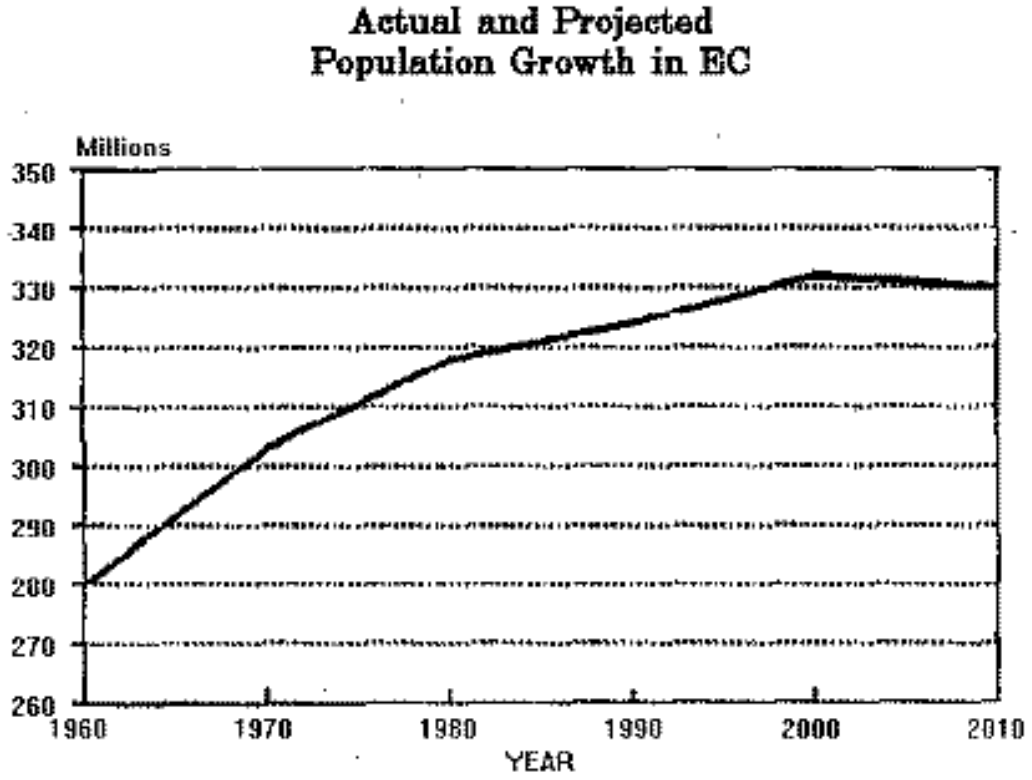

Figure 2

Looking still at the European community, the average number of children per woman to maintain our current industrial staffing levels will be 2.1 children per woman. Growth projections show the only area in Europe that will achieve that rate is Ireland. One might say "that's the religious significance of its Roman Catholic character" until one considers the case of Italy, which has one of the lowest replacement level projections.

An examination of likely occupational changes from 1988 through the year 200 shows dramatic increases in managerial and professional ranks. However, there will be a decrease in those working in semi-skilled and unskilled jobs. This is because projections show tasks for these workers being taken over by machines and robots.

Of considerable concern for those of us in aviation maintenance is the forecast for the population of 16 year olds. These, after all, are our mechanics and engineers of the future. Projections show the population of 16 year olds in a decline at this time with a possible bottoming out in the 1993-1995 timeframe. Considering the personnel demands made by our industry, we must make certain that we increase our market share of ths declining resource.

In summary, we are facing what we might call a demographic time bomb. All projections point to deficiencies in the personnel resources likely to be needed to support maintenance operations for a world wide air transportation industry. There are many reasons. More extensive family planning is one. Another is the fact that children are encouraged to remain longer in school in order to obtain better qualifications and in turn better jobs at a later time. Some predictions are, by the year 2000, the number of 18 year olds in higher education in Great Britian will have risen to an all time high of 18 percent.

British Airways is aware of the coming problems and predicts a major shortage of maintenance capacity. We have recently purchased a number of Boeing 747-400 aircraft with the intention that, when these aircraft came on line, we would retire our older 747-100's. The plan was to find a buyer for these older 747-100 jumbo jets. However, if these aircraft do not have the life extension program and the corrosion prevention program done, no one will buy them. At the present time, due to current economic conditions, even if these programs are done no one will buy them anyway. We must wait for the current market to turn around. In the meantime, we are going to invest money in these old airplanes. We are going to do all the rework programs and, in due course, spend millions of dollars. Hopefully when a resale program becomes feasible, we will have some return on our investment.

The above program presents British Airway with a genuine problem. We do not have the capacity to service the number of aircraft currently in our inventory. In fact, we have a projected shortfall in maintenance capacity over the next five years equivalent to three 747 major overhaul lines. That is a lot of hangar space, a lot of money, and a lot of people. How will we deal with this matter? To seek an answer, we have been looking not only around England, but all over the world. Our search has covered sites such as Singapore, facilities in Arab countries, and many other places. We have included in our search sites in Africa but have learned that their own industrial projections will use all available youngsters in that area.

In a continuing program to expand our capacity, British Airways have requested financial support from the Government to build a maintenance facility and recruit people with compatible skills to those we require. Under this program we are going into Cardiff in South Wales to build a maintenance facility at a small airport there, with Government backing. This makes sense to us and it also makes sense to the local residents. Many of these people were employed in the coal industry and have suffered as a result of the depression in that and other industries.

As we attempt to come to grips with the problems of the next decade, we need to know what we are going to do and also what our competitors are going to do. For example, one of our competitors is Ford U.K. This company has developed a plan in which they will release 15 engineers on a a full time basis to become consultants in the English education system. These consultants will work both with educators and students to develop programs that will ensure the necessary flow of qualified labor.

British Petroleum is doing much the same thing as Ford U.K. British Petroleum has developed an apprenticeship program under which students may be prepared for later employment. In their programs, as in ours, we are concerned with the image as well as the qualifications of an aviation technician. We recognize that simply changing his name from mechanic to technician will do little unless the full image is changed along with the name. This is difficult, but we are attempting to do that in some programs that we have established at British Airways.

Apprenticeships at British Airways started to decline and we were not sure why. As we explored the problem, we found that it was due mainly to increased competition in the marketplace. Young people were going to work in computer industries. They see these jobs as having a larger image than engineering. Although most of our technicians are referred to as "engineers," it is still the same job as your mechanic. In order to improve this situation, in 1988 we began a program of "Links With Education." Under this program, we asked volunteer engineers within British Airways to adopt a school. Since our company is a world-wide organization, we have engineers within England, Scotland, Ireland, Wales, and elsewhere. Each engineer was free to adopt any school at any location.

In our Link With Education, we want to enhance the image of engineering; we want to promote it within the schools; and we want to do whatever is required to support and encourage the volunteers who form this link. We want them to be professional as they work with the schools. To ensure this, we give them training in presentation skills. We help them prepare presentations. They then go to job fairs and to school fairs where they give presentations and are supported by an abundance of information that promotes British Airways.

Another part of our link with education includes a feature called "work experience." This is available for students who are in their last year of school and are close to going into the world of employment. Many of them do not have a clear idea of just what they want to do. So we offer a two-weeks work experience program. Under this, they work at our facility and are placed as close to the job they request as we can do while still attending to all safety considerations. The program appears to be successful as a technique for getting students interested in engineering as a future. As a result, we have had an increase in the number of applications for apprentice positions.

Our Link With Education program provides one source of apprentices. Other sources of maintenance manpower include companies with which we are affiliated such as British Airways Engine Overhaul, Ltd., who train their own apprentices. We also recruit university graduates for a one-year apprenticeship, some of whom then come to us as engineers. In many cases, however, these recruits represent future managers, with engineering assignments as only part of their career progression. Under these conditions, they do not really solve our manpower problem.

The real solution to our manpower needs rests with the British Airways Apprenticeship Program. This apprenticeship is a three-year standard based program, as outlined in Table 1. By standard based, we mean that at the end of year one, a student must have reached a certain standard. Each student is examined at the end of each year. If he does not meet the established standard, he does not proceed to the next year. A student actually can achieve this three-year program in slightly less than three years if he is an excellent student. However, for the most part, it is a straight three-year program.

Table 1

British Airways Engineering Apprenticeship

-Three-Year Course-

First Year

14 weeks College studies - in house

26 weeks Engineering Skills Training Centre

06 weeks Practical work experience

Second Year

14 weeks College studies - in house

32 weeks Practical work experience

Third Year

46 weeks Practical work experience

College studies if necessary

College studies are carried out on a block release basis.

The first year of training is spent entirely in the apprentice training school. Subsequent years involve considerable hands on experience. Students rotate through all departments within our maintenance facilities. Some of the students will go on to work on airplanes. Others will proceed to working on components. In any event, when they begin their apprenticeship, they know where their program is leading. In doing this, we are relying on our learning from an earlier mistake in which we promised all apprentices that "You'll end up working on airplanes." When they finished their apprenticeship some years ago, some of the students were assigned to workshops. They did not like this at all, since they all wanted to work on airplanes. To avoid this discontent, we now tell each student exactly where he/she is going to go.

In addition to our apprenticeship procedures we have developed something called an *"ab initio* program." This program is developed to address the training needs of persons who already may have a certain measure of skill. For example, a number of our applicants have a military background. These people generally have skill in one discipline. Since we do not employ any single discipline people, we must provide training for the other skills and also ensure that these skills now address issues in civil aviation. Finally, there is the matter of standards. Generally speaking, to get to the equivalent of the U.S. A&P license -- a license without a type rating -- three years of aircraft experience is required. This represents half of the entire picture. We can take any student with appropriate skills and lead them to the aircraft maintenance certificate (AMC), which is half way toward a full license. It shows a level of attainment. With the AMC, a technician can proceed to licensure without type rating in about two more years. At that point they become my problem, since I am the Maintenance Training Manager. We then train to authorization level those individuals who hold the license without type rating.

In summary, we have described a crisis that is coming. In one way of looking at this, the crisis may represent an opportunity. However, it is a crisis nonetheless. We have looked at our program to increase our apprentice numbers; we have looked at our links with education; we have looked at work experiences; and we have looked at the *ab initio* program. There is one other alternative. This involves placing a paper bag over one's head, with the words on the front of the bag saying "Method 1. Place bag over head and pretend it will not happen."

INCREASED USE OF WOMEN AND MINORITIES IN MILITARY AVIATION MAINTENANCE

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This presentation addresses the topic of women and minorities in aviation maintenance. All of the information to support this presentation is taken from aviation maintenance in a military setting. However, the information may offer something new for many of you. There are interesting trends in military aviation maintenance that perhaps are shared with civilian industry.

Aviation Maintenance Occupations

The occupation of aviation maintenance in the military is an elaborate structure. The Department of Defense Job Classification System divides aviation maintenance positions into five general categories, all under the broad heading of Electrical/Mechanical Equipment Repairer. The five general categories include (1) aircraft, general; (2) aircraft engine; (3) aircraft accessories; (4) aircraft structures; and (5) aircraft launch equipment, which is only a Navy or Marine Corps occupation. Actually, there are about 216 separate aviation maintenance job titles within these categories, with 28 specialties in the Army, 90 in the Navy, 78 in the Marine Corps, and 20 in the Air Force.

Table 1 shows the number and percentage of enlisted personnel assigned to aviation maintenance occupations. Not surprisingly, most aviation maintenance billets are found in the Air Force, with over 69,000 enlisted personnel. By comparison, the Navy currently has close to 50,000 sailors in maintenance occupations, followed by the Army with almost 16,000 and the Marine Corps with over 11,000. Most people in each of the services work in the field called general aircraft.

Table 1
Number and Percentage Distribution of Active-Duty Enlisted Personnel Assigned to Aviation Maintenance Occupations, by Type and Service, June 1990

	Army		Navy		Marine Corps		Air Force	
Type of Occupation	Number	Percent	Number	Percent	Number	Percent	Number	Percent
General Aircraft	12,683	80.2	27,740	56.0	5,773	50.8	35,477	51.2
Engine	656	4.1	4,201	8.5	1,391	12.2	9,142	13.2
Accessories	1,656	10.5	6,898	13.9	1,866	16.4	20,522	29.6
Structures	826	5.2	2,971	6.0	1,908	16.8	4,124	6.0
Launch Equipment	0	0.0	7,742	15.6	419	3.7	0	0.0
TOTAL Aircraft-Related	15,821	100.0	49,552	100.0	11,357	100.0	69,265	100.0

Source: Derived from data provided by the defense Manpower Data Center

Table 2 shows the number and percent of all active duty enlisted personnel assigned to each of the five areas over the period 1972-1990. This table shows that both the number and proportion of the forces involved in aviation maintenance have decreased since 1972. In the larger military force of 1972, about 10.5 percent of all enlistees were assigned to aviation maintenance. By 1980, this number had decreased to 8.7 percent and by 1990 to 8.4 percent. Table 2 also shows that, over the 18-year period from 1972-1990, there was a loss of over 60,000 jobs in military aviation maintenance.

Table 2

Number and Percentage of Active-Duty Enlisted Personnel Assigned to Aviation Maintenance Occupations, By Type, 1972, 1980, 1990

Type of Occupation	Number 1972	Number 1980	Number 1990	Percent 1972	Percent 1980	Percent 1990
General Aircraft	121,989	83,900	81,673	6.2	4.8	4.7
Engines	28,280	20,846	15,390	1.4	1.2	0.9
Accessories	48,743	32,199	30,942	2.5	1.8	1.8
Structures	9,268	9,345	9,829	0.4	0.5	0.6
Launch Equipment	*	7,186	8,161	*	0.4	0.4
TOTAL Aircraft-Related	208,280	153,476	145,995	10.5	8.7	8.4

Source: Derived from data provided by the Defense Manpower Data Center.
* Not used as seperate occupational type before 1976.

Assignment Patterns by Racial/Ethnic Group

The proportion of minorities assigned to aviation maintenance has increased since 1972. However, one should recognize that the proportion of minorities in the military has also increased. Nineteen hundred and seventy-two (1972) marks the end of the draft and the beginning of the All- Volunteer Force, with the last draftee entering active duty in June 1973. Over the past 10 years, the racial/ethnic composition of enlistees in aviation maintenance has remained remarkably similar, with whites representing about 80 percent, blacks about 13 percent, Hispanics about 4 or 5 percent, and people in other races about 4.5 percent.

Levels of racial/ethnic representation are shown in greater detail in the next several tables. These tables use the racial/ethnic categories of white, black, Hispanic, and other. The "other" group includes primarily persons of Asian descent. In representation studies, the proportion of a group within the total force is used as a standard or a basis for comparison. These proportions can be seen in the column labeled "Total Active Duty" at the bottom of Table 3, Table 4, and Table 5. If the proportion of the group in a certain occupation is lower than the proportion of that group in the force as a whole, that group is considered to be underrepresented. If it is higher, of course, the group is considered overrepresented.

Table 3

Percentage of Active-Duty Enlisted Personnel Assigned to Aviation Maintenance Occupations, by Type and Racial/Ethnic Group, 1972

Type of Occupation	White	Black	Hispanic	Other	All Groups
General Aircraft	87.9	8.0	3.3	0.8	100.0
Engines	86.7	8.6	3.4	1.3	100.0
Accessories	86.8	8.8	3.5	0.9	100.0
Structures	87.6	7.7	3.8	0.9	100.0
Launch Equipment	*	*	*	*	*
Total Aircraft-Related	87.4	8.3	3.4	0.9	100.0
Total Active Duty	81.5	12.6	4.0	1.9	100.0

Source: Derived from data provided by the Defense Manpower Data Center.

* Not used as separate occupational type before 1976.

Table 4

Percentage of Active -Duty Enlisted Personnel Assigned to Aviation Maintenance Occupations, by Type and Racial/Ethnic Group, 1980

Type of Occupation	White	Black	Hispanic	Other	All Groups
General Aircraft	79.7	12.1	3.8	4.4	100.0
Engines	76.9	13.3	4.5	5.3	100.0
Accessories	77.8	13.5	4.0	4.7	100.0
Structures	76.7	14.5	4.6	4.2	100.0
Launch Equipment	68.5	22.0	3.9	5.6	100.0
Total Aircraft-Related	78.2	13.2	4.0	4.6	100.0
Total Active Duty	69.7	21.9	4.0	4.4	100.0

Source: Derived from data provided by the Defense Data Center.

Table 5
Percentage of Active-Duty Enlisted Personnel Assigned to Aviation Maintenance Occupation, by Type and Racial/Ethnic Group, 1990

Type of Occupation	White	Black	Hispanic	Other	All Groups
General Aircraft	79.0	11.9	4.6	4.5	100.0
Engines	74.8	14.1	5.7	5.4	100.0
Accessories	75.7	15.5	4.8	4.0	100.0
Structures	80.8	10.5	4.9	3.8	100.0
Launch Equipment	60.9	25.1	7.8	6.2	100.0
Total Aircraft-Related	77.1	13.5	4.9	4.5	100.0
Total Active Duty	67.7	23.0	4.9	4.4	100.0

Source: Derived from data provided by the defense Manpower Data Center.

Table 3 shows that in 1972 each of the three minority groups was underrepresented in every aviation maintenance category. For example, blacks comprised about 8.3 percent of persons in all maintenance jobs though they accounted for close to 13 percent of the total enlisted force.

By 1980 (Table 4), the proportion of minorities in all maintenance positions was 21.8 percent. This is up from 12.6 percent in 1972. Yet the proportion of minorities in the enlisted force had also grown from 18.5 percent in 1972 to 30.3 percent in 1980, leaving blacks at 22 percent of the total. Again, blacks are underrepresented in all categories of aviation maintenance except Launch Equipment.

Little had changed by 1990. The proportion of minorities in the total enlisted force increased by just two percent. The proportion of minorities in aviation maintenance increased by just one percent. Again, blacks were noticeably underrepresented in all areas except Launch Equipment, a Navy occupation. This underrepresentation can be seen especially in General Aircraft and Structures. However, this pattern is not the same for Hispanics and other minorities. For example, Table 5 shows that Hispanics are overrepresented in Engines as well as Launch Equipment, and approximately represented in the other areas. The same is true for other minorities, who are essentially underrepresented in only Structures and Accessories.

When racial/ethnic assignments are further considered for male and for female enlistees, the picture changes very little. For example, whites account for about 77 percent of all men assigned to aviation maintenance, while white women account for almost 80 percent of such assignments. At the same time, blacks comprise 13.6 percent of men and 12.9 percent of women serving in aviation maintenance. Gender differences will be explored in greater detail later.

Table 6 compares racial/ethnic distributions by service. Blacks are underrepresented in aviation maintenance within all four branches of the military; especially in the Army, where they account for almost one-third of enlisted personnel and just 13 percent of persons assigned to these maintenance positions. Minority group participation is highest in the Navy at 28 percent and lowest in the Marine Corps at 20 percent. It is interesting to note that the Navy has the highest proportion of blacks assigned to aviation maintenance, almost 15 percent, though it has the lowest level of total black representation at just over 17 percent.

Table 6

Percentage Distribution of Active-Duty Enlisted Personnel Assigned to Aviation Maintenance Occupations, by Racial/Ethnic Group and Service, June 1990

Racial/ Ethnic Group	Army		Navy		Marine Corps		Air Force	
	Aviation Maintenance	All Active Duty	Aviation Maintenance	All Active Duty	Aviation Maintenance	All Active Duty	Aviation Maintenance	All Active Duty
White	78.4	59.2	72.0	71.1	80.5	69.0	79.8	75.3
Black	13.1	31.9	14.7	17.4	11.0	20.7	13.2	17.6
Hispanic	3.5	4.3	6.5	5.9	6.2	7.2	3.9	3.8
Other	5.0	4.6	6.8	5.6	2.3	3.1	3.1	3.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Derived from data provided by the Defense Manpower Data Center

Assignment Patterns by Gender

Table 7 addresses assignment differences by gender across the services. These data show that women generally are underrepresented in aviation maintenance. Female representation is highest in the Navy, where close to 10 percent of personnel assigned to Aircraft Accessories are women. Women are overrepresented among sailors assigned to Aircraft Engines, at about 13 percent. As of June 1990, there were 6,875 women assigned to an aviation maintenance job. Over one-half of these women were in the Air Force, and 39 percent were in the Navy.

Table 7
Women as a Percent of All Active Duty Enlisted Personnel Assigned to Aviation Maintenance Occupations, by Type and Service, June 1990

Type of Occupation	Army	Navy	Marine Corps	Air Force	All Services
General Aircraft	2.3	3.8	1.7	3.8	3.4
Engines	4.7	12.8	2.7	6.6	7.8
Accessories	2.7	9.9	4.3	6.6	6.9
Structures	3.5	8.5	1.7	5.9	5.7
Launch Equipment	*	5.7	4.5	*	2.3
Total Aircraft-Related	2.5	5.4	2.4	5.1	4.7
(Number)	(398)	(2,690)	(268)	(3,537)	(6,875)
Women as a Percent of All Active Duty Enlisted Personnel	11.3	9.9	5.0	13.9	10.9

Source: Derived from data provided by the Defense Manpower Data Center.
* The Army and Air Force have no personnel assigned to this occupational type.

The percentages of women in the five occupational categories (by selected years from 1972 to the present) are shown in Table 8. Basically, the number and proportion assigned to aviation maintenance increased after the end of the draft, but assignment rates have remained fairly stable for the past decade. In 1980, women represented 8.5 percent of all enlisted personnel and 4.3 percent of those assigned to aviation maintenance. By 1990, the proportion of women in the enlisted force had risen to just under 11 percent. At this time women accounted for fewer than five percent of personnel assigned to aviation maintenance. Numerically, there were over 41,000 more female enlistees in 1990 than in 1980, yet the number serving in aviation maintenance increased only by about 300. The number of women assigned to aviation maintenance in 1990 also marked a decline from the level of 1988.

Table 8
Women as a Percent of All Active-Duty Enlisted Personnel Assigned to Aviation Maintenance Occupations, by Type, Selected Years, 1972-1990

Type of Occupation	1972	1976	1980	1984	1988	1990
General Aircraft	a	2.0	2.7	2.1	3.0	3.4
Engines	o	2.6	6.9	6.8	7.1	7.8
Accessories	o	2.5	7.5	6.9	6.8	6.9
Structures	o	1.8	4.1	5.3	4.5	5.7
Launch Equipment	b	0.3	0.2	1.5	3.2	2.3
Total Aircraft-Related	a	2.1	4.3	4.0	4.4	4.7
(Number)	(3)	(3,333)	(6,540)	(5,991)	(6,958)	(6,875)
Women as a Percent of All Active Duty Enlisted Personnel	1.6	5.3	8.5	9.5	10.4	10.9

Source: Derived from data provided by the Defense Manpower Data Center.
a. Less than 0.5 percent.
b. Not used as separate occupational type before 1976.

Possibly the most interesting column in Table 8 is the one for 1972, which shows that there were just three lonely female technicians spread between General Aircraft and Launch Equipment. My guess is that the one in Launch Equipment was a coding error in the database, leaving only two women in the field, which also may be the result of coding errors. The interesting feature, however, is that in just 6-8 years, the number of women assigned to aviation maintenance grew from virtually zero to well over 6,000. This is a remarkable increase in the number of women within a specialized branch of the workforce.

Possible Reasons for Trends in Participation by Women and Minorities

Several factors may have influenced the patterns of participation by women and minorities in aviation maintenance. First, there is the factor of individual choice. Recruiters may try to "steer" new recruits into certain occupations, but the element of personal choice reigns supreme as a possible reason for an assignment decision in our All-Volunteer Force. Nevertheless, recruiter influence is a variable to consider. Service-provided incentives are also used to fill some occupations, and service policies or legal restrictions (such as limitations on assigning women to combat) may play a role.

A critical factor, which can limit the range of choices for a new recruit, is the aptitude test used to determine eligibility for training in specific military occupations. All services use the Armed Services Vocational Aptitude Battery (ASVAB) for initial selection and for assignment to specific jobs. Each service uses its own composites of subtests from the ASVAB to determine eligibility. Composites and cut scores are validated against successful completion of training in the relevant occupations. Yet, there remain wide differences in test performance by racial/ethnic groups. And because the selection test is a vocational aptitude battery emphasizing traditionally-male occupations, or traditionally-male skills, the scores of men generally are higher than those of women on most of the subtests and composites. The largest differences are found on ASVAB subtests dealing with electronics, automobiles, and shop practices.

For Table 9, a representative aviation maintenance job was selected in each of the services and an estimate made of the proportion of the general population (ages 18-23, by racial/ethnic group) that could qualify for the job based on the service's enlistment standards and the aptitude composite cut scores for assignment to training. Physical and strength requirements were not considered here. As can be seen, enlistment and assignment criteria for these aviation maintenance jobs are more selective for minorities than for whites. For example, two out of three young white men in the general population would probably qualify for enlistment and assignment to a typical aircraft maintenance job in either the Army, Marine Corps, or Air Force. This compares with about one out of four Hispanics, and one out of ten blacks. In the Army, 64 percent of young white men could probably qualify for training as a Utility Airplane Repairer, compared with 8.8 percent of blacks, and 26.4 percent of Hispanics.

Table 9

Percentage of Young Men (18-23 years old) Who Would Qualify for Enlistment and Assignment to Aviation Maintenance Training, by Service and Racial/Ethnic Group

Racial/ Ethnic Group	Army Utility Airplane Repairer	Navy Aviation Machinist's Mate	Marine Corps Aircraft Mechanic	Air Force Tactical Aircraft Maintenance Specialist
White	63.7	73.6	63.3	66.6
Black	8.8	21.6	10.8	13.5
Hispanic	26.4	36.4	26.0	28.6
All Group	54.2	64.4	54.1	56.7

Source: M.J. Eitelberg, Manpower for Military Occupations (Washington, D.C.: Office of the Assistant Secretary of Defense [Force Management and Personnel], 1988).

Table 10 compares men and women in terms of the effect of the aptitude criteria on eligibility rates in the same jobs. The projected elibility rates for all young men are over 50 percent, compared with a rates ranging from 18 percent in the Army to 27 percent in the Air Force for women. Note that eligibility rates for both men and women are higher in the Navy than in other services. Proportionately more women and minorities may be able to meet enlistment and aptitude standards in aviation maintenance in this particular service. This may help to explain why the Navy has the largest proportion of minorities serving in these occupations.

Table 10

Percentage of Population (18-23 years old) Who Would Qualify for Enlistment and Assignment to Aviation Maintenance Training, By Service and Gender

Gender	ARMY Utility Airplane Repairer	NAVY Aviation Machinist's Mate	MARINE CORPS Aircraft Mechanic	AIR FORCE Tactical Aircraft Maintenance Specialist
Male	54.2	64.4	54.1	56.7
Female	17.6	51.5	20.7	27.1

Source: M.J. Eitelberg, Manpower for Military Occupations [Washington, D.C.: Office of The Assistant Secretary of Defense [Force Management and Personnel], 1988).

Other factors may bear on assignment trends. For example, participation by women in aviation maintenance may be affected by legal and policy restrictions on women in combat. Also, certain physical or strength requirements may operate to screen out women at the start, or cause them to leave training or the job after some time. Anecdotal evidence suggests that the physical demands of the military's aviation maintenance jobs may be greater than anticipated by some women -- resulting in training attrition or personnel turnover after initial assignment.

Continuation Rates for Enlisted Personnel Assigned to Aviation Maintenance

Once assigned to aviation maintenance, do minorities and women tend to remain in this occupation as long as their white male counterparts? Table 11 presents continuation rates of enlisted personnel assigned to aviation maintenance over the 16-year period from 1974-1990. These data show that minorities originally assigned to aviation maintenance remain on active duty at rates greater than those of their white counterparts. Minorities likewise tend to continue longer than do their white counterparts in aviation maintenance. For example, over 22 percent of blacks who were originally assigned to aviation maintenance in 1974 remained on active duty as of June 1990. Almost 15 percent of these were still assigned to a job in aviation maintenance. Comparable rates for whites were 15 percent on active duty and nine percent in aviation maintenance.

Table 11

Continuation Rates of Enlisted Personnel Assigned to Aviation Maintenance over a 16-year Period: Persons Who Joined 1974 (circa) As of 1990, By Racial/Ethnic Group and Gender

Racial/Ethnic Group	Number Assigned in 1974	Percent Still on Active Duty	Percent Still in Aviation Maintenance
White	13,695	14.6	9.3
Black	2,609	22.4	14.5
Hispanic	888	18.6	12.8
Other	292	26.7	1.5
Gender			
Male	16,107	15.9	10.8
Female	1,377	18.4	5.9
Total	17,484	16.1	10.4

Source: Derived from data provided by the Defense Manpower Data Center.

Continuation rates for women assigned to aviation maintenance are consistently lower than the rates for men. At the same time, differences between the active duty continuation rates of men and women are smaller, with the percentage of women actually higher than that of men after 16 years. Table 11 shows that just six percent of women originally assigned to aviation maintenance in 1974 were still serving in a related area after 16 years, compared with about 11 percent of men.

One reason military technicians may be leaving is because they are offered jobs in civilian industry. This may be a real problem for the military in years ahead. As demographers have pointed out, the available population will be shrinking. At the same time, there has been a remarkable decline in scores on widely-used tests of aptitude and scholastic achievement -- including a drop in scores on the Scholastic Aptitude Test that began in 1963 and apparently leveled off in the 1980's. The proportion of people who can qualify for high-tech occupations or aviation maintenance occupations or avionics occupations is relatively small in the general population, particularly in the case of minorities and women. There may well be serious competition between the military and the civilian sector for these qualified people in coming years.

Several factors may help to explain continuation rates for different groups. Minorities tend to reenlist in the military at relatively higher rates. This often is attributed to the "push/pull" relationship between military opportunities and civilian employment. Pushing the minority member into the military are civilian unemployment or underemployment, and other social or economic inequities. Pulling the minority into the military are the many benefits of military service, which now include substantial money for college (through the G.I. Bill) and training in "civilian-transferable" occupations.

Women who enlist in the military seem to look for traditional employment. Surveys conducted over the past several years have found that women joining the military were most interested in traditionally-female jobs such as administration and nursing. This may say something about our school systems, about our culture and upbringing. It may also say something about how the military is "sold" to these women. Nevertheless, placing women into non-traditional areas has not been particularly easy.

Commissioned Officers Assigned to Aviation Maintenance by Racial/Ethnic Group and Gender

This section looks at the racial/ethnic and gender differences among commissioned officers, those who lead and direct the aviation maintenance crews. Table 12 shows that black officers are somewhat underrepresented in aviation maintenance, a trend that has continued for at least 18 years. For example, as of June 1990, blacks accounted for about seven percent of all officers and between five and six percent of officers working in aviation maintenance. Hispanics and other minorities make up a small proportion of the officer corps, but are approximately represented in aviation maintenance.

Table 12

Percentage Distribution of Commissioned Officers Assigned to Aviation Maintenance and all Occupations, by Racial/Ethnic Group, Selected Years 1972-1990

Racial/ Ethnic Group	1972		1980		1990	
	Aviation Maintenance	All Occupations	Aviation Maintenance	All Occupations	Aviation Maintenance	All Occupations
White	96.9	96.1	93.5	90.7	89.7	87.9
Black	1.6	2.3	3.5	5.0	5.5	7.0
Hispanic	1.1	1.2	1.2	1.1	2.1	2.1
Other	0.4	0.4	1.8	3.2	2.7	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Derived from data by the Defense Manpower Data Center.

To become an officer in the military, a candidate must have a college degree. Blacks account for about six percent of all persons (ages 20 through 29) with a four-year college degree. If that figure is used for comparison, the military is doing quite well. If the general population is used for comparison, then blacks should be considered underrepresented in the officer corps.

Table 13 shows the percentage distribution of commissioned officers by gender over the 18-year period since the start of the All-Volunteer Force. Female officers have been underrepresented in aviation maintenance for the entire 18 years. Women currently comprise over 11 percent of the officer corps and just over eight percent of officers in aviation maintenance. In 1972, about four percent of officers were women, compared with one-tenth of one percent of female officers assigned to aviation maintenance. Since then, the picture has improved, but they remain underrepresented.

Table 13

Percentage Distribution of Commissioned Officers Assigned to Aviation Maintenance and All Occupations, by Gender, Selected Years, 1972-1990

Gender	1972		1980		1990	
	Aviation Maintenance	All Occupations	Aviation Maintenance	All Occupations	Aviation Maintenance	All Occupations
Male	99.9	96.2	95.6	92.3	91.7	88.7
Female	0.1	3.8	4.4	7.7	8.3	11.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Derived from data provided by the Defense Manpower Data Center.

Conclusions

This discussion has been more descriptive than prescriptive, but several important issues are noted. Following the advent of the All-Volunteer Force in 1972, the percentage of women and minorities working in aviation maintenance has increased. However, these groups remain underrepresented in this area. Certainly, an important element -- perhaps even more important than personal choice -- is the test used to determine eligibility for specific jobs. Performance on this test will ultimately determine the alternative job choices available to the new recruit.

Both the military forces and civilian industry in coming years will be drawing on an increasingly tight labor market to meet their demands for aviation maintenance. Women and minorities must be used more extensively. We must continue to explore better ways to recruit, train, and use these valuable resources.

AVIATION MAINTENANCE WITH A SMALL WORKFORCE

Brian Whitehead
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When I was first asked to speak about the problems of managing aviation maintenance in a country that can only draw on a small workforce, my immediate answer was that I could speak about the problems, but would not be able to shed much light on the solutions. That assessment has not changed. I can, of course, outline the systems we have adopted in the Canadian industry, but I cannot claim that they are the answer to all our prayers. In fact, in some ways I think we are moving in the wrong direction. In these particular areas, my personal views may differ from those of the industry at large and the present policies of my department. I should say, therefore, that these opinions are mine alone.

Although we speak of Canada as drawing on a small work-force, this is true only by comparison with the United States. In global terms, the Canadian Air Transport industry is quite large. In fact, the Canadian civilian aircraft fleet is the second largest in the western world.

Canada's geography makes air transport an essential part of the country's infrastructure. The country covers an area slightly larger than that of the United States, although the population is only one tenth the size. Most of this population is spread along a narrow ribbon bordering the U.S. and this is where most of the large jet activity takes place, as shown in Figure 1. There are a few large northern communities that are served by the big airlines, but there are many more small settlements distributed across the entire northern area. Here the demand is more for bush aircraft, including float planes and helicopter services. For some more remote communities, air travel is the only practical means of access. Even between major centers, the distances involved effectively rule out other means of transportation.

Figure 1

The Canadian Air Transport industry is like the U.S. industry in microcosm. It is one tenth the size, by almost any yardstick you care to apply. Not only do we have one tenth of the total number of aircraft, but the same ratio applies to the numbers of aircraft in various categories and even, to a large degree, to the numbers of each type of aircraft.

We have a total of about 28,000 aircraft on the register, most of them private; two place and four place machines. Figure 2 shows the proportions of the various classes of aircraft that make up the fleet. I believe the general distribution is similar to the U.S. register.

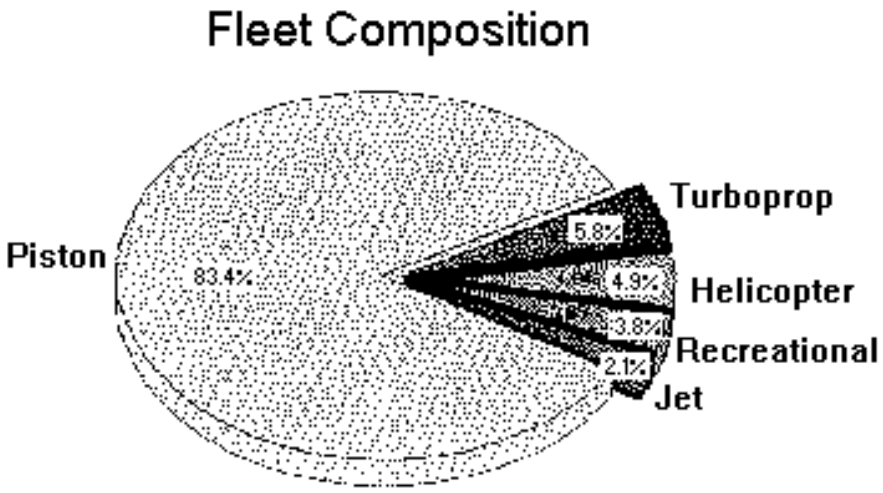

Figure 2

The important thing to keep in mind here is that the type of technology is far more important than the total numbers. An operator acquiring, say, five aircraft of a new type faces the same challenges as an operator acquiring fifty. What he does not get are the economies of scale.

Although the Canadian fleet is one tenth the size of the U.S. fleet in terms of the number of aircraft, it is practically the same in terms of the types operated. Almost every type of aircraft certified in the western world is represented on the Canadian registry eventually.

Apart from the differences in size, there are of course cultural and political differences between the two countries. The most obvious cultural difference is the use of two official languages, but another is a different perception of the role of government. Compared with the U.S. there is maybe more of a tendency to look to government, rather than private industry, for solutions, although that gap seems to be closing on both sides of the border. The political differences show in the rulemaking process. Although the system is more rigidly controlled than the European models, it is probably still considerably more flexible than the U.S. system.

Like many of our maintenance rules, the Canadian aircraft maintenance licensing system was initially based on the British model. Although it has since undergone major changes, it still has more in common with that system than with FAR 65.

The differences between the Canadian Licence system and the FAA system are so great as to make comparisons almost meaningless. For a start, the privileges of the AME licence are concerned with the certification of the work, not with its performance.

Anyone may perform maintenance except that, if the aircraft is engaged in commercial operation, the work must be done under the control of an approved organization. Only an AME may make the necessary certification. It is difficult to draw direct comparisons, but the privileges of the AME Licence are broadly equivalent to the FAA Inspection Authorization.

The requirements for issue are roughly in line with this. For the basic category "M" licence, they specify four years experience, plus the examination and training requirements. There are additional experience requirements for each of the various rating groups.

One element of the U.S. system for which there is no counterpart is the practical test. We would like to introduce practical testing but it is just too costly. Even a delegated system such as you have in the U.S. would be expensive and, I think most people would agree, open to abuse.

Since the AME licence is a supervisory qualification rather than a tradesman standard, it follows that not everyone employed in the industry need hold one. Figure 3 will give some idea of the proportions of licensed AMEs in the work force for various segments of the industry.

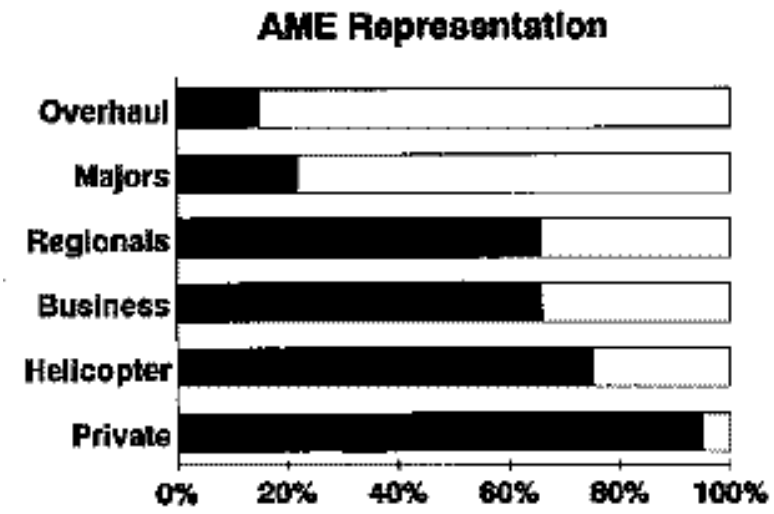

Figure 3

As you can see, the segments that tend to work in large organized teams need relatively few AMEs, usually in supervisory positions. In general aviation, where it is much more common for the individual to work alone, almost everyone holds a licence. Another factor influencing the proportion of AMEs in the workforce is the degree of specialization required. Although the licence system makes some provisions for specialists, for the most part the AME is a general practitioner. Some more highly specialized off-aircraft maintenance tasks are performed by organizations having no AMEs at all.

I should add here that my previous statement that only AMEs are allowed to certify maintenance applies only to work done on the aircraft. In specialist component shops, unlicensed technicians may be authorized to sign. This procedure corresponds roughly to the FAA certified repairman system.

Although the aircraft technician forms the single largest segment of the work force, this still only amounts to 38 percent of the total. The various other specialties combined total almost twice as much.

When certifying maintenance, the AME is not acting for his employer. He is exercising professional judgement on his own behalf and will be held personally accountable for his decisions. The same applies to authorized signatories in component shops. The employer is held separately accountable under parallel legislation.

The Canadian Aircraft Maintenance Engineer (AME) Licence comes in one of four categories, as shown in Figure 4. It is a complex system, that takes a lot of administering. It has had advantages but I personally think that it has now outgrown its usefulness. I will say more about this later.

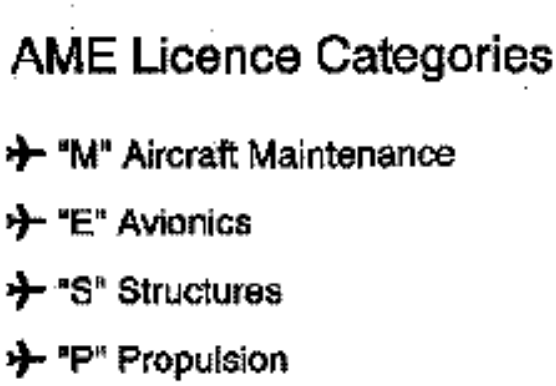

Figure 4

Over the past few years, as the effects of deregulation have started to be felt, it has become obvious that one of the main factors limiting the growth of the industry is the supply of skilled maintenance personnel. The Canadian Employment and Immigration Commission (CEIC) recently completed a study of this problem and reported that, although the recent period of growth was expected to level off in the short term, the long term prospects for the industry were strong. They estimated that the Canadian aircraft maintenance industry will require 10,000 to 30,000 new workers by the year 2000.

The industry has traditionally neglected any kind of forward planning for future personnel needs. This contrasts strongly with the European approach with its apprenticeship system. Instead, Canada has relied on three major sources of supply; the armed forces, immigration, and on-the-job training. The first two are now almost non-existent. Our present armed forces are so small as to make only a negligible contribution and, in any case, they offer a sufficiently attractive career in their own right so that the really qualified people tend to stay in. Even for those who do leave, the armed forces trade specializations are so narrow that the transition to civil aviation is difficult and many ex-servicemen become discouraged.

The pattern of immigration has changed and Canada is no longer as attractive to the skilled European tradesman as it once was. In fact, for the first time, we are now seeing the flow reversed and European companies are recruiting in North America. We still get some qualified people from Asia but, by and large, the shortage of aircraft maintenance technicians is worldwide, so we have to compete on that basis. Given that the profession carries a higher status in most countries than it does here, we are not doing too well.

So far as on-the-job training is concerned, the complexity of modern aircraft pretty well rules it out altogether. In fact, as of this year, formal structured training has been made a mandatory requirement.

The demand for skilled personnel will not be limited to AMEs. The areas of greatest need will be in the specialized trades. Sheet metal and composite structure technicians, avionics technicians, interior refurbishers, and NDT specialists will be in particular demand. The problems are compounded by the lack of a structured career system for these specialties.

In the short term, the difficulty in recruiting is likely to be felt most by the smaller carriers. In the long term though, the large carriers and the repair and overhaul sectors will be the most affected.

The present rate of turnover for the industry as a whole is in the order of 10 to 15 percent. If evenly distributed, this would not be too bad but, unfortunately, the turnover in the smaller carriers and general aviation is considerably higher than the average. Also, much of the activity is a result of workers leaving the industry altogether.

There is a definite drift of trained workers away from the industry. There are many reasons for this drift but one obvious one is uncompetitive pay rates. Figure 5 shows entry level pay rates for comparably skilled workers in several industries. These figures relate to unionized companies. Many smaller carriers are not unionized and the pay rates are accordingly lower. Figure 6 shows the breakdown of pay levels by industry sector and contrasts starting levels with the levels paid to experienced personnel. Business aviation is the clear winner here perhaps because they tend to hire mostly senior technicians. After that, the major carriers pay reasonably well but the rest of the industry is uncompetitive. The horizontal line at $25,000 represents the mean rate for all hourly paid workers in Canada.

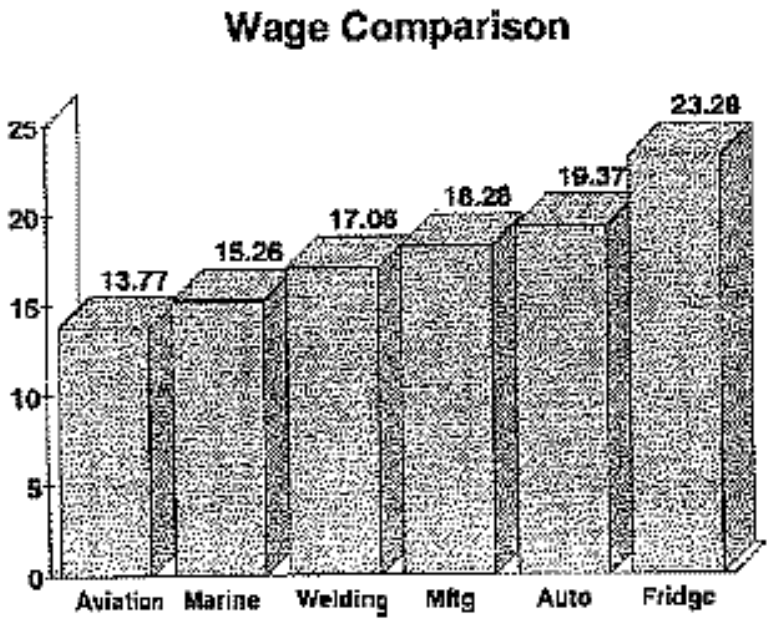

Figure 5

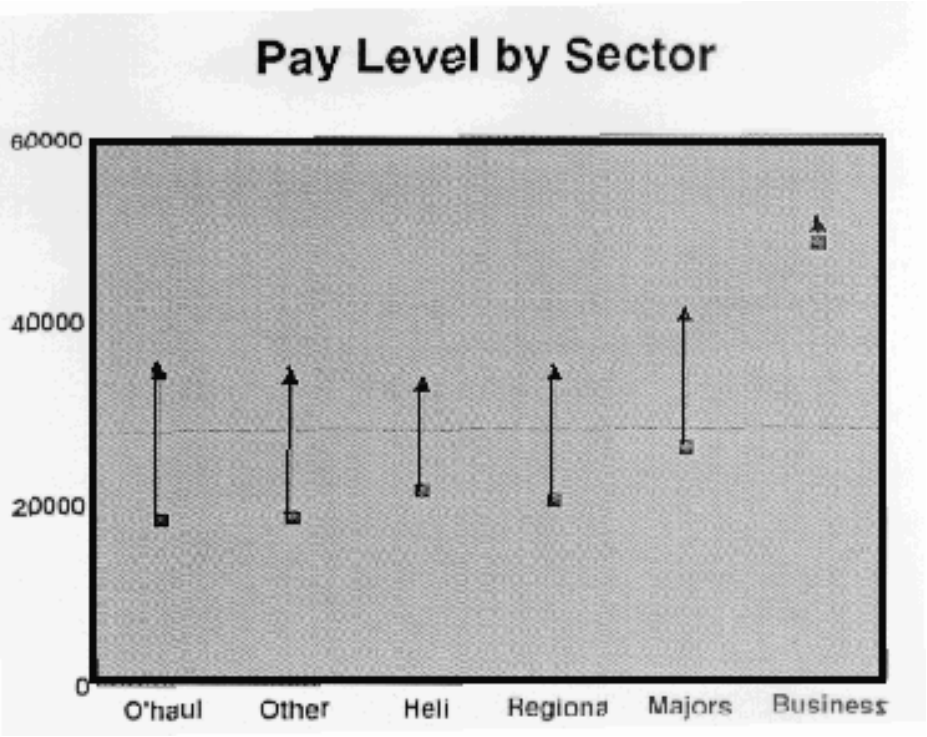

Figure 6

Aviation maintenance has never been known for high pay levels but it has traditionally made up for this by offering other incentives. In particular, the glamour of aviation used to be a big drawing card and probably most of us were first attracted to the industry by the mystique of flight. I know I was and I still feel the same way. I have a lot in common with the honey cart driver who went home after a particularly hard day covered in the contents of a toilet that had spilled out due to a stuck valve. When his wife suggested he think about changing jobs, he replied, "What, and get out of aviation?".

It would be a mistake to expect today's youth to see the industry through our rose tinted spectacles. To many, the airplane is just another means of transportation. Compared with the current glamour jobs in computing and communications, there is no contest.

The industry as a whole has done a lousy job of selling itself as a field in which to have a satisfying career. The public at large still does not have the slightest idea of what aircraft maintenance is. Much of this ignorance is the result of previous airline policies. Years ago, when I worked for BOAC, we were told to keep out of sight when we were in coveralls. The management thought it was bad for business for the passengers to see a mechanic and be reminded that aircraft were technical devices that could go wrong.

Personally, I would be concerned to fly on an airplane that appeared to have no maintenance but the public was thought to believe otherwise. Things are changing now, to the extent that some airlines are even stressing the competence of their maintenance staff in commercials but we still have a long way to go. During the CEIC study, high school students in technology related courses, who might have been expected to be strong candidates for a career in aviation, speculated that aircraft maintenance must be dirty, boring work; consisting mostly of refueling.

So, we not only have to do something about our pay levels, we have to work on our image. We also need some nationally, or better yet internationally, recognized standards for some specialist trades. Some of these specialties are unique to aviation but many can be based on the requirements of other industries. Among the major specialties are avionics technicians, NDT technicians, sheet metal technicians, welders, composite material specialists, engine overhaulers, hydraulic and pneumatic specialists, machinists, painters, and upholsterers.

Another area in need of standards is maintenance management. In this respect, the U.S. is definitely ahead of Canada as several colleges already offer courses on the subject. I hope we can develop something similar in Canada soon because it is a real area of weakness. If we are to make the most of our limited resources, we will need knowledgeable leadership. We will also need a regulatory framework that will allow the leaders to use their knowledge. We hope to get that through an emphasis on regulation by objective.

The only basic aircraft maintenance training available in Canada is for the aircraft maintenance technician and the avionics technician. In both cases, the training is more appropriate for the general aviation field than for large carrier aircraft although the need is for the latter.

Figure 7 shows the distribution of the workload across various sectors of the industry. If we contrast this with the earlier pie chart on fleet composition (Figure 2), we can see that the massive preponderance of small piston powered aircraft does not have much effect on the requirement for maintenance personnel. Only 4.1% of the work force is employed in this area. But this is the sector the schools are teaching for! Figure 8 gives some idea of the distribution of the work force within the commercial sector. You can see that the biggest employers are in third line support, mainly equipment overhaul, with the major carriers a close second.

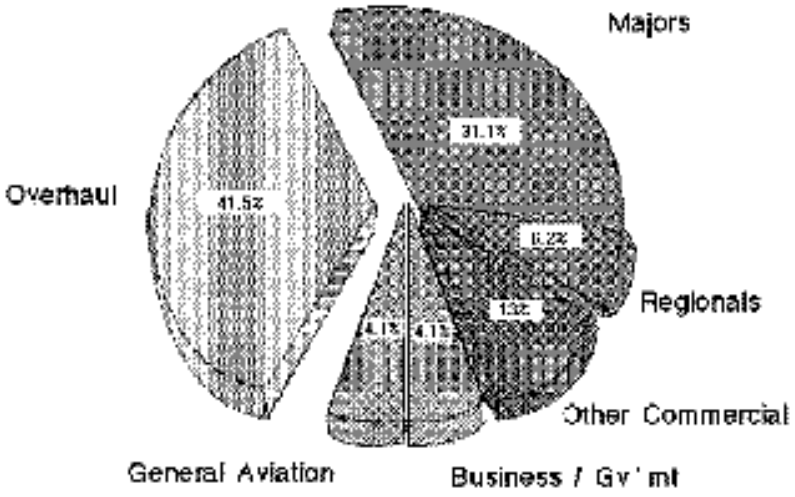

Figure 7 Workload Distribution

Aircraft Maintenance Industry

	Companies	Aircraft	Employees
Major Carriers	2	231	6000
Regional / Charter	17	235	1200
Other Commercial	718	3619	2500
Overhaul	200	-	8000
Business / Gv'mt	88	535	800

Figure 8

The schools have a tendency to teach what they are equipped for, rather than equipping for the training that the industry needs. It is hard to blame them for that, though, as the required equipment is pretty expensive. Nevertheless, the emphasis will have to change. Computer based interactive training techniques might be one answer to the equipment problem.

Currently, we have 12 colleges in Canada, offering [aircraft maintenance training] with course lengths from one to three years. They collectively graduate about 675 students per year. Not all graduates enter the industry; some go on to higher education and eventually work in other related fields. Others simply move to a more attractive career in a different industry.

To meet the needs that will arise over the next decade, we need to attract more suitably qualified young people to a career in aircraft maintenance. To do this, we must not only ensure that pay levels are competitive with other industries but we must also improve the image of the business. We also have to keep an open mind regarding new developments that will allow us to get the most efficient use of out people in a rapidly changing field.

As you can see, the problems in Canada are the same as in the U.S. The solutions may be a little more difficult due to the absence of the economies of scale that apply in the much larger industry.

We are trying to combat the image problem by taking the message to the high schools. As part of this campaign, we will be making an effort to attract women and visible minorities. At present, the Canadian aircraft maintenance industry is almost exclusively white and male.

I already mentioned the change in attitude of the airline marketing departments who are no longer afraid to mention maintenance and are beginning to treat it as a selling point. This should help by providing some much needed visibility. Whether the pay levels will rise sufficiently to make a difference remains to be seen. The economic climate right now is not conducive to big increases but the problem has at least been recognized and compensation levels will probably grow slowly.

The Department of Transportation is working closely with the industry associations and educators to try to ensure that the training requirements for aircraft technicians are valid and up-to-date. Apart from the obvious need to address modern technology, we have to put more emphasis on analytical skills, problem solving, and communication.

Transport Canada policy will be to concern itself directly only with the core skills of aircraft maintenance. I should qualify that by saying with the" supervision" of aircraft maintenance. In the area of the specialist trades, we will take an advisory role only. These trades have so much in common with other, provincially regulated, occupations that it would be wasteful for the Federal government to duplicate the existing requirements. We will be available for consultation, as required, and we will offer advice where necessary.

We have already assisted in identifying some trade areas that are deserving of registration on the "Red Seal" program. This is a program designed to give inter-provincial recognition of certain trade qualifications in order to facilitate movement of labour between provinces. This will also be of real value to the large carriers who have bases in a number of provinces.

In the strictly aviation courses, we will attempt to achieve a level of standardization that will enable the granting of cross-credits between courses but, at the same time, we recognize that the field of maintenance is so broad that no one school will be able to cover all aspects of it equally. There is much to be said for a degree of specialization that will allow each school to develop its own niche. The success of this approach will depend to a large extent on a liberal attitude on the part of the provincial education authorities in regard to opening of enrollment to out-of-province students.

The new Canadian Maintenance Regulations emphasize freedom-of-choice for the maintenance organization and will, therefore, support different modes of employment from traditional patterns. We will probably see more specialized maintenance organizations offering services, under contract, to a number of air carriers. This kind of arrangement enables more efficient use of limited resources. The new Canadian maintenance rules are specifically designed to accomodate these organizations. Something similar is now being introduced in the European JARs and has been proposed here as FAR 146.

One of the remaining problem areas is the AME licence system. I mentioned earlier that my personal views were not necessarily shared by the Department, or by the majority of the industry, and it is in the field of licensing that the differences show.

Along with the management of Transport Canada, I am a strong supporter of the AME licence. We have made big improvements in the licensing system lately and it is only by having an effective licensing system that we have been able to weather the storms of deregulation with so few maintenance problems. In my opinion, however, the basic structure of the system is showing its age.

Our licence system would be complex under any circumstances but it is particularly inappropriate in a country with such a widely dispersed work force. It certainly compounds the difficulties of obtaining properly qualified staff.

There are three major aspects to the problem; one is the specialized "off-aircraft" licence, for structural repair, engine overhaul, and propeller overhaul. These were originally called "ICAO Type I" licences, as opposed to the "Type II", line maintenance, licences.

This entire Type I - Type II concept is now generally accepted as being outdated. Indeed, in Canada, we already extend Type I privileges to the Category "M" line maintenance AME. This is logical as there is no need for a special licence to perform work that is "Major" in the sense that it constitutes a major design change. A good example of this is a change in engine model. The change may well be "Major" to the engineer who has to assess its effect on the airworthiness of the aircraft but, to the AME who complies with the change, it is just a matter of taking the old engine out and putting the replacement engine in.

Once this fact is acknowledged, it becomes apparent that the off-aircraft licences are really tradesman qualifications and are best associated with the approved organizations. The closest equivalent in U.S. terms is the certified repairman working in an approved repair station.

The existing specialist licence holders, however, are loath to give up their status and, indeed, the pressure to maintain this type of licence is so great that we have recently introduced a new one, for turbine engine overhaul.

Another problem is the avionics licence. This was only introduced about five years ago and was long overdue but, such is the speed with which our business is changing, it is already obsolete. The reason is the introduction of integrated systems. With the latest generation of aircraft exemplified by the A320, mechanical and electronic systems are so closely integrated that it is impossible to say where one discipline ends and the other begins.

It seems to me that the only long term answer is to go back to the idea of having a single person qualified on the entire aircraft. Of course, we will always have individuals who are specialists in one field or the other, but the average line technician is going to have to be an all-rounder.

This is actually the least controversial proposal. It has gained a fair degree of acceptance to the point that we have already introduced a requirement for an exam in basic electronics for the AME applying for a rating on these advanced aircraft. This will probably be the first step in a process that will integrate the mechanical and avionic licences into a new "super licence" by the next century.

Finally, the most controversial proposal relates to the type rating system. The "M" licence is made up of a highly complex system of type ratings. It is highly regarded by most Canadian AMEs who take pride in amassing an impressive list of licence endorsements. The system has been very successful in the past. It provided assurance that the licence holder was truly qualified, not only in his basic profession but also, on the particular aircraft on which he worked.

Once again, though, things have changed. Transport Canada has neither the resources nor the expertise to examine applicants on all of the various types on the register. As I mentioned before, although our register is only a tenth of the size of the U.S. in sheer numbers, we have just as many different types of aircraft. The emphasis has therefore shifted from examination to training. Type endorsements are mostly based on the applicant's having completed an approved course.

In addition, the new rules ensure that each maintenance organization that maintains commercial aircraft has an acceptable training program. And there lies the problem. The maintenance organizations are, naturally, expected to teach the aircraft configuration that they operate. The licence rating, however, is generic. Modern aircraft undergo many changes over their service life of twenty years or more, all under the same general type designation. There is a world of difference between the first Boeing 737 and the product being manufactured today but they are both covered by the same licence rating.

It is possible to allow for this to some extent, of course, and we do this in the case of the 747, for example. The 400 series is treated as a separate type for licensing purposes but this approach is a band-aid at best. It certainly cannot allow for the major differences between individual aircraft of the same series and model due to extensive in-service alterations.

The only acceptable long term solution I can see is to treat the AME licence like any other professional qualification; set the standard high enough so that we can have a good degree of confidence that the licence holders can handle anything that they might reasonably be expected to encounter. We will leave it to the professionalism of the individual and the other regulatory provisions to ensure that they get the required additional specialized training on type.

If this sounds familiar, it should. What I am advocating in Canada has a lot in common with the existing FAA A and P licence system. I hasten to add that does not mean I favour the existing A and P standards. We need some serious changes in the scope and depth of the curriculum. A licence with the authority I envision would require up to three years of training and a further three years of practical experience but it would do more to meet the needs of the industry than anything we have now.

As I mentioned before, however, most AMEs are proud of their type ratings so, at the present time, only a small minority in the industry agree with me. I hope that this will change as they come to see the advantages that go with a qualification that would be regarded as truly professional.