Journal of Transportation Management

Volume 10 | Issue 2 Article 4

9-1-1998

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Cover Page Footnote
The authors wish to thank the editor, Dr. Jerry Wilson, and the reviewers for their comments. This manuscript could not have been completed without the assistance of Dr. Robert N. McGrath, Sergio Da Silva, Eram Gran, Anthony Boyd, Matt Rogaliner, and Michael Blake of UAL Corp.

ASSESSING THE IMPACT OF THE SHORTAGE OF AVIATION MAINTENANCE TECHNICIANS ON AIR TRANSPORTATION

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Global aviation activity is poised for a decade of sustained growth. While economic difficulties are a fact of life in the aviation transportation industry, the future demand for aviation transportation services is promising. One factor that may greatly dampen this projected growth may be the lack of qualified aviation maintenance technicians (AMTs) necessary to keep the air transport fleet flying. This investigation examines the future of global aviation activity while presenting factors impacting the corresponding lack of growth in the AMT population that threaten the future of air transportation.

INTRODUCTION

This research report investigates the relevant supply and demand issues concerning Aviation Maintenance Technicians (AMT). Immediate and long term effects upon the aircraft maintenance environment are evaluated. The analysis focuses on three areas: (1) the general economic forecast for the US aviation industry; (2) an overview of the global aviation maintenance industry in general; and (3) current developments within US AMT and global maintenance training.

All aspects of the aviation industry have sustained cyclical trends and AMT hiring has seen these same cycles (Lombardo 1998; Young 1998). However, the aircraft maintenance industry from general aviation to the major air carriers is positioned for a rather dramatic change within the next five years. One change the aviation maintenance industry has to deal with is the impending shortage of qualified AMTs. Already some flights have been cancelled due to a lack of maintenance personnel and firms are scheduling maintenance procedures weeks in advance. The days of being able to call a

maintenance facility in the morning and fly the plane in for service that afternoon are gone (Lombardo 1998).

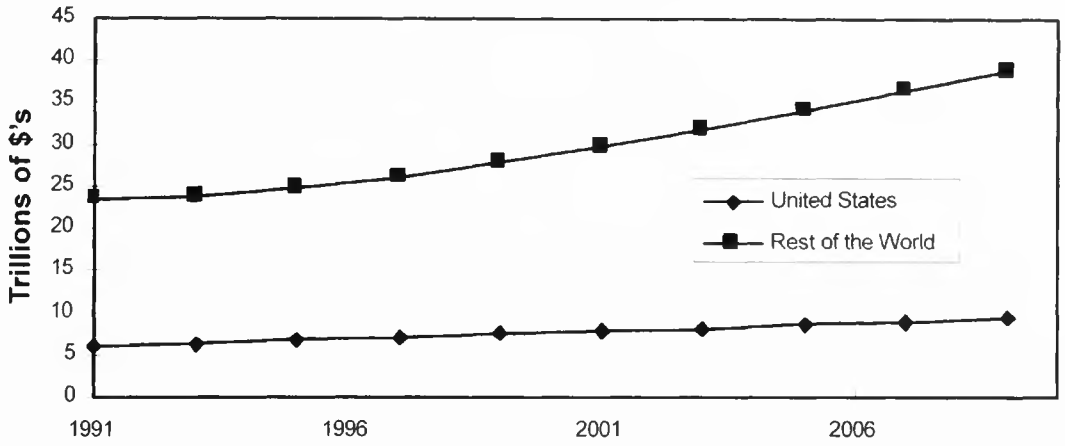
The recent supply of AMTs is approximately 11,000 newly certified aviation mechanics annually. The recent annual demand for just the major air carrier industry alone has been around 10,000 AMTs (Lewis 1998) with one forecast predicting the demand for AMTs through the year 2004 averaging about 15,000 new hires per year (Lombardo 1998). When considering the additional need for AMTs within the commuter, general aviation, third party outsourcing firms, and even the manufacturing sector, it is easy to see that the current surplus of 1,000 AMTs not needed by the major air carriers is not enough to satisfy the forecast demand. Even though the current market situation is not yet extreme, changing market conditions within the next five years warrants considerable concern and proper planning.

THE AVIATION INDUSTRY OUTLOOK AN OVERVIEW

The Economic Environment

The growth within the US aviation industry is linked directly to the performance of the US economy. With no significant inflationary pressure, the US economy has maintained its current expansion, now into its seventh year. This is the third longest expansion period in the post-World War II era. Real Gross Domestic Product (GDP) has averaged a gain of 2.9% annually since the early 1990's, and just recently the GDP growth for 1997 was 3.6%. World GDP also increased, at an annual rate of 2.6%. Even when factoring in current regional uncertainties, the strongest showings have been within the Asia-Pacific sectors, up an average of 7.8% per year (FAA 1998). Figure 1 represents the recent and anticipated US and World economic growth over the next 12 years as measured by GDP.

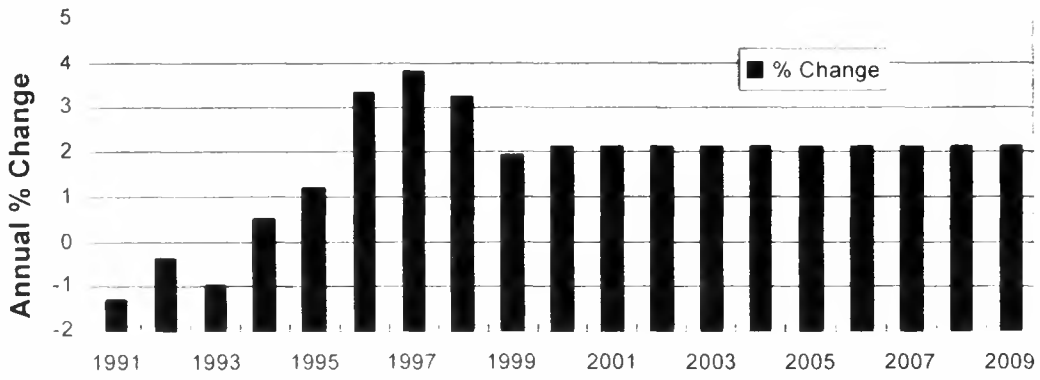
Figure 1
GDP Forecasts for the U.S. and the Rest of the World
(Figures based on $1990)



Source: FAA Aviation Forecasts, Fiscal Years 1998-2009

This growth in both world and US economies will have a major impact upon the demand for aviation services. One potential factor to consider when forecasting economic activity, and its impact upon the aviation industry, is fuel prices. For example, the Gulf War of the early 1990's, and its effect upon world oil prices had serious ramifications for the aviation industry (FAA 1998). Changes in future oil prices must therefore be included in any long-term economic outlook. Fortunately, fuel prices are expected to stay relatively stable throughout the long-term (Figure 2).

Figure 2
Oil & Gas Price Changes



Source: FAA Aviation Forecasts, Fiscal Years 1998-2009

According to the FAA Aviation Forecast (1998-2009) additional positive indicators of economic growth in the US relate to demographic and income trends in the long-term. The results of an aging population, associated with growth in disposable income for the older generations, contribute to the positive indications of increased demand for air travel. As the generations become older their tendency is to spend more on air travel (FAA 1998). The current and future elderly populations have more time and money to travel than previous generations. The result is increased leisure travel among the elderly, especially once baby boomers begin to reach retirement age.

By combining the factors of US and global GDP growth, oil price stabilization, and an aging population, the long-term future for the economic environment affecting the aviation industry looks positive. In the short run however, different international regions may experience dramatic financial and economic fluctuations. Though the effect on the US domestic aviation market would not be significant, the increased level of globalization by US based aviation organizations may result in short term economic difficulties. For example, US trade and travel to Asia has been affected due to the recent downturns in that regions economic fortune. Thus, while the world marketplace demonstrates some instability, the current and long-term growth prospects for the US aviation industry are encouraging.

The Air Carrier Environment

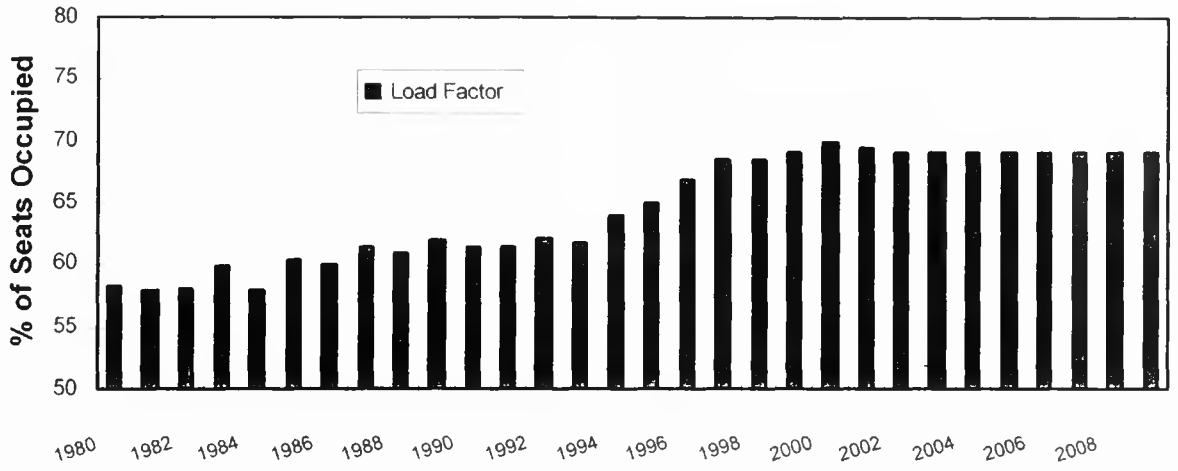
The recent 1997 fiscal year was an overall success for the US major air carriers. Industry wide available seat miles (ASMs) rose by roughly 3%. On the other hand, the more exciting news

was that revenue passenger miles (RPMs), or demand, grew by 5.1%. The result was record level load factors across the board for the large U.S. air carriers that averaged 70.3% for 1997. Figures 3 and 4 represent the expected economic situation for the air carriers:

Figure 3
U.S. Commercial Air Carriers Scheduled Passenger Enplanements

Source: FAA Aviation Forecasts, Fiscal Years 1998-2009

Figure 4
U.S. Commercial Air Carriers Passenger Load Factors
(Domestic)



Source: FAA Aviation Forecasts, Fiscal Years 1998-2009

The air carrier predictions are based on expectations of promising economic growth. The fiscal performance of the U.S. airlines within recent years has been healthy, but that is a direct result of overall economic conditions. The domestic air carrier market has proven to be very sensitive to economic conditions. During the early part of the 1990's, the domestic carriers lost more money and market share than foreign competitors. However, during the recent resurgence in the economy the domestic air carriers have financially outperformed their foreign competitors. This performance directly relates to the validity of any aviation forecast. Almost all indicators point to a positive growth within the air carrier industry. Because the success of the airlines is strongly correlated with the economy, any negative or slow growth periods within the forecast period could result in a considerable downturn in critical operating characteristics, such as expected ASMs or load factors.

The U.S. aviation industry operates in a dynamic environment. Two major factors contributing to potential changes in the marketplace are business travel substitutions and aircraft retirement (FAA 1998). Communications technologies, particularly in the later half of the forecast period, may significantly impact business travel. Developments in computer interfaces and teleconferencing, in addition to video/computer conferencing, are major forces that may hinder the growth of the business travel segment. Also, retirement of a considerable number of aircraft will occur in the near future. Stage-2 aircraft are replacing quieter more efficient stage-3 aircraft (FAA 1998). These retirements should improve the overall industry productivity and consequently lead to enhanced economic conditions.

Additional factors contributing to change within the industry are:

- Matching supply and demand more accurately through the use of yield management systems
- Continued emergence of low-cost carriers
- Efforts to reduce unit costs and restructuring
- Global strategic alliances
- Increased efficiency and productivity
- Declining real fares

Regional/Commuter and General Aviation Developments

Within the aviation industry, the fastest growing sector is that of the regional/commuter airlines. These carriers have an average RPM increase of 9.6% since 1993 (FAA 1998). The increased number of codesharing agreements between regional/commuters and major air carriers, along with the increased acquisition and consolidation within the regional/commuter industry, has contributed to the significant growth. The transfer of a large number of short feeder routes from the majors to the regional/ commuters has also assisted in maintaining the high growth rates. All of the previously mentioned factors are expected to continue into the future, resulting in a sustained long-term expansion for the regional/commuter industry.

General Aviation (GA) also experienced significant growth. The main contributor to the resurgence within this sector was the General Aviation Revitalization Act of 1994 (FAA 1998). The result has been extremely encouraging with manufacturers almost on the brink of extinction now ramping up to full production. These manufacturers are beginning to re-invest in research and development, create new product lines, and rejuvenate old lines. Within the corporate aviation sector of the GA marketplace most manufacturers' production is sold out through the year 2001 (Shay 1999). General aviation is positioned and ready to realize tremendous growth within the next decade.

THE AVIATION MAINTENANCE INDUSTRY

The maintenance sector of the aviation industry has experienced the same dynamic change that other sectors of aviation have experienced. These changes are primarily due to the maintenance market evolving to meet the needs of its largest client, the major air carriers. The airlines spent over $23 billion on maintaining, repairing, and overhauling (MRO) budgets in 1996. This figure is expected to be over $33 billion by the year 2005 (Ebbs 1997). The primary reason for this growth is that maintenance expenditures are directly linked to the hours that aircraft fly (Figure 5).

Figure 5
U.S. Commercial Air Carriers Airborne Hours

Source: FAA Aviation Forecasts, Fiscal Years 1998-2009

Total aircraft hours for both wide-bodied (WB) and narrow-bodied (NB) aircraft will approach the 20 million hour level by 2009 as indicated in the figure above. This represents the level of demand for aviation maintenance services. The increased utilization of aircraft within the U.S. air carrier industry directly results in increased MRO activities required for the future. Additionally, there are still relatively few new aircraft being utilized and the resulting aging of airline fleets tends to push maintenance costs upward (Strahler 1995).

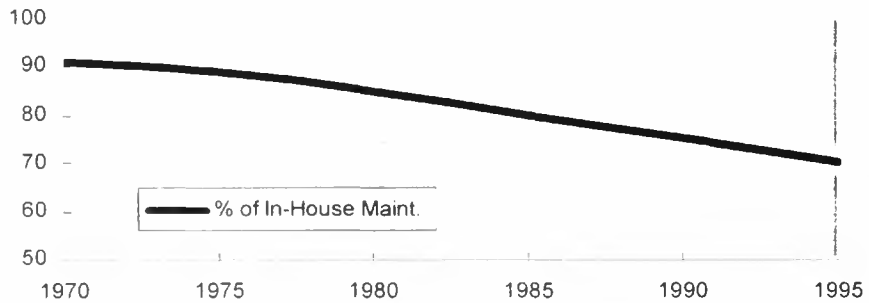
The MRO field is also changing internally and not simply because of changes in hours of aircraft utilization. Airline management is beginning to view maintenance as a non-core activity (Ebbs 1997). The implications for the industry include a shift from maintenance performed in-house at the airline's maintenance facilities to more third party firms or even original equipment manufacturers (OEMs) conducting airline maintenance (Smith and Culley 1997). The aviation maintenance industry is changing its structure to meet market requirements. Five key factors impacting the future of the maintenance industry are (Ebbs 1997):

- Outsourcing
- Increased regulatory oversight
- Greater manufacturer participation
- Restructuring of the supply chain
- Advancements in information technology

Outsourcing

Outsourcing (Figure 6) is the most prevalent change within the maintenance industry. Airlines are realizing that outsourcing can result in significant cost reductions, without hampering the operational requirements of aircraft. More importantly, the airlines can lower their costs without reducing profitability (Ozdener 1995). The indirect activities of purchasing, quality control, engineering, and logistics are not core competencies that many airlines employ (Ebbs 1997) and therefore outsourcing becomes a viable economic option. The airlines are identifying the areas where maintenance legitimately adds value and those maintenance operations that do not add value are being outsourced.

Figure 6
Proportion of Maintenance Work Done In-House



Source: Airline Business

Additionally, there is a trend for some of the large air carriers to turn their maintenance capabilities into subsidiary companies, thus increasing their commitment to maintenance and identifying maintenance as one of the company's core functions. This trend has led to situations where some maintenance is being performed by an airline's competitor (Ebbs 1997).

Oversight

There is also a growing need for airlines that outsource maintenance functions to increase oversight of the MRO stations. The Value-Jet crash accelerated the already increasing regulatory concerns that there was a failure of both company and FAA oversight (McKenna 1996). The crash will cause the airlines that outsource to become "partners" with the firms completing the maintenance. There is a need for increased communication and quality among the airlines and the outsourcing firms. The airline is ultimately responsible for the care of its aircraft, and communicating quality and operational concerns is vital (Ebbs 1997).

Consolidation and New Entrants

Consolidation is affecting the MRO market as well. Several of the largest industry players have recently been acquired by competitors. Combining a number of maintenance sites under the control of one management authority has led to a reduction in maintenance costs. This is forcing the smaller and medium sized repair facilities to find specialized niche areas or consider being acquired. The result is more competitive pricing as the larger players achieve greater economies of scale (Seidenman and Spanovich 1997).

Finally, the OEMs are increasing their presence within the MRO market. Historically, the aftermarket services sector was not even a consideration to the major aircraft, engine, and component manufacturers. Today, OEMs have increased their market share to 15% (Ebbs 1997) with MRO activities becoming a major revenue stream for the companies. A critical factor to the OEMs success is the ability to control parts supply combined with an after sale services package. Even Boeing is entering the maintenance market with its Boeing Enterprises Unit, focusing on airframe maintenance. There is a perceived demand to provide "cradle-to-grave" maintenance support to airlines and their alliances (Warwick 1998).

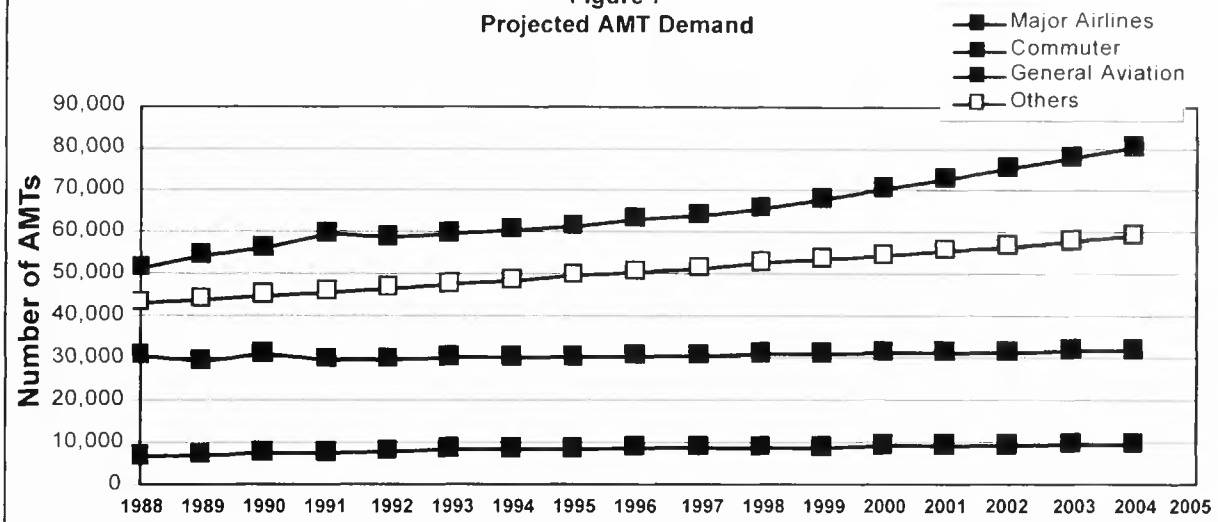
THE AVIATION MAINTENANCE TRAINING ENVIRONMENT

There are approximately 150,000 AMTs working within the U.S. aviation maintenance industry (FAA 1993). Historically, AMTs received training through the military, but over the last several decades the military stream of AMTs available to the aviation industry has diminished. Military AMTs are now trained in highly specialized maintenance functions. Crossover to civilian operations is increasingly more difficult for military AMTs requiring additional training for major air carrier needs (FAA 1993). Currently, the majority of AMTs come from civilian schools. There are approximately 185 AMT certified Part 147 schools throughout the United States. These schools are usually structured around an 18 month training environment encompassing a multitude of technical subject areas (Lewis 1998).

Demand for AMTs

The number of AMTs required within the aviation industry is directly related to the number of aircraft flying and how often these aircraft are utilized (FAA 1993). Different sectors of the aviation industry have different demands for AMTs. One estimate of AMT demand reports that each new transport category aircraft requires an average of 14 additional AMTs for support, each new regional aircraft 4 AMTs, and each new general aviation aircraft 0.15 AMTs (Young 1998). The following chart shows the divided historic and future expectations for each industry segment.

Figure 7
Projected AMT Demand

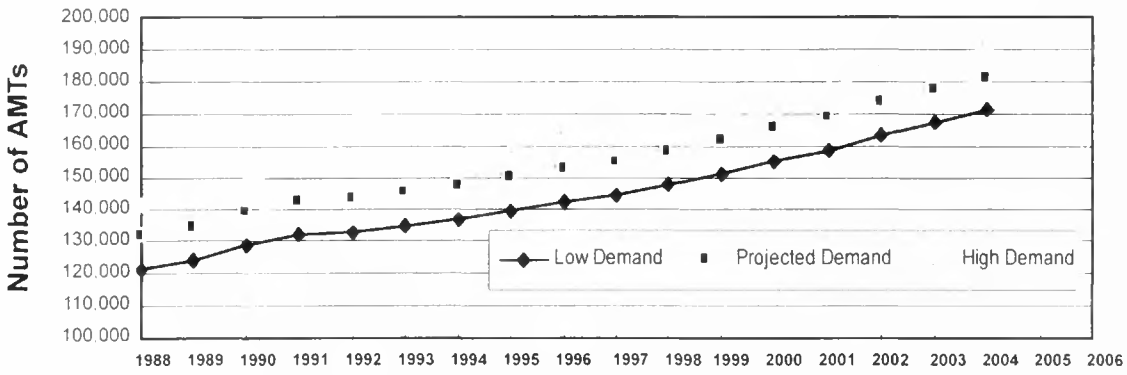


Source: FAA-Pilots and AMT's for the 21st Century, Availability and Quality 1993

The major airlines have the highest demand for AMTs, but they are closely followed by the "Others" maintenance category, which includes third party maintenance firms, OEMs, and firms that work for the federal government. This forecast was created in 1993, before the tremendous growth within the regional and commuter segment of the industry, passage of the General Aviation Revitalization Act (1994) and before many of the major airlines began a new purchasing cycle of replacement aircraft. Therefore, the demand for the fastest growing sector, regional/commuter aviation, may be understated and the forecast does not take into account the recent airline purchasing behavior. Additionally, early retirements from the AMT workforce is adding to the needed technician demand at the present time (Young 1998). Combining this demographic force with the growth in the regional/commuter market indicates that there will be additional pressure on the demand for AMTs at the air carrier level. The current supply of AMTs may become inadequate, as each category of the aviation market - from general aviation to the major air carriers - competes to attract qualified AMTs. Figure 8 demonstrates total projected AMT demand, with high and low estimates. Due to the recent changes in the regional/commuter and general aviation segments, the "high" projected AMT demand is the best representation of the situation currently affecting the domestic aviation industry.

Currently, there is no immediate crisis involving the demand of AMTs. The supply of AMTs is satisfying the demand of the major U.S. carriers (Lewis 1998), although some manufacturers and maintenance organizations are reporting having open positions for technicians the firms cannot fill (Shay 1999). However, as the previous sections indicate, the aviation industry is positioned for dramatic growth within the coming years, and without proper planning firms could be hard pressed to find quality candidates as overall industry demand for AMTs increases. The recruitment and retention of qualified AMTs is becoming more expensive and vital for the success of any maintenance organization (Berner 1998). In the past, airlines and maintenance firms kept a qualified pool of AMT candidates and when a new technician was needed they could easily find one within the pool. Today this is becoming more difficult as everyone—airlines, OEMs, and third

Figure 8
High, Low and Projected AMT Demand



Source: FAA-Pilots and AMT's for the 21st Century, Availability and Quality 1993

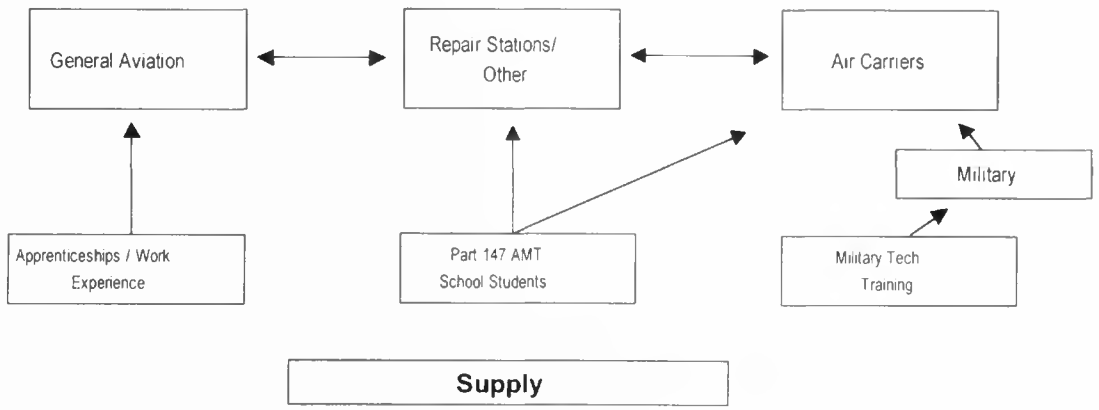
party outsourcing firms—are all competitively recruiting for the dwindling pool of applicants (Berner 1998; Lombardo 1998; Shay 1999).

Supply of AMTs

Figure 9 shows the supply lines for AMT technicians and how there are three main sources from which the industry can acquire AMTs. Historically the military was the leading supplier, but recently, the military supply has slowed and will continue to be a less significant factor in providing AMTs (Lombardo 1997). Now the Part 147 AMT schools are the leading suppliers of AMTs.

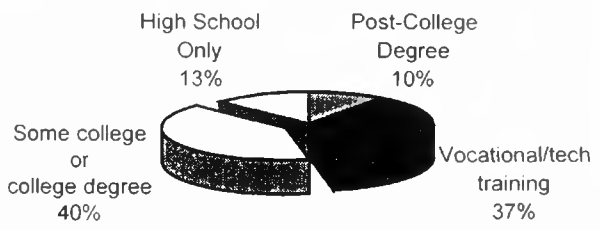
As mentioned, the majority of candidates entering the AMT field are from civilian-trained AMT schools. There are several concerns that the pool of students entering these schools will not be able to meet the quality requirements of the industry. Students entering the AMT schools need to posses greater skills in science, math, english, and communication (FAA 1993). Otherwise those entering the AMT workforce will not have the skills necessary to keep a modern airfleet operating. In a survey conducted of transportation sector companies (airlines, OEMs, and MROs), currently 72% of those entering lack motivation, 56% lack the ability to write clearly and concisely, and 50% lack the ability to work

Figure 9
Demand



with figures (Reed 1998). The apparent skills shortage is of considerable concern to future AMT employers because the increased technical requirements of newly manufactured aircraft will involve hiring AMTs with higher levels of education. This would lead to schools having to offer an increasing level of technology-specific training, which could lengthen the time students must take to complete these courses. Lengthening of the training process would lead to further increasing supply problems. The current level of education of AMTs is illustrated in Figure 10.

Figure 10
Education Level of Current AMTs



Source: Aviation Maintenance

Over half of the AMTs working today have no college education at all. This may satisfy today's requirements, but as airlines replace old DC-10s and 747s with 777s, increased skill levels will be needed. Also, students who are quality candidates considering entering the AMT field are drawn away by larger salaries in the automotive, robotics, and heavy machinery industries. The airlines are offering competitive salaries but only after several years of experience (Young 1998). The other fields have more immediate payoffs.

At the same time that quality issues are becoming an important factor in AMT training, demographic indicators are also causing some concern. Currently, there are fewer candidates available to enter AMT schools from the baby bust (Generation X) cohort. This decreased youth population, in conjunction with the growth of high technology applications within the aviation industry, will result in further AMT supply problems in the near term.

The solution is for airlines and other maintenance firms to work closely with educators and government regulators to establish standardized airline-oriented training programs (Young 1998). There has to be some additional motivational factors introduced to the AMT training environment to encourage young people to enter the field (Shay 1999). As the Baby Boomlet (Generation Y) begins maturing and looking for career opportunities at the turn of the century, efforts must be made to educate this cohort on the number of opportunities in the AMT field. These efforts could be accomplished with stronger industry participation. Greater industry participation and involvement can only improve any supply issues that emerge. Schools with close ties to the aviation industry will be able to attract higher quality candidates and consequently those industry partners would have a better trained pool of available candidates.

AMT-Part 147 School Trend Analysis

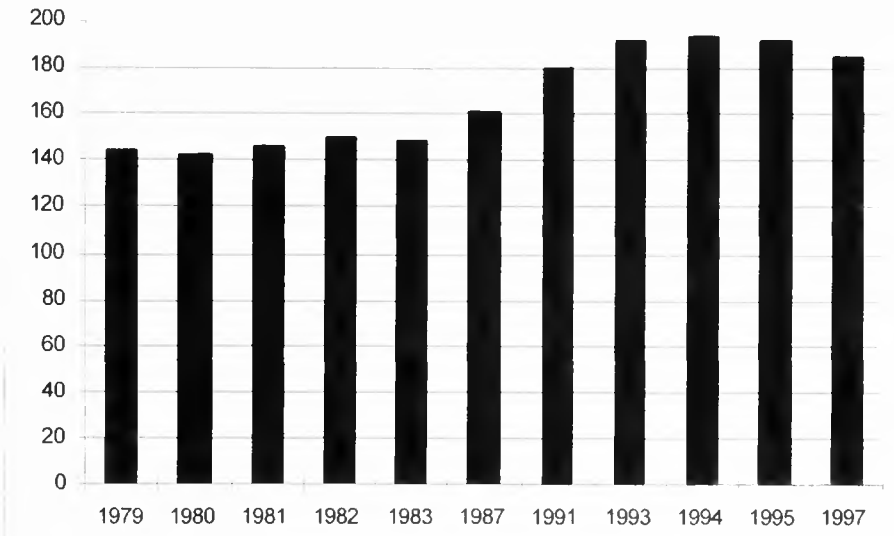
In order to fully understand the reasons for the fluctuating number of AMTs per year, several aspects of the industry were studied. An analysis of the number of schools offering an Airframe and Powerplant (A&P) program during the past 20 years was also conducted. To ensure reliability, the reference source used was FAR Part 147 Advisory Circulars (AC) with the subject heading: *Directory of FAA Certificated Aviation Maintenance Technician Schools.* The data compiled from the advisory circulars covered the following years with the respective document numbers (AC numbers):

1979	AC 147-2T	1991	AC 147-2Z
1980	AC 147-2U	1993	AC 147-2AA
1981	AC 147-2V	1994	AC 147-2BB
1982	AC 147-2W	1995	AC 147-2CC
1983	AC 147-2X	1997	AC 147-2DD
1987	AC 147-2Y		

The gaps exist because advisory circulars were not issued yearly. This may present a problem when trying to determine when a specific school either initiated or ceased operations. The problem is most noticeable between the years 1983 to 1987 and 1987 to 1991, where within the three-year gap several schools initiated or ceased operations without specific dates.

The analysis indicated a fairly stable number of schools per year from 1979 to 1983. However, in 1987 the number of Part 147 schools began to grow every year until 1994, when the number peaked for the period of analysis with 193 schools. The years 1995 and 1997 began to indicate a cessation of growth and a gradual decline in the number of schools offering an A&P program. The results of the analysis are graphically depicted in Figure 11.

Figure 11
Number of Schools Per Year



The Immediate Future and Managerial Implications

Consolidation within the AMT training industry is taking place. Consortiums of schools banding together with industry partners are attempting to solve some of the more immediate supply concerns. Delta Air Lines has officially launched the Delta Air Lines Career Academy for Aviation Technology (DALCAAT). The academy partners the airline with select high schools around the country including New York City's Aviation High, South Atlanta High in Atlanta, Denbigh High School in Hampton, Va., and Skyline High School in Dallas; a first for a major air carrier (PR Newswire 1998, Fiorino 1998). While not guaranteeing employment with Delta, the program offers students financial assistance, internships, scholarships and summer employment programs (Fiorino 1998). Additionally, certain regions of the country with a high concentration of aviation maintenance schools are consolidating and partnering with firms from the industry to not only attract more students of a higher quality, but also to avoid going out of business. In Texas a group of seven colleges and aviation industry representatives from the state (Hughes) formed the Texas Aviation Maintenance Technician Consortium (TAMTC) (Shay 1997). Schools are now more than ever considering partnerships both with industry and competitors.

Besides the partnerships mentioned above, airlines are actively becoming involved in the operation of aviation maintenance and management programs. United Airlines recently donated a Boeing 737-200 to Southern Illinois University at Carbondale. The plane, which is fully equipped and operational, will allow students in the aviation management, maintenance management and flight programs hands-on instruction on one of the most popular passenger airplanes in the world (Philanthropy Journal On-line 1999; UAL Press Release 1999). In addition to aiding schools, some airlines are becoming actively involved in the aviation maintenance training business. AirTran just graduated this past March the first class from their new apprentice maintenance program.

Completed over a 12 to 24 month period, depending upon individual performance, the program emphasizes on-the-job training for aircraft maintenance students (Business Wire 1999). "The program was established to attract candidates who will become competent, experienced and well rounded technicians and valued team members," says Robert W. Zoller, senior vice president maintenance and engineering, AirTran (Business Wire 1999).

The research presented demonstrates the need for airline, OEM, and MRO managers to become active in stimulating the supply of aviation maintenance technicians in an attempt to solve the impending shortage. As some researchers have noted (McGrath and Waguespack 1999) firms may have to investigate quasi-backward integration strategies or tapered integration to address their technician and maintenance needs. For the firms selecting this course of action (such as AirTran above), a recognized benefit is the ability to shape the curriculum to the needs of the airline and to have some assurance about the skills of technicians completing the course. While beginning such a program requires additional capital expenditures, increased costs to the firm, and implies a long term commitment on the part of management, the benefits from lower recruitment costs, lower initial training costs and the knowledge that the new technician is already familiar with your aircraft systems and procedures, greatly offsets the additional burden to the bottom line of the firm. The value added skills brought into the organization by graduates of such programs assure that while the total demand for aviation maintenance technicians may not be met, the quality of skills possessed by these technicians meets the needs of the maintenance industry.

Currently the aviation maintenance industry faces a situation of overcapacity (Ionides 1999; McKenna and Scott 1997). The number of firms and available facilities outnumbers the current demand for services. Aviation maintenance firms, especially OEM and MRO firms, not only face a competitive marketplace that is putting downward pressure on price, but now a skilled mechanic shortage that may exert upward pressure on a major cost component of the firm, labor. Consolidation of the MRO industry is occurring (Gallacher 1999). With the forecasted needs of the major passenger carriers, and other segments of the air transport industry (general aviation, cargo, regional, etc...) for technicians, the OEM and MRO segments will need to become more active in the training infrastructure. Airlines are taking the necessary steps to position themselves to train and recruit new aviation maintenance technicians. OEM and MRO firms must become competitive not only for maintenance customers, but also for the supply of qualified maintenance technicians. The OEM and MRO firms are in danger of becoming too competitively focused, while not prepared for a major issue that could ultimately limit the amount of business the firms could acquire.

The future for air transport, while facing some economic difficulties in areas throughout the world, appears promising. The industry is starting to react to a major non-economic problem that may hamper this growth, the lack of qualified AMT mechanics, both in the U.S. and globally. Airlines, OEM organizations, third party maintenance firms and air transportation trade associations are taking actions to address this shortage. The maintenance industry is now willing to work with the schools and universities to address the coming shortage and forums are being held to address the situation (Shay 1999). The question remains though, will these actions be enough in the short term to meet the needs of the air transport industry now and in the future?

ACKNOWLEDGEMENTS

The authors wish to thank the editor, Dr. Jerry Wilson, and the reviewers for their comments. This manuscript could not have been completed without the assistance of Dr. Robert N. McGrath, Sergio Da Silva, Eram Gran, Anthony Boyd, Matt Rogaliner, and Michael Blake of UAL Corp.

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