

5-2019

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Recommended Citation

Lutte, Rebecca K., "Women in Aviation: A Workforce Report" (2019). *Aviation Institute Faculty Publications*. 6.

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LANSING COMMUNITY COLLEGE / KEVIN McFLOWER



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May 2019

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This research is supported by a grant from the NASA Nebraska Space Grant, NNX15AI09H. The research was conducted in cooperation with Women in Aviation International.



Introduction

Aviation industry forecasts reveal the depth of the need for qualified personnel worldwide and the projected growth of the industry. Over the last five years, the industry has experienced average year over year passenger traffic growth of 6.5%, resulting in “unprecedented” financial prosperity for North American airlines (Boeing, 2018a). North American air carriers have accounted for more than half of the global industry prosperity in the last five years (Boeing, 2018a). The growth is attributed to multiple factors including lower air fares, higher standards of living in large emerging markets such as China and India, new airline business models, and growth in travel and tourism (Boeing, 2018a). The trend is expected to continue with a forecast growth rate of 4.7% average passenger growth over the next twenty years. (Boeing, 2018a). To meet that need, Boeing is forecasting that the number of jet airplanes in the commercial market will nearly double through 2037 (Boeing, 2018a). Growth in general aviation (GA) is also impacting the industry. In 2018, general aviation aircraft shipments experienced an increase of 5% for piston aircraft, 5.2% for turboprop aircraft, and a 3.8% increase in business jets (General Aviation Manufacturers Association [GAMA], 2019). While the overall GA fleet is forecast to remain relatively stable through 2039, growth in turbine and rotorcraft fleets is anticipated while fixed wing piston aircraft are forecast to decline (Federal Aviation Administration [FAA], 2019a). The number of GA hours flown is projected to increase in the same time period (FAA, 2019a). With the anticipated growth in both GA and commercial markets, operations at FAA towers are projected to grow .9% a year through 2039 (FAA, 2019a). The FAA also anticipates growth in the area of commercial space operations (space launch activities other than military and civilian government such as NASA) (FAA, 2019a). Such expansion in commercial space flight will result in increased FAA activity in the areas of approval for equipment, training, technicians, inspections and other related activities. As a gauge of the level of current activity in this area, the “FAA currently conducts as many as 400 pre-flight/reentry, flight/reentry, and post-flight reentry safety inspections per year” (FAA, 2019a, p. 35). One of the fastest growing market segments in aviation continues to be Unmanned Aircraft Systems (UAS). In the short time since UAS registration went into effect (December 2015), there are over 900,000 registered UAS, compared to just over 212,000 registered active GA aircraft (FAA, 2019a). A highly trained workforce to meet the needs of the expanding industry remains essential. As an example of the growing need, between 2018 and 2037, Boeing forecasts a need for 790,000 new pilots, 754,000 new technicians, and 890,000 new cabin crew (Boeing, 2018b).

Women in the aviation workforce are a vital resource for meeting the personnel needs. Before exploring the number of women in aviation, it is interesting to begin with a look at women in the U.S. workforce. The number of women in the workforce in the U.S. has increased over the past several decades (Toossi & Morisi, 2017). Women made up about 1/3 of the workforce in 1950 compared to 46.9% of the workforce in 2018 (Toossi & Morisi, 2017; Bureau of Labor Statistics [BLS], 2018). The gender gap is expected to continue to narrow (Toossi & Morisi, 2017). In addition, the women’s labor force is projected to become more diverse, “reflecting greater racial and ethnic diversity” in the next ten years (Toossi & Morisi, 2017, p. 18). It is also interesting to note that the proportion of women ages 25 to 64 in the labor force who hold a Bachelor’s degree and higher increased from 11% in 1970 to 42% in 2016 (BLS, 2017). By comparison, the number of men ages 25 to 64 in the labor force who hold a Bachelor’s degree and higher was slightly more than doubled during the same time frame, reaching just over 36% in 2016 (BLS, 2017).

Currently there is insufficient data on the number of women in the aviation workforce. While solid information is available on some segments of the industry, through FAA data for example, it remains a challenge to get a baseline of information in many segments in the industry. Data sources such as the Bureau of Labor Statistics and member participation in aviation specific professional groups has been targeted to attempt to fill these gaps. The purpose of this report is to provide a comprehensive study of the number of women in the aviation workforce. When able, data from multiple sources are provided. In addition, the work will provide a baseline so future reports can be developed to establish and monitor trends in the workforce. At a time when the industry is facing unprecedented shortages of qualified personnel, understanding these key gaps in the workforce can lead to strategies to not only expand the workforce but also enhance diversity.

Methodology

The purpose of the report is to present data on the number of women employed in a variety of aviation occupations. This will provide a better understanding of the gaps in employment to assist in outreach and retention efforts. Data searches were conducted to collect data from publicly available sources. When multiple sources existed, those sources were each presented. The author does not make a determination of the best indicator but instead presents the data sources available. Other sources utilized when publicly available data were not accessible included contacting professional organizations or creating data sets where able (such as the Dr. Luedtke research on aviation faculty). Sources of data are noted in the report.

Summary of Results

The results of the report reveal that while women are underrepresented in many areas of aviation, the areas with the largest gaps include technical operations and leadership positions. Table 1 provides an overall breakdown of the results of the report. It shows that women make up less than 10% of pilots, maintenance technicians, and airline executives. While continued outreach to underrepresented groups in all areas of aviation is essential for further developing the aviation workforce, the results reveal areas that require additional emphasis include pilots, maintenance technicians, aerospace engineers, dispatchers, cybersecurity experts, airport managers, air traffic controllers, and a continued focus on the need for women in aviation leadership positions. While there are many excellent outreach programs in aviation, these results can assist in providing additional information on where to focus our outreach efforts as an industry. Increasing the number of women in the field will help meet the needs of industry. In particular, more emphasis is needed to build upon the 3% women airline executives and 1% women airline captains. While increasing the number of women on the flight deck is important, it is equally important to increase the number of women in the left seat, and the number of women in board seats.

Table 1
Women in the Aviation Workforce

% Women in the Field	Occupation
< 5%	Maintenance technicians Airline executives (CEO, COO)
5% - 10%	Pilots
11% - 20%	Aerospace engineers Dispatchers Airport managers Air traffic controllers Aviation higher education leadership Cybersecurity
21% - 30%	FAA employees Aviation higher education faculty
31% - 40%	TSA screeners NTSB employees NASA employees
> 70%	Travel agents Flight attendants

Workforce Areas

Professional Pilots

Bureau of Labor Statistics Data

When using the Bureau of Labor Statistics, one should note there are several categories for professional pilot. The overall category, Aircraft Pilots and Flight Engineers (BLS number 53-2010) includes two occupations, Airline Pilots, Copilots, and Flight Engineers (BLS number 53-2011) and Commercial Pilots (53-2012). Figure 1 depicts the categories. The BLS definitions for the occupations are included below:

53-2010 Aircraft Pilots and Flight Engineers

This broad occupation includes the following two detailed occupations:

53-2011 Airline Pilots, Copilots, and Flight Engineers

53-2012 Commercial Pilots

53-2011 Airline Pilots, Copilots, and Flight Engineers

Pilot and navigate the flight of fixed-wing aircraft, usually on scheduled air carrier routes, for the transport of passengers and cargo. Requires Federal Air Transport certificate and rating for specific aircraft type used. Includes regional, national, and international airline pilots and flight instructors of airline pilots. Excludes “Electro- Mechanical and Mechatronics Technologists and Technicians” (17-3024).

Illustrative examples: Airline Captain, Airline Pilot in Command, Charter Pilot (Air Transport Pilot Certificate Required), Charter Pilot (Airline)

53-2012 Commercial Pilots

Pilot and navigate the flight of fixed-wing aircraft on nonscheduled air carrier routes, or helicopters. Requires Commercial Pilot certificate. Includes charter pilots with similar certification, and air ambulance and air tour pilots. Excludes regional, national, and international airline pilots. Excludes “Electro-Mechanical and Mechatronics Technologists and Technicians” (17-3024).

Illustrative examples: Aerial Crop Duster, Charter Pilot (Commercial Pilot Certificate Required), Flight Instructor (Commercial Pilots), Helicopter Pilot

(Office of Management and Budget [OMB], 2018, pp. 202 – 203)

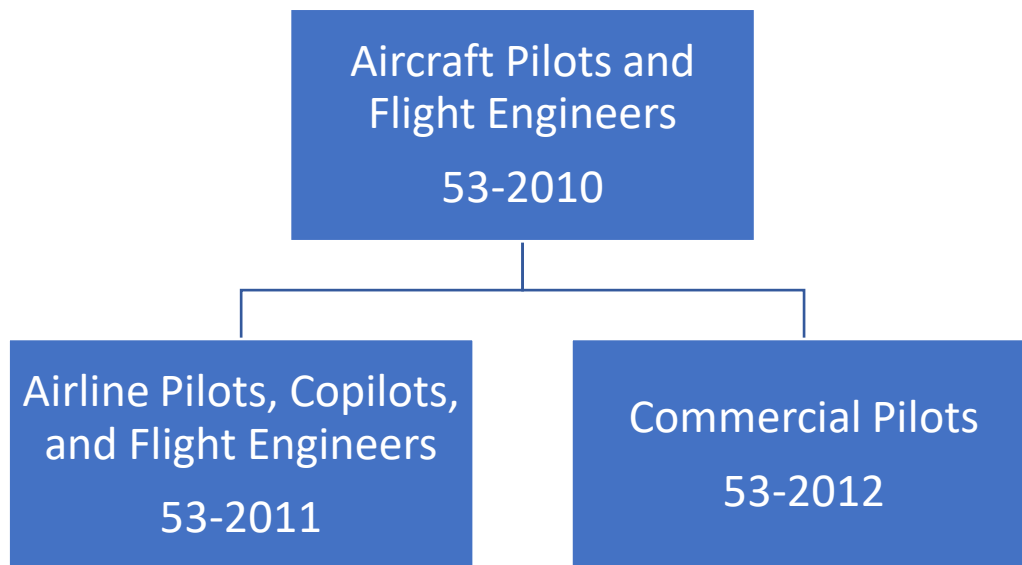


Figure 1: BLS Occupational categories: Pilots

Within BLS data, there are numerous sources of data. The most specific data by occupation are the Occupational Employment Statistics (OES) which produce estimates for over 800 occupations, including categories 53-2011 and 53-2012 (BLS, 2019a). The employment data for May 2018 is provided in Table 2. However, the OES does not gather demographic information so a break down by gender is not available for OES data. By comparison, BLS also provides data in the form of the Current Population Survey (CPS). The CPS is a “monthly survey of households conducted by the Bureau of Census for the Bureau of Labor Statistics” (BLS, 2019b). The CPS does break down data by gender but does not provide the detailed category breakdown for categories 53-2011 and 53-2012. The CPS data is available in Table 3.

Table 2
May 2018 Pilots, BLS OES Data (BLS, 2019a)

Occupation	Employment	Mean annual wage
Aircraft Pilots and Flight Engineers (532010)	120,760	
Airline Pilots, Copilots, and Flight Engineers (532011)	82,890	\$169,560
Commercial Pilots (532012)	37,870	\$96,530

Table 3
2018 Pilots, BLS CPS Data (BLS, 2019b)

Occupation	Total employed	Percent women
Aircraft Pilots and Flight Engineers	119,000	9%

By comparison, the Bureau of Labor Statistics: Women in the Labor Force report presents the following data (Table 4) for 2016 (BLS, 2017, p. 88).

Table 4
2016 Pilots and Flight Engineers, Women in Labor Force Report (BLS, 2017)

Occupation	Total employed	Percent women
Aircraft Pilots and Flight Engineers	141,000	5.2%

Federal Aviation Administration Data

One of the most commonly cited sources for pilot statistics is the FAA. Table 5 and Figures 2, 3, and 4 depict FAA data on active airmen certificate holders (FAA, 2019b).

Table 5
2018 Percentage of Women Pilot Certificate Holders (FAA, 2019b)

Total Pilots	633,317
Total Pilots (women)	46,463
% Women Total	7.3%
Student	167,804
Student (women)	22,266
% Women Students	13.3%
Private	163,695
Private (women)	10,255
% Women Private	6.3%
Commercial	99,880
Commercial (women)	6,556
% Women Commercial	6.6%
Airline Transport	162,145
Airline Transport (women)	7,136
% Women ATP	4.4%
Flight Instructor	108,564
Flight Instructor (women)	7,335
% Women CFI	6.8%

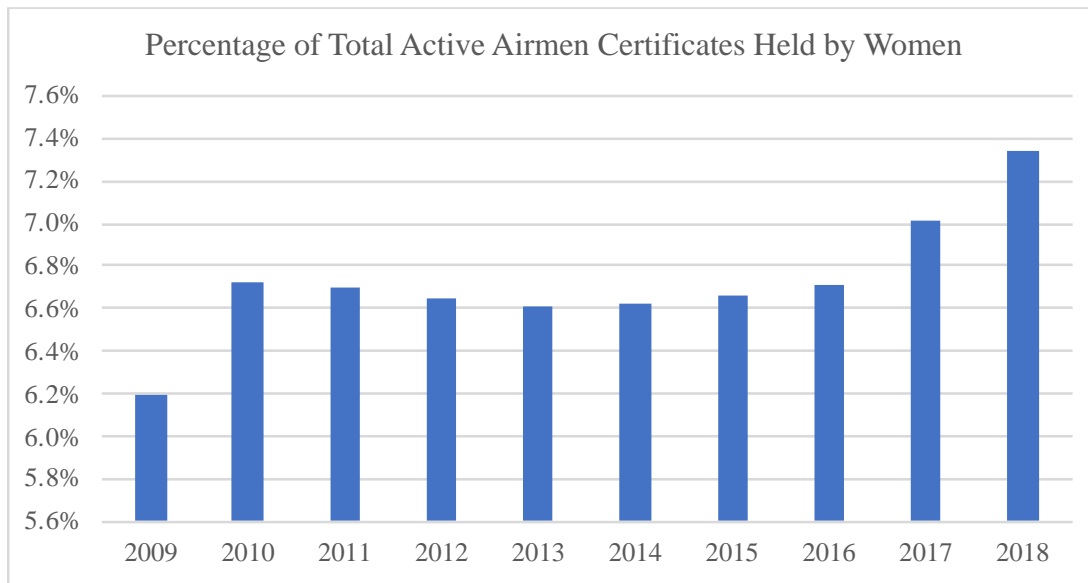


Figure 2: Percentage of airmen certificates held by women (FAA, 2019b)

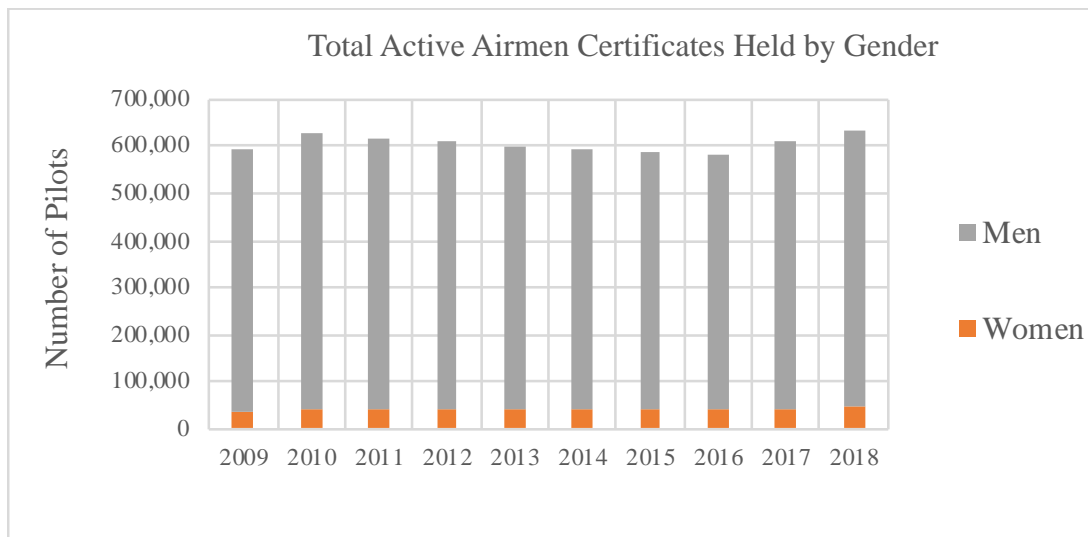


Figure 3: Comparison of total active airmen certificates held by men and women (FAA, 2019b)

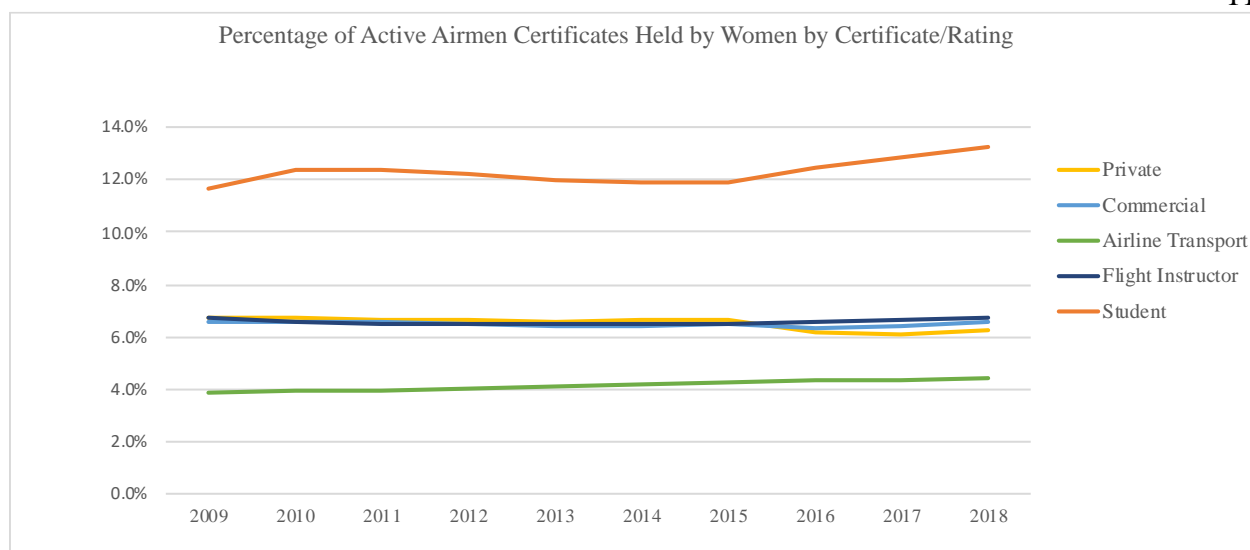


Figure 4: Percentage of active airmen certificates held by women by certificate/rating (FAA, 2019b)

International Society of Women Airline Pilots Data

An additional source for pilot data includes the International Society of Women Airline Pilots. These numbers represent self-reporting by industry personnel (International Society of Women Airline Pilots [ISWAP], 2019). The ISWAP data is provided in Table 6 and Figure 5.

Table 6
2019 US Airline Women Pilots, ISWAP Data (ISWAP, 2019)

Total airline pilots	Women airline pilots	Women airline captains
92,722	4,726 (5%)	1,376 (1%)

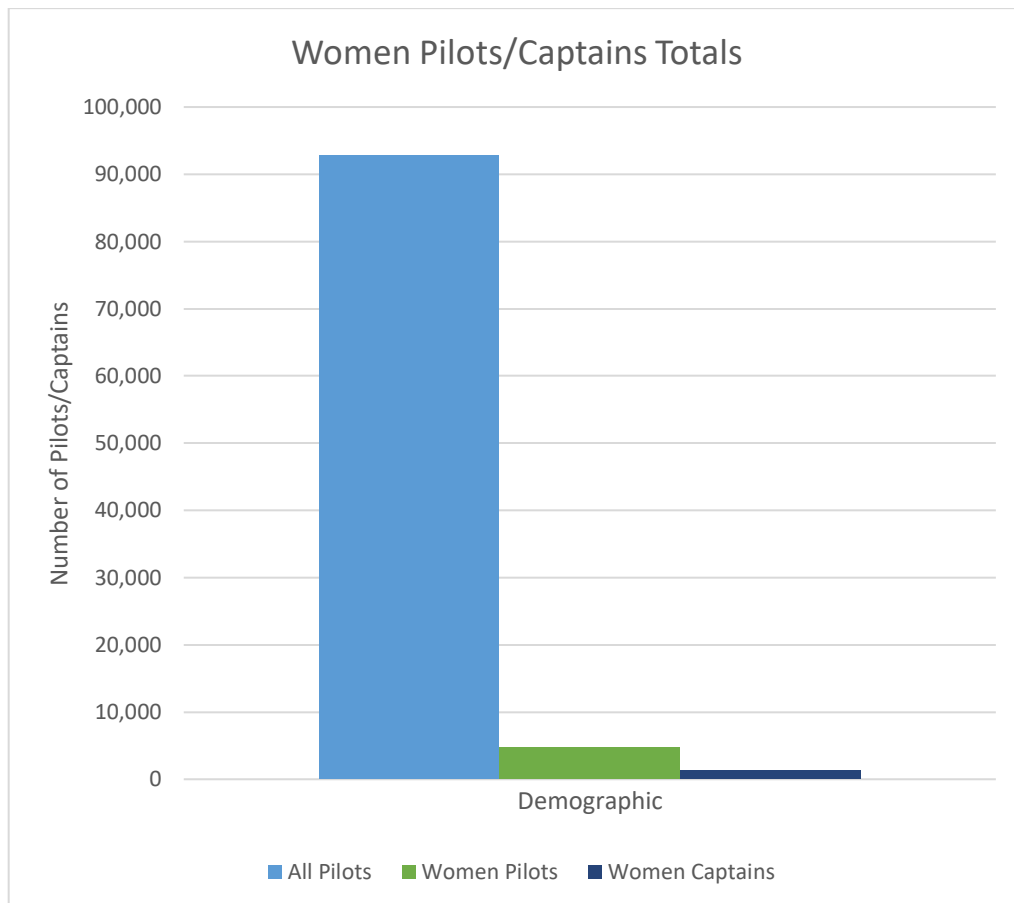


Figure 5: 2019 US airline women pilots, ISWAP data (ISWAP, 2019)

As an additional indicator of women pilot data, the International Society of Women Airline Pilots also provides a graph (Figure 6) of major airlines with the most female pilots (McCarthy, 2019).



Figure 6: Major airlines with the most female pilots (McCarthy, 2019)

Remote Pilots

FAA Data

Table 7
2018 Remote Pilots, FAA Data (FAA, 2019b)

FAA certificate held	Total	Women
Remote Pilot	106,321	6,188 (5.8%)

Airline Management

94% of airlines are run by men. (CAPA, 2015)

According to a study by CAPA which reviewed the number of women in leadership positions at global airlines, in 2010, 15 airlines had appointed a woman as CEO or managing director. By 2015, a follow up study showed that number had only increased to 18 (CAPA, 2015).

Women make up only 3% of CEOs and COOs in the world's top 100 airline groups and 8% of airline CFOs are women (International Air Transport Association [IATA], 2018).

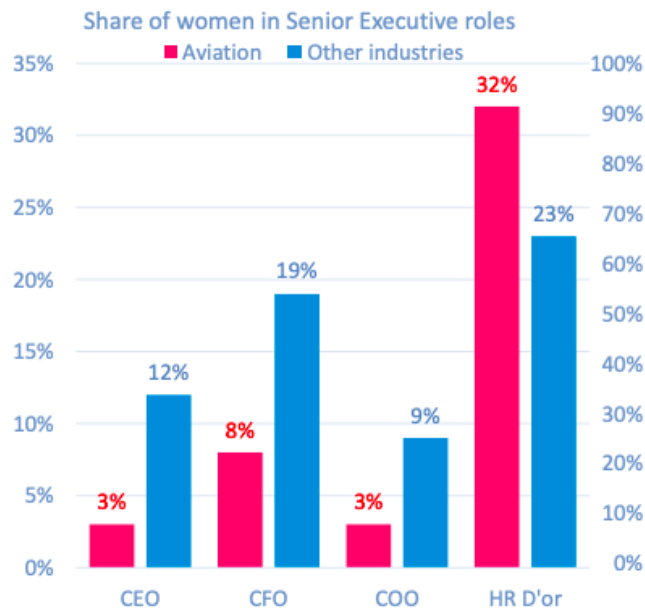


Figure 7: Women in aviation executive roles at world's top 100 airline groups (IATA, 2018)

Maintenance Technician

Bureau of Labor Statistics Data

Aircraft Mechanics and Service Technicians (49-3011): Diagnose, adjust, repair, or overhaul aircraft engines and assemblies, such as hydraulic and pneumatic systems. Excludes “Avionics Technicians” (49-2091). *Illustrative examples: Aircraft Engine Specialist, Airframe Mechanic, Flight Test Mechanic, Helicopter Engine Mechanic* (OMB, 2018, p. 174)

Table 8
2018 Mechanics and Service Technicians, BLS CPS data (BLS, 2019b)

Occupation	Total employed	Percent women
Aircraft mechanics and service technicians	164,000	3.6%

FAA Data

Table 9
Mechanic, FAA Data (FAA, 2019b)

FAA certificate held	Total	Women
Mechanic	292,002	7,133 (2.4%)

Aerospace Engineers

Bureau of Labor Statistics Data

Aerospace Engineers (17-2011): Perform engineering duties in designing, constructing, and testing aircraft, missiles, and spacecraft. May conduct basic and applied research to evaluate adaptability of materials and equipment to aircraft design and manufacture. May recommend improvements in testing equipment and techniques. *Illustrative examples: Aeronautical Engineer, Aircraft Design Engineer, Flight Test Engineer* (OMB, 2018, p. 54)

Table 10
2018 Aerospace Engineers, BLS CPS Data (BLS, 2019b)

Occupation	Total employed	Percent women
Aerospace Engineers	147,000	13.4%

As a point of comparison, the Bureau of Labor Statistics, Women in the Labor Force report lists the percentage of women Aerospace Engineers in 2016 at 7.8% women (BLS, 2017, p. 68)

Travel Agents

Bureau of Labor Statistics Data

Travel Agents (41-3041): Plan and sell transportation and accommodations for customers. Determine destination, modes of transportation, travel dates, costs, and accommodations required. May also describe, plan, and arrange itineraries and sell tour packages. May assist in resolving clients' travel problems. *Illustrative examples: Corporate Travel Expert, Travel Service Consultant* (OMB, 2018, p. 139)

Table 11
2018 Travel Agents, BLS CPS Data (BLS, 2019b)

Occupation	Total employed	Percent women
Travel Agents	79,000	85.5%

As a point of comparison, the Bureau of Labor Statistics, Women in the Labor Force report lists the percentage of women travel agents in 2016 at 84.7% women (BLS, 2017, p. 77).

Air Traffic Controllers

FAA fact sheet for March 2019 lists the number of air traffic controllers as over 14,000 (FAA, 2019c).

16.7% of FAA air traffic controllers are women. (P. Wilson, President Professional Women's Controllers, personal communication, April 5, 2019)

Dispatchers

FAA Data

Table 12
2018 Dispatcher, FAA Data (FAA, 2019b)

FAA certificate held	Total	Percent women
Dispatcher	21,465	4,086 (19%)

Flight Attendants

Bureau of Labor Statistics Data

Flight Attendants (53-2031): Monitor safety of the aircraft cabin. Provide services to airline passengers, explain safety information, serve food and beverages, and respond to emergency incidents. *Illustrative examples: Airline Flight Attendant, Airplane Flight Attendant* (OMB, 2018, p. 203)

Table 13
2018 Flight Attendant, BLS CPS data (BLS, 2019b)

Occupation	Total employed	Percent women
Flight Attendant	104,000	74.9%

FAA Data

Table 14
2018 Flight Attendant, FAA Data (FAA, 2019b)

FAA certificate held	Total	Percent women
Flight Attendant	231,355	183,519 (79%)

Transportation Security Screeners

The Bureau of Labor Statistics, Women in the Labor Force report lists the number of women transportation security screeners at 16,000 out of 40,000 (40%) for 2016 (BLS, 2017, p. 133). The BLS CPS lists the 2018 total employment number of transportation security screeners at 41,000 (no gender breakdown is provided) (BLS, 2019b).

Table 15
2017 Transportation Security Screeners, Women in Labor Force Report (BLS, 2017)

Occupation	Total	Percent women
Transportation Security Screeners	40,000	16,000 (40%)

Airport Management

To obtain data on airport managers, the American Association of Airport Executives (AAAE) was contacted. The organization is the largest professional organization for airport executives (American Association of Airport Executives, 2019). A request was made for the number of women who hold the Accredited Airport Executive (A.A.E.) designation, a defining credential for airport managers.

Table 16
2018 Airport Managers, AAAE Data

	Total	Women
Active Accredited Airport Executives (A.A.E.)	469	78 (16.6%)

2018 (A. Calliari, personal communication, January 29, 2018)

Aviation Higher Education

Women Postsecondary Faculty and Administrators

The target population for this component of the study was all full-time aviation faculty who are employed at postsecondary aviation programs. The definition of full-time aviation faculty included fully-appointed faculty who teach non-engineering related aviation subjects. Excluded from this study were adjuncts, visiting faculty and flight instructors. Data was gathered from the 2018 University Aviation Association (UAA) Collegiate Aviation Guide (University Aviation Association [UAA], 2018). Both UAA and non-UAA member schools were investigated, with data obtained through the UAA Guide or by direct contact with the universities. Of the 818 full-time aviation faculty members employed at 67 universities/colleges with aviation programs, 170 (20.8%) were female; of the 197 faculty who were identified as being in academic leadership positions, 38 (19.3%) were women. Table 17 shows results for female full-time aviation faculty as well as female aviation administrators as of 2018. As a point of comparison, in 2010 women were 8.1% of aviation faculty and 11.9% of aviation academic leadership positions (Chair, Dean, Director) (Ison, 2010).

Table 17
2018 UAA Member Institutions' Aviation Department Employment (Luedtke, 2019)

	Total	Women
Full time aviation faculty	818	170 (20.8%)
Aviation academic leadership positions	197	38 (19.3%)

Aviation Government Organizations

The following data was collected from the Office of Personnel Management (Office of Personnel Management [OPM], 2019). The numbers represent total employment at the organization.

Table 18
2018 Aviation Government Organizations Employment (OPM, 2019)

	Total	Women
FAA employees	44,895	10,539 (23.4%)
NTSB employees	400	157 (39.2%)
TSA employees	62,692	25,416 (40.5%)
NASA employees	17,183	5,867 (34.1%)

Cybersecurity

The global cybersecurity workforce consists of 11% women.

Women number 4% of the leadership positions in global cybersecurity. (Leadership positions are defined as C-level such as CEO, COO, CIO, Executive management, Directors)

(Frost & Sullivan, 2017)

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