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Recognizing trends in industry and higher education: A women in aviation approach

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Abstract
Aviation plays a crucial role in both the national and global economy. People are connected, economic growth is supported, and humanitarian efforts are facilitated worldwide through air transport. Even though aviation has a global reach, the industry is not diverse in all areas, including training, airline operations, and military aviation. Women make up under 5% of pilots worldwide, and current enrollment trends in aviation programs indicate that significant improvements in diversity are unlikely without a dedicated effort for change.
This underrepresentation persists even though expanding the field to include women would contribute to alleviating the well-documented pilot shortage and shortages in other aviation professions, such as mechanics and aeronautical engineers. Unlike studies related to engineering, medicine, and law, research into the elements affecting diversity in aviation has not garnered significant attention from scholars. The anticipated rise in travel demand over the next two decades makes it essential to better comprehend these diversity issues in light of current and impending shortages of aviation labor.

Keywords: Women in aviation, human factors, work education

Introduction
Today, women are more likely than men to earn a bachelor's degree, and they constitute nearly half of the U.S. workforce (Bureau of Labor Statistics 2018a, 2018b). However, there is a lack of representation in professional areas marked by significant income and stability, like STEM and legal professions. As per the U.S. Department of Labor (2018), women make up only 13% of engineers and 35% of lawyers in total employment. Considering the expected increase in aviation careers due to the growth of global aviation, it is crucial to comprehend the underrepresentation of women in this field. This significance stems from various factors, including diversity considerations, labor shortages, transportation capacity issues, and global trade perspectives. This paper will thus offer the impetus and groundwork for additional studies at the level of higher education regarding the diversity issues noted in aviation. The initial section will describe the gender trends, both current and historical, in the aviation workforce at the national and industry levels. The second section will analyze gender in aviation programs within higher education and at World Wide University. The last section will address prior studies on women in aviation and male-dominated professions to lay the groundwork for comprehending the current gender imbalance in aviation.

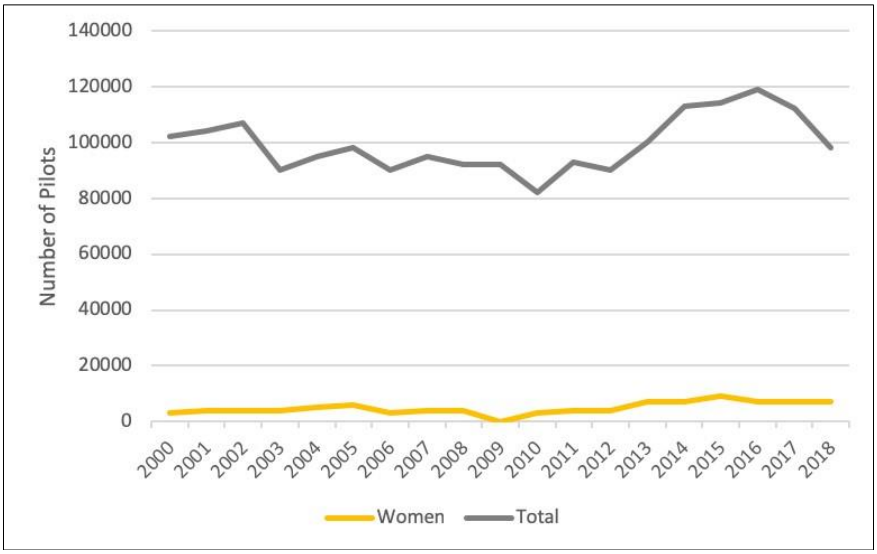
Gender Inclinations in the Aviation Workforce
With the rise in worldwide travel demand, the need for skilled aviation professionals across all facets of air transportation will grow (Boeing 2019). Even with the aviation hiring boom after the 2008 Great Recession, the number of women has not risen alongside the expanding pipeline. Women in aviation have not seen much promise over the past twenty years. This problem affects military aviation as well, which has acknowledged the existence of a gender issue among its ranks amid concerns over pilot shortages in the Air Force's future (Keller et al. 2018). The impending global aviation workforce shortages highlight the urgent need to boost women's involvement in the aviation sector. Nonetheless, jobs in various aviation professions are falling behind.
The Bureau of Labor Statistics classifies and tallies five of the primary career areas in aviation during Current Population Survey data collection. All of these professions are

essential to the air transportation system at both the domestic and global levels. The primary professional fields include aircraft pilots, aircraft mechanics, aerospace engineers, personnel working on aircraft structures, and air traffic controllers. The Bureau of Labor Statistics' Current Population Survey dataset can be utilized to analyze employment and wage data by gender for each profession.

According to the Bureau of Labor Statistics (2017), aircraft pilots guarantee that aircraft are operated safely while transporting cargo and passengers. The previously mentioned deficit of these aviation experts is a significant worry for airlines, military air forces, and flight schools worldwide. One of the strategies to address this shortage is to enhance the number of female aviators (Opengart and Ison 2016). Even though it is necessary to bolster the future supply of pilots, there has been little progress in raising the number of women pilots.

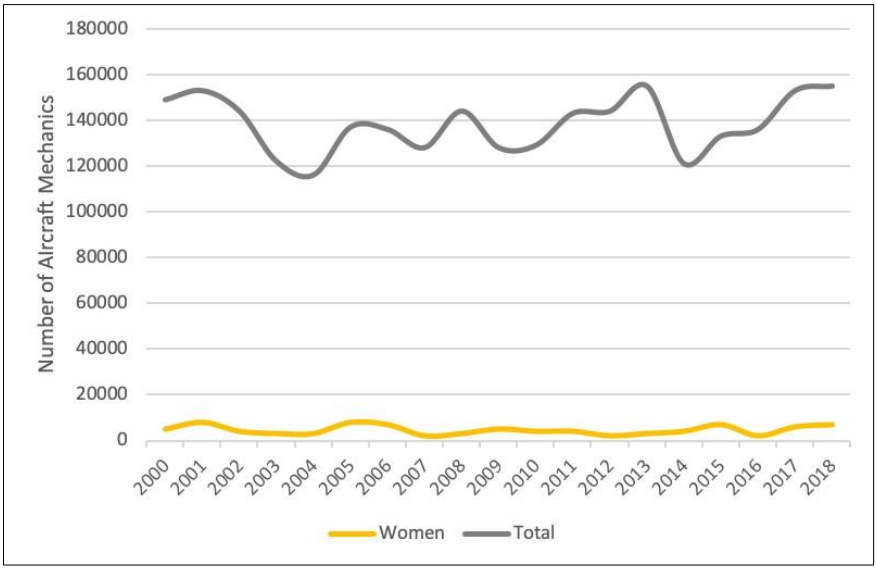
The gender gap in the pilot career field is illustrated in Figure 1. Women constituted an average of just 4.8% of full-time employed pilots in the U.S. from 2000 to 2018. With women making up 7% of the total employed pilots, 2018 boasted one of the highest proportions of female pilots in almost twenty years. A potential reason for this could be the decrease in the total number of full-time employed pilots, as retirements (of more experienced, male pilots) within the industry have risen.

As older mechanics retire, shortages in the aircraft mechanic profession are being reported and anticipated (Wyman 2017). While the aircraft mechanic pipeline tries to address this shortfall, women are once more finding it difficult to advance in the workforce. The persistent gender gap in aircraft mechanics over the past 18 years is depicted in Figure 2. The data illustrates the astonishing disparity in employment between genders that exists among aircraft mechanics. In the mechanic career field, the average gender gap is worse than in the pilot field, at 3.3% and 4.8%, respectively. The data from 2018, the most recent year, indicate that women account for 4.5% of employed full-time mechanics.



***Source:** Bureau of Labor Statistics' Current Population Survey

Fig 1: Full-Time Employed Pilots in the U.S., 2000-2018*

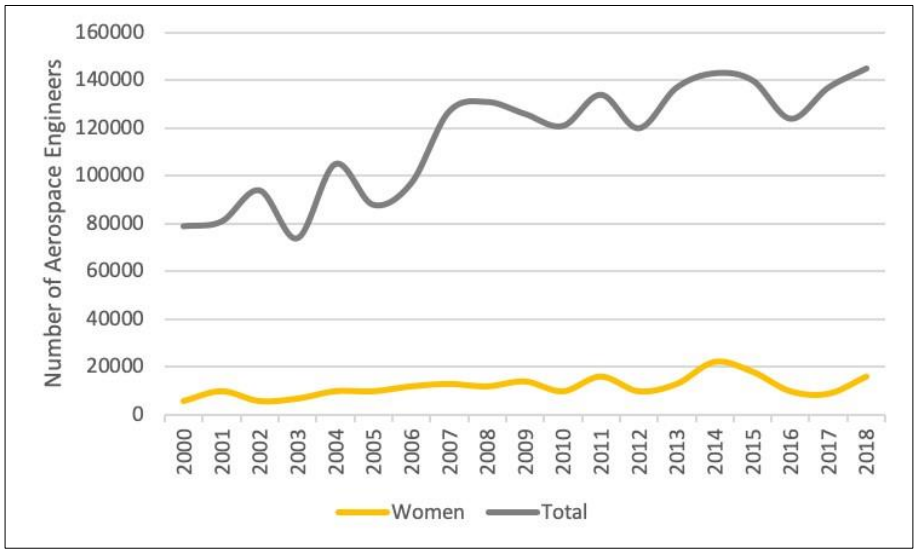


***Source:** Bureau of Labor Statistics' Current Population Survey

Fig 2: Full Time Employed Aircraft Mechanics in the U.S., 2000-2018*

Aerospace engineers play a vital role in advancing air and space transportation in today's world. As stated by the Bureau of Labor Statistics (2017), these experts enhance and develop air transport capabilities through engineering advancements and innovations. Wilkinson (2007) emphasizes the difficulties in addressing the shortfall of engineers in the aerospace sector and the existing gender gap. The labor supply of qualified aerospace engineers constrains the production of new aircraft driven by increased demand. Further evidence of the gender imbalance in aerospace engineering is shown in Figure 3. As we discussed before, the entire field of engineering has its own gender issues, and aerospace engineering is almost certainly a reflection of this problem.

Schools of engineering are striving to fix the imbalance (Griffith 2010); over the past 18 years, however, women have comprised only 10% of aerospace engineers in the U.S. Women made up 11% of full-time employed aerospace engineers in the latest year (2018). Even though the involvement and inclusion of women in aerospace engineering are limited, this field is performing better than that of pilots and aircraft mechanics regarding gender inclusion.

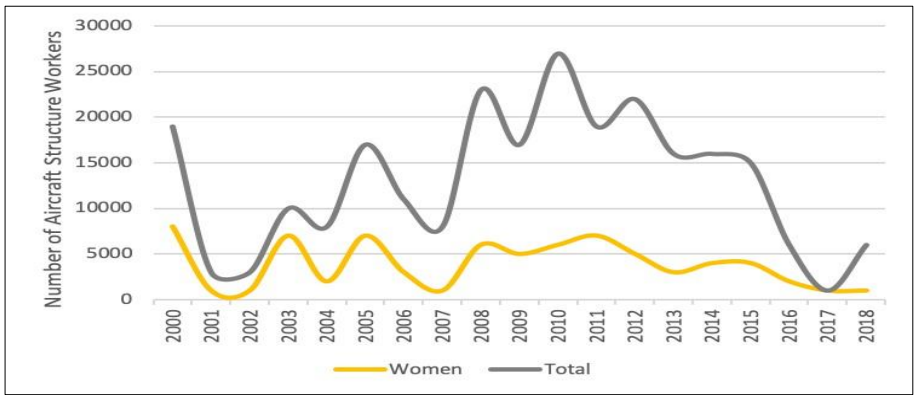


*__Source:__ Bureau of Labor Statistics' Current Population Survey

Fig 3: Full Time Employed Aerospace Engineers in the U.S., 2000-2018*

According to the Bureau of Labor Statistics (2017), aircraft structure workers are essential for assembling aircraft and spacecraft, contributing to the manufacture of these vehicles and the ongoing operation of air transport. In general, this profession features one of the highest ratios of women to men among all examined aviation careers. The employment statistics for aircraft structure workers are shown in Figure 4. The data indicates that from 2000 to 2018, women constituted an average of nearly 30% of the workforce in the aircraft structures career field. The proportion of women in this case exceeds that of aircraft mechanics by over six times and that of aerospace engineers by three times. Unfortunately, in 2018, the percentage was significantly lower, as women made up only 15% of the workforce.

The last profession in aviation that is analyzed is that of air traffic controller. Air traffic controllers, one of the most crucial roles in aviation, ensure the safety of airways and facilitate an efficient movement of air traffic across the nation's airways (Bureau of Labor Statistics 2017).



*__Source:__ Bureau of Labor Statistics' Current Population Survey

Fig 4: Full Time Employed Aircraft Structure Workers in the U.S., 2000-2018*

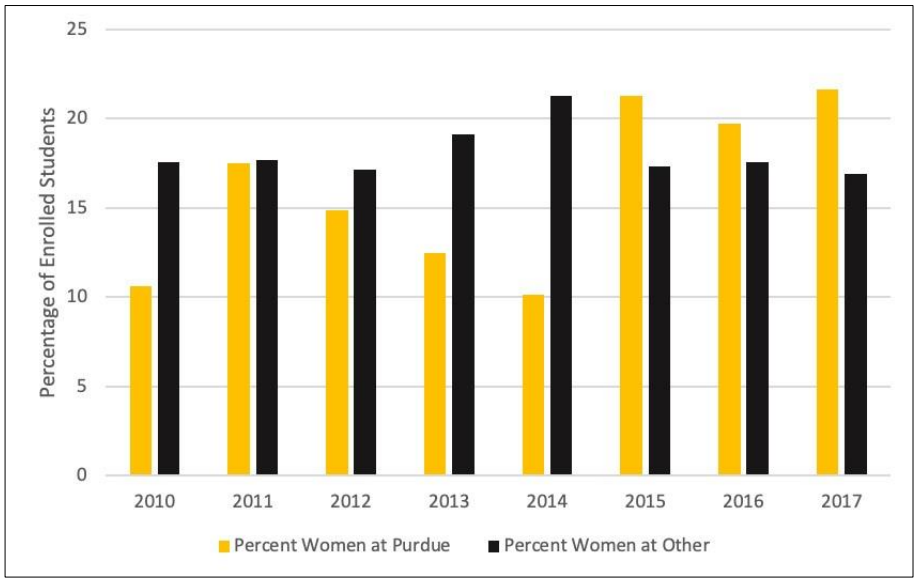
As demand for airport traffic rises, these professionals are currently experiencing overwork, understaffing, and their own shortages (Smith 2015). Incorporating more women into this vital aviation career could ease the burden on current air traffic controllers and reduce airspace congestion. The trends in the air traffic controller workforce are shown

in Figure 5. From 2000 to 2018, the average percentage of women in the air traffic controller workforce was over 15%. In 2018, women made up just 7% of the workforce for air traffic controllers. The recent figures are on par with those in the pilot career field, exceed those in the mechanics career field, and fall short of those in both the aerospace engineer and aircraft structures career fields.

Gender Inclinations in the Aviation Higher Education

Over the last twenty years, women's involvement in aviation higher education programs has experienced a minor decline (Ison, Herron, and Weiland 2016). It has been difficult for programs to raise the number of female students and graduates. At World Wide University, which offers one of the premier aviation programs in the U.S., the enrollment rates of female students have fluctuated over a seven-year span and in comparison to similar aviation higher education programs in the country. Using the National Center for Education Statistics database from the Department of Education, one can compare the total number of female students at World wide University with the average in similar aviation programs across the U.S.

It is significant to point out the major aviation subfields when reviewing the enrollment data at World Wide University. Students at World Wide University can choose to enroll in various programs within the School of Aviation and Transportation Technology, including aeronautical engineering technology, aviation management, professional flight, and unmanned aerial systems. Aeronautical engineering students belong to a different college and are not represented in Figure 5. Data on the subfields of aviation at the micro level are available only until fall 2015. Consequently, the latest data will be employed to conduct a more detailed investigation of women's enrollment in these higher education programs.



***Source:** Department of Education's National Center for Education Statistics

Fig 5: Air Transportation Related Program Enrollment (Women)

Conclusion

A multitude of studies have investigated the reasons behind the scarcity of women in male-dominated professions, including those in STEM fields, law, medicine, and economics (see for example Dasgupta and Stout 2014; Ginther and Kahn 2004; Schultz and Shaw 2003). The studies identify various factors that influence women's involvement in these areas. The primary contributors arise from the effects of implicit biases and discrimination. Gender norms exist in both the sciences and humanities, resulting in gender stereotyping that assigns men and women to gendered professions (Charles and Bradley 2009; Cundiff et al. 2013). The studies offer a more lucid comprehension of the elements affecting the recruitment, retention, and success of women in fields dominated by men.

Even with the awareness among academics of the disparity issues in professional domains, the recent Professional Climate Survey by the American Economic Association underscored that gender biases and discrimination remain widespread, despite historical advancements in fields such as economics that are regarded highly (American Economic Association 2019).

Even with the gender-related challenges present in both higher education and industry, enhancing diversity and inclusion remains a primary focus for all parties involved in aviation. This paper has established a basis and rationale for additional investigation into these gender disparities. Further studies might pinpoint aspects that facilitate the successful incorporation of women into higher education programs in aviation. An examination of World wide University's initiatives to enhance inclusion might demonstrate benefits for the recruitment, retention, and success of women in aviation.

The examination in the future might function as a developing process aimed at enhancing the policies, procedures, and practices at the university level to boost women's involvement in aviation programs. A future study's results would benefit not only one of the top aviation programs in the country but also other institutions aiming to enhance the diversity of their programs. Enhancements in diversity within higher education will eventually result in advancements at the industry level, thereby diminishing the inequality currently observed in the aviation sector.

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