



Aviation Workforce Challenges in the United States and the United Kingdom

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Summary

The global aviation industry faces growing workforce challenges. Strong competition for workers, the changing nature of high-skill jobs, and a retiring generation all profoundly affect many countries' modern economies. The problem is especially acute in the United States and the United Kingdom, the largest and third largest aviation markets in the world, respectively. Both countries need to attract new workers to fly and maintain aircraft, manage airports, control air traffic, build and run terminals, and conduct every other job related to advancing a safe, secure, and high-tech aviation industry. Unfortunately, pragmatic policy solutions that comprehensively address workforce challenges across all aviation subsectors are limited.

This report reviews workforce challenges across the critical sectors of the aviation industry in the US and the UK: professional pilots, air traffic controllers, aircraft maintenance and repair, airport workers, flight attendants, and aerospace manufacturing. It finds common themes that are important to understanding how to prepare the industry and its workforce for the future:



The aviation industry will face a number of workforce pipeline challenges as demand for air travel grows in the coming years. Though the outlook on worker availability varies depending on the specific occupation, the number of jobs in aviation is expected to grow.



The degree to which technology will replace jobs is unknown, but **technology will change the nature of jobs** across the entire aviation workforce. The industry must ensure that new and existing personnel are trained to utilize new technologies.



Workforce demographics are shifting, as a wave of current employees prepares to retire and the generations that replace them are more diverse. To fill future jobs, the industry will need to appeal to a broader demographic.



Following a number of challenges that resulted in cost cuts between roughly 2001 and 2009, **the aviation industry has since begun to increase wages**. The industry has used incentives, signing bonuses, and higher salaries to attract and retain workers.



The aviation industry is **competing with itself, other professions, and other countries to retain workers**. “Workforce bleed” to other industries, offshoring to other countries, and recruiting established personnel from other sectors (e.g. airlines hiring military pilots) are all manifestations of this competition.

Methodology and Data

Ample research on the challenges and opportunities in the UK and US aviation-aerospace sectors is often segmented by occupation. Much of the previous documentation on the subject is out of date as the global economy is fully out of the 2009 recession, and unemployment is nearing historic lows. This analysis combines, updates, and summarizes the challenges facing the aviation workforce using information from industry-based trade groups, independent academic research, governmental reports, and news reports. It includes case studies to serve as models of effective industry practices to meet workforce challenges.

The following six sections explore specific occupations with accompanying tables summarizing demographics and other workforce characteristics drawn from available public government data sources. However, neither country's sources provide full or wholly consistent information, and there are notable gaps for some information points, making it difficult to make direct comparisons. For instance, ethnic and gender information was available for the US for which there was no comparable information available regarding the UK. In addition, for some of the occupations, this report lists total counts of personnel employed from both the US Census Bureau's American Community Survey and the Bureau of Labor Statistics' Occupational Outlook Handbook. However, because the two US sources define and sort the occupations in slightly different ways, they list different head counts and salaries. Another inconsistency in the data between the two countries is that for the US, average pay across both genders is represented as median salary, while for the UK, this salary information is represented as an average.

For some of the occupations described in this report, we address the possibility of workforce shortages, that is, whether there are fewer people unemployed than there are job openings. Across all sectors in the US, the Bureau of Labor Statistics reported just over seven million job openings while just fewer than six million people were classified as unemployed in September 2018.¹ In the UK, there were 845,000 job openings between August and October 2018 while 1.3 million were classified as unemployed between July and September 2018.²

This report does not explicitly determine whether there is a definite shortage within the six occupations detailed, as this is a determination best left to economists familiar with how employment assessments are made of each occupation in the US and UK. However, the issues we discuss, such as impending retirements, offshoring of labor to overseas competitors, and high training and educational costs that deter

potential workers from pursuing certain occupations, are all indicative of what we consider to be *pipeline challenges*. If left unaddressed, such pipeline challenges may lead to workforce shortages in any given occupation in future years as vacancies come available and there are no prospective workers to fill those vacancies.

Additional information about and explanation of data sourcing can be found in Appendix A.

Appendix B includes a table with country-wide information for the US and UK to allow for comparisons between the workforce characteristics of the six aviation occupations detailed in this report and each country's workforce as a whole.

Professional Airplane Pilots

In a recent speech, the Acting Administrator of the US Federal Aviation Administration (FAA), outlined the challenges facing the pilot workforce:

In the last 10 years, the number of private pilots holding active airmen certificates has decreased by 27 percent. The number of commercial rated pilots in the same period has decreased by 21 percent. The military, which used to be one of our best sources for new hires, isn't turning out as many pilots as it used to. College aviation programs don't have enough instructors to teach new students, because they're taking jobs with the airlines as soon as they log enough time. Only about 40 percent of commercial airline pilots are under the age of 45. And the huge bubble of B-scale hires in the 80s, of which I am one, will create a tsunami of retirements in the next five to 10 years that's going to further deplete the ranks.³

Data are mixed as to whether a pilot shortage currently exists, but projected employment growth and expected retirements signal one may be coming. The industry is aware of its need to train and certify thousands of new pilots over the next decade.⁴ Private jet owners in the US and UK are finding it “increasingly difficult” to find pilots for their aircraft.⁵ Business aviation pilots are increasingly switching to work for major airlines.⁶ Recent trends suggest that airlines are increasing pay and signing bonuses to retain and attract pilots.⁷ But high costs of education and flight training, age restrictions, and rapid growth in demand for air travel pose challenges for prospective pilots and the industry.

Requirements to Become a Pilot

The aviation sector has a long successful history of prioritizing safety, which manifests in governmental regulations and rules for pilot training, qualification, and required flight experience. Licensing requirements can vary by the type of aircraft and flight (commercial, freight, or private).⁸

This report focuses on airplane pilots – inclusive of private, unscheduled or for-hire commercial, and scheduled airline transport – given that professional pilots often supply the workforce for regional and major airlines. In 2016, 84,000 airline pilots (including copilots and flight engineers) comprised two-thirds of the total 124,800 pilot jobs in the US workforce.⁹

The cost of education and flight training poses a daunting financial burden for incoming pilots. The UK's Civil Aviation Authority describes becoming a pilot as an endeavor that “requires a lot of hard work, and quite a lot of money.”¹⁰ In the US, undergraduate degrees coupled with flight training can cost students between \$150,000 and \$200,000, and in some cases more.¹¹ In addition to university expenses, the average cost to attain a necessary private pilot certificate in the US is \$9,500.¹² This is more expensive than traditional four-year US college tuition, which amounts to \$38,864 for in-state students at public schools and \$142,704 at private institutions.¹³

In the UK, aspiring pilots must take a course to obtain an Airline Transport Pilot's License (ATPL). The license can be obtained in 18 months of full-time study costing between £60,000 and £90,000 in total.¹⁴ Some estimates put the entire scope of training costs for pilots in the UK at over £120,000. Beyond initial training, UK pilots must achieve specific type ratings, which are regulatory agency certifications of a pilot to fly a particular type of aircraft. This can cost up to £42,000.¹⁵ For comparison, the average three-year UK college degree costs a maximum of £27,750 in tuition and fees.¹⁶

While a bachelor's degree is typically required to become an airline pilot in the US and the UK, commercial pilot licenses (CPLs) only require a high school diploma or equivalent.¹⁷ In both countries, CPLs can be obtained at trade schools offering flight training or through flight schools that are part of aviation degrees at two- and four-year universities. These programs can cost much less than traditional bachelor's degrees.

Training requirements for pilots in the US and the UK are very similar because international flights adhere to global standards, namely those set by the International Civil Aviation Organization. Most often, airline transport flights require two pilots: the pilot in command (PIC, or captain) and the first officer (co-pilot).¹⁸ Airline Transport Pilot (ATP) certificates are required for the pilot in command on airline flights, although first officers can have a restricted ATP (R-ATP).

ATP requirements include:

- Be at least 23 years old;
- Have 1,500 hours of flight time;
- Have 50 hours of multi-engine experience;

- Have an aircraft type rating, or additional airplane-specific training.

An R-ATP certificate can be granted to those at least 21 years of age who have not met the 1,500-flight hour target, as long as they have military pilot training and recognized collegiate or university aviation coursework/degrees.¹⁹

The FAA released the Final Rule for pilot certification, commonly referred to as the “1,500 Hour Rule” or “First Officer Qualification (FOQ),” in 2013.²⁰ The rule was created in response to the 2009 crash of Colgan Air Flight 3407, which the US National Transportation Safety Board ruled was a result of the flight crew’s failure to monitor and respond to the situation.²¹ Prior to the rule, first officers were only required to possess a commercial pilot certificate, which can be obtained with 200 flight-hours experience.²²

Professional airline pilots also have a mandatory retirement age at 65 in both the US and the UK, and pilots 60 years or older must be accompanied by pilots younger than 60.²³ While many sectors are grappling with an aging workforce, the challenge is especially acute for pilots due to these legally mandated retirements.

Compensation

After the financial and time burdens associated with training, new pilots are met with average entry-level annual wages for first officers of \$20,000 to \$40,000 in the US and between £20,000 and £30,000 in the UK.²⁴ This is lower than entry-level wages among other occupations in the US, including those who majored in the physical sciences (\$42,474), engineering (\$65,455) or computer and information sciences (\$73,768).²⁵ The median gross base salary for entry-level employees in the UK is £26,000.²⁶ Once pilots advance to senior positions as captains at major commercial airlines, their annual wages can grow to an average of \$214,000 in the US and £140,000 in the UK.²⁷

Compensation for airline pilots is closely tied to the economic performance of the major airlines. Financial challenges followed September 11, 2001; during the next decade, US Airways, United, Northwest, Delta, and American all filed for bankruptcy. No large airline based in the UK went bankrupt during that same period.

Regardless of the exact cause, the financial stress had a direct impact on the workforce. Many pilots lost their defined-benefit pensions, or saw them frozen

through Chapter 11 bankruptcy restructuring.²⁸ Pilots experienced increased flying time and significant reduction in wages, which dissuaded military pilots from becoming airline pilots and civilians from entering training programs in the first place.²⁹ This chilling effect slowed both pipelines of airline pilot talent.

Recent trends indicate an upward pressure on wages. In Europe, pilots at Ireland's Ryanair are forming unions, and pilots with Air France went on strike over pay.³⁰ These organized industrial actions paired with record profits at major airlines have led to better compensation for existing and new pilots. There are more frequent reports of US regional carriers offering starting salaries of \$60,000, tripled up from \$20,000.³¹ Other kinds of airlines are offering signing bonuses of up to \$50,000.³²

While increasing compensation might encourage more to enter the profession, it has made it harder for regional airlines to compete.³³ Smaller cities, served primarily by regional carriers, might lose some of their service if wages continue to rise.³⁴ This potential decline in regional miles flown would hamper regional carriers' positions as valuable feeders and as training grounds for major airline pilots.

Sourcing of and Competition for Airline Pilots

Professional airline pilots are increasingly coming from colleges, universities, and private pilot training schools instead of the traditional source for pilots: the military. In the US, only one-third of private-sector pilots have backgrounds in military aviation, down from a rate of more than 80 percent in the 1960s.³⁷ The US Government Accountability Office estimates that an annual average of 2,400 pilots left the military between 2001 and 2012 and expects this trend to continue.³⁸

The military itself is experiencing a shortfall in available pilots. The US Air Force projected a 26-percent gap between the number of available funded positions and the number of pilots filling them.³⁹ In the late 1960s, Air Force pilots were required to serve four years upon certification; today they are required to serve 10 years and are met with bonuses up to \$455,000 for signing up for an additional 13-year military commitment.⁴⁰ This bonus may work in private carriers' favor because military-trained pilots can choose to secure their pension after 20 years of service and then, prior to retirement, can move to the private sector for a higher salary.⁴¹

Competition between general aviation and commercial airlines also affects pilot availability. General aviation refers to all flights, often private or business aviation, that are not conducted by the military or by scheduled airlines. Due to their expanding fleets and increased travel demand, compounded by the high costs associated with obtaining commercial instrument ratings, major airlines often draw from business aviation's available workforce of pilots experienced with sophisticated aircraft.⁴² The pilots making this switch tend to be younger, have less flight time with their employers, and prefer the airlines' schedule predictability, compensation, retirement benefits, and job stability.⁴³

Case Study: Priming the Pipeline for Airline and Freight Pilots

Private airlines and freight companies are creating their own initiatives to attract pilots to the workforce. Republic Airlines, a regional carrier based in Indianapolis, created the Lift Academy, an in-house training program that encourages "people of all genders, ages and races," to apply.³⁵ The one-year program costs \$65,000, but graduates are guaranteed a job with Republic, which advertises a starting wage of \$60,000. As part of the program, Republic offers a loan of up to \$15,000 for tuition, which does not have to be repaid if the pilot remains with the airline for at least five years. FedEx's Purple Runways program is a partnership with universities and technical schools to train students interested in piloting and other aviation careers. In October 2018, the program announced \$2.5 million in grants to fund scholarships at participating universities.³⁶

Pilot Demographics

Males have long dominated the pilot workforce. In the US, women make up only 5.5 percent of the airplane pilot workforce.⁴⁴ The percentage of women in pilot positions is comparable in the UK: in 2016, 4.3 percent of airline pilots were female.⁴⁵

Of the 42,694 active women holders of US airmen certificates in 2017, 14.7 percent worked for commercial services (i.e. freight, cargo), 16.4 percent fly for passenger airlines, and 45 percent are students. Women accounted for 6.4 percent of commercial pilots and 4.4 percent of passenger airline pilots.⁴⁶ Data on the gender split among British cargo pilots was not available.

Table 1: US and UK Pilot and Flight Engineer Demographics

| | US | UK [†] |
|--------------------------------|-------------------------------|---------------------------------|
| Total (not including students) | 420,441 [^] | 23,128 |
| Percent women | 5.5 [^] | 7.5 |
| Percent white | 92.3 [*] | No information |
| Students | 149,121 [^] | No information |
| Percent women | 12.89 [^] | No information |
| Average pay | \$111,930 ^{^^} | £113,150 |
| Average male salary | \$124,171 [*] | £113,672 |
| Average female salary | \$96,978 [*] | £99,072 |
| Average male age | 43.7 [*] | No information |
| Average female age | 41.7 [*] | No information |
| Projected job growth | 4% through 2026 ^{^^} | 6.1% through 2023 ^{**} |

Note: For the US, overall average pay data represents median pay. for the UK, this information is an average.

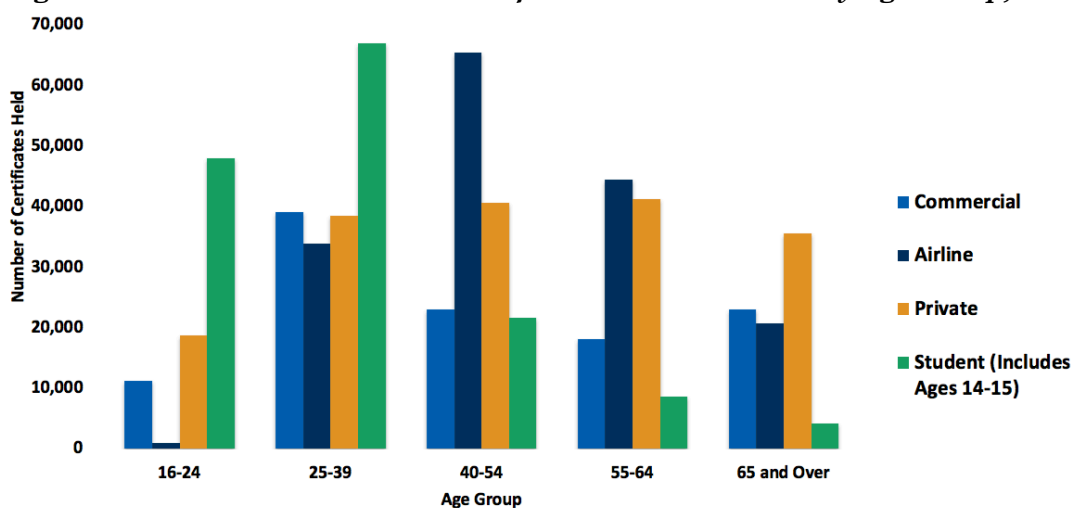
Sources: [^]FAA 2017 Active Civil Airmen Statistics (Count is comprised of Active Airmen Certificates held among private, commercial, and airline transport pilots); ^{^^}Bureau of Labor Statistics, Occupational Outlook Handbook: Airline and Commercial Pilots, 2018; ^{}Data USA, 2017; [†]Office of National Statistics Annual Survey of Hours and Earnings, 2017; ^{**}Careersmart, Aircraft Pilots and Flight Engineers, 2017*

In the US, the number of women airline pilots grew by 31 percent from 2007 to 2017, and women comprised 13 percent of students in pilot programs in 2017.⁴⁷ Scholars have pointed to perceptions of piloting as a career associated with masculinity, skillfulness, and bravery as one difficulty of attracting women to piloting.⁴⁸ Such perceptions can perpetuate women's hesitance to exploring aviation as a possible career in the first place. Further, researchers find that many young girls are not encouraged to explore the mechanics of objects, a skill that is inherent to flying a plane.⁴⁹ Underrepresentation in science-based and math-based education is also to blame: women comprise merely 35 percent of the US bachelor's degrees earned in science, technology, engineering, and mathematics.⁵⁰ In the UK, 24 percent of STEM graduates are women.⁵¹

Once on the job, women continue to experience challenges associated with the male-dominated field. Research has long documented cases of sexual harassment and sexist attitudes and remarks have prevented women from feeling comfortable sharing the cockpit with male colleagues.⁵² Family leave policies may also deter women from entering the field; major airlines typically do not offer paid maternity leave or breast-feeding accommodations.⁵³

In terms of age, Figure 1 shows that most commercial and airline pilots fall within the 40-to-54 age bracket. Because commercial airline pilots are not allowed to fly past age 65, many license-holders beyond that age can only work flying unscheduled tourism services, training, commercial flights with nine or fewer passengers.⁵⁴ Students make up the vast majority of pilot certificates for those under 40, indicating an existing replacement population. However, it is difficult to determine whether those trainees will be “enough” to satisfy growing demand.

Figure 1: Estimated Active Pilot Certificates Held in the US by Age Group, 2017



Source: FAA 2017 Civil Airmen Statistics

Pilot Job Prospects

After a 2016 slowdown in hiring expectations, a June 2018 International Air Transport Association report expects acceleration over the next year.⁵⁵ However, training new pilots might not necessarily add to the domestic workforce. A survey of UK trainees found that 48 percent intend to work in other global markets.⁵⁶ Although aviation is projected to grow in the US and UK, most air travel demand will stem from the Asia Pacific region. Over the next 20 years according to Boeing, demand for pilots is expected to be strongest in Asia Pacific (requirement of 240,000, or 38 percent of world demand), followed by North America (requirement of

127,000, or 20 percent of world demand) and Europe (118,000, or 18 percent of world demand).⁵⁷

The US Bureau of Labor Statistics estimates 4-percent growth in employment for airline and commercial pilots between 2016 and 2026, which is slower than the expected average growth across all occupations nationally.⁵⁸ Given the projected employment growth and exit of retirees, the US GAO predicts the need for 1,900 to 4,500 pilots per year over the decade leading up to 2024.⁵⁹

In 2014, the US GAO acknowledged low unemployment rates among pilots as a signal of a labor shortage, but also noted evidence of decreasing employment and earnings since 2000 as an indicator that pilot demand has not exceeded supply.⁶⁰ This finding came in the wake of a decade of airline bankruptcies, and the industry has changed in the years since.

Notably, airline wages have increased dramatically in the past few years, which may point to airlines' efforts toward – and success in – recruiting pilots.⁶¹ The Air Line Pilots Association (ALPA), the largest pilots' union in the world, suggests “there is no pilot shortage in the United States.”⁶² ALPA points to increased compensation from airlines, added career advancement opportunities, and more paths for employment through international code-share agreements. Airlines have also begun to train prospective pilots directly, rather than relying on entry-level pilots to first train in the military or in commercial or regional aircraft.⁶³ This direct training, combined with attractive sign-on bonuses, may indicate that airlines are directly meeting their own personnel needs while leaving vacancies among the military and regional and commercial airlines.

The labor market is similarly tight in the UK and might grow worse in the coming years. A major UK flight training school recently estimated that up to 20 percent of the qualifying trainees are not EU citizens and, upon receiving their licenses, gain employment in their home countries.⁶⁴ With the highest future demand for pilots expected in Asia, labor offshoring may become a bigger straining factor on the pilot workforce.

Some of the workforce pressures might be resolved through automating pilot tasks. Boeing is “actively working on technology that would remove the need for two pilots in the cockpits of its passenger jets.” Boeing’s rival, Airbus, is working on similar technology, and both are targeting cargo aircraft as the first step toward reducing the need for two pilots in commercial airline flights. But despite the uncertain promise of this innovation that might be ready “in the near future,” there are serious hurdles to reducing crews, particularly due to vehement opposition from safety and labor advocates.⁶⁵

Summary: Airplane Pilots

- It is unclear whether there is a true pilot shortage in the US or UK. However, increased demand for air travel is paralleled by growth in projected pilot jobs globally, a trend that will be challenged by impending retirements and high barriers for those interested in the profession to enter the field.
- The cost of training may inhibit many from pursuing careers in piloting. Airlines have been increasing wages and signing bonuses to make the profession more competitive.
- The decreased flow of pilots from sources like regional carriers and the military are causing additional strain on the available workforce from which professional airlines may draw.

Air Traffic Controllers

In a 2016 hearing before the United States House of Representatives Committee on Transportation and Infrastructure Subcommittee on Aviation, the president of the National Air Traffic Controllers Association (NATCA) offered written testimony stating that the US air traffic control (ATC) workforce had reached a “crisis level”:

Controller staffing has been a concern for many years, but it has now reached a crisis level: the [National Airspace System] NAS has declined to a 27-year low for Certified Professional Controller (CPC) staffing. Controller staffing has fallen nearly 10 percent since 2011, and the FAA has missed its hiring goals in each of the last seven years...If this staffing crisis continues along its current trajectory, the FAA will be hard-pressed to maintain its current capacity, let alone expand and modernize the system through NextGen programs.⁶⁶

The controller workforce challenges are particularly acute in the United States, in part due to strict training requirements and federal budget shortfalls. The 2019 government shutdown, which ended on January 25 after 35 days, exacerbated workforce challenges by withholding controller paychecks and shuttering the only controller training facility. The UK is not at crisis level, but “staffing shortages, especially in German and UK ATC providers” were blamed for thousands of European flight delays and cancellations earlier in 2018.⁶⁷ Although the National Air Traffic Service (NATS), the UK provider of ATC, denied that workforce shortages caused the delays, similar problems of training and recruiting new entrants exist in both the US and UK.⁶⁸

Governance

Air traffic control is a unique safety function that has one primary employer in each country. In the US, the vast majority of air traffic controllers are employees of the federal government.⁶⁹ The Air Traffic Organization (ATO) is an arm of the Federal Aviation Administration (FAA), and over 14,000 controllers work across the US.⁷⁰ It operates all of the air route traffic control centers and terminal radar approach control facilities along with the higher volume, higher complexity airport towers. It also contracts with three private contractors to operate approximately 250 lower volume and complexity towers as part of the Federal Contract Tower program.

During the 115th US Congress (2017-2018), there was an unsuccessful attempt to spin off air traffic control out of the FAA into an independent, nonprofit entity.⁷¹ NATCA and a broader coalition including major airlines, manufacturers, and airports supported that legislation as a way to insulate the workforce from federal political infighting, among other benefits. In the most extreme examples, the 2013 budget sequester resulted in controller furloughs and halted controller hiring and training for a year. A government shutdown later that year put controller paychecks in limbo.⁷²

The UK has used a private-sector governance model for air traffic control since 1996, when the Civil Aviation Authority created a government-owned corporation for NATS. NATS was restructured again in 2001, then as a public-private partnership where airlines own 46 percent, employees own 5 percent, and the national government owns the remaining 49 percent of the organization.⁷³ NATS has two main service divisions, NERL, which is the sole provider of civilian en-route air traffic control services over the UK, and NSL, which competes for contracts in the free market to provide air traffic control at airports in the UK and overseas. Several other providers operate towers, including London Gatwick Tower, which is operated by Air Navigation Solutions Ltd (ANS), a subsidiary of the German state owned Deutsche Flugsicherung (DFS). As a public-private partnership, NATS has greater autonomy to make its own capital decisions, invest in efficiencies, and create workforce initiatives while still retaining partial government oversight and ownership.

Requirements for Becoming an Air Traffic Controller

Air traffic controllers have among the strictest professional requirements across all aviation occupations, and the US rules are more stringent than in the UK.

In the US, minimum requirements include citizenship, security and medical examinations, English language skills, passing a pre-employment aptitude test, and having three years of experience (direct work experience, a bachelor's degree, or a combination of the two).⁷⁴ The US also has strict limits on age: applicants must be at least 18 years of age but cannot be older than 30 years of age on the closing date of the application period. The law also grants preferential consideration to a smaller pool of applicants who have prior air traffic control specialist (ATCS) experience from civil or military service. For that pool of ATC candidates, the law allows five additional years to apply to FAA job vacancy announcement, which delays the application cutoff to right before one's 36th rather than 31st birthday.⁷⁵ By law,

controllers are forced to retire by age 56. This is based upon significant research that shows that controllers' cognitive abilities and job performance decline beginning at approximately age 45 and decline more rapidly after age 50.⁷⁶ Maximum entry-age limits help to ensure that controllers remain in the workforce long enough to justify the government's training investments.⁷⁷

The first 17 weeks of initial qualification training for entry-level controllers occurs at the FAA Academy in Oklahoma City, Oklahoma. The FAA Academy has throughput capacity for 2,000 new employees per year, although it has not maximized that throughput recently.⁷⁸ Successful academy graduates are then assigned to a facility and begin on-the-job training within their facility as developmental controllers for 18 to 36 months working under the supervision of fully certified professional controllers (CPCs). Once developmental controllers complete their on-the-job training, they become CPCs and can operate independently. Further, recurrent training occurs every six months at all air traffic facilities. In a 2016 audit, the Department of Transportation's Inspector General, a federal oversight body, recommended that FAA track training progress for its controllers in an anonymized national database.⁷⁹

The FAA also partners with 30 community colleges and four-year universities through its College Training Initiative to provide air traffic and aviation administration curricula.⁸⁰ Degree holders from those schools are then eligible for preferential admission and to begin the FAA Academy at the sixth week of instruction, bypassing the first five weeks of basic coursework. After that point, they are subject to the same hiring standards and process for final FAA employment.

In the UK, baseline eligibility requirements include:

- Be over 18 years of age;
- Be legally permitted to work in the UK;
- Have Class 3 Medical certificate and security clearance;
- Have 5 GCSEs at grades 9 to 4 (A* to C), including English and math (owing to a need for calculations and communication)

NATS previously required that all applicants be 35 years old or younger to apply, though 2006 Age Discrimination regulations rendered the practice unlawful.⁸¹ Currently anyone can apply to be a NATS controller between the ages of 18 and the

mandatory retirement age of 60. Unlike in the US, a bachelor's degree is not required, but training is nonetheless very rigorous.

According to NATS in 2016, few applicants are successful in becoming controllers due to the rigor of the training and requirements. The success rate for new controllers is 0.5 percent, averaging 15 new hires from 3,300 applicants. Early weeding stages include online tests, computer assessments for personality, knowledge, and skills, and in-person interviews. Twenty students advance to the NATS College of Air Traffic Control in Hurn for up to 12 months, depending on their assignment as an area, aerodrome, or approach controller.⁸² Trainees are paid throughout this schooling and also receive living cost stipends, which can end up costing the government £600,000 per trainee.⁸³ After this specialized education in classrooms and with simulators, they work as trainees on-the-job at Hampshire. From initial application to independent validation, a prospective UK controller undergoes a three- to four-year-long process.

Compensation

In the US, air traffic controllers earn a median annual wage of \$124,540.⁸⁴ This is compared to median full-time annual earnings across all US occupations of \$52,146 for men and \$41,977 for women.⁸⁵ In the UK, NATS employees earned an average annual salary of £101,679 in 2017.⁸⁶ Across all occupations in the UK, the median annual salary for full- and part- time male workers is £25,700 and for women, it is £20,300.⁸⁷ In both countries, each of the air navigation service providers (ANSPs) pay for controller training, unlike other aviation professions like pilots who work for private corporations. Like all federal government employees, air traffic controllers receive a defined benefit retirement. They receive an accelerated benefit, due to their age-56 mandatory retirement, similar to federal law enforcement officers and federal firefighters.⁸⁸

Demographics of Air Traffic Controllers

The air traffic control workforce is mostly white and male. The US has made some efforts to try to diversify its workforce. In 2013, the FAA released a barrier analysis reviewing its ATC hiring process, concluding: “Overall, women and minorities were underrepresented among those successfully completing the ATCS Centralized Hiring Process and being hired.”⁸⁹

The FAA then implemented a revised hiring process for air traffic controllers in 2014. Those changes included implementing a new cognitive aptitude entrance

exam known as the Air Traffic Skills Assessment (AT-SA), which replaced the Air Traffic Selection and Training (AT-SAT) entrance exam, as well as a “biographical questionnaire” (BQ).⁹⁰ The FAA designed the BQ, in part, to compare common personality traits that controller applicants share with the current controller workforce. After the FAA’s initial implementation of the BQ in 2014, NATCA worked with the FAA to validate the BQ on the incumbent workforce in 2015, resulting in a new, validated BQ.

Table 2: US and UK Air Traffic Controllers Demographics

| | US | UK† |
|-----------------------|--------------------|---------------------|
| Total | 14,050~ (24,900^^) | 8,639 |
| Percent women | 19.9* | 13.9 |
| Percent white | 80* | No information |
| Average salary | \$124,540^^ | £101,679 |
| Average male salary | \$90,363** | £104,286 |
| Average female salary | \$70,098** | £83,950 |
| Average male age | 38.2^ | No information |
| Average female age | 37^ | No information |
| Projected job growth | 3% through 2026^^ | 6.1% through 2023†† |

Note: For the US, overall average pay data represents median pay. for the UK, this information is an average.

*Sources: ~Federal Aviation Administration, “Air Traffic by the Numbers”, 2017; *American Community Survey (ACS) Public Use Microdata Sample (PUMS) 1-Year Estimate 2016; **Data USA, 2017, ^ACS PUMS 5-Year Estimate 2016; ^^Bureau of Labor Statistics, Occupational Outlook Handbook: Air Traffic Controllers, 2018 (likely includes front line supervisors, traffic management coordinators, and flight service station air traffic controllers, thus inflating headcount and salary estimates); †Office of National Statistics Annual Survey of Hours and Earnings, 2017; ††Careersmart, Air Traffic Controllers, 2017*

The implementation of the revised hiring process forced thousands of controller applicants already in the pipeline to re-apply under the revised controller vacancy announcement, and several applicants brought lawsuits against the FAA. Critics have called the process a risk to safety, citing prioritization of affirmative hiring to achieve ethnic diversity over merit-based hiring.⁹¹ But others, including the president of NATCA, have clarified that this process only applies to the initial pool, and certified controllers still must pass the cognitive entrance exams that do not account for diversity, pre-employment medical and security screenings, and rigorous academic and on-the-job training requirements.⁹² Even though the FAA has recently discontinued its use of the BQ in its controller hiring process, it is unclear whether the initiative produced a more workforce diversity.

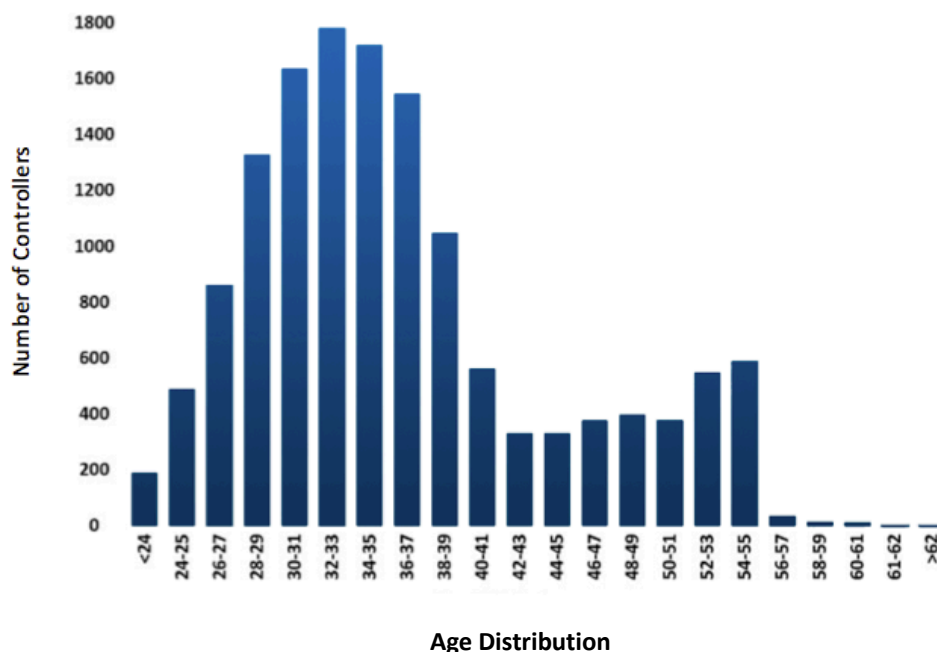
The US also has a unique issue related to its aging workforce, with its roots in a historical moment: the 1981 controller strike. After a number of labor actions during the 1970s, controllers went on strike on August 3, 1981.⁹³ The courts deemed this strike illegal and upheld then-US President Ronald Reagan decision to

terminate over 11,000 controllers and prohibit them from ever being re-hired by the FAA.⁹⁴

In 1993, President Bill Clinton lifted the ban.⁹⁵ The FAA had to rebuild the workforce quickly, and this created a continued cycle of staffing problems.⁹⁶ The cycle hit a peak in 2007 when over 800 controllers retired. Retirement rates have since declined, as the majority of the early 1980s hires have retired and a new generation of controllers is working. But Figure 2 shows another cycle of controllers that were hired in the early 2000s to replace the exodus of retirees.

Although 15 to 20 years away, the large-scale retirements of controllers who are now in their early to mid-30s will need to be strategically replaced. FAA should not repeat the boom and bust cycle. On the shorter horizon, the FAA estimates 11,029 total workforce losses over the next decade, with the most coming from academy attrition of new hires who do not complete the training program (3,903) and retirements (3,098).⁹⁷

Figure 2: Controller Age Distribution, 2017



Source: Federal Aviation Administration, “Air Traffic Controller Workforce Plan,” US Department of Transportation, 2018.

Job Prospects

Amid steady demand for air traffic controllers over the past 30 years, the FAA anticipates that it will need to hire 10,773 controllers over the next decade.⁹⁸ It hired 1,880 new

controllers in fiscal year 2017. As for the UK, the 2018 NATS Annual Report noted an uptick in their recruitment rate to keep up with traffic growth – 150 new controllers annually in the last few years.⁹⁹ Regardless of their incremental progress, evidence of a persistent workforce challenge exists in both the US and the UK.¹⁰² In the UK, NATS outsourced one of its towers at Gatwick airport to Germany’s DFS.¹⁰³

The nature of air traffic control technology, which has direct effects on the workforce, is evolving. Both the UK and US are implementing multi-year plans to modernize their systems, including replacement of outdated paper slips to track flights with digital infrastructure. NATS implemented electronic flight slips (EXCDS) in five stages from November 2017 to June 2018 while the FAA lags behind schedule.¹⁰⁴ These transformative programs improve the efficient use of airspace by leveraging automation. Although manual data entry and meticulous attention to detail remain an indispensable part of their jobs, controllers working directly with state-of-the-art digital systems are expected to reduce communication errors (i.e. make fewer verbal telephone calls) and thus boost their accuracy and productivity.¹⁰⁵ Nevertheless, despite technological advancements, controller fatigue remains as a major problem due to the nature of the job and staffing concerns, as noted above.¹⁰⁶

Case study: Early-careers Recruitment Schemes

NATS has developed several programs that target youth as a means to supplement the future workforce and address gender imbalances. After reports of only 11 percent of the UK's controllers being women, NATS held a "bring your daughter to work" day in July 2018.¹⁰⁰ The event was part of NATS' "early careers" recruitment scheme, which aims to foster interest of female engineers and technicians. NATS has also partnered with the privately funded Jon Egging Trust (JET), which organizes children to participate in aviation-related careers through mentoring programs and sessions.¹⁰¹ Given that these programs are relatively new, it is not clear whether they are producing the workforce results that NATS aims to achieve, and they should thus be monitored closely.

Since 2004, US Congress has required the FAA to publish annual air traffic controller workforce plans to address predicted shortfalls or other workforce issues. According to the 2018 report:

The FAA continues to be able to attract large numbers of qualified controller candidates. Through a revised two-track controller hiring process, and use of the updated Employee Request Reassignment process, the FAA will attract and recruit a sufficient number of applicants to achieve this hiring plan.¹⁰⁷

The latest report highlights the FAA's plan to meet the ATC workforce goals by improving training and scheduling processes, in part through simulators and improved hiring practices.

NATCA and a report from the Transportation Research Board take issue with the FAA's annual controller workforce plan, pointing out that the Agency inaccurately counts trainees (who are not yet certified to work alone) the same as fully certified controllers, which does not account for the operational needs of each air traffic control facility.¹⁰⁸

2018-2019 US Partial Government Shutdown

On December 22, 2018, the US federal government partially shut down when the President and Congress failed to agree on a 2019 fiscal year appropriations bill. During the 35-day lapse in federal funding, employees at affected agencies missed two paychecks, either because they were furloughed or were required to work without pay. FAA-employed air traffic controllers were required to work without pay during the shutdown.

Amidst the shutdown, NATCA filed a lawsuit against the federal government stating that workers were unlawfully deprived of wages, and that failure to pay at least the minimum wage to ATCs excepted from furloughs violated the Fair Labor Standards Act.¹⁰⁹ As the shutdown continued, controllers began to call in sick,

leading to staffing shortages that caused delays at major airports such as New York's La Guardia.¹¹⁰

Yet the shutdown's effects on the ATC workforce may last far longer than the time it takes to distribute workers' backpay for the two paychecks that were missed. Trainers and trainees at the ATC federal training facility in Oklahoma City were furloughed, pausing the pipeline of new workers to an existing ATC staff that is currently at its lowest point of fully trained controllers in 30 years.¹¹¹

Summary: Air Traffic Controllers

- Workforce challenges are most acute in the US, but also exist in the UK.
- Differences in governance – the US ATC system is entirely public, while the UK ATC system operates as a public-private partnership – may influence the ability of each respective country to maintain, recruit, and train necessary personnel.
- Stricter eligibility requirements in the US than in the UK may further inhibit the US from attaining the numbers it needs to sufficiently staff its ATC workforce needs.
- In both countries, new and incumbent personnel will need to be trained to keep up with new technologies.

Aircraft Maintenance, Repair, and Overhaul

The demand for aircraft maintenance, repair and overhaul (MRO) of aircraft continues to grow, supported by a series of factors that strain the workforce. According to a management consultant firm:

These are heydays for the commercial aviation industry as well as businesses supporting it from the maintenance, repair, and overhaul (MRO) sector. For the first time in airline history, carriers recorded three consecutive years of record or near record profits, thanks to constrained fuel prices and operational efficiencies. Rising demand for air travel is keeping production lines at aircraft, engine, and component manufacturers busy and setting records. Lower oil prices, along with the willingness of airlines to spend on upkeep, are resulting in delayed retirements of older jets, which in turn provide more business for the MRO industry because of their additional servicing needs.¹¹²

As the aviation industry grows, the demand for maintenance, repair, and overhaul employees will also expand to make sure that planes are kept in safe working order. Global MRO spending is expected to rise from \$77.4 billion in 2018 to \$114.7 billion in 2028.¹¹³

The industry is already experiencing growing pains. In a 2017 Aeronautical Repair Station Association survey of international repair station companies, 55 percent of respondents reported having unfilled maintenance technician positions, though in the same survey nearly 60 percent stated an expected growth in revenue and markets over the following year.¹¹⁴ Yet while more than half of respondents indicated expectations to add positions to support market growth, 82 percent pointed to at least some level of difficulty in finding qualified workers to fill open positions.¹¹⁵

To meet the increasing demand for air travel and the accompanying growth in airline fleet, the MRO market needs to increase the size of its workforce to continue to maintain operating aircraft in working conditions over their 20 to 30-year lifespan. MRO professionals will have to adapt to work on both new aircraft and older jets. While major manufacturers are delivering record numbers of high-tech planes, many airlines have delayed the retirement of older, less fuel-efficient models due to lower oil prices.¹¹⁶

Certification Requirements

In the United States, MRO positions are typically divided into three categories: airframe (the aircraft body), power plant (the engine), and avionics (aircraft electronics). Before entering the field, most MRO workers must receive training through the military, a university, or a technical college. Upon graduation or entering the civilian workforce, workers get licenses or certifications for either type of work.

Initial aircraft maintenance course fees range in the thousands of dollars. US two-year associate degrees typically cost between \$2,000 and \$6,000 per year, depending on the college.¹¹⁷ This is on par with average annual fees for two-year degrees across all programs in the US, which were \$3,570 in 2017-2018.¹¹⁸ For-profit institutions and trade schools may charge even higher tuition rates. One program at the City of Bristol College costs £9,500 a year for a minimum of two years of training. The next level of training comes to £4,000 for just one year.¹¹⁹ Some universities are working directly with industry to provide financial assistance to encourage students to train for aviation maintenance.¹²⁰

Employers are also recruiting and developing internally, such as Southwest Airlines equipping their ramp workers to apprentice and become mechanics.¹²¹ Earlier in the US educational system, students can enroll in aviation-specialized career and technical education programs at some secondary schools.¹²² The recently rebranded University Technical College Heathrow, a taxpayer-funded university technical center educating 14 to 19 year old students, partners with several local aviation partners and employers, including the Heathrow Airport Holdings and the Royal Aeronautical Society.¹²³

Training through the military offers the benefits of lower costs and hands-on experience with complex aircraft. Military maintenance programs, which include training and certification, can turn into jobs both in and beyond the military upon completion.¹²⁴ Royal Air Force trainees receive pay during training and must commit a few years of service after completion.¹²⁵

In the UK, aircraft maintenance engineers must obtain Part 66 licensing for any of the following categories:¹²⁶

- Category A: basic line maintenance and simple defect rectification
- Category B1: structural, electrical, and engine
- Category B2: avionic and electrical systems

- Category C: release of aircraft to service by licensed engineers

To obtain Part 66 licensure from the European Aviation Safety Agency (EASA), Category A and B applicants must complete an examination demonstrating one to five years of practical maintenance on operating aircraft, depending on the amount of training experience completed and the category to which the trainee is applying.¹²⁷ Initial applications cost £330 per category/sub-category, and additional service applications incur additional fees. Part 66 EASA (standard aircraft, including most commercial jets) licenses are valid for five years, after which the applicant must pay a fee to renew the license.

Alternatively, license-seekers can obtain a British Civil Airworthiness Requirement license for work including design, manufacture, certification, maintenance, and continuing airworthiness management and flight testing on non-EASA aircraft.¹²⁸ Initial applications cost several hundred pounds in addition to renewal fees, and applicants must submit a variety of approval and application forms.¹²⁹

In the US, aviation maintenance technicians are broken into two subcategories: aircraft mechanics who repair aircraft bodies, and avionics technicians who test and troubleshoot aircraft instruments and components. While certification is not required to work as an aviation maintenance technician in the US, without the credential, mechanics cannot approve aircraft for return to service.¹³⁰ Therefore, in times of extreme cost savings, airlines could hire a small number of “inspectors” to sign off on maintenance in the aircraft log even if the mechanics performing the work do not hold those certifications.¹³¹ The most common (92 percent) form of certification is the Part 147 combined airframe and power plant (A&P) rating, for which applicants must complete the following prerequisites:¹³²

- Complete courses at an FAA-certified aviation maintenance technician (AMT) school (including 750 curriculum hours in airframe subjects, 750 curriculum hours in power plant subjects, and 400 curriculum hours in general education topics), and demonstrate and document relevant A&P work experience gained through on-the-job training (including 30 months of practical experience concurrently performing the duties appropriate to A&P ratings);
or
- Demonstrate and document work experience or some combination of work experience and education gained through the military.

There is no FAA certification required to become an avionics technician, and training can be obtained through schooling (i.e. through an associate's degree), on the job, or in the military.¹³³

In recent years, there has been some pushback against “outdated” federally mandated technician training requirements in the US.¹³⁴ For example, in the spring of 2018, the Director of Maintenance at Southern Utah University (SUU) unsuccessfully petitioned the FAA for exemption from the Part 147 federal training requirements of approved curricula that satisfy a minimum number of instruction hours and curricula that cover specific subjects and items. In its exemption request, SUU claimed that these requirements severely limited the institution’s ability to design a program that meets its students’ needs and further, the rules “require training on items that an extremely high percentage of AMTs will never utilize during their future AMT careers.”

Compensation

The median pay in the US for aircraft mechanics and avionics technicians was just over \$60,000 per year in 2017.¹³⁵ Entry-level positions typically start at about \$40,000 annually, with comparable compensation in the UK.¹³⁶ The barriers to entry for mechanics are not as high as for pilots or air traffic controllers, and the skills acquired during training can be transferred to other technical professions beyond aviation.

Mechanic Recruitment and Retention Challenges

Among the biggest challenges facing the aviation technician field is attracting and retaining skilled employees. Within the field there is concern of “workforce bleed,” or the idea that certified graduates pursue careers in other fields for higher wages or better working conditions.¹³⁷ In the US, it is estimated that only 60 percent of aviation maintenance students take the FAA mechanic certification test, and among those who do, 20 percent of graduates pursue careers in fields outside of aviation.¹³⁸ A similar concern exists in the UK, with reports of licensed engineers moving up to management positions, leaving vacancies on frontline MRO activities.¹³⁹

However, there is indication that in North America, challenges associated with filling aviation maintenance workforce gaps are highly regionalized. Brian Sartain of AAR, an aviation maintenance company with seven US locations, summarized his company’s experience: “We typically don’t have any issue in finding good

qualified labor in Miami which is why we have a lot of people based there, but in other areas we've certainly been challenged.”¹⁴⁰

In the US, enrollment at FAA-certified AMT schools has decreased by 2 percent in recent years, and despite increasing recruitment efforts, AMT school programs are operating at about 50 percent capacity.¹⁴¹ Between 1990 and 2009, there was a 20-percent decrease in the percentage of public high school students earning occupational career and technical education (CTE) credits in the Repair and Transportation occupational area.¹⁴²

This trend is part of a broader shift, seen across a range of industries, of decreased interest among younger generations for technical education programs at the high school level. The primary reason is that shifts in course requirements toward core academic areas, funding limitations, and societal expectations that young people should pursue traditional four-year college degrees.¹⁴³ Amidst concerns that young people are indicating preference for four-year college degrees at the expense of CTE, calls have been made to modernize MRO curriculum, experiment with new training styles, and increase the flow of funding to MRO training programs.

US aviation groups have also expressed concern that Part 147 places emphasis on time spent in a classroom over skills and subject mastery.¹⁴⁴ Today, the average graduation rate for airframe and power plant students in the US is 78 percent.¹⁴⁵ Some in the industry have expressed concern that the quality of job applicants has declined in recent years, pointing to fail rates of up to 30 percent when applicants are tested on repair capability, regulatory knowledge, and “soft” skills.¹⁴⁶

Case study: Financial and professional aid for college students

A new program, “Wichita Promise Move”, at Wichita State University is designed to offer opportunities to students outside of the traditional aviation industry candidate pool.¹⁴⁷ The program provides both financial and professional assistance:

- For students living at least 75 miles away from the school, relocation expenses, housing and cost of living expenses, and tuition and fees are covered;
- Students receive certifications and credentials for program participation, personal career coaching, a guaranteed job interview on program completion, and a potential signing bonus if an offer is extended from a local aviation MRO company

Primary funding for Wichita Promise Move comes from a \$500,000 grant from the Wichita Community Foundation, though the program has spurred additional funding from additional organizations and businesses in the Wichita area to offset housing costs.

Apprenticeships can serve as important stepping stones into the industry, providing a more tailored education experience for students who may struggle in traditional classroom settings. In both the UK and the US, engineering firms and airline maintenance divisions have begun to expand apprenticeship programs in recent years, in some cases specifically recruiting women.¹⁴⁸

At a recent FAA symposium on the topic of workforce development, industry officials expressed concern about securing the necessary funds to administer training programs. US government officials responded by pointing to the US Department of Labor’s sector-based – rather than company-specific – approach on funding apprenticeships to encourage industry-wide collaboration.¹⁴⁹ In 2018, the US Congress introduced two bills to create programs that would provide grants of up to \$500,000 for aviation maintenance workforce development programs.¹⁵⁰

Offshoring of Maintenance Jobs

Much of the aviation workforce cannot be outsourced to other countries, but major repair and maintenance tasks like airframe heavy maintenance and engine repair are performed overseas. As airlines expand their international schedules and look to cut costs, plane repair increasingly occurs abroad. A report by the Transport Workers Union claims that 24 percent of heavy aircraft maintenance is performed in other countries, listing South America, China, and Europe as the most common locations for outsourced work.¹⁵¹ This is up from only 7 percent in 2003. This translates to \$2 billion in maintenance work, or what the report claims to be 8,200 US jobs. Aside from “lost” jobs, the union claims that outsourcing affects safety although this has been disputed by airlines, citing a very high safety record globally. On the other hand, smaller-scale line maintenance – light, routine checks such as troubleshooting, defect rectification, and overnight maintenance – is still mostly performed in-house at the airport or onsite at the MRO provider.¹⁵²

Current and Projected Demographics

Like many of the other fields in aviation, a growing subset of employees is nearing retirement age. The Aviation Technician Education Council estimates that 30 percent of the current workforce is at or near retirement age, while new entrants comprise only 2 percent of the workforce annually. The average age of a working FAA mechanic is 51.¹⁵³ In 2017, the median age for those employed as aircraft mechanics and service technicians in the US was 46.5.¹⁵⁴

Table 3: US and UK Mechanics Demographics

| | US: Aircraft and Avionics Equipment Mechanics and Technicians | UK: Aircraft Maintenance and Related Trades† |
|-----------------------|--|---|
| Total | 149,500^^ | 28,176 |
| Percent women | No information | 1.7 |
| Percent white | 72.3* | No information |
| Average salary | \$61,260^^ | £42,757 |
| Average male salary | No information | £43,279 |
| Average female salary | No information | £38,064 |
| Projected job growth | 5% through 2026^^ | -6.2% through 2023** |

Note: For the US, overall average pay data represents median pay. for the UK, this information is an average.

*Source: *American Community Survey (ACS) Public Use Microdata Sample (PUMS) 1-Year Estimate 2016; ^^ Bureau of Labor Statistics, Occupational Outlook Handbook: Aircraft and Avionics Equipment Mechanics and Technicians, 2018; †Office of National Statistics Annual Survey of Hours and Earnings, 2017; **Careersmart, Aircraft Maintenance and Related Trades, 2017*

Around 41 percent of FAA certified mechanics work for repair stations, air carriers, general aviation, and aviation maintenance technical schools. Particularly at the entry level, mechanics can expect \$19.29 hourly starting salary and earn up to occupational median wage of \$28.98 per hour (with or without certification) at repair stations and regional airlines, the two dominating employers.¹⁵⁵

Far more workers are certified than are employed in the industry due to retention challenges. In the US, the number of FAA-certified aviation mechanics has decreased gradually from 326,276 in 2008 to 286,268 in 2017, with 2.3 percent of 2017 certificates administered to women.¹⁵⁶ Notably, UK Part-66 certification issuances are on a 10-year decline while renewals are slightly rising; 1,950 licenses were newly issued or renewed in 2016.¹⁵⁷ Women comprise only 1.7 percent of the employed British aircraft maintenance and related trades workforce.¹⁵⁸

Job Prospects

Much like other sectors, the MRO profession will soon be affected by retirements among aging generations. While the total number of positions is expected to grow modestly in the US, mass retirements will create significant vacancies that the industry will need to fill. Not only will MRO providers need new bodies to fill existing roles, but also the future workforce will need to be trained to work with new, more technology-intensive aircraft. Such new technologies include factors like advanced avionics and increased use of composites and advanced materials, use of electrical power in place of hydraulics and pneumatics, use of monitoring

technologies to track the health of airframe, systems, and engines, and enhanced cabin and interior features.¹⁵⁹

There was no definitive explanation regarding the steep decline that the UK Office of National Statistics projects for jobs in aircraft maintenance in the UK, and why this number contrasts with the expected increase in jobs in the US. A potential factor is the possibility of the UK government to leave the European Union (EU), known as “Brexit.” The UK’s ability to export goods in the EU and globally relies on European Aviation Safety Agency (EASA) certification, and if the UK leaves the EU, it will also leave EASA. While the direct effects of this scenario are unknown, it is highly likely that Brexit would result in challenges with regulating the aviation sector, with downstream influences on the maintenance workforce.¹⁶⁰

Summary: Aircraft Maintenance, Repair, and Overhaul

- The global aircraft MRO industry is expected to grow from \$77.4 billion in spending in 2018 to \$114.7 in 2028, in part due to the delayed retirement of older aircraft.
- Many repair stations have unfilled maintenance technician positions and are experiencing difficulty finding qualified workers for these positions.
- The Aerospace Industries Association is concerned about “workforce bleed,” where many of those who receive aircraft maintenance certification choose to pursue careers in higher-paying fields or quickly moving into upper management positions.
- Reduced enrollment in aircraft maintenance programs mirrors larger industry trends in which younger students are foregoing technical education opportunities.
- Heavy maintenance tasks are increasingly shifting to locations abroad, potentially reducing available jobs for domestic aircraft maintenance workers.

Airport Workers

The 55 commercial airports in the UK employed 157,000 people in ground-based jobs in 2012 and directly contributed £8.1 billion to UK GDP.¹⁶¹ Some work directly for the airport, while other employees are concessionaires or government contractors. In the US, 485 commercial airports employed up to a total of 3.6 million people with an estimated direct economic impact of \$2.68 billion in 2013. These jobs include airport activities employing concessionaires, baggage handlers, managers, and construction workers as well as capital improvement programs that bring in architects, construction workers, engineers, and consultants for projects like runway rehabilitation.¹⁶²

A US Transportation Research Board report on airport workforce requirements listed the following occupations as airport mission critical:¹⁶³

- Airport Development (e.g. architects; real estate professionals)
- Airport Operations (e.g. cargo and freight agents; laborers & freight, stock, and material movers; baggage handlers)
- Airport Security (e.g. security guards; transportation security screeners)
- Electricians
- Engineering (e.g. civil, electrical, and mechanical engineers)
- Financial Analysis and Planning (e.g. accountants; budget and financial analysts)
- Information Technology (e.g. computer and information research scientists; computer programmers)
- Project Planning (e.g. cost estimators; urban and regional planners)

Each of these occupations has unique workforce challenges, making it difficult to generalize the challenges and thus, inform policy solutions across the entire airport workforce. This section will highlight challenges unique to jobs that do not require a college education, which represent the majority of airport jobs and receive the lowest wages. These jobs also face competition from the broader labor market: while a pilot is trained to only fly planes, an electrician can get a job at an airport or in dozens of other sectors.

Airport Worker Compensation

September 11, 2001 reshaped the labor landscape for airport workers. As the US federal government created the Transportation Security Administration (TSA),

labor standards and wages for security screeners at American airports rose. But the decline in passenger volumes and subsequent bankruptcies of US airlines put downward pressure on wages for other airport positions. Long before the effects of 9/11, US deregulation of the airline industry in 1978 led to the outsourcing of workers from airlines to external contractors, in some cases for much lower pay.¹⁶⁴

While airports in US are exclusively owned and operated by the public sector (with the sole exception being in San Juan, Puerto Rico), most airports in the UK are privatized.¹⁶⁵ In fact, 53 percent of UK airports are fully privatized, and another 26 percent have at least some private sector ownership. UK airport workers are thus private sector employees and contractors.

The UK model of private-sector operations differs significantly from the US with respect to one particular airport occupation: airport screeners. In the US, the TSA employs airport screeners as federal workers. However, US airports are not required to use TSA to fill screener positions. Under the Screening Partnership Program (SPP), TSA-regulated airports can apply to have screening services carried out by private contractors. Currently, 22 American airports participate in the program, the biggest of which is San Francisco International.¹⁶⁶ A 2011 staff report for the US House of Representatives Committee on Transportation and Infrastructure indicated that, at the time, SPP screeners were 65 percent more efficient than TSA screeners and a switch to the SPP model among the US's top 35 airports would save \$1 billion in worker salaries alone. The report points to significant recruiting and training costs associated with TSA staff.¹⁶⁷

Federal TSA screener salary estimates range from about \$25,000 for entry-level employees to nearly \$45,000 for experienced employees.¹⁶⁸ Transportation security officers for Covenant Services, the private contractor that runs screening operations at San Francisco International, make an average of \$45,000 annually.¹⁶⁹

Despite public sector ownership, outsourcing of jobs to private sector contractors plays a major role for other airport positions, especially among budget airlines. In 2014, the market for external services provided to airlines was estimated to be worth more than €200 billion globally.¹⁷⁰ Amidst increased outsourcing from the US, weighted average hourly wages across both direct and outsourced industries fell between 2002 and 2012, with the starkest decline in wages felt among bellhops and baggage porters (-45 percent, adjusted for inflation) and a more modest decline in wages among freight, stock, and material movers (-3 percent, adjusted for inflation).¹⁷¹ Wages are even lower among tipped workers such as wheelchair

attendants, who earned \$5.95 per hour before tips in 2017.¹⁷² (The US federal minimum wage is \$7.25 an hour, but a business can pay a tipped employee as little as \$2.13 as long as gratuities make their hourly earnings at least \$7.25).

In addition to low wages, there is also indication that airport workers receive few job benefits.¹⁷³ However, the specific details of what types of benefits employees receive, and who administers those benefits – be it the union, the employer, a spouse’s employer, the military, or a public program – are unclear and inconsistent across airports.

The tide may be turning for these workers with union-driven efforts improving wages and working conditions worldwide. For example, workers at Aberdeen International Airport have rejected a wage increase below inflation for the third time in two years.¹⁷⁴ Contracted baggage handlers, wheelchair attendants, cabin cleaners, and skycaps for JetBlue went on strike in protest of threats and illegal surveillance by management during their union formation at Logan Airport in Boston.¹⁷⁵ Airport workers fought for a significant wage increase at Reagan National Airport, with the minimum wage increased to \$11.55 from \$7.25 (the federal minimum wage rate) in 2017.¹⁷⁶

In recent years, instances of airports increasing wages above cities’ minimum wages, requiring vendors to offer paid sick leave, and passing policies to encourage worker retention have manifested across the US; since 2014, unions have assisted over 100,000 airport staff in the US to obtain rules for improved labor and safety standards.¹⁷⁷ Collective bargaining to achieve wins of this nature is no small feat, given the complex system of contracted airport services through which airlines often use third-party companies for services like baggage handling, catering, and gate services.¹⁷⁸

Case Study: Improved Workplace Standards at San Francisco International Airport

In the early 2000s, the San Francisco International airport commission enacted a series of policies aimed at improving worker conditions: 1) a Quality Standards Program mandating that workers be paid \$9 per hour (\$10.25 without benefits), to be increased over time; 2) labor peace rules governing agreements between employers/contractors and labor unions; 3) a worker retention policy protecting workers from being laid off in the event of third party contract termination.

Since the implementation of these policies, numerous studies have pointed to evidence that higher wages for airport employees reduce employee turnover and lead to better employee performance without hurting passenger volume or employment.¹⁸¹ For example, there was evidence of a 44 percent reduction in turnover among cabin cleaning firms as a result of these policies.¹⁸²

Over the past two years, SEIU officially became the recognized union of 11,000 low-wage airport workers in the US, representing a strong and growing constituency in a time when union membership is on the decline, and other unions have fought for higher labor and safety rules for airport staff over the last four years.¹⁷⁹

Unionization efforts are contentious among some in the industry. Airline advocacy groups have opposed ordinances to raise wages due to concerns regarding labor peace provisions, agreements that unions will not strike and companies will not resist organizing.¹⁸² Others cite the inherent, shared interest of airport-related employers' commitments to safety as why unionization is not necessary.¹⁸³

Demographics of Airport Workers

Due to the range in occupations that fall under the “airport worker” category, it is difficult to assess the current and future demographic composition of these employees. However, because of this occupational variety, this group represents a more racially, age, and gender-diverse labor pool than other aviation occupations. This aligns with future trends in the larger US workforce, where the future labor market will be more ethnically diverse. The US population as a whole is trending toward the aging and decline of whites, counterbalanced by an increase of young non-whites.¹⁸⁴

Table 4: US and UK Airport Worker Snapshot Demographics

| | US: Aircraft Cargo Handling Supervisors [^] | US: Transportation Security Screeners | UK: Security Guards and Related Occupations [†] | UK: Air Transport Operatives (Cargo Handlers, Refuellers, Ramp Agents, Etc.) [†] |
|-----------------------|--|---------------------------------------|--|---|
| Total | 7,600 | 46,100 ^{^^} | 195,066 | 15,222 |
| Percent women | No information | 35.8* | 16.1 | 8.1 |
| Percent white | No information | 57.7* | No information | No information |
| Average salary | \$48,150 | \$40,580 ^{^^} | £25,550 | £28,157 |
| Average male salary | No information | No information | £25,550 | £28,679 |
| Average female salary | No information | No information | £25,029 | £26,071 |
| Average male age | No information | 42.3*** | No information | No information |
| Average female age | No information | 39.6*** | No information | No information |
| Projected job growth | 6% through 2026 ^{^^} | 3% through 2026 ^{^^} | No information | 0.6% through 2023 ^{††} |

Note: For the US, overall average pay data represents median pay. for the UK, this information is an average..

*Source: ^Bureau of Labor Statistics, Occupational Employment and Wages, 53-1011 Aircraft Cargo Handling Supervisors, 2017; ^^Bureau of Labor Statistics, Occupational Outlook Handbook: Data for Occupations Not Covered in Detail, 2017; **Data USA, 2017; ***ACS PUMS 5-Year Estimate 2016; †Office of National Statistics Annual Survey of Hours and Earnings, 2017; ‡Careersmart, Air Transport Operatives, 2017*

Job Prospects

In the coming years, the number of airport jobs will need to grow in order to meet increasing passenger volumes at major hub airports, though airports of all sizes will likely demand more personnel to accommodate the growing traveling public.¹⁸⁵

Increases in airport investment contribute to this growth. The FAA's National Airspace System Capital Investment Plan targets funding investments of \$2.766 billion per year between 2018 and 2022.¹⁸⁶ In London, the Cabinet approved plans to build a new £14 billion privately funded runway at Heathrow in mid-2018.¹⁸⁷

Public policy in the US has made it harder for airports to recruit workers. Over 50,000 TSA screeners, who are among the lowest paid federal employees, were among the federal workforce required to work without pay during the early 2019 partial US government shutdown.¹⁸⁸ Workers missed two paychecks, which resulted in a record 10 percent of the TSA workforce calling in sick to work and security checkpoint lines to be shut down across the country.¹⁸⁹ Although the shutdown ended on January 25, the long term effects are unknown as industry experts and analysts worry that low morale and future shutdown threats make the job less appealing.¹⁹⁰

To meet the growth in demand and increased capacity at airports, more frontline workers will be needed to operate and maintain airport activity. Personnel needs range from those who interact directly with passengers, like wheelchair pushers, to those that facilitate increased airport capacity, like civil engineers who design terminals and runways.

Unlike manufacturing jobs, airport workers are hard to outsource to foreign countries. But automation is increasingly influencing global airport operations, with speculation that soon passengers will travel “from the curb to the plane without interacting with a single airline employee.” Online and kiosk check-ins, electronic boarding passes, and self-tagging services are among the most recently automated airport features. The effect of automation on the demand for manual labor is unclear, though some have countered fears of job loss, stating that advanced technology will result in faster passenger throughput and will free employees to personally assist passengers.¹⁹¹

Summary: Airport Workers

- Additional airport workers will be needed to meet the growing demand for air travel. Automation may affect airport workers’ jobs, freeing employees to serve in more public-facing roles.
- Wages appear to be increasing across a range of airport occupations. A healthy economy coupled with low unemployment is creating an environment for collective bargaining and other union-driven efforts to increase wages and create better working conditions in both countries.
- In the US, security screeners are primarily employed by the federal government. While there is limited information comparing wages among these workers with their private sector counterparts, the Screening Partnership Program is an opportunity to compare the relative costs and efficiency of public and private sector screeners.

Flight Attendants

Cabin crew members serve an important role in maintaining safety for air passengers. These employees play one of the most public-facing roles in the aviation industry, and they must balance customer relations with broad and precise knowledge on how to handle emergency situations as first responders.¹⁹²

While there have been some reports of airlines facing cabin crew shortages, applicant interest is high industry-wide.¹⁹³ Various on-the-job challenges face cabin crew employees and cause them to threaten and carry out work strikes, as noted by numerous headlines in 2017 and 2018.¹⁹⁴

Application Process

In both the US and the UK, cabin crews may not witness the same tight labor supply seen in much of the rest of the aviation industry. In recent years, some airlines have had up to hundreds of thousands of applicants apply for far fewer open flight attendant positions, resulting in fewer than one percent of applicants being hired. Despite the fact that most flight attendant positions do not require applicants to have a college-level degree, some compare the odds of being admitted to an Ivy League school as higher than being selected as a flight attendant.¹⁹⁵

The low acceptance rate is in part due to the rigorous safety expertise that applicants must have in addition to customer service experience. The recruitment process can take weeks or months of multiple rounds of interviews and multi-week on-site training programs where trainees mimic procedures for mock emergencies.¹⁹⁶

In the US, the FAA regulates the number of flight attendants that must be on a passenger-carrying plane from a minimum of one flight attendant (for airplanes with a maximum payload capacity of more than 7,500 pounds and a seating capacity of more than nine but less than 51 passengers) to a maximum of two flight attendants plus one additional flight attendant for each unit of 50 passenger seats above a seating capacity of 100 passengers.¹⁹⁷

In the EU, the minimum number of cabin crew must be the greater of the following: the number of cabin crew members established during the aircraft certification process in accordance with the applicable certification specifications (for the aircraft cabin configuration used by the operator); the number of cabin crew established

during the aircraft certification process for the maximum certified passenger seating configuration reduced by one for every whole multiple of 50 passenger seats of the aircraft cabin configuration used by the operator falling below the maximum certified seating capacity; or one cabin crew for every 50, or fraction of 50, passenger seats installed on the same deck of the aircraft to be operated.¹⁹⁸

In terms of training requirements, the FAA requires flight attendants to hold Certificates of Demonstrated Proficiency, which are obtained upon completion of a three to six-week FAA training program.¹⁹⁹ Similar requirements are in place in the EU.²⁰⁰

Working Conditions

In recent years, there have been a number of strikes and efforts to organize for workplace protections among flight attendants. In 2017, over 3,200 Unite the Union members in the UK engaged in strikes exceeding 80 days against British Airways over low pay and company discipline against 1,400 employees who had previously been involved in collective bargaining.²⁰¹ In the US, Delta flight attendants have also organized over lack of contract protections safeguarding jobs when scheduling is disrupted due to weather and other events, and American Airlines flight attendants have organized in response to a new policy where disciplinary points are administered when flight attendants take more than two personal days within a 12-month period or call in sick during holidays.²⁰²

Studies have pointed to occupational health hazards among flight attendants, including higher incidence of cancer.²⁰³ In 2017, American Airlines flight attendants filed a lawsuit against the company's uniform maker, citing respiratory distress, nausea, headaches, cognitive issues, and rashes as a result of the uniforms.²⁰⁴

Both in the US and the UK, the majority of flight attendants are women and the profession has a long history, reinforced by references in popular culture, of sexualizing female flight attendants.²⁰⁵ Results from a recent Association of Flight Attendants survey of more than 3,500 flight attendants from 29 US airlines indicated that more than two-thirds of flight attendants have experienced sexual harassment – comments that respondents described as “nasty, unwanted, lewd, crude, inappropriate, uncomfortable, sexual, suggestive, and dirty” – during their flying careers.²⁰⁶ According to the same survey, nearly 20 percent experienced physical sexual harassment from passengers in the year preceding the survey. Further, 68 percent of respondents indicated that the airlines for which they work

have taken no efforts to address this harassment, which can undermine flight attendant confidence that the airline will support them in situations in which passengers harass fellow passengers. Only seven percent of flight attendants who experienced abuse reported it to their employers.

Flight attendants must also handle passenger-on-passenger sexual harassment incidents. However, one victim of airplane sexual harassment suggested a lack of training among flight attendants on protocol for handling cases of harassment.²⁰⁷ According to an Association of Flight Attendants member survey, more than half of flight attendants are unaware of specific policies to handle reports of passenger sexual harassment.

Flight Attendant Demographics

In contrast to other fields within aviation, flight attendants have historically been predominantly white women. However, male pay is still higher than female pay, despite the fact that women flight attendants are slightly older on average and thus have more seniority. Overall, women comprise 75.6 percent of US flight attendants and 68.7 percent of U.K. air travel assistants.

Table 5: US and UK Flight Attendant Demographics

| | US: Flight Attendants | UK: Air Travel Assistants [†] |
|-----------------------|--------------------------------|--|
| Total | 116,600 ^{^^} | 46,850 |
| Percent women | 75.6 [*] | 68.7 |
| Percent white | 72.7 [*] | No information |
| Average salary | \$50,500 ^{^^} | £27,636 |
| Average male salary | \$54,060 ^{**} | £29,721 |
| Average female salary | \$44,605 ^{**} | £26,071 |
| Average male age | 44.8 [^] | No information |
| Average female age | 45.4 [^] | No information |
| Projected job growth | 10% through 2026 ^{^^} | 0.7% through 2023 [~] |

Source: ^{*}American Community Survey (ACS) Public Use Microdata Sample (PUMS) 1-Year Estimate 2016; ^{**}Data USA, 2017; [^]ACS PUMS 5-Year Estimate 2016; ^{^^}Bureau of Labor Statistics, Occupational Outlook Handbook: Flight Attendants, 2018; [†]Office of National Statistics Annual Survey of Hours and Earnings, 2017; [~]Careersmart, Air Travel Assistants, 2017

According to the Trades Union Congress, the British section (LHR) of the international Association of Flight Attendants-CWA, has 500 Heathrow-based employees who fly for United Airlines, 150 of whom are male.²⁰⁸ The largest union is the British Airlines Stewards and Stewardesses Association, a branch of the trade-sector Unite the Union, representing 8,000 cabin crew members of flagship

carrier British Airways.²⁰⁹ In the US, the Association of Flight Attendants-CWA represents nearly 50,000 flight attendants at 20 airlines.²¹⁰

Job Prospects

Both countries expect increased job opportunities among flight attendants over the next five to 10 years. As a consequence of new larger planes in airline fleets and upcoming retirements of older flight attendants, the 10-percent US projected growth rate outpaces the general workforce projection of seven percent.²¹¹ Boeing estimates that by 2037, demand for new cabin crew will grow to 321,000 in the Asia-Pacific region, followed by 187,000 in Europe and 174,000 in North America.²¹²

While flight attendants will be in high demand to meet the anticipated growth in air travel, this demand has not yet manifested in a workforce shortage within the occupation. Further, due to the customer-facing nature of this job, the same threats of automation facing much of the rest of the aviation industry are not likely to threaten the cabin crew workforce anytime soon.

Summary: Flight Attendants

- There does not seem to be a shortage within the flight attendant occupation. Rather, record rates of applicants are applying for highly competitive jobs.
- Flight attendants have engaged in strikes over wages and working conditions, to varying degrees of success
- The majority of flight attendants are women, and the profession has a long history of struggling with sexual harassment of its female workforce.

Aerospace Manufacturing Workforce

US aerospace and defense sales generate \$143 billion in exports and a positive trade balance of \$86 billion.²¹³ The UK boasts a similarly large aerospace industry in the world, second only to the US.²¹⁴ The UK's industry generates £31 billion in sales, of which 90 percent are for export.²¹⁵ The aerospace industry is indispensable for both the US and UK economies and appears poised for continued growth. Management consulting firm Oliver Wyman forecasts significant manufacturing growth:

Where in our 2017–2027 forecast we projected annual growth averaging 3.4 percent, our current outlook ratchets up that yearly increase to 3.7 percent. The two biggest, Boeing and Airbus, have reported they expect their production of Boeing 737s and A320s to reach an unprecedented 60 aircraft per month each sometime in 2019. This compares with 42 per month as recently as 2015—a jump of 43 percent in just four years.²¹⁶

The aerospace manufacturing sector extends beyond complete aircraft. Dozens of large firms manufacture engines, parts, and components that are vital to growing the global fleet.

Range of Professions and Skills

A slew of occupations, including business strategy, cyber security, data science, engineering, information technology, and direct manufacturing, supports the aviation manufacturing industry. This wide scope makes it difficult to define a single workforce issue for aerospace manufacturing. Boeing's careers webpage lists 15 different occupations the company is currently seeking just in the "manufacturing" category:²¹⁷

- Aircraft mechanic
- Aircraft painter
- Composite parts fabricator
- Electrical assembler
- Electrician
- Flight line mechanic
- Functional test technician
- Machinist
- Mechanical assembler
- Painter

- Plumber
- Quality inspector
- Sealer and tester
- Tool and die maker
- Welder

This varied list shows the expanse of skills and training needed in aerospace manufacturing. Some skills, such as welding, may require certification without education beyond a high school degree, while other jobs, such as designing and testing prototypes, often require a degree in fields such as aerospace engineering or mechanical engineering.²¹⁸

Among the occupations requiring advanced skills, the industry recognizes the urgent need to train students in the fields of science, technology, engineering, and mathematics (STEM) while industry-wide, workers must also be versed in broader skillsets like problem-solving, critical thinking, literacy, communication, and collaboration. In addition, there is concern that among those who do have the necessary skillsets to enter into the aviation workforce, many are instead pursuing tech careers in Silicon Valley, resulting in workforce bleed.²¹⁹

Much like other industries, aerospace manufacturers are concerned about upcoming retirements.²²⁰ Boeing, for example, employs more than 14,000 people in the US over age 61, which amounts to about 10 percent of their total US workforce.²²¹ It is unclear whether industry retirements will come in a major wave or will be more gradual, and there is also concern that many will choose to shift their role in the workforce by reducing the number of hours worked or transitioning into other roles.²²²

Contrary to concerns about pending retirements and a shortage of skilled workers to replace retirees, a recent US GAO study found mixed evidence of a workforce shortage: “Aerospace engineers have experienced a low unemployment rate – the most direct measure of a labor shortage – and increases in employment suggest a shortage may exist. However, earnings for the occupation have stayed about the same.”²²³

Geopolitical and Economic Implications

Both the US and the UK have experienced recent geopolitical and economic events that have unknown implications on aerospace manufacturing. In the lead up to the

Brexit referendum vote, the Organization for Economic Cooperation and Development forecasted that by 2020, GDP in the UK would be over 3 percent lower than what it would have otherwise been with continued European Union membership.²²⁴ Barriers to trade, particularly in a hyper-globalized market such as the aerospace manufacturing industry, make supply chains more expensive, hurt production, and ultimately hit the workforce.²²⁵

In the US, threats of a global “trade war” implicated aircraft manufacturing in early 2018, when the US proposed 25-percent tariffs on Chinese goods including aircraft, propellers, turbojet engines, and other aerospace parts, and China responded with 25-percent tariffs on airplanes weighing between 33,000 and 99,000 pounds.²²⁶ Some have speculated that this could make the US aviation manufacturing industry less globally competitive, while others have suggested that the Chinese tariffs on US planes would only affect a small subset of the planes manufactured by Boeing, most of which are much heavier than those targeted by the tariffs.²²⁷

Demographics among Aviation Manufacturers

Industry-wide, white men are the most common demographic. As older generations age and decreasing percentages of minorities and women are pursuing STEM educations, fewer potential workers will be able to replace retirees. Further, foreign nationals who pursue engineering degrees at US universities may not be qualified to pursue jobs in the US due to strict employment regulations.²²⁸

Table 6: US and UK Aerospace Manufacturer Demographics

| | US: Aerospace Engineers | US: Aircraft Structure, Surfaces, Rigging, & Systems Assemblers | US: Aerospace Engineering & Operation Technicians | US: Aggregate Aerospace Product & Parts Manufacturing | UK: Mechanical Engineers† | UK: Engineering Technicians† |
|--------------------------|-------------------------------|--|--|--|---------------------------------|------------------------------------|
| Total | 69,600^^ | 41,130~ | 12,100^^^ | 478,090~~ | 88,646 | 85,116 |
| Percent women | 11.5* | 18* | No information | 25.3* | 5.3 | 11.4 |
| Percent white | 80.9* | 60.4* | No information | 72.7* | No information | No information |
| Average salary | \$113,030^^ | \$53,510~ | \$67,240^^^ | \$81,740~~ | £49,536 | £39,107 |
| Average male salary | \$108,990** | \$51,954** | No information | \$91,444** | £49,536 | £39,629 |
| Average female salary | \$90,788** | \$19,105** | No information | \$80,021** | £43,800 | £33,893 |
| Average male age | 44.9^ | 49^ | No information | No information | No information | No information |
| Average female age | 40.2^ | 35.5^ | No information | No information | No information | No information |
| Projected job growth | 6% through 2026^^ | -17%** | 7% through 2026^^^ | -0.7%** | 4.7% through 2023†† | 1.7% through 2023††† |

Note: For the US, overall average pay data represents median pay. for the UK, this information is an average.

*Source: *American Community Survey (ACS) Public Use Microdata Sample (PUMS) 1-Year Estimate 2016; **Data USA, 2017; ^ACS PUMS 5-Year Estimate 2016; ^^Bureau of Labor Statistics, Occupational Outlook Handbook: Aerospace Engineers, 2018; ^^^ Bureau of Labor Statistics, Occupational Outlook Handbook: Aerospace Engineering and Operations Technicians, 2018; ~ Bureau of Labor Statistics, Occupational Employment Statistics: 51-2011, 2018; ~Bureau of Labor Statistics, Occupational Employment Statistics: NAICS 336400, 2018; †Office of National Statistics Annual Survey of Hours and Earnings, 2017; ††Careersmart, Mechanical Engineers, 2017; †††Careersmart, Engineering Technicians, 2017*

Job Prospects

The International Air Transport Association’s anticipated growth in air travel to 7.8 billion passengers per year by 2036 will create demand for new aircraft and thus, an expanded workforce to produce planes.²²⁹ However, the effects of international geopolitics on the aviation manufacturing industry remain yet to be seen, and further disturbances may yet come.

While Boeing and Airbus have historically dominated the market for commercial aircraft, there is speculation that competition from companies based in China, Russia, and Japan may challenge this “duopoly.” Over the next 20 years, Chinese airlines are expected to order over 6,300 airplanes, according to Boeing, though some of these aircraft may come from the new Chinese manufacturers.²³⁰

In the UK, strong research and development investment in aerospace manufacturing (£1.95 billion for 2013-2026) allows the industry to plan for continued growth.²³¹ Partnerships between the government and the industry, such as the Aerospace Growth Partnership and the Aerospace Technology Institute, apply research and development initiatives to companies’ goals of growing their customer base.²³² On the contrary, in the US, the President’s 2018 request of \$350.9 million for general research and development activities and facilities at the Federal Aviation Administration represented an 18-percent decrease from 2017.²³³

Summary: Aerospace Manufacturing Workforce

- The expected growth in air travel will result in increased demand for new aircraft, though major geopolitical events like Brexit in the UK and threats of a global trade war from the US may affect major aerospace manufacturers.
- Aerospace manufacturing is comprised of a variety of subfields with different educational and certification requirements. Nonetheless, potential recruits will need to be trained in science, technology, engineering, and mathematics, as well as in more general workplace skills, in order to attract and maintain a qualified workforce.

Similarities, Differences, and Takeaways

This report outlines major workforce challenges facing professional airplane pilots, air traffic controllers, airport staff, aircraft maintenance personnel, flight attendants, and aircraft manufacturers, and documents whether or how these challenges compare across industries. Further, the report compares and contrasts industry challenges between the US and the UK, homes of the two largest aerospace industries. Aside from a few differences, the challenges facing the UK and US aviation workforces are very similar. The following five themes emerged as key takeaways of this review.

1. The aviation industry suffers from workforce pipeline challenges in general rather than personnel shortages specifically.

The outlook on whether personnel shortages exist across aviation occupations is unclear and mixed, depending on the specific occupation. Low unemployment rates among pilots and aircraft mechanics mirror the larger national economies in the UK and US signal a very tight labor market. In the second quarter of 2018, the UK had an unemployment rate of 4.1 percent, and the US had an unemployment rate of 3.9 percent.²³⁴ The only sector where the industry cites a shortage is the air traffic control workforce in the US, as a direct result of its unique retirement cycles and most stringent workforce age requirements for entry and exit.

Nevertheless, projected growth in employment to meet the increasing demand for air travel will require new cohorts of workers to enter the aviation workforce pipeline. The International Air Transport Association forecasts that 7.8 billion international passengers will travel by air in 2036, nearly double the four billion flyers in 2017.²³⁵ The US is expected to witness about 401 million new passengers for a total of 1.1 billion, and the UK is expected to grow from about 225 million to just over 300 million passengers. To serve this expanded demand in air travel, Boeing estimates that hundreds of thousands of new aviation jobs will be created worldwide.

The partial US government shutdown that lasted from December 2018 to January 2019 may pose long-term challenges on the US federal government's ability to recruit qualified candidates. Though the recent 35-day funding gap was much longer than any other in history, shutdowns are a persistent threat to the US federal workforce, including those at agencies like the FAA and the TSA. Halted paychecks and low morale may deter candidates from pursuing

employment with the federal government, particularly when national unemployment levels are low.

What is often framed as a personnel shortage in the aviation industry may actually be mistaken for widespread pipeline issues, that is, difficulty filling available positions. Both the US and UK acknowledge societal emphasis on higher levels of general education at the expense of vocational training that could fill gaps in mid-ranking skilled jobs. The wider industry recognizes that filling vacant roles will depend on attracting a larger swath of the population to aviation careers and beginning to build interest in aviation careers as early as the primary school level.

2. The extent to which technology will *replace* jobs across the aviation industry is unclear, but technology will undoubtedly influence the nature of current jobs and training.

Industry associations and workers fear that automation will replace the need for human labor. Technology currently under development could, for example, replace some pilot and air traffic control functions and automate customer service at airports. But right now, the likelihood of technology replacing jobs is unknown. The proliferation of automated telling machines (ATMs) elicited similar concerns in the 1970s, but US bank teller employment instead grew between 1980 and 2010 because ATM technology increased the overall demand for banking and thus, led to a rise in the number of bank tellers.²³⁶

What is known is that technology will change the nature of jobs. Workers will need to build and repair planes with more advanced electronics and computing capability. Air traffic controllers will need to adjust to a system based on GPS rather than radar. While some have speculated that future passengers will bypass all human interaction in the airport, expanded use of technology for tasks like check-ins and baggage tagging will free employees to serve overall higher volumes of people. New and existing employees alike will need to be trained and retrained as technology continues to upgrade. Skills necessary for the modern aviation industry, such as critical thinking, problem solving, adaptability, and communication, will not be replaced by technology.

3. Workforce demographics are shifting as all aviation sectors experience a wave of retirement.

A reduction of the workforce among those at or nearing retirement age will create significant strain on the workforce's ability to replenish itself. Succession planning and leadership development training could reduce the loss of institutional knowledge.

In both the US and the UK, most aviation professions are dominated by white (with the exception of airport service jobs) and male (with the exception of flight attendants) workers. If the aviation sector is going to compete for an emerging workforce that is more ethnically diverse, it needs to foster an environment that is attractive to that broader population. Even beyond demographics, the industry will need to be attractive both monetarily and in terms of career expectations to potential employees.

4. The aviation industry is increasing wages across the board to attract workers.

The attacks of September 11, 2001, numerous bankruptcies, airline consolidations, and the global economic recession from 2007 to 2009 were among the factors forcing airlines and airports to cut costs. These problems were more acute in the US, but affected the UK to a similar degree. As a result, the aviation industry restricted hiring and personnel development. As the global economy recovered, travel demand growth led to record profits among airlines and low unemployment rates across aviation occupations.

Parts of the industry have responded with higher wages. Airlines are offering new incentives, signing bonuses, and higher salaries to attract pilots. Airport workers have organized to secure higher minimum wages and contracts with requirements to provide benefits. But students and trainees still face high educational and certification costs, and even after completing such requirements, they are met with low entry-level pay. The industry seems to recognize that compensation packages for both technical and service jobs will need to increase in order to attract and retain the necessary workforce.

5. The aviation industry will compete with other professions, with other countries, and with itself for its future workforce.

With unemployment hovering around four percent in the US and the UK, aviation will need to compete with the broader economy for its workforce. Concerns of “workforce bleed” – the notion that skilled trainees choose occupations in other fields – is a stated fear. Aviation manufacturing, aircraft maintenance, pilot, and air traffic controller groups have all called for more STEM education to attract the technical abilities that the workforce needs. But STEM jobs are expected to grow faster than all occupations for the broader economy, and aviation will need to compete with the medical, engineering, and technology sectors for those workers.

The increased outsourcing of occupations to other countries as a means to cut costs, as well regulations preventing foreign students from working in the country they were trained and thus prompting them to return with new talent to their home countries, are other manifestations of external competition to the aviation industry. The UK reports high levels of pilots trained domestically, only to get jobs in high demand areas in Asia and other parts of the world. Outsourcing to other countries is more difficult and less likely for airport service jobs, but manufacturing and repair jobs are particularly at risk.

Internal competition has manifested within specific aviation occupations. For example, among pilots, airlines increasingly draw personnel from military, private, and regional positions, pushing airlines and private plane owners to drive up wages to attract workers.

Overall, the aviation industry faces many of the same challenges present in the global workforce: impending retirements may strain the available workforce in the coming years, and these positions will need to be thoughtfully replaced. Younger generations entering the workforce may have different skillsets, educational pursuits, and career expectations. To effectively fill the pipeline of future workers, employers will need to consider how best to attract the emerging workforce and refresh the existing one.

These workforce challenges are top-of-mind to companies and organizations within the industry. Each of the sectors discussed in this report has started to create some way to address workforce issues. Models ranging from partnerships (between industry, governments, military, and academic/community institutions) to internships and apprenticeships are increasingly common in aviation and must continue to receive funding and evaluation. To continue addressing workforce challenges, the aviation industry must continue to model its efforts after best

practices within its own ranks, but also outside of the aviation industry.

Appendices

Appendix A: Occupational Categories

US table data is drawn from (1) the Data USA visualization portal, which draws from the US Census Bureau’s American Community Survey (ACS) Public Use Microdata Sample (PUMS) 1-Year Estimate 2016 or (2) the Bureau of Labor Statistics’ Occupational Outlook Handbook or May 2017 Occupational Statistics and Wages pages by occupation.²³⁷ All UK table data comes from the Prospect professional union’s Careersmart independent online occupations directory populated with Annual Survey of Hours and Earnings and Labour Force Survey data collected by the Office of National Statistics.

Relevant Official Standard Occupational Categories Used by Country

| Major Job Grouping | US Category | SOC | UK Category | SOC |
|---------------------------------|---|--------------|---|------|
| Pilots | Aircraft pilots and flight engineers | 53-2010 | Aircraft pilots and flight engineers | 3512 |
| Flight Attendants | Flight attendants | 53-2031 | Air travel assistants | 6214 |
| Air Traffic Controllers | Air traffic controllers | 53-2020 | Air traffic controllers | 3511 |
| | Airfield operations specialists | 53-2022 | | |
| Aircraft Mechanics | Aircraft mechanics and technicians | 49-3011 | Aircraft maintenance and related trades | 5235 |
| | Avionics technicians | 49-2091 | | |
| Aircraft and Part Manufacturers | Aerospace engineers | 17-2011 | Mechanical engineers | 2122 |
| | Aerospace engineering and operations technicians | 17-3021 | Engineering technicians | 3113 |
| | Aircraft structure, surfaces, rigging, and systems assemblers | 51-2011 | | |
| | [Aggregate] Aerospace products and parts manufacturing | NAICS 336400 | | |
| Airport Operations | Aircraft cargo handling supervisors | 53-1011 | Air transport operatives | 8233 |
| | Transportation security screeners | 33-9093 | Security guards and related occupations | 9241 |

Additional information sources, such as individual government reports for specific occupations, are otherwise indicated immediately beneath the data tables in the report text. All data are from 2016 or 2017. Job growth for the United States is projected from 2016 to 2026 while the United Kingdom’s rates are forecast from 2016 to 2023.

It was difficult to perfectly match occupations across the two nations’ statistical entities. Therefore, in the interest of transparency, the table below lays out the categories used and indicates their respective standard occupational category numbers. If seeking further inquiry, a quick search by SOC number with the US Bureau of Labor Statistics and the UK Office of National Statistics leads directly to longer work descriptions and job titles.

Appendix B: General Workforce Demographics

US and UK General Workforce Demographics

| | US | UK |
|--|----------------------|---------------------|
| Total (full- and part-time) | 153,337,000* | 32,409,000^ |
| Percent women | 47* | 46.9^^ |
| Percent white | 78* | 76^^^ |
| Median personal salary for full- and part-time workers | | |
| Males | \$44,408** | £25,700~ |
| Females | \$31,610** | £20,300~ |
| Projected total job growth | 7.4% through 2026*** | 6.2% through 2024~~ |

*Source: *US Bureau of Labor Statistics, Labor Force Statistics from the Current Population Survey: Employed and Unemployed Full- and Part-Time Workers by Age, Sex, Race, and Hispanic or Latino Ethnicity, 2017; **US Census Bureau, Income and Poverty in the United States: 2017, September 2018; ***US Bureau of Labor Statistics, Employment Projections: 2016-26 Summary, October 2017; ^Office for National Statistics, Number of People in Employment (aged 16 and over, seasonally adjusted); ^^ Office for National Statistics, UK Labour Market: November 2018; ^^^Department for Work and Pensions, Ethnicity Facts and Figures: Employment, September 2018; ~HM Revenue and Customs, Distribution of median and mean income and tax by age range and gender, February 2018; ~~UK Commission for Employment and Skills, Working Futures 2014-2024, April 2016.*

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- ⁶ Ron Rapp, “Connecting the Dots: Corporate Aviation Has Its Own Pilot Population Shortages,” *AOPA*, April 1, 2018
- ⁷ John Genovese, “Valley Flight Schools Seeing Boom in Students Amid Pilot Shortage,” *Arizona ABC 15*, September 13, 2018.
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