

Article

Flying High: Revealing the Sustainability Potential of Women in Aviation

Maria Vittoria Corazza 

Department of Civil, Environmental and Building Engineering—DICEA, Sapienza University of Rome, 00184 Rome, Italy; mariavittoria.corazza@uniroma1.it

Abstract: This paper explores the predominantly male-dominated aviation sector and highlights the benefits of increasing female representation. The key objectives are to analyze the gender pay gap, assess the current gender imbalance, and explore how addressing these issues could contribute to the sector's sustainability and operational success. A combined quantitative and qualitative methodology is employed, including scenario-building based on monetary indicators and achievements from other industries where female workforce participation has been enhanced. The results demonstrate that closing the gender pay gap and boosting female participation in air transport operations, in line with supranational recommendations, can lead to significant financial gains and operational improvements. The study concludes that promoting gender equity is not only a social imperative but also a crucial factor for achieving sustainability goals within aviation.

Keywords: women; aviation; equity; policies

1. Introduction

Air transport plays a crucial role in connecting communities and economies across the globe. As the aviation industry, business, and supply continue to grow, the concepts of equity and fairness become increasingly significant. However, the challenges and opportunities associated with achieving both in air transport are still to be deeply explored, especially when considering factors such as accessibility, economic considerations, environmental impact, and social implications.

One of the fundamental aspects of equity in air transport is ensuring accessibility for all, regardless of their socio-economic background. This involves four major areas of investigation: land use; the transportation system; time periods; and passenger segments [1], with the cost of access travel time variability becoming central [2]. This is just one facet of the approach, which also includes the study of equitable distribution of economic benefits within the air transport sector as a vital driver for ensuring fairness, which relies on the appropriate allocation of resources, job opportunities, and profits among various stakeholders (from airline companies and airport authorities to service providers and local communities), although it is acknowledged that such benefits still lack a non-market-driven distribution [3]. But, equity in air transport extends beyond economic considerations to environmental sustainability. The aviation industry is a major contributor to greenhouse gas emissions, and efforts to reduce its environmental impact are crucial for achieving fairness. The development and adoption of sustainable aviation technologies are well described in the scientific literature with several examples of scenarios building [4,5], case studies [6,7], and policies that aim to minimize the carbon footprint of air travel and prevent negative effects on communities [8–10].

Lastly, the social dimension of equity in air transport encompasses universal design [11], inclusion, and the impact of air travel on local communities [12], again with several case studies available in the literature, many of which address tourism-associated development [13,14].



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Policies and initiatives that address all of the above contribute to a fair and inclusive air transport system, but often they are biased by the lack of gender-specific actions, with women's needs most often remaining unmet. But, where women's needs are unmet, their underrepresentation becomes evident, highlighting a critical gap in equity and inclusion efforts. This prompts the research problem of this paper, i.e., the significant underrepresentation of women in the aviation industry, coupled with a persistent gender pay gap. This issue is highly relevant because it not only reflects broader societal inequalities but also undermines the potential for the aviation sector to achieve optimal operational efficiency and, above all, sustainability. Addressing the gender imbalance and increasing female representation is crucial, as it can lead not only to substantial financial gains but can also align the sector with global sustainability goals.

Rationale of the Paper

Moving from the underrepresentation of women, the study's objective is to explore the gender pay gap and the current gender imbalance within the aviation industry, and to demonstrate how addressing these issues can contribute to the sector's sustainability and operational success. The research aims to provide a comprehensive analysis through a combined quantitative and qualitative approach, highlighting the tangible financial and operational benefits of increasing female representation in the aviation sector.

This paper's approach, then, is to proceed in two distinct but related directions. Initially, an examination of the female gender gap (i.e., women's disadvantage, as in [15]) and the social implications thereof within the context of air travel systems will be undertaken, as outlined in Section 2. This literature review is specifically reported to establish a robust theoretical framework for understanding gender inequality in aviation by thoroughly examining representation, pay disparity, and access to leadership roles. It incorporates global perspectives, referencing international policies, which situates the aviation gender issue within a supranational context. Additionally, it addresses emerging aspects (e.g., the intersectionality of gender with factors such as ethnic background and socioeconomic status) to provide a comprehensive basis for the next step, i.e., the potential advantages of promoting equity, explored through a scenario-building process. Thus, by analyzing all of the above, this paper identifies several gaps that it aims to fill in the existing literature and practice: the underrepresentation of women; the persistent gender pay gap within the aviation sector; the lack of gender-specific policies associated with paucity of initiatives that promote gender diversity across all job categories in aviation; and, last but not least, the limited research on gender equity benefits, especially within transportation studies, where the advantages of increasing the representation of women in aviation seem to be neglected. To cope with the limited investigation into the tangible benefits associated with an increased female quota, a quali-quantitative methodology with referenced evidence to validate the underlying assumptions (Section 3) is developed. Given all of the above, the research question that this study seeks to answer is whether there are positive outcomes at the corporate level and beyond when more women are employed in air transport operations and when the female gender pay gap (i.e., women less paid than men for the same job position) is eliminated. The results, described in Section 4 and discussed in Section 5, show the potential profitability deriving from more balanced and equitable conditions for female staff, especially if supported by specific policy actions, which are described in Section 5. The concluding remarks (Section 6) stress the need for more investigations, all with the ultimate goal to advance knowledge about gender issues in the broader transportation studies sector.

2. Women in the Aviation Sector

In the literature, the binomial "women-aviation" seems to be mostly characterized by studies on gender inequality, analyzed by different key points of view: the underrepresentation of women in leadership (described in Section 2.1) due to a series of factors like the historical barriers generating the phenomenon; the structural challenges and partialities;

the socioeconomic factors and the related job segregation (all synthesized in Section 2.2); the role of global initiatives (further analyzed in Section 2.3); and eventually the rising issues associated with female gender inequalities (as reported in Section 2.4).

Generally speaking, the aviation sector has been the subject of considerable criticism with regard to its lack of diversity and gender equality, due to a notable absence of women in both leadership and operational roles within the aviation sector. This disparity can be attributed to a multifaceted interplay of historical, cultural, and structural factors that have impeded women's advancement in the industry. This is not unexpected, as this is the prevailing approach across the entire transportation sector. In this context, there is a dual aspect of inequality, encompassing both access and opportunities. This disparity affects various facets, including employment in transportation and the provision of transport services. More importantly, it impedes the integration of gender considerations in transport policies. The transportation sector (from industry to academia) remains predominantly male-oriented, with a significant proportion of "experienced men" in leading decision-making positions [16]. One illustrative example from the aviation sector is the case of Betty Crites Dillon, who only in 1971 became the first woman to occupy a seat on the International Civil Aviation Organization (ICAO) Council, thereby achieving a groundbreaking milestone.

Yet, the fifth objective delineated in the United Nations' "Agenda for Sustainable Development by 2030" still underscores the pivotal role of gender equality, and the OECD (Organization for Economic Co-operation and Development) makes a compelling argument that countries facing gender-based segregation and discrimination are challenged in achieving sustainability goals. This is all in line with the growing recognition that enhanced access to transportation can serve as a pivotal driver in narrowing the female gender gap [17].

2.1. Quantifying the Women Workforce

The underrepresentation of women in key roles in aviation is the major facet of the problems of gender equity in this sector. The paucity of women in leadership roles within the aviation industry is evidenced by a number of factors. Despite the passage of over five decades since the landmark Crites Dillon achievement, women account for only 3% of Chief Executive Officers (CEOs) in the aviation industry, a figure that stands in stark contrast to the 6.5% representation observed among Fortune 500 CEOs [18]. Concurrently, a 2022 study by the International Air Transport Association (IATA) revealed that only 26% of airline CEOs are women, while women occupy only 20% of leadership roles overall [19]. This indicates that women constitute approximately 5% of commercial pilots globally, which further underscores a notable gender disparity in a pivotal sector of the industry [20]. Furthermore, a study conducted by the International Labor Organization (ILO) in 2019 revealed that women are disproportionately represented in lower-paying and less visible positions within the aviation industry, such as administrative and customer service roles [21].

When considering Eurostat data, in the European Union as a whole, 42.0% of those employed in the air transport sector in 2021 were women. This figure implies that the imbalance is modest when compared to other transportation sectors, such as road transport, where the ratio is 85% men to 15% women [22]. But these numbers can mislead and the clear correlation existing between the sectoral structure of employment and the proportion of males and females in the aviation workforce looks different when analyzing different sources. A review of global data on the aviation workforce [23] reveals significant discrepancies (Table 1). A contrasting trend is evident when flight attendants are considered, with a gender ratio of 79% female to 21% male in the United States [24,25], comparable to that observed in Europe [26]. This reinforces the prevailing stereotypes regarding the roles of women and men in this context, with women typically associated with hosting and men with leading.

Furthermore, statistics highlight the gender pay gap, with women earning between 10 and 72% less than men in the same sector. In the United States, female flight attendants, for instance, earn 94 cents for every dollar earned by men in the same position [25]; this is

in line with the generally observed situation regarding the disparity in job salaries between men and women [27].

Table 1 shows the existence of disparities in a number of carriers and positions, with a greater prevalence of opportunities in the traffic control sector in comparison to maintenance and piloting. A possible explanation could be the former's focus on cognitive skills over physical demands and the associated controlled work environments (such as control towers or centers, where the work looks like "more desk-bound" if compared to piloting (which can involve irregular hours and time away from home) or maintenance (which involves physical labor, working in hangars, or on the tarmac).

With regard to piloting, additional data indicate some regional specificities. In 2021, India held the top position globally for the highest percentage of female pilots, with approximately 12.4% of pilots in the country being women. South Africa was ranked third (9.9%), significantly ahead of the United Kingdom (4.9%), the United States (5.5%), and Germany (6.9%) [28]. It is noteworthy that in 2021, an all-women cockpit crew from India piloted the world's longest commercial flight, which spanned 17 h and exceeded 9900 miles in distance [29].

Table 1. Aviation workforce by category, gender, and area, 2023, adapted from [23].

Area	Air Traffic Controller (%)		Airline Transport Pilot License (as Registered in the Reporting State) (%)		Licensed Aircraft Maintenance Engineers and Technicians (%)	
	Female	Male	Female	Male	Female	Male
Africa	15	85	5	95	3	97
Asia and Pacific	20	80	3	97	4	96
Europe	22	78	4	96	4	96
Latin America and Caribbean	35	65	2	98	3	97
Middle East	7	93	3	97	2	98
North America	18	82	5	95	3	97

When examining the youngest generations, statistical evidence indicates that women still face significant challenges. A recent survey conducted in the United States has revealed a notable increase in the number of female student pilots over the past few years. Specifically, the number of female student pilots has grown by 189% in the 2015–2022 period, increasing from 14,580 to 42,184 units. This trend suggests that an increasing number of women are contemplating careers in aviation, despite the fact that the percentage of licensed female pilots has been rising at a relatively slower pace. In 2017, only 5.1% of licensed pilots were female, and this percentage increased by less than 1 point (6.03%) in four years [30]. This indicates that while more women are entering pilot training, the pipeline to becoming licensed pilots is not yet fully flowing. However, major barriers in the training process seem difficult to identify [31], which again suggests barriers associated with the corporate culture, rather than educational issues. The latter may be associated with the high costs of training and limited access to necessary resources, which deter many potential candidates or hinder the final achievement of a license. More likely, industry-specific challenges, such as demanding work conditions and societal expectations, surely limit the appeal of piloting careers, particularly for women. These factors contribute to the slow and uneven flow of new pilots into the profession.

2.2. Barriers, Biases, Limitations

For the above mentioned figures, when it comes to the analysis of historical and cultural barriers, a number of reasons may explain the fact that the aviation sector has historically been male-dominated, and women continue to be underrepresented in various roles and across different domains. All have distant roots such as economic inferiority when it comes to wages and salaries and limitations to job opportunities, as the availability of most positions is at lower hierarchical levels, part-time jobs, and jobs without corporate

benefits [32] (prompting the research question mentioned above), due to women's (traditional) primary responsibility for domestic work and child-care [33]; this is exacerbated by the observation that transport planning does not recognize the social position of its actors as fully elaborated in [34], with reasons relying on a planning approach based on "western" values, which steer the planners' focus on male commuting and private cars, often unaffordable to the lower strata of urban women. Moreover, historically, the early days of aviation were marked by a strong emphasis on masculinity and physicality (also associated with military background), which discouraged women from pursuing careers in the field. This left room for roles traditionally associated with femininity, such as hosting [35] (where the service-facing function only recently has semantically passed from "hostess" to the more gender-neutral "flight attendant" or "cabin crew member").

In terms of structural challenges and partialities, deep-seated cultural biases continue to affect gender dynamics within the aviation industry. Stereotypical views that portray women as less assertive, risk-averse, or lacking technical competence can act as barriers to their career advancement. These biases are frequently reinforced by unconscious or implicit attitudes among colleagues, both male and female [16,17]. Eventually, structural challenges stemming from aviation's hierarchical and male-dominated culture can make it difficult for women to succeed. Networking opportunities and mentorship programs often favor men, while inflexible work schedules and a lack of childcare support can make it challenging for women to maintain their careers while juggling family commitments [33].

2.3. Policies and Practice

The data presented in Section 2.2 are based on the distinctive setup of the air transport industry, characterized by company-driven activities, internal policies, business strategies of individual firms, and governance at both the national and supranational levels. These governance frameworks ensure regulatory compliance. But the corporate-oriented approach to operations significantly influences workforce composition, with companies prioritizing the hiring of qualified pilots. Required qualifications include licenses such as private, commercial, or airline transport pilot licenses, and typically an educational background in aviation or a related field.

The slower progression of female trainees in their licensing programs significantly contributes to the lower representation of women in this field, in addition to the social and cultural barriers discussed earlier and thoroughly examined in the literature by [36]. Furthermore, modern labor practices such as zero-hour contracts and pay-to-fly schemes create additional obstacles for women entering the aviation industry [37].

Conversely, recognizing the unsustainability of the gender gap has led to the implementation of several supranational policies aimed at enhancing women's employment and equal opportunities, as summarized in Table 2. The key initiatives include capacity building (such as disseminating best practices), raising awareness, fostering cooperation, and increasing accountability. These efforts aim to boost the female employment ratio, with IATA aiming for gender diversity by ensuring at least 25% representation of women in events, panels, governance roles, and top senior positions. The primary objective of all these initiatives is to close the persistent pay gap in transport labor management, despite various supranational regulations addressing the issue from multiple angles [36,37]. Notable examples include the European Commission's directives on equal pay for equal work (Directive 2006/54/EC), transparency (Recommendation Document 32014H0124), and work-life balance (Directive 2019/1158), as well as initiatives like the European Pact for Gender Equality and the EU Action Plan 2017–2019, aimed at tackling the gender pay gap [38,39]. While not legally binding, Recommendation Document 32014H0124 is of great importance in the field of aviation, because the pay scales and career progression pathways within this sector can often be unclear and difficult to navigate. By increasing transparency, this document might help women realize their potential pay discrepancies and challenge them when necessary. Similarly, given the demanding schedules and extended periods away from home that are common among women in this field, policies on work-life balance,

which are designed to implement specific measures such as parental leave and flexible working arrangements, can provide women in aviation with more flexibility and support, thereby facilitating the balancing of career and family responsibilities.

However, the initiatives listed in Table 2, while conceived to create more equitable and inclusive job opportunities, are merely advisory policies in the context of the pervasive and recurrent gender disparities that are evident at the corporate level. Concurrently, disparities still persist at the corporate level, as evidenced by the data presented in Table 1 and the many limitations documented in practice. However, the gray and scientific literature highlight some effective cases for reducing the gender gap, with certain airlines actively improving female recruitment to meet national gender equality regulations [40]. These companies incorporate diversity into their broader sustainability policies [41] and address issues like sexual harassment [42]. However, an analysis of these recruitment efforts reveals that airlines mainly concentrate on achieving gender equality in cockpit roles, often overlooking other positions within the industry [43]. This neglect extends to flight training and maintenance sectors, which are further hindered by the lower appeal of these career paths [44]. Yet, no reverse approach appears to be enforced for cabin crews, as there are no specific policies targeting the male quota. Corporate advertisements continue to reinforce the stereotype of female beauty associated with flight attendants [45]. These ads often emphasize maternity (when promoting services for unaccompanied minors or users with special needs), availability and kindness (for inflight services), or even symbolically link the attendants to the company's region of origin to promote tourist destinations [43].

It would appear that equality is also lacking during periods of crisis or when restructuring policies are required. A study examining the impacts of the 9/11 crisis on the US commercial aviation sector revealed that human resource policies were applied uniformly without gender bias. This was evidenced by the implementation of measures such as reduced training, pay freezes, forgoing holiday pay, and fewer shifts, which affected both men and women equally. Nevertheless, airline management conceded that these restructuring policies had a disproportionate impact on cabin crew and, to a lesser extent, customer service personnel—positions that were predominantly held by women (for example, in 2001, 80% of US flight attendants were women). Therefore, despite the absence of discriminatory intent, these policies ultimately had a more pronounced impact on female workers compared to their male counterparts [46]. Furthermore, structural issues such as an imbalance between work and personal life and the status of non-standard workers serve to exacerbate inequality, as previously mentioned.

Table 2. Main supranational initiatives to close the female gender gap.

Body	Initiative	Year	Main Gender Equality Focus			
			Air Transport	Transport (All Modes)	Labor	Diversity and Inclusion
ICAO	Gender Equality Programme promoting the participation of women in the global aviation sector.	2016	X			X
European Commission	Women in Transport—EU Platform for change	2017		X	X	X
IATA	25by2025	2019	X			X
UN International Labour Organization	SECTOR	2019			X	X
EUROCONTROL	Supporting Women in Aviation	2020	X		X	X
ALPA	Diversity, Equity, Belonging, and Inclusion Committee	2020				X
UN Women and World Bank	Course on Gender Equality in Transportation	2021		X		
EASA	Gender Equality Plan 2024–2027	2023	X		X	X

X: Addressed area.

2.4. Additional Issues When Considering Gender Inequalities

As the aviation industry continues to expand and evolve, it still faces a persistent and critical challenge due to gender inequality. This issue is not only about representation and leadership, but also about the broader dynamics that influence who can participate in and benefit from opportunities within this sector. There are emerging or novel issues when addressing gender inequality in aviation, which are starting to be highlighted in the literature, like the importance of intersectionality, education, and technology.

Intersectionality and diversity beyond gender is receiving more and more attention. Actually, gender inequality in aviation cannot be fully understood without considering the concept of intersectionality, based on documented case studies in aviation [47,48]. Women in aviation face unique challenges that are compounded when factors such as ethnicity, cultural background, and socioeconomic status intersect with gender. For instance, women from diverse ethnic backgrounds in aviation often face gender biases, which can limit their opportunities for advancement in roles outside the cabin, simply because they do not match the stereotypes that are held about the groups (pilots, maintenance staff, etc.) they are identifying with [49]. Moreover, women from lower socioeconomic backgrounds may encounter additional barriers, such as limited access to expensive flight training programs or a lack of allyship [50], which are crucial for entering the industry as a pilot. LGBTQ+ individuals in aviation also face challenges, including workplace discrimination and a lack of representation. For example, transgender pilots may face regulatory hurdles related to medical certifications, which can impede their career progress [51]. Addressing gender inequality in aviation thus requires a comprehensive approach that goes beyond gender to include the experiences of all marginalized groups within the industry.

As introduced in Section 2.1, the female gender gap in aviation begins with the educational pipeline, particularly in STEM fields that are critical for many aviation careers. Historically, girls have been underrepresented in subjects like physics, mathematics, and engineering, which are essential for roles such as aircraft maintenance engineers, aeronautical engineers, and pilots. This underrepresentation continues into higher education, where women are less likely to pursue degrees in aerospace engineering or aviation management. [52]. To address this, initiatives need to be focused on encouraging young women to explore careers in aviation from an early age. For example, the Women in Aviation International (WAI) Girls in Aviation Day [53] introduces girls to aviation careers through hands-on experiences and mentorship and is crucial for inspiring the next generation of female aviation professionals. Career awareness is also a critical factor. Many young women may not consider aviation as a career option simply because they are unaware of the opportunities available. Educational outreach that highlights the diversity of the roles within aviation, from piloting and air traffic control to aviation law and aerospace technology, can help to build a stronger pipeline of female talent entering the industry [52,54].

Strictly focusing on novel technologies, the rise of automation in aviation presents both challenges and opportunities for gender equality. Automation in areas such as flight operations, aircraft maintenance, and air traffic management can reduce the physical demands of certain jobs (for example, advances in cockpit technology have made piloting less physically demanding), giving the female workforce chances to adapt through knowledge transfer [55], and more generally, making the associated activities and roles more accessible.

3. Building Scenarios for the Advancement of Equity

The aforementioned facts imply a clear necessity for the implementation of measures and policies that facilitate equal opportunities for women in all aspects of the aviation workforce in order to address equity issues. The existing scientific literature on the advantages of increasing the representation of women in the aviation workforce remains limited in scope, with recent developments in [56–58]. This paucity of research certainly prompts the need for further investigation into the social and cultural dimensions of this issue. However, it does not address the fundamental research question posed in Section 1,

namely the quantification of the tangible benefits derived from increasing the female quota in the overall workforce of commercial aviation and eliminating the gender pay gap.

3.1. The Adopted Methodology

The response to this research question embraces a two-pronged vision as a prerequisite: (i) ensure fair representation and compensation across various job categories and (ii) launch adequate and constant actions to have both aspects become structural. This underpins the development of a quanti-qualitative three-year scenario, using basic indicators further described, to illustrate the tangible and expeditious outcomes that can be achieved by merely eliminating the pay gap and implementing an average 5% increase in the female population of the aviation sector. The conditions and hypotheses that support these research goals are grounded in the literature and in the practice, with the most notable being the following facts:

- a. The IATA's goal of increasing the representation of women in leadership roles by 25% in 2025 [59].
- b. Between 2010 and 2030, the ICAO projects a substantial rise in the number of commercial aircraft, from 61,833 to 151,565. Departures are expected to grow from around 26 million to nearly 52 million annually. This surge will create a demand for pilots, maintenance staff, and air traffic controllers that more than doubles the current supply. Training facilities will fall short, lacking the capacity to train 160,000 pilots, 360,000 maintenance personnel, and 40,000 air traffic controllers [60]. Looking ahead to the post-pandemic period from 2023 to 2042, the need for aviation professionals could reach 2.3 million, with fleet and traffic growth at 3.5% and 6.1%, respectively, assuming 2019 traffic levels return by the end of 2024. This growth offers significant career opportunities for women in the industry [61].
- c. The long-lamented pilot shortage cited by airlines could accelerate the recruitment process for women, as frequently reported by the US press [62,63], manufacturers, and training associations [64].
- d. The percentage of women in aviation leadership and technical roles has remained relatively stagnant, with the number of female pilots increasing slowly from 14% in 2017 to 17% in 2022 [65], reflecting a modest growth rate (also affected by the pandemic crisis), which justifies the average 5% increase in women population assumed above.

The resulting scenario actions (listed in Table 3) are multisectoral in nature, as they entail the implementation of a comprehensive strategy focused on the two fundamental pillars of pay equity and female representation. These move from the scenario baseline that is consistent with the findings reported in the existing literature, namely that female staff receive reduced wages and that this represents approximately one-quarter of the total workforce.

The pillar actions include the recruitment of new talent, the provision of mentorship, the introduction of inclusive policies, the promotion of role modeling, the delivery of training, the measurement of performance, the facilitation of open communication, the advancement of advocacy initiatives, and the implementation of a continuous evaluation process. While not the focus of this study, such initiatives are typical of companies that seek to embrace equity and fairness in their corporate environment. This approach would yield an enhanced workplace culture, characterized by inclusivity, support, and equity for all, along with a fortified talent pipeline for the aviation industry, thereby attracting and retaining top female talent.

Nevertheless, the scenario actions would also yield positive effects on the overall economy, namely increased productivity, innovation, and competitiveness. Although it is challenging to ascertain with precision the manner in which the revenue trajectory would shift as a consequence of these measures, there is a body of evidence indicating that a more equitable and inclusive work environment could have a favorable impact on revenue generation. For example, it has been observed that companies that are able to successfully

close the gender pay gap are likely to experience an increase in revenue of between 2% and 5%, being also able to outperform peers that lack diversity policies [66,67]. This revenue increase aligns with the IATA 2023 forecast [68], which anticipates a return on invested capital close to 5% by 2024, along with a 7.6% increase in revenue.

The scenario is projected over three years, in line with typical short-term corporate business plans but also complies with hypotheses (a) and (b), both requiring near horizons. The scenario's target actors are clearly airlines as they are the most flexible players in commercial aviation, but the assumptions, pillars, and results can apply to all the staff areas reported in Table 1.

The scenario relies on secondary data extracted from the gray literature, following a purposive approach in selecting sources that are directly relevant to the themes of sustainability and gender in aviation [18–21]. As a result of such sampling method, the selected data represent the foundational context for the scenario hypotheses development and, at the same time, ensure that the findings elaborated in Section 4 are applicable and significant to prospective similar studies sharing the same objectives. The analytical technique in Section 4 involves a scenario-based assessment where indicators associated with gender pay gap elimination and workforce gender balance are used to model potential outcomes. As a result, this exploratory approach combines qualitative insights from the literature with quantitative projections, enabling a robust examination of the impact of gender equity measures in the aviation sector. In other words, this scenario can be considered quanti-qualitative because it blends both quantitative and qualitative research approaches. The quantitative aspects include the use of data and well-known economic indicators to project outcomes, while the qualitative components involve interpreting the literature and practices to understand the broader implications of gender equity, thus capturing both measurable effects and contextual understanding.

Resorting to the gray literature data enables the development of assumptions (the scenario hypotheses and pillars) that align with aviation real-world dynamics, and using well-established indicators and metrics widely accepted in broader economic analyses also in other transportation study fields [69,70] ensures validity; at the same time, as the scenarios developed are based on widely applicable principles (e.g., the benefits of gender diversity), and the data are representative of broader trends in the aviation sector, the findings could be considered valid in other contexts where gender disparity occurs as well. Likewise, through the use of fully available data sources like gender pay gap statistics and workforce demographics from the gray literature, the calculation of prospective benefits according to the consolidated indicators and scenario building techniques ensure full replicability.

Table 3. The three-year scenario's pillars and actions.

Year Target	Pay Equity	Female Representation
1	Reduce the pay gap to 75% by conducting pay equity audits and adjusting wages where necessary	Increase female representation to 27% by expanding apprenticeship and training programs and highlighting successful women role models.
2	Further reduce the pay gap to 70% by implementing transparent salary structures and promoting inclusive workplace policies	
3	Achieve full pay equity by incorporating pay equity metrics into performance reviews and establishing a culture of open communication	Achieve 35% female representation by partnering with industry associations and governments to advocate for gender-equal policies and continuously evaluating and refining strategies.
Baseline	Hourly pay for women is 80% of that for men (assumed as average from [21])	Current percentage of women in the aviation workforce is 25% (assumed as average from [18–21])

Lastly, the quantitative milestones associated with the pillars' actions, which move from two specific baseline references, are considered: (i) the average hourly pay for women which is 80% of that for men [21] for the pay equity pillar and (ii) the average 25% quota

of women in the current aviation workforce [18–21] for the female representation pillar. Moving from these as a reference scenario, the trends observed in the literature [71] for other employment sectors often shows that gradual improvements in pay equity are more sustainable and realistic than attempting to close the gap too rapidly. Achieving 75% as a first year's reduction and the second year's further reduction of 70%, could be seen as a significant step forward that is challenging yet achievable within the given timeframe. Likewise, increasing female representation to 35% reflects an ambitious yet attainable growth in female workforce participation, considering the existing barriers, mirroring similar experiences in other fields [72], requiring at least 30% of women in leading positions or being in line with specific regulatory requirements valid for any employment sector. For example, in 2018, the State of California passed the SB 826 law requiring publicly traded companies to have at least one woman on their board of directors by the end of 2019, and up to three women by 2021, depending on the size of the board. This led to a significant increase in female representation on boards across industries in California [73]. The goal to reach 35% female representation could be seen as a similar effort to legally mandated diversity initiatives, pushing for substantial improvements within a set timeframe.

3.2. The Scenario Indicators

Accordingly, an increased revenue can be associated with three specific business areas: enhanced customer satisfaction, productivity and innovation, and brand reputation, as a consequence of policies designed to reduce the gender pay gap and to increase the proportion of women in the workforce. This expectation is supported by the literature cited below, which describes positive developments in other business areas when such gender issues are resolved.

The increases in each area have been calculated by the indicators reported in Table 4, and more specifically, include the following: (i) P_{ipcs} as the potential increase in profit associated with customer satisfaction; (ii) P_{ipw} as the potential increase in profit due to more diverse workforce, and eventually (iii) ROI_p as the potential return on investment an airline can expect to see as a result of achieving gender parity.

Table 4. Indicators to quantify revenue.

Business Area	Indicator	Equation	
Enhanced Customer Satisfaction	increase in profit associated with customer satisfaction	$P_{ipcs} = \frac{CSW_i \times R_a}{100}$	P_{ipcs} —potential increase in profit associated with customer satisfaction (currency) CSW_i —increase in customer satisfaction generated by the increase in female representation (%) R_a —average revenue per airline (currency)
Productivity and Innovation	increase in profit due to more diverse workforce	$P_{ipw} = \frac{Pm_a \times W_i \times R_a}{100}$	P_{ipw} —potential increase in profit due to more diverse workforce (currency) Pm_a —average profit margin (%) W_i —increase in female representation (%) R_a —average revenue per airline (currency)
Brand Reputation	return on investment	$ROI_p = \frac{C_{dc} \times M_a \times S_a}{100}$	ROI_p —potential return on investment an airline can expect to see as a result of achieving gender parity, (Currency) C_{dc} —quota of diversity-conscious consumers (%) M_a —average marketing budget (currency) S_a —average of increase in sales per diversity-conscious customer (%)

The selection of these three indicators allows for a quality assessment to be made, as they are robust and valuable for assessing the monetary implications of addressing the gender pay gap and increasing female workforce participation. This is due to the fact that they cover a range of financial benefits, from customer-driven revenue to internal efficiencies and investment attractiveness. This provides a holistic view of the potential

profit increases. To illustrate, P_{ipcs} is pertinent as customer satisfaction directly impacts customer retention, loyalty, and repeat business, which are pivotal revenue drivers for airlines. Similarly, P_{ipw} is relevant since workforce diversity is directly linked to enhanced innovation, better decision-making, and improved operational efficiency, all of which can significantly influence profitability. Lastly, ROI_p is relevant since achieving gender parity aligns with ethical business practices and regulatory compliance. It demonstrates how gender equity can directly influence financial performance through improved employee satisfaction and productivity. Furthermore, as gender parity is crucial for creating a fair and inclusive work environment, ROI_p is strategically important for measuring long-term sustainability and corporate reputation.

4. Resulting Monetary Benefits from Reducing Female Gender Pay Gap and Increasing Women Workforce

By transferring best practice data from other corporate fields, and “feeding” the three indicators presented in Section 3.2 accordingly, it is possible to calculate the scenario’s overall outcomes for a given airline potentially committed to increase gender equity.

To be noted, the following assumptions to “feed” the indicators reported in Table 4 are suggested by the cited literature but have been applied in a more prudent way to avoid overstated figures and ensure the robustness of the estimates.

In terms of enhanced customer satisfaction, as said, a diverse workforce generally fosters a more inclusive and welcoming atmosphere for passengers, which can boost customer satisfaction and loyalty. Just as in other industries, customers are more inclined to choose airlines that emphasize diversity and inclusion [66,74]. As for other market areas, airlines prioritizing these values can see customer satisfaction improve by up to 25% [66]. Considering that the average airline generates approximately USD 1.792 billion annually [68,75], the financial benefits of achieving gender parity can be estimated using the P_{ipcs} equation in Table 3. For example, assuming an average airline maintains a profit margin of 2.6% and generates an annual average revenue of USD 1.792 billion [68,75], a mere 2% increase in female representation (e.g., rising from 3% to 5%) could lead to an annual increase in revenue of USD 448 million per a given airline.

For what concerns the productivity and innovation area, a workforce with diverse backgrounds and perspectives fosters innovation and creativity by bringing together a wider array of ideas. Research and empirical evidence show that companies benefiting from diversity often achieve greater productivity and profitability [76,77]. Therefore, the projected profit increase can be calculated via the P_{ipw} equation in Table 3, which by assuming the same parameters used above, i.e., an airline’s average revenue of USD 1792 million and a profit margin of 2,6% per year [68,75], and by increasing the female representation by 2% (for example, passing from 3% to 5%), leads to a potential profit boost of up to USD 10,750,400. To be noted, the 2% increase is coherent with the scenario’s first two years where the female quota is expected to pass from 25% to 27% and hypotheses a. and d. described in Section 3.1.

Eventually, when it comes to increased brand reputation, a commitment to gender equality can bolster a company’s brand reputation, rendering it more appealing to investors and partners. This is a very sensitive area, as for an airline, such a dedication could be perceived as a competitive advantage to other companies, which reiterate female stereotypes (and eventually mitigate the risk of public relations crises related to discrimination or inequity and prevent potential backlash and negative publicity). In other words, since consumers increasingly value diversity and inclusion, companies that highlight these commitments in their marketing strategies may see positive impacts on brand loyalty and sales, and improve the quality of public relations and marketing. However, it is challenging to ascertain definitive data regarding consumer inclination to patronize business or commercial services that prioritize equity and inclusion. For instance, a global survey of consumer attitudes in 26 countries revealed that 59% of respondents indicated a propensity to purchase from a company with such commitments [74]. Regardless, the following

three assumptions can be made: (i) the average airline marketing budget is estimated to be USD 100 million per year, a figure that is significantly below the actual expenditure of major airlines (for example, in 2022, one of the largest US airlines invested USD 165 million in advertising activities [78]); (ii) 5% of consumers are more likely to purchase from brands that are committed to diversity and inclusion (if compared to what is observed in [76], a very prudent value due to the variety of figures available in the gray literature, all of which are higher); and (iii) an average increase in sales per customer is estimated to be around 5%. These three assumptions can yield a return on investment generated by a commitment to achieve gender equality for a given airline (estimated by the ROI_p equation in Table 3) of around USD 2.5 million.

The results presented above are ballpark figures conveying the magnitude of financial benefits for a near horizon scenario, which can increase when considering the long-term impact and sustainability of gender diversity initiatives observed elsewhere [66,67]. Yet, more importantly, they are the results of the proposed scenario that aligns with broader social trends towards equality and diversity, as well as regulatory pressures worldwide, as evidenced in Section 2. Airlines adopting this vision and proactively embracing these values can stay ahead of potential regulatory requirements and societal expectations in a rapidly changing regulatory and cultural landscape (to be noted, all the initiatives listed in Table 2 span over a very short timeframe). In this process, monetary benefits, such as those reported above, can help the transition from supranational advisory policies to fully enforced codes of practice at the corporate level of the measures associated with the initiatives reported in Table 2.

5. Discussing the Feasibility of a More Equitable Workforce

Any scenario has its caveats. Also, in the present scenario, limitations cannot be ignored but nevertheless they do not diminish the validity of the findings described in Section 4, which are mostly based on corporate resistance. Despite the potential financial and reputational benefits of achieving gender equity, significant barriers nowadays prevent airlines from fully embracing these initiatives due to several aspects such as the cultural resistance to change, the expected expenditures to support the process, and the complexity of the aviation organizational structure.

Regarding cultural resistance to change, from the literature described in Sections 1 and 2, cultural norms and entrenched attitudes towards gender roles within the aviation industry can create a reluctance to cultural reforms that promote gender equity [79]. Addressing these cultural barriers requires comprehensive cultural change management strategies and leadership commitment. To be noted, resistance to change has also been observed for other fields of innovation in aviation, i.e., the introduction of new technologies [80], and in general, innovation itself might ask for acceptance in the transportation sector [81].

Further barriers can be found in the expenditures initially required to launch the equity process and remove the pay gap. Implementing all of the above certainly involves upfront costs, such as adjusting pay structures to achieve pay parity, investing in diversity training programs, and developing supportive policies and practices. For airlines operating within tight profit margins and facing competitive pressures, allocating resources toward these initiatives may be perceived as financially burdensome in the short term. However, the fast post-COVID19 crisis recovery stressed strengthened profitability projections for airlines [82], which should lead to an easy compensation of such expenditures.

The initial costs and cultural resistance are also associated with the complex organizational structure of the aviation sector. Achieving gender equity requires systemic changes across recruitment, promotion practices, workplace culture, and leadership representation. This complexity can pose challenges in terms of coordination, alignment of stakeholders, and ensuring sustained commitment from all levels of the organization. Airlines may struggle with managing these multifaceted changes while initially maintaining operational efficiency. They may also struggle because of some relevant regulatory and legal considerations since compliance with existing labor laws and regulations regarding gender equality

can also pose challenges. It should be noted that airlines, the whole aviation sector, is multinational; thus, operating in different jurisdictions may face varying legal frameworks and compliance requirements, adding another layer of complexity to their efforts to achieve gender equity.

5.1. Key Actions for More Inclusive Policies

Overcoming these obstacles necessitates a strategic and sustained approach from the aviation sector and its stakeholders. This entails not only the implementation of policies and practices that promote gender equity but also the fostering of a supportive organizational culture that values diversity and inclusion. Furthermore, it necessitates the provision of consistent and sufficient financial support to successfully facilitate the reorganizational process, thereby demonstrating not only economic benefits but also additional advantages, such as enhanced employee morale and customer satisfaction, and long-term financial sustainability. While recent initiatives (outlined in Section 2) have yielded some results at the supranational level, there is still a need for comprehensive policy recommendations to promote the inclusion of women in the aviation industry. In light of the aforementioned barriers, a coherent policy should contemplate five key actions as a means of addressing them:

- **Improve awareness on gender diversity:** Surveys and studies have shown that while the benefits of a diverse workforce are theoretically acknowledged, this is difficult to translate into practice, as aviation companies often prioritize other aspects of service management. This calls for increased awareness of the costs of gender imbalance for all stakeholders and requires companies to assess the impact of their recruitment and retention policies on gender diversity when making strategic decisions.
- **Integrate gender diversity into the industry's strategic goals:** The decision to promote gender diversity should be included in the overall strategic management policies of aviation companies as mandated by supranational governance bodies (e.g., IATA). This should involve creating targeted recruitment programs, offering mentorship opportunities, and fostering an inclusive workplace culture. The goal should be to have a coordinated approach that aligns with broader industry, transport, and employment policies.
- **Provide regular funding for diversity initiatives:** Increasing awareness and implementing policies to promote gender diversity at local, national, and international levels requires constant funding. Without regular funding, gender diversity may not be considered a top priority, and no sustainable investments will be made to improve gender balance in the workforce. Moreover, the funding must be adequate to the extent of the initiatives. One-off funds usually result in modest improvements, whereas regular, sufficient funding can drive substantial progress, particularly for smaller aviation companies where even modest funds can prompt significant investments in diversity programs.
- **Finding innovative subsidies to support gender diversity initiatives:** The current economic climate may lead to a reduction in conventional funding, compelling aviation companies to deprioritize diversity initiatives. To counteract this, innovative subsidies and partnerships should be explored. Organizations specializing in diversity, equity, and inclusion could expand their scope to include fundraising, sponsorship, and public-private partnerships for the promotion of gender diversity within aviation. This certainly requires effective communication strategies that emphasize the business case for gender equity while addressing concerns about fairness and merit.
- **Enforce standard regulations to promote continuous gender diversity efforts:** Although gender equality laws and regulations exist at national and international levels, local enforcement and specific rules to compel aviation companies to promote gender diversity are often lacking. A compulsory assessment of the quality of local gender diversity efforts could help aviation companies plan and implement sustainable diversity initiatives more effectively.

- These key actions are designed to solve the problems described in Section 2 and are synthesized in Table 5 in four major groups: (i) historical and cultural biases; (ii) reiteration of stereotypical roles; (iii) structural challenges; and (iv) lack of targeted policies.

Table 5. Policy key actions and addressed problem.

Action	Addressed Problem			
	Historical and Cultural Biases	Stereotypical Roles:	Structural Challenges:	Lack of Targeted Policies
Improve awareness on gender diversity	To counteract the male-dominated culture and deep-seated biases against women	To challenge the stereotypes that confine women to certain roles in aviation, such as flight attendants		
Integrate gender diversity into the industry's strategic goal			To reduce the industry's hierarchical nature that discourages women from advancing	To ensure that Integrating gender diversity at a strategic level can become priority, promoting the development of policies that support it
Provide regular funding for diversity initiative			To fund programs development that accommodate women's social roles, and help in managing responsibilities such as childcare	To incentivize via subsidies the creation and implementation of policies specifically designed to promote gender diversity at corporate level
Finding innovative subsidies to support gender diversity initiatives			To help overcome financial barriers, enabling more inclusive policies that support gender diversity	
			To promote innovative subsidies that can help overcome financial barriers, enabling more inclusive policies that support gender diversity	
Enforce standard regulations to promote continuous gender diversity efforts	To help combat entrenched cultural biases by mandating gender diversity practices across the industry and education	To enforce broader participation of women in various roles, breaking traditional stereotypes		

5.2. Need for More Knowledge and Studies

- The results of this study indicate that increasing female representation in the aviation sector could lead to significant financial gains and operational improvements. The findings align with the existing literature, emphasizing the benefits of gender diversity in the workplace [66,67]. Prior studies have demonstrated that diverse teams are more innovative and effective in decision-making, leading to better financial performance and a competitive advantage [74,77]. This study contributes to this body of knowledge by providing industry-specific evidence from the aviation sector, an area where gender diversity has been historically low and under-researched.
- However, the study also highlights potential limitations in applying these findings universally across the aviation industry. Cultural resistance and deep-rooted gender biases, which have been documented as significant barriers to gender equity in other sectors [71], remain a challenge in aviation. The scenario-building approach used in this study, while innovative, is based on data from sectors where gender diversity initiatives have already been more widely implemented. This stresses the urgency of developing more studies to consolidate facts and figures for the aviation sector, where such initiatives are still in their infancy.

- Moreover, while the study quantifies the financial benefits of closing the gender pay gap and increasing female participation, it leaves many avenues to explore, such as the role of systemic cultural change, which is often slower and more resistant to transformation than the availability of financial incentives to drive gender equity.
- Therefore, this study attempts to advance the limited research on demonstrating the potential economic benefits of gender equity in aviation. At the same time, it also underscores the need for further research to explore the specific challenges of implementing gender diversity initiatives in this unique industry context.

6. Concluding Remarks

If the practice of a pay gap is a consolidated one, it becomes important to question why renouncing it would be beneficial. The data presented in Section 4 are estimates derived from the gray literature on the aviation sector and the general business market. However, they provide an answer and demonstrate the validity of generating sound revenue and debunking the “comfort zone” of the pay gap. Furthermore, these figures provide concrete evidence of the necessity to enhance female representation in the male-dominated aviation industry. It is crucial to acknowledge that these figures are merely estimates. The actual impact of these changes on operations and profits is likely to vary depending on several factors, including the specific airline, the industry sector, and the effectiveness of implementing these initiatives. As a limitation of this work, however, these figures’ exploratory assessment can pave the way for further assessments and refinements in prospective studies. The scenario aimed at quantifying monetary benefits for aviation companies is the first assessment in the literature, and it would benefit from consolidated facts and figures, which could provide more indicators and enhance evaluation by developing sensitivity analyses and the development of additional scenarios according to different time horizons and corporate policy changes. It is also important to consider the existence of structural barriers, which, if addressed proactively, enable airlines to better position themselves to reap the rewards of gender equity initiatives. This necessitates further analyses that account for different sizes and fields of aviation operations, as well as specific career positions. Such analyses will be addressed in future research. Achieving gender parity in the aviation sector is crucial and can yield numerous benefits for airlines and aircraft manufacturers. These include increased revenue, improved customer satisfaction, enhanced innovation, and a stronger brand reputation. Additionally, a commitment to diversity and inclusion can boost employee engagement, making both men and women feel equally valued and respected.

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