

The Aviation Workforce of Tomorrow

Where Are They Needed—and Where Will They Come From?

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Inside the terminal at Chicago Midway Airport. Commercial airlines across the country serve 2 million passengers on nearly 30,000 flights each day.

Every day, the U.S. airspace is busy with more than 68,000 aircraft flying between two of the 3,300 public use airports throughout the country. Commercial airlines provide nearly 30,000 flights carrying more than 2 million passengers daily, traveling for business or personal reasons. Several thousand business and private aircraft are widely used every day for air travel. A vast network of air traffic control facilities provides a safe and efficient environment for airborne travelers to depart and arrive safely at airports conveniently located near their home or place of business and their destination.

The workforce that supports this miracle com-

prises tens of thousands of highly skilled professionals, who ensure that each flight has a successful conclusion and that the U.S. air transportation system remains the safest in the world. Who are these people?

The aviation workforce has a variety of components, each with a vital role in the operation of a complex system, in an environment that is unforgiving of the slightest errors. With a rapidly growing demand for technologically savvy workers and a diminishing pool of people entering the labor market, the prospects for recruiting aviation professionals pose a new challenge that requires new approaches.



PHOTO: CHICAGO DEPARTMENT OF AVIATION

The Labor Pool

For more than five decades, baby boomers have been a demographic force in the labor market. Beginning in 1946, the U.S. birth rate exploded, adding more than 76 million to the nation's population by 1964. Baby boomers now range in age from 54 to 70 and currently represent more than 22 percent of the total workforce age 16 and older.

Baby boomers have dominated the labor market since the mid-1960s—the military buildup during the Vietnam era, 1961 to 1974, for example, drew primarily on boomers. From 1964 to 1973, the military added 8.3 million enlisted personnel through conscription and voluntary enlistments. When these soldiers, sailors, and airmen left the armed forces, they brought their training and skills to the civilian world, especially to the aviation industry.

The U.S. birthrate has declined steadily in the past 60 years; as the boomers begin to retire, fewer people are entering the labor market. At the same time, the national economy is growing and shifting toward dig-



PHOTO: LEE ESTES, U.S. AIR FORCE

Early in the Vietnam War, the Air National Guard unloads supplies at Tân Sơn Nhất Airport. After returning to the United States, many Vietnam veterans went to work in the aviation industry.

itally focused technology, and the global economic environment is increasingly competitive, exacerbating the demand for skilled workers. Table 1 (above, right) illustrates the impact of declining numbers in the entry-level workforce in the next 10 years.

The total workforce is projected to grow by a slight 0.5 percent, but the young workforce of 16- to 24-year olds is expected to decline by 1.3 percent, as is a subgroup of 20- to 24-year olds, the “emerging workforce.” This subgroup represents the majority of those needed by the aviation industry to meet the demands for qualified and capable employees. The emerging workers will require some college, military, or work experience, along with specialized training, to enter the field of aviation.

TABLE 1 Emerging Workforce

Workforce	Age (years)	2015 (thousands)	Total (%)	2024 (thousands)	CAGR (%)
Total	16+	156,867	100.0	163,770	0.54
Young	16–24	20,611	13.1	18,498	–1.34
Emerging	20–24*	15,271	9.7	13,705	–1.34
Receding	55+	33,860	21.6	40,575	2.29

Note: CAGR = compound annual growth rate.

*Assumes 2024 emerging workforce remains constant at 74 percent of young workforce.

TABLE 2 Aviation Activity

Activity	2015	2024	CAGR (%)
Commercial jet aircraft	4,727	5,401	14.3
Enplaned passengers	760,846,798*	961,000,000	26.3
Aircraft operations	49,723,000	53,778,000	8.2
Control towers	516	same	
Commercial service airports	551	same	

*For 2014.

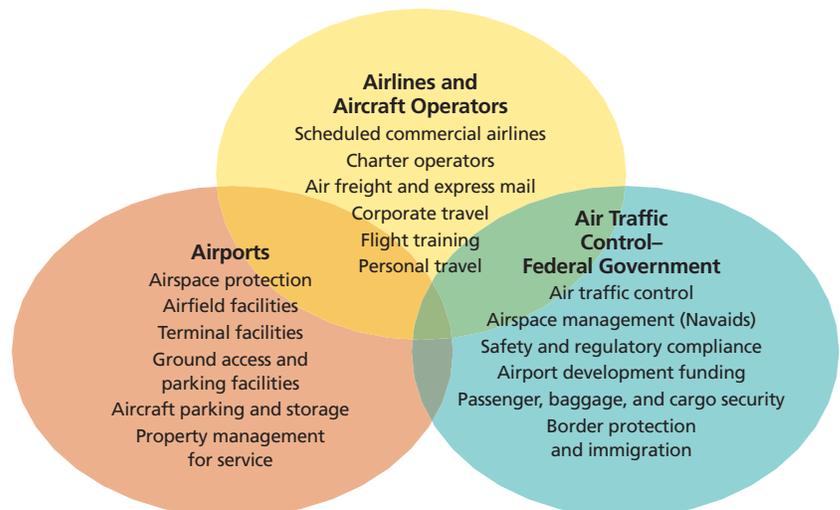
SOURCE: FAA Aerospace Forecasts; FAA National Plan of Integrated Airport Systems.

Work Environment

The national air transportation system draws on three major sectors: aircraft operators, air traffic control, and airports. Figure 1 (below) illustrates the relationship and general functions of each workforce component.

Distinct entities govern and operate each segment of the U.S. air transportation system. The federal government operates the nation's airspace, including almost all air traffic control towers. Aircraft operators are exclusively in the domain of the private sector and include airlines, corporations, and individual aircraft owners. Local, regional, and state political subdivisions own and operate airports. Table 2 (above) presents measures of air transportation network activity, as well as a 10-year forecast for each activity.

FIGURE 1 The U.S. National Air Transportation System.



As the national air transportation system expands, so does the need for trained airport and aviation personnel.



PHOTO: ESTHER DYSON, FLICKR

The national air transportation system is expected to grow significantly. In particular, the increase in commercial jet aircraft will require more flight crews and mechanics. The increase in aircraft operations will call for the addition of air traffic control specialists, even with the implementation of automated NextGen technologies. Passenger levels are expected to surge by more than 26 percent. To handle the increased travel demands, airports will have to expand, or new ones will need to be constructed, and additional staff will be needed.

Aviation Workforce

The foundation of the aviation system is safety, which involves the trust that all who operate within the system do their part. The complexities of the system require a workforce that is highly educated, trained, and experienced.

For example, pilots must acquire and maintain licenses and ratings. Air traffic controllers must be certified and be familiar with their area of responsibility. Airport staff must understand and comply with an extensive set of regulations and requirements to ensure a safe and secure airfield environment.

Each person in a critical front-line aviation occupation must have licenses, certifications, training, and experience that are not easily attained. Most employers require or prefer a two- or four-year college degree.

Pilots

The airline pilot is perhaps the most visible career in the aviation workforce. In their distinctive uniforms, pilots are a common sight in most air terminals, walking through concourses or checking in at a gate. Because of their skills and ultimate responsibility for conducting safe flights, pilots are highly regarded as consummate professionals.

Cost of Training

Many young people interested in aviation aspire to become airline or military pilots and pursue an aviation-related college degree. The high costs of flight training, combined with tuition and living expenses, however, present a significant financial burden. A collegiate aviation program can cost \$150,000 to \$200,000 or more for a degree and the requisite flight ratings. Flight training combined with higher education can take 4 to 5 years.

In the past 15 to 20 years, the expectation for an immediate return on investment has been low. The average annual compensation for an entry-level first officer on a regional airline turboprop ranges from \$29,000 to \$38,000. The trade-off is gaining the experience and the flight hours, essential to advance to larger aircraft, for promotion to captain, and for a position with one of the large mainline air carriers that offer a significant increase in compensation. The junior pilots pay their dues, as did their predecessors, but can look forward to an average annual compensation of \$214,000 or more as a 10-year captain at a major airline.



PHOTO: KENT WIEN

Although starting salaries for commercial pilots are low, the career path can lead to a well-compensated position at a major airline.

Entry-Level Changes

The labor environment for entry-level pilots has changed radically in the past few years. Bankruptcies and mergers among the major and regional airlines have been disruptive, and the legislative reaction to a tragic airline accident has had a deleterious impact on the pilot workforce pipeline.

In July 2013, FAA implemented a rule that all first officers of commercial airline flights hold an Air Transport Pilot (ATP) license. The ATP license requires a minimum of 1,500 flight hours; previously, an entry-level first officer could be employed with a commercial pilot license that required 250 flight hours.

A “restricted privileges” ATP (R-ATP) is available and can reduce the hours requirement for pilots who have graduated from a 2- or 4-year collegiate aviation program. Most graduates, however, have acquired only 300 to 500 total flight hours and must find other means to attain the balance to qualify for the R-ATP.

Finding gainful employment to build up flight hours and to meet the requirements for employment as an airline pilot can set a graduate back by 1 to 2 years. In the meanwhile, student loan payments and other financial obligations can force some to find employment elsewhere, sometimes in other aviation-related jobs, but sometimes in other careers.

Regional Airlines’ Needs

Regional airlines traditionally have served as a pipeline for pilots to the major airlines but recently have met difficulties in finding entry-level pilots; the ATP requirement is only partly the cause. Airline mergers, the consolidation of markets, and the high operating costs of aircraft have hampered the profitability of regional airlines.

Moreover, as the number of airline pilots retiring at age 65 is growing, many experienced pilots are leaving the regional airlines to take their place. The delayed entry of R-ATP licensed pilots and the higher costs of attracting new first officers have compounded the problem.

Maintenance Technicians

Aircraft maintenance technicians are no less important than pilots for the safe operation of aircraft. To attain a certificate to work on aircraft, a prospective technician must complete 18 months of practical work experience applicable to either an airframe or a powerplant rating. To earn both ratings, the technician must complete a certified aviation maintenance program or demonstrate 30 months of applicable experience.

Each rating requires at least 400 hours of general course work plus 750 hours related to airframe or



PHOTO: KEVIN FOWLER, LANSING COMMUNITY COLLEGE

powerplant technology. Technicians pursuing both ratings need a combined total of 1,900 hours. The combined program typically takes 18 to 24 months. Many collegiate programs throughout the United States offer a 2-year technical degree in aircraft maintenance.

Airlines hire entry-level maintenance technicians primarily from the aviation programs with which they are familiar. Other industries, however, have discovered the skills and competence of these graduates and are now competing with the airlines—notably the automobile industry, which is increasing its focus on technology related to automated and connected vehicles.

Air Traffic Controllers

The demand for air traffic controllers has remained steady for the past 30 years. In August 1981, the Professional Air Traffic Controllers Organization (PATCO) called a general strike nationwide. More than 11,000 PATCO workers refused the order to return to work immediately and were fired. Not just anyone can be a controller—rebuilding the rank-and-file operators of the air traffic control system to the pre-strike staffing level took FAA more than 10 years.

A hands-on laboratory at the Lansing Community College Aviation Technology Program trains students to work on aircraft.



PHOTO: FAA

A technician monitors systems supporting air traffic control service at the Chicago En Route Center in Aurora, Illinois. The Federal Aviation Administration has a rigorous qualification and training program for prospective employees.



Biologists conduct research to reduce wildlife collisions with aircraft. Airport employees cover a variety of disciplines.

Controllers must have certain traits and must exhibit organizational, analytical, and decision-making skills. They must undergo strict medical and psychological screening, and can be disqualified for most anomalies, including a history of drug use. Trainees must be under age 31, pass the medical and security requirements, and have a minimum of 3 years of progressively responsible work experience, a bachelor's degree, or a combination of post-secondary education and work experience.

A new candidate requires 18 to 36 months after graduation to qualify operationally for a position. FAA expects that the current workforce of 14,000 controllers will lose nearly 12,000—or 86 percent—in the next 10 years. The agency attributes the projected losses to a variety of reasons, but because controllers must retire from active duty at age 56, 34 percent of the attrition will result from retirements, the majority in the next 5 years.

Airport Operations Personnel

Like the other components, airports require a well-

trained and skilled workforce to provide services in a multifaceted and dynamic environment. In this sector as well, many of the most experienced workers are approaching retirement.

Airports that accommodate air carrier operations must meet a complex series of operational requirements to maintain certification. Although FAA provides the oversight, the airport operator is responsible for providing a safe and secure environment for all users. The personnel who manage airfield and terminal facilities must undergo significant training in a variety of activities, including wildlife control, emergency preparedness—such as aircraft rescue and firefighting—snow removal, runway inspections, pavement maintenance, and security.

Airports typically fill entry-level operations positions with graduates from collegiate aviation management programs, including those who have completed some flight training but are not continuing or pursuing a flying job.

Industry's Response

The increasing rate of retirements among key personnel in each of the components of the aviation field has compounded the difficulty of attracting, hiring, training, and retaining a workforce with the required skills. Although providing opportunities for advancement, the retirements create a vacuum for filling vacancies as personnel are promoted or recruited.

Table 3 (below, left) illustrates the state of the aviation workforce and the anticipated need for personnel within the next 10 years. The projections are based on data from Table 2, applying simple metrics to associate aviation activity directly with each workforce category.

Assessing the Outlook

The projections may be conservative in the context of manufacturers' forecasts for new aircraft. Both Boeing and Airbus anticipate significant orders for new aircraft in the next 20 years. Airbus expects a need for more than 1,900 new aircraft—in addition to those replacing the aging fleet—for North American markets by 2034. Boeing's forecast is more aggressive and includes regional jets—a demand for 2,600 new aircraft during the same period.

Table 3 does not explicitly account for several complicating factors: (a) the momentum of baby boomers leaving the aviation workforce; (b) the increasing difficulty of finding qualified, eligible, and interested new candidates; and (c) the competition from nonaviation and foreign interests for U.S. workers through better compensation and less restrictive qualifications.

TABLE 3 Aviation Workforce Projections

Workforce Category	2015	Metric	2024
Airline pilots ^a	73,240	15.5	83,683
Airline mechanics ^a	46,835	9.9	53,513
Air traffic controllers ^b	14,007	3,549.9	15,149
Airport staff ^c	40,750	18.7	51,470
Total	174,832		203,815

^a Per aircraft.

^b Per 1,000 aircraft operations.

^c Per 1,000 enplaned passengers.

SOURCE: Bureau of Transportation Statistics TranStats; FAA Air Traffic Controllers Workforce Plan; FAA Certification Activity Tracking System (443 airports reporting).

Ab Initio Training

The aviation industry in the United States is responding with new approaches. Historically, several international airlines had established ab initio flight training programs that offer young people free flight training in return for several years of dedicated service to the airline. The U.S. military essentially has used this approach for decades through the military academies, the Reserve Officers Training Corps, and aviation cadet programs, but airlines in the United States only recently have begun to explore the ab initio model.

JetBlue, for example, has started a program of ab initio flight training for a small group of candidates. Other airlines are participating with colleges through bridge programs that offer candidates a guaranteed interview or similar incentive for employment. These programs may serve the interests of the sponsoring airlines, but the enrollments do not come close to meeting the needs of the airline industry as a whole.

FAA Initiatives

In 1989, FAA instituted the Collegiate Training Initiative (CTI), which partnered with aviation colleges and trade schools to prepare graduates for air traffic control and similar technical positions. Although not a guarantee of employment with FAA, the CTI program pre-screened qualified and motivated candidates for acceptance into the FAA Academy. Graduates of the CTI program, as well as military-trained controllers, were a preferred source of applicants and could bypass the first phase of the FAA Academy training.

In 2013, FAA changed its hiring practices to encourage a broader base of applicants and to open

the recruiting process to the general public. The impact has been substantial—enrollments at many of the CTI programs have dropped, and students have changed majors to flight programs and to unmanned aircraft systems programs. At the University of North Dakota, for example, enrollments in the CTI program dropped 49 percent between 2013 and 2015. Beaver College in Pennsylvania has reported a drop of 70 percent, and Aims Community College in Colorado has experienced a 66 percent decline.

The agency has acknowledged that the failure rate among new candidates at the FAA Academy increased after the shift in recruitment strategies and expects that the numbers of washouts will accelerate in the next 5 years. FAA plans to counter this trend by increasing the number of candidates and operating the FAA Academy close to capacity for the next few years.

Organizational Outreach

Through organizations such as the American Association of Airport Executives (AAAE) and the Airport Council International–North America (ACI-NA), the airport community has actively encouraged aviation students to consider careers in airport operations and management. Many students participate in student chapters of these organizations and in other on-campus programs, which provide incentives to attend regional chapter and national conferences.

Through recruitment for entry-level jobs, scholarships, internships, and networking, the airport industry is developing a strong relationship with aviation management students and encouraging them to pursue careers in the airport workforce.



PHOTO: BENJAMIN MORAN, U.S. AIR FORCE

An Air Force Reserve Officers Training Corps (ROTC) cadet learns about aerial refueling during an orientation flight. ROTC serves as an ab initio flight training program for pilots.

Airline workers at Minneapolis–St. Paul International Airport assist travelers. As its current workforce retires, the aviation industry must increase efforts to attract and retain new workers.

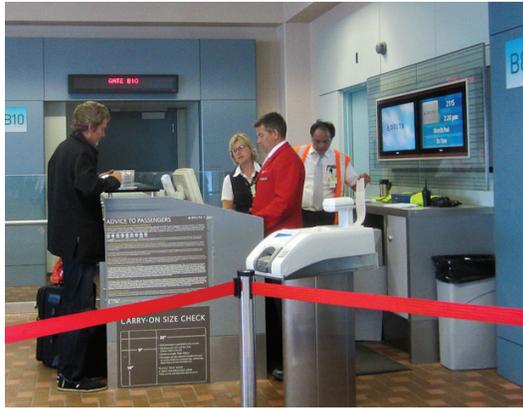


Photo: Kim Brooks, Flickr

Working Together

Headlines predicting pilot shortages and other shortfalls in the aviation workforce as a result of large-scale retirements will continue as the numbers of those entering the labor market do not fill the numbers of vacancies. National and global economic growth will accelerate the demand for qualified and capable pilots, technicians, air traffic controllers, and airport operations staff. Applicants for entry-level positions may go wanting in the short term, but the industry must increase efforts to provide compensation and other incentives to attract the emerging workforce to aviation careers.

Industry, government, and academia together need to recruit, educate, and place young professionals into the aviation workforce. In the private sector, airlines will have to develop stronger compensation packages and career paths for entry-level candidates. They also will need to support collegiate aviation programs in attracting and retaining students, by developing strong relationships with faculty, initiating mentoring programs, and perhaps offsetting some of the costs of pursuing an aviation career.

Faculty at aviation programs should ask industry about the aptitudes and abilities that will make their graduates employable. This is a critical link in the workforce chain—students need to acquire valuable skills from more than lectures. Aviation is a dynamic field that requires hands-on, real-world learning and experience. Schools must ask for—and industry must provide—internships, cooperative training arrangements, and other proactive programs to connect student with the world of aviation.

The federal government needs to foster an environment that supports aviation workforce development—for example, by addressing the impact of the R-ATP rule on the regional airlines. Moreover, hiring practices for air traffic controllers may need refinement if qualified candidates are lacking.

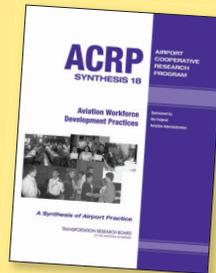
Research Projects Explore Aviation Workforce Development

DAVID A. BYERS

The Airport Cooperative Research Program (ACRP) began to examine the future of the aviation workforce in 2010, with the publication of Synthesis 18, *Aviation Workforce Development Practice*.^a The findings emphasized that aviation workforce development is a multifaceted process that starts before hiring and continues through succession planning. The synthesis identified several aviation industry organizations and academic institutions with innovative programs that leverage resources to target and meet the industry's workforce development needs.

More recently, ACRP has commissioned two projects on workforce development. ACRP Project 6-04, *Identifying and Evaluating Airport Workforce Requirements*, is collecting data to (a) identify and evaluate current and future airport workforce requirements; (b) identify and evaluate education, training, and other workforce development resources; and (c) develop strategies to address future airport workforce requirements. The Transportation Research Board will publish the findings as a guidebook.

ACRP Project 1-34, *Developing Innovative Strategies for Aviation Education and Participation*, is assembling resources to enhance young people's interest in aviation and to promote aviation as a career.



Best and Brightest

What then are the sources for the young professionals needed to run the national air transportation system? Students in collegiate aviation programs are uniquely qualified—they are motivated and are focused on aviation as a career. As they matriculate, aviation students tend not to be distracted by risky behaviors and indiscretions, especially those involving alcohol or drugs, because the slightest infraction can end a career.

Aviation will attract those who have the passion; for many others, the compensation holds a strong interest. The high cost of tuition, plus flight training and the investment of time, will continue to create additional pressures for aviation students to complete a program.

Scholarships, ab initio and sponsored education and training programs, loan repayment policies, and compensation commensurate with the serious responsibilities are needed to attract the best and brightest of the nation's emerging workforce. Airlines, airports, and air traffic control services have vested interests in ensuring an adequate pipeline of qualified and capable candidates. The traveling public deserves to have the best and the brightest at work to ensure that the U.S. air transportation system continues the safest and most efficient in the world.

^a www.trb.org/Main/Blurbs/163380.aspx.

Helping Aviation Research Careers Take Off

ELAINE C. MCKENZIE, MATT BEAMER, CLAYTON STAMBAUGH, AND PENG WEI

In 2011, the Transportation Research Board (TRB) created the Young Members Council (YMC) to encourage and expand participation by young professionals in all aspects of the TRB community. Although focused on assisting young professionals and students age 35 or younger, council activities are open to anyone involved in TRB. The YMC-Aviation (YMC-A) Subcommittee was launched in 2012 to interact more directly with young members in the TRB aviation community.

The YMC-A mission is “to encourage and support the involvement, education and growth of students and young professionals within TRB, its related activities, including the Annual Meeting, and the aviation industry as a whole.” The goals are as follows:

- ◆ Provide positive experiences to undergraduate and graduate students interested in aviation and aviation-related research,
- ◆ Promote aviation-related careers to students and young professionals,
- ◆ Support a positive experience at the TRB Annual Meeting by providing guidance and mentoring for new attendees interested in aviation,
- ◆ Identify avenues for young members to become involved in aviation-related committees and activities within TRB,
- ◆ Assist committee chairs by identifying young members interested in filling committee vacancies,
- ◆ Provide educational content of interest and value to young members, and
- ◆ Have fun as a group and promote networking.

YMC-A contributed to several activities at the 2016 TRB Annual Meeting, including the cosponsorship of two sessions:

McKenzie is an Associate, Cambridge Systematics, Inc., Chicago, Illinois. Beamer is a consultant with Ricondo & Associates, Inc., Chicago, Illinois. Stambaugh is Airport Manager, Pekin Municipal Airport, Pekin, Illinois. Wei is Assistant Professor, Aerospace Engineering, Iowa State University, Ames.



The Young Members Council-Aviation supports TRB participation and involvement for young aviation professionals and students.

- ◆ The Human Side of Aviation: Exploring Next-Generation Workforce Challenges (Session 371) and
- ◆ Multimodal Connections: Passenger Accessibility (Session 578).

YMC-A members also participated in the Aviation Caucus and held a subcommittee meeting, followed by a networking event.

At the 2017 TRB Annual Meeting, YMC-A members are sponsoring a workshop and follow-up session to examine key policy, technology, and workforce questions for the future of the aviation industry. The subcommittee also is sponsoring a student poster session. Upcoming priorities include the following:

- ◆ Working with the committees in the TRB Aviation Group to sponsor or cosponsor sessions aligned with the interests of young members,
- ◆ Sponsoring a by-invitation session featuring student poster presentations, and
- ◆ Increasing coordination and

networking opportunities with young members groups in other organizations, such as the Airport Consultants Council, National Business Aviation Association, and the other YMC subcommittees.

Active participants include young professionals from nearly 50 organizations, more than 20 states, and several countries. YMC-A members serve on each TRB Aviation Group committee, and several serve in leadership positions, such as Committee Communication Coordinator. To get involved in YMC-A,

- ◆ Visit the website, <https://sites.google.com/site/ymcaviation/>;
- ◆ Connect with members via a LinkedIn group, at <https://www.linkedin.com/groups/5056548>; or
- ◆ Send an e-mail to ymcatrb@gmail.com.

Young professionals or students interested in aviation and camaraderie are welcome to join in—YMC-A offers a great way to take advantage of all the collegial, professional, and career benefits and opportunities that TRB and YMC have to offer.