

# 2022 VERTICAL FLIGHT WORKFORCE REPORT: DIVERSITY, EQUITY & INCLUSION IS VITAL

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*“The secret of change is to focus all of your energy, not on fighting the old, but on building the new.” - Socrates*

## **About HYSKY**

HYSKY Society envisions a sky with zero aviation emissions. Its mission is to cultivate an inclusive hydrogen aviation community that advances hydrogen aviation across North America. We do this through advocacy, public and private partnerships, events, and education. Danielle McLean is the CEO. She was an advisor to VFS for workforce and hydrogen initiatives, 2020-2022.

One of HYSKY'S programs is the Hy-Sky Network. It was created to connect and empower women and other underrepresented groups in hydrogen aviation and overlapping technologies with like-minded people to succeed in decarbonizing aviation and growing a much-needed inclusive workforce.

## **About VFS**

The Vertical Flight Society, founded in 1943 as the American Helicopter Society, is the world's only international technical society for engineers, scientists and others working to advance vertical flight technology. The support of the vertical flight workforce — from students to engineering professionals to CEOs and innovators — is its primary constituency and a major part of its mission.

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This study was conducted by HYSKY Society for the Vertical Flight Society.

This study is focused on the US.

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# FOREWORD

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This report was conducted by HYSKY Society for VFS, both of which are 501(c)(3) educational non-profit organizations. The study was requested to provide an outside look at how to improve the chances of success of expanding the workforce of the vertical takeoff and landing (VTOL) industry — the current rotorcraft and the burgeoning electric vertical takeoff and landing (eVTOL) segments — in the years and decades to come, particularly in the US. HYSKY provides their perspective in this report and has identified diversity, equity and inclusion (DEI) as being vital; this is the major focus of their report.

The results of a VFS workforce analysis in January 2020 indicated that the VTOL technology workforce is at a critical juncture. At the same time that the US Department of Defense has kicked off several multi-billion-dollar rotorcraft acquisition efforts under the Future Vertical Lift (FVL) initiative, and traditional aerospace and defense (A&D) companies struggle to fill hundreds of vacancies seeking talented VTOL engineers, the “Electric VTOL Revolution” also requires thousands of engineers.

VFS estimates that each clean-sheet civil VTOL aircraft development requires on the order of \$1B, a decade of development, and 1,000 employees to get to certification. While several eVTOL companies have been working for several years, many additional developments are also underway. Military rotorcraft developments typically require significant more time, money and employees. VFS

forecasts 10,000 additional engineers (over and above the current workforce level) are needed in the next decade to support planned military and civil rotorcraft developments, as well the burgeoning eVTOL / advanced air mobility (AAM) market.

The strength of VFS is the diversity of its members from industry, academia and government, from around the world. Aircraft development by its nature is multi-disciplinary, drawing on the diverse expertise of the design and development team. Similarly, VFS — through its 22 technical committees and two dozen chapters around the world — has technical and geographical diversity as an integral part of its structure.

In addition, studies have shown (e.g., [McKinsey & Company, 2015](#)) that greater gender and ethnic diversity correlate with better performance of organizations. VFS has taken strides to encourage such diversity in its own structure of volunteers, with positive results.

VFS has also been working with intention to support diversity and inclusion in the VTOL industry for several years (see [www.vtol.org/workforce](http://www.vtol.org/workforce)). In my Jan/Feb 2022 Vertiflite Commentary, [“Workforce: Diversity, Inclusion and Equity Too,”](#) I wrote: *“I’ve been appalled to hear and see some of the gender bias — even today, in the 2020s! — in our industry. As a white man, it’s been easy to think that civilized society has transcended some of the more puerile behavior, but listening more to women tell these stories as a common occurrence*

*has been a wakeup call.*” Figure 3 in the report notes the differences in perspectives and experiences if you are male or female: in 2005, 7.8% of male engineers reported having seen instances where women or racial and ethnic groups were overlooked for career opportunities, while five times as many women engineers — nearly 40% — reported seeing this discrimination. Encouragingly, this number was down significantly from 12 years earlier.

The A&D sector — and the rotorcraft community in particular — has made tremendous progress over the past several decades in transitioning to a more diverse and inclusive workforce, with many programs underway to continue the progress. One needs only to look at the hiring websites of the major helicopter companies to see inspiring images and stories with a predominance of women and ethnic minorities, and themes like “celebrating differences” prominently displayed. They show the vision of all serious A&D companies.

There is still work to be done, however, to achieve the vision, as this report shows. While some may find the results uncomfortable, the study identifies a number of areas to work on, as highlighted in the Key Findings section. Those in the VTOL workforce, especially management, should review the study results as diagnostic for areas to work on for improvement.

It is important that organizations track diversity and inclusion data — at least on some level — to ensure that their workplace supports all of their employees. Hiring diverse candidates will not provide the benefits of a diverse workforce if ostracism or a lack of inclusion does not foster perceptions of equity and being valued by their

employer. This report by HYSKY is the first time that the aerospace and defense sector has officially discussed intersectionality — how different experiences overlap — which is essential to capturing data and identifying a root cause.

This is especially important for the young eVTOL/AAM segment of the VTOL industry. The disruptive thinking and energy of a new startup attracts certain types of personalities. It is important for the success of a new, small company to be looking for a diversity of capabilities and perspectives. The infamous “bro culture” of the tech industry is a cautionary tale of what could happen in AAM without purposeful intention to attract the widest possible talent pool to addressing the challenges of vertical flight.

Vertical flight is one of the most exciting technical challenges for today’s engineering workforce. We have made tremendous strides in providing a welcoming environment for everyone. We hope that this study will help to focus attention on how the VTOL industry can improve its ability to attract and retain talent by reaching out beyond the traditional A&D pipelines.

Mike Hirschberg  
VFS Executive Director  
November 2022

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## KEY FINDINGS

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An estimated 10,000 additional engineers are needed over the next decade to meet the demand for expected advanced vertical flight aircraft developments in the US. <sup>1</sup>

Significant additional funding for academia is needed to train enough highly skilled engineers to meet industry demands.

Training new engineers is not enough. New engineers must also be attracted and retained.

The most impactful metric to predict employee retention is whether or not employees feel valued and appreciated at work. An employee's *perceived* value is more important than their salary amount.

It costs a company about **\$1M** to replace 1 highly skilled engineer, so high attrition rates can be detrimental.

The legacy Aerospace and Defense (A&D) industry has 2x the attrition rates than that of the national average. The Advanced Air Mobility (AAM) sector likely has 4x attrition rates of the national average.

**Workplace ostracism** is likely a major cause.

Workforce ostracism could result in a threat to national security.

Workplace ostracism, or “social death,”<sup>2</sup> is the number one predictor of attrition rates. If it can be predicted, it can be mitigated. Successful programs exist to mitigate workforce ostracism.

A&D companies that have equitable representation at the highest level will likely be the most competitive and most likely to succeed in the coming years. Conversely, companies without equitable representation at the highest levels may atrophy and die.

Examining the challenges of the future vertical workforce is not about being “woke,” it’s about collecting and analyzing data to understand what causes someone to be attracted to a company, feel valued, and want to stay.

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<sup>1</sup> CREATING THE FUTURE VERTICAL WORKFORCE, 2020.

<sup>2</sup> CONSEQUENCES OF WORKPLACE OSTRACISM: A META-ANALYTIC REVIEW, 2021

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## RECOMMENDATIONS

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Companies should be transparent about demographics of attrition rates, employee's perceived value, salaries with respect to the actual work being done versus job title, and rate of promotion.

A&D workforce analysis groups should conduct an industry-wide study on workforce ostracism that includes intersectionality.

Rather than wasting energy on companies who refuse to evolve, focus workforce efforts on supporting those with equitable representation at the highest levels.

***For people who feel ostracized:*** Join communities to connect with like-minded people who will empower you.

***For companies:*** Be introspective on how to improve inclusivity and focus on the data.

Aircraft developers should invest in academia (including VLRCOEs) to train the future vertical workforce if they expect to access the talent pipeline.

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## INTRODUCTION

The booming global electric vertical takeoff and landing (eVTOL) industry is projected to be worth \$1T by 2040<sup>3</sup>. This bullish prediction is considered unrealistic by many naysayers, but eVTOL companies are hiring, nonetheless. Typical aerospace engineering degrees rarely cover electric aviation or vertical takeoff and landing (VTOL) in depth, so a graduate degree or a decade's worth of experience is often required. For a fast-moving startup, ten years is too long. eVTOL startups need employees now, so they have been forced to hire workers away from the most logical source — the traditional rotorcraft industry.

The United States military currently depends on 50-to-60-year-old helicopter designs such as the Chinook, Black Hawk/Seahawk, Apache and Huey/Cobra, as well as the V-22 Osprey, which first flew in 1989. The Future Vertical Lift (FVL) program began in 2009 to develop next-generation rotorcraft with leap-ahead technology to replace legacy aircraft. Several advanced rotorcraft programs are under development for the Army, Navy, Marines, and other services, so the need for experienced rotorcraft talent in the coming years is at an all-time high. FVL programs cannot afford to lose their irreplaceable rotorcraft expertise to the eVTOL industry, especially at this critical juncture of emerging technologies. This need for more engineering talent has been cited as a critical issue for FVL<sup>4</sup> as stated in various studies and presentations, including at the Vertical Flight Society's Forum 77 in May 2021.<sup>5</sup>

Developing a commercial VTOL aircraft, from concept to certification, typically takes on the order of:

- \$1B
- 1,000 engineers
- 1 decade of development

This is then followed by continuing engineering to develop and implement new improvements after certification.

Hundreds of eVTOL aircraft have been designed and if only 10 of these companies are successful over the next decade, **an additional 10,000 engineers will be required**. The traditional vertical lift industry does not have 10,000 engineers to supply the eVTOL talent pool.

In addition, the cost to develop a single military rotorcraft to a production decision is likely \$10-15B over two decades and requires several thousand engineers across multiple companies per aircraft.

In 2021, the Vertical Flight Society analyzed the relationship between funding and the number of people hired at several eVTOL companies, summarized in a notional graphic (Figure 1) that indicates an estimated 1,000 engineers over a decade is required for a \$1B certification effort. This has created competition for talent between eVTOL companies, other tech industries, and especially the rotorcraft industry. Top talent at rotorcraft companies that are vital to maintaining the United States' national security are being recruited by eVTOL startups. Vertical lift programs and eVTOL companies competing over talent is unsustainable and provides no workforce growth to either segment of the VTOL industry, leading to unattainable development and certification milestones.

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<sup>3</sup> EVTOL/URBAN AIR MOBILITY TAM UPDATE: A SLOW TAKE-OFF, BUT SKY'S THE LIMIT, 2021

<sup>4</sup> ASSESSING THE INDUSTRIAL BASE IMPLICATIONS OF THE ARMY'S FUTURE VERTICAL LIFT PLANS, 2020

<sup>5</sup> THE US ARMY SEES WORKFORCE AS A TOP CONCERN FOR ACHIEVING DEMANDING REQUIREMENTS FOR FUTURE VERTICAL LIFT, 2021

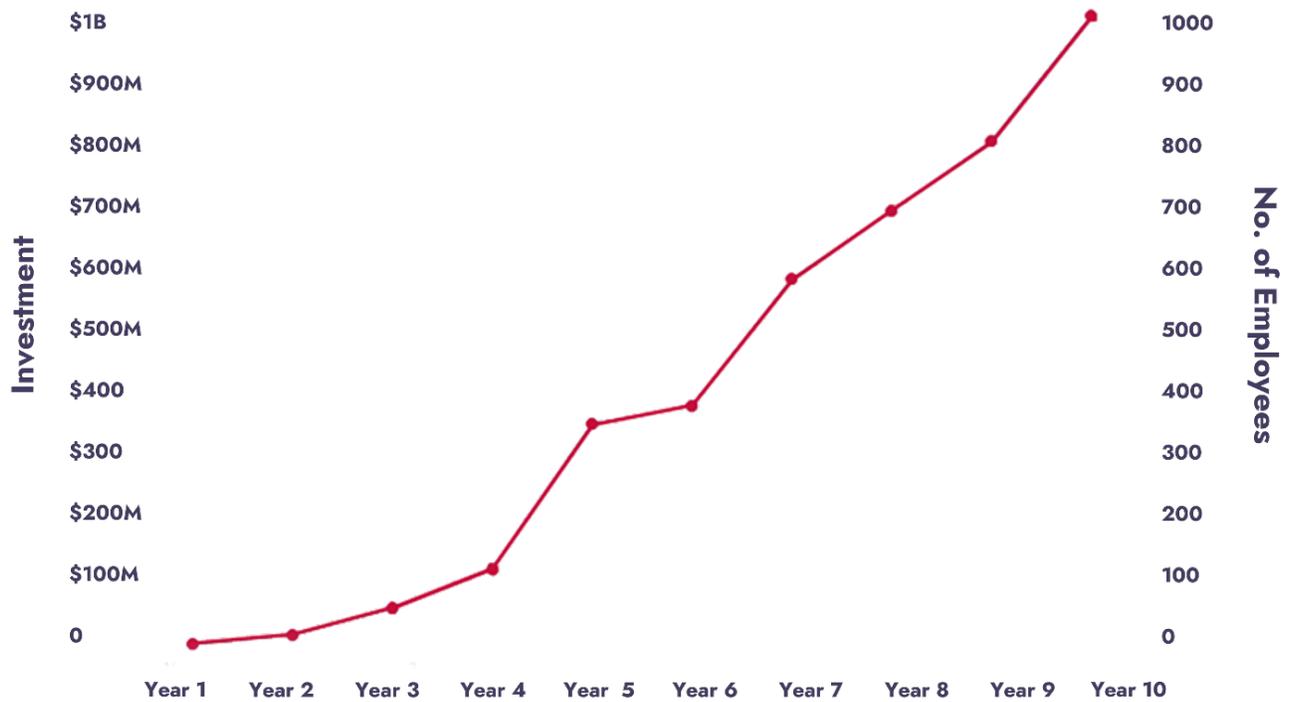


Figure 1: Notional eVTOL workforce demand: 1,000 engineers, \$1B and 1 decade

The VFS study was critical in predicting talent demands; however, the talent shortage is only one piece of the challenge. A closer look at eVTOL startup and the aerospace and defense workforces illuminated **an even bigger problem: Diversity, Equity, and most importantly, Inclusion.**

At the time of this publication, aerospace engineers are 89% men and 73% white<sup>6</sup>. This report analyzes how a majority white male workforce impacts underrepresented groups like women, people of color, people from non-US countries, the lesbian, gay, bisexual, and transgender (LGBT) community and more.

However, it's important not to blame white men for the problem that exists within the US culture. Indeed, many of today's non-white men in the A&D technical field come from highly patriarchic societies where women are not valued as equals. It is simply a problem of men in a company, university, agency, etc., who insult, disrespect or don't support women colleagues due to their gender. Similarly, treating other groups, including LGBT colleagues, poorly because of who they are is also highly corrosive to productivity in the workforce.

<sup>6</sup> AEROSPACE ENGINEER DEMOGRAPHICS AND STATISTICS IN THE US, 2022

## DIVERSITY, EQUITY, AND INCLUSION

### PREAMBLE

Providing an inclusive workplace is what most A&D leaders strive for. Diversity, equity and inclusion (DE&I) initiatives are ubiquitous on company websites. However, truly diverse, and inclusive workplaces are extremely difficult to achieve. Every group has a partial understanding of how diversity functions in society because we each form beliefs around our own experiences since childhood.

Sadly, when the topic of diversity comes up, it can trigger a defensive response because it is often perceived as an attack on white people, especially white men. White men have expressed feelings of being unwanted, feeling like the problem, and even feeling like everyone is out to get them<sup>7</sup>. Ironically, underrepresented groups also feel unwanted by people in power who are, typically, white men.

The good news is that we all share more in common than we think. Inclusion is not inclusive if we exclude white men. This is a tricky conversation because being sensitive to white men's experience can feel like gaslighting to underrepresented groups, while being sensitive to underrepresented groups can feel like an attack to white men. Underrepresented groups often express feelings of invalidation when they perceive a narrative centered around white men — the group who statistically is paid more and has higher positions — being the victim.

The lack of diversity in A&D is a systemic problem that was not caused by one person nor is any one person to blame. However, fixing the problem requires that each of us acknowledge its existence, regardless of how uncomfortable that might be.

In this regard, male leaders are the linchpin to achieving an inclusive workplace. Therefore, it is important to let men know that they are welcome and that their experience is valued, just as much as everyone else's. We must all put our personal beliefs and opinions aside and intentionally have unfamiliar, uncomfortable conversations. This requires vulnerability, which is often viewed as a weakness. However, if we think about moments when we were vulnerable — such as military combat knowing everyone may not survive, making business decisions with uncertain outcomes, or making a major life change that others thought was unwise — we are actually recalling times of admirable courage<sup>8</sup>.

In short, vulnerability is courage, and it requires intention. Lots of intention. The vertical flight industry is made up of some of the brightest and bravest people in the world. There is no doubt that if anybody can solve the DEI problem, it is us. Being vulnerable (brave) and reciprocating compassion is something that we, as an industry, can achieve.

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<sup>7</sup> HOW TO SHOW WHITE MEN THAT DIVERSITY AND INCLUSION EFFORTS NEED THEM, 2019

<sup>8</sup> DARING TO BE VULNERABLE WITH BRENÉ BROWN, 2016



Figure 2: Courageous Together (courtesy of Microsoft stock images)

## THE BOTTOM LINE

McKinsey & Company conducted a three-part study on how gender and ethnic diversity affect a company's bottom line in the US. They divided corporations into four quartiles, with the lowest quartile being the least diverse and the highest quartile being the most diverse.

Executive boards in the top quartile for gender diversity are 28% more likely to financially outperform competition and are 25% more likely to achieve above-average returns. Companies with over 30% women on executive leadership teams will financially outperform those with little-to-no female leadership by 48%. Earnings before interest and taxes (EBIT) increases by 3.5% for every 10% increase of gender diversity<sup>9</sup>. For every 1% increase of women representation there is a 3% increase in sales revenue<sup>10</sup>.

In addition, for every 10% increase of racial and ethnic diversity in C-suite positions, a company's EBIT increases by nearly an entire percent. Companies with the most racial diversity earn, on average, almost 15 times more sales revenue than companies with the lowest racial diversity.

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<sup>9</sup> WHY DIVERSITY MATTERS, 2015

<sup>10</sup> THE BUSINESS CASE FOR DIVERSITY AND INCLUSION, 2020

## PERCEPTION AND AWARENESS

In a 2005 survey, the Society of Women Engineers (SWE) reviewed 6,000 engineering graduates with bachelor’s and master’s degrees<sup>11</sup>. Nearly 40% of women have reported instances where women or racial and ethnic groups were overlooked for career opportunities. Conversely, over 90% of male engineers, reported to have never witnessed instances of women or underrepresented groups being overlooked<sup>11</sup>. The data suggests that most male engineers are unaware of or ignore bias and discrimination in the workplace (see Figure 2).

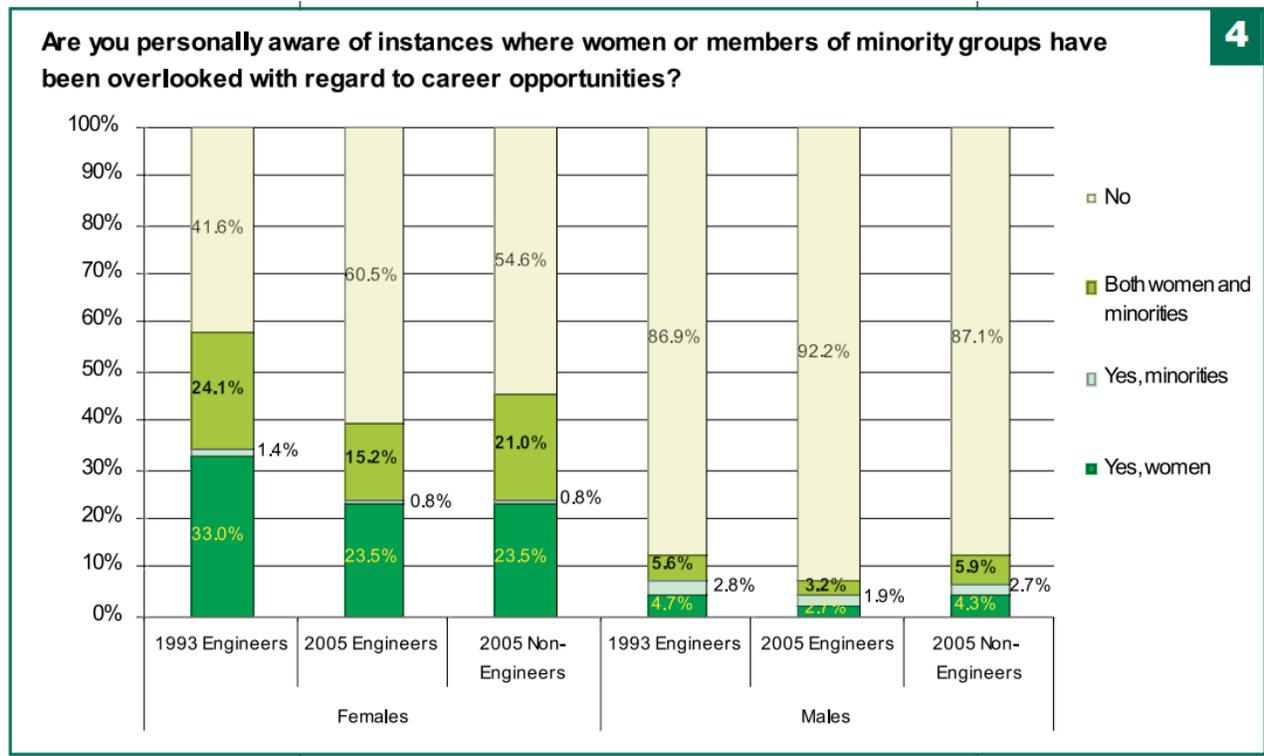


Figure 3: Differences in experiences noted by the Society of Women Engineers<sup>11</sup>

## ATTRITION RATE

The voluntary attrition rate of the US A&D industry ranges from 5% to almost 8%, while the national average ranges from only 3.5% to 4%<sup>12</sup>. According to Sparkbay, a Canadian company focused on employee retention tools, the cost to replace employees are as follows<sup>13</sup>:

- Entry-level: 30–40% of their salary
- Mid-level: 150% of their salary
- Highly skilled: up to 400% of their salary

<sup>11</sup> NATIONAL SURVEY ABOUT ENGINEERING, 2009

<sup>12</sup> AEROSPACE AND DEFENSE WORKFORCE STUDY, 2021

<sup>13</sup> A STEP-BY-STEP GUIDE TO CALCULATING THE EXACT COST OF TURNOVER, 2022

Therefore, using US Bureau of Labor Statistics data for aerospace engineer salaries<sup>14</sup>, when a company loses 10 employees in a year, the effect on the bottom line is as follows:

- 10 entry-level employees lost – cost to company **\$210K**
- 10 mid-level employees lost – cost to company **\$1.8M**
- 10 highly skilled employees lost – cost to company **\$6.8 M**

## 2017 A&D WORKFORCE STUDY

Perhaps the most alarming data is from the Aviation Week 2017 Workforce study — supported by the American Institute of Aeronautics and Astronautics (AIAA), the Aerospace Industries Association (AIA) and PricewaterhouseCoopers (PWC) — which is the only free and easily accessible report with data on A&D attrition demographics. In 2017, 42% of A&D **voluntary** attritions were non-white male employees<sup>15</sup>. Interestingly enough, 42% of current employees believe there is no opportunity for them to grow. There was no discussion on whether or not a correlation exists.

	Rate of Voluntary Attrition
Female	5.1%
American Indian/Alaska Native	5.3%
Asian	4.4%
African-American	6.5%
Latino/Hispanic	5.9%
Hawaiian/Pacific Islander	5.1%
Employees of 2 or more races	9.6%
Employees Not Identifying	13.5%

Figure 4: Rate of Attrition by Demographic<sup>15</sup>

Although well-intentioned, the Aviation Week Workforce Study is furthering the marginalization of underrepresented groups. Aviation Week has improved their data collection methods to follow those of the US government; however, the US Equal Employment Opportunity Commission (EEOC) data conflicts with many statements and data collection methods as discussed in the following paragraph.

The 2017 survey did include Black and Hispanic women engineering executives and workforce women, which is an improvement from 2016. However, it only included Black and Hispanic women, lumping the rest of non-white women together as “all minorities.” Further, lumping workforce women together doesn’t capture non-executive women engineers, where some of the greatest inequities exist.

<sup>14</sup> AEROSPACE ENGINEERS, 2022

<sup>15</sup> A&D LEADERS WORK TO MANAGE MULTIPLE GENERATIONS; SURVEY RESPONSES CALL FOR REBRANDING OF INDUSTRY, 2017

	2017	2016
<b>Workforce Women</b>	24%	21.9%
Blacks	5%	6.7%
Hispanics	6%	6.3%
All Minorities	21%	15.2%
<b>Executive Payroll</b>	1.3%	2%
Women	24%	20%
Blacks	3%	NA
Hispanics	2%	NA
All Minorities	11%	12%
<b>Engineering Executives Women</b>	16%	11%
Black	2%	NA
Hispanic	2%	NA
All Minorities	8%	10%

Figure 5: The Face of A&D—Demographics<sup>15</sup>

The study states that the reasons people leave are, “salary, desire for a new challenge and the ability to expand their competencies and skills<sup>15</sup>.” This may be the reason for the male majority, but for women, especially Black women, this is not the case, according to EEOC. Being isolated, having expertise questioned, being pressured to conform to a traditional feminine role, and being doubted after having children (all which affect women of color even much more than white women) are reasons women left<sup>16</sup>. Reasons for leaving need to be broken down by demographics, otherwise the results will only reflect the majority — white males — which does not provide meaningful data to improve retention of underrepresented groups.

There is no mention of lesbian, gay, bisexual, transgender, queer/questioning (LGBTQ) people — who collectively make up about 8% of the US population<sup>17</sup> — even though they are highly discriminated against in American society<sup>18</sup>. Another targeted group that was not mentioned was persons with disabilities. The study also did not consider political or religious bias. Inclusion of these groups would likely account for more significant percentages of voluntary attritions.

Lastly, it has been widely known and accepted that the term “Blacks” (as a noun) is offensive in the US<sup>19</sup> but the term was used eight times in the report. This is a perfect example of why diversity matters. If more Black women, one of the most oppressed group in the US, were afforded opportunities to advance in A&D, terms like this wouldn’t slip through the cracks. It is unacceptable that the A&D

<sup>16</sup> DIVERSITY IN HIGH TECH, 2015

<sup>17</sup> WE ARE HERE: LGBTQ+ ADULT POPULATION IN UNITED STATES REACHES AT LEAST 20 MILLION, ACCORDING TO HUMAN RIGHTS CAMPAIGN FOUNDATION REPORT, 2021

<sup>18</sup> THE COSTLY BUSINESS OF DISCRIMINATION, 2012

<sup>19</sup> TIPS FOR SOCIALLY RESPONSIBLE WRITING, 2017

industry — which is considered to employ some of the smartest people in the world — used an offensive racial term in an official diversity study. It's no wonder that the A&D industry has a difficult time attracting and retaining diverse talent. Assuming that this was an honest mistake, consider how many more mistakes are unknowingly made behind closed doors that have devastating effects on one's psyche. No sane person would subject themselves to that.

Aviation Week first published data on the demographics of women in A&D in 2017. Though not exhaustive, it is a massive contribution to understanding the A&D workforce. Aviation Week's 2017 study demonstrated precisely the kind of bravery and vulnerability that A&D needs. We are human and we will always make mistakes. No person or group could possibly know every single thing that is offensive, especially with the world becoming more connected. The key to unlocking diversity is to accept the critique and use it as a learning opportunity even though it is human nature to become defensive, give up, and stop having the difficult conversations. Staying open requires intense vulnerability which is, of course, bravery. As long as we stay curious, demonstrate continuous learning, and have good intentions, mistakes are easily forgiven.

## 2021 A&D WORKFORCE STUDY

In 2021, AIA and AIAA worked with Ernst & Young LLP to conduct an updated workforce study. The study found that women represent 25% of A&D employees compared to the 47% national average in the US workforce. It is important to note that the percentage of women in A&D represents all women, whose roles range from technicians to C-Suite executives.

The study reported that women in executive roles have increased, however, this "increase" was not limited to C-Suite positions, especially those with technical backgrounds, suggesting that a broader range of roles were taken into consideration. Moreover, the term "executive" was not defined. No numbers were published on women in C-Suite roles.

The study also states that Black, Hispanic and Asian (another outdated term that discounts the 48 countries in Asia from the Middle East to the Far East) people represented at the executive level is disproportionately lower than the respective groups' overall representation<sup>20</sup>. This suggests that the respective groups leave the companies and/or advancement opportunities are absent for them. No numbers were published for Black, Hispanic or Asian representation.

Like the 2017 study, there was no mention of intersectionality and did not capture data for groups such as LGBTQ, women of color, accessibility, and non-Christian religions. Neither study examined the pain that many people from underrepresented groups have to endure that often results in them leaving the organization and sometimes the entire A&D industry.

Intersectional demographics should be captured by these organizations in future studies. For example, instead of categorizing someone as "man" and "woman" or "Black" and "white," they should be categorized as "able-bodied straight Christian Black man" and "non-religious lesbian white woman with a disability" in order to capture the critical data.

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<sup>20</sup> A&D WORKFORCE STUDY: HOW TO PREPARE NOW FOR THE WORK OF THE FUTURE, 2021

## ATTRITION AND ADVANCED AIR MOBILITY

Attrition rates in the A&D industry are around double than those of the U.S. national average. For A&D companies with fewer than 1,000 employees, attrition rates are four times the national average<sup>21</sup>. At the time of this writing, all eVTOL companies have less than 1,000 employees, which suggests that employees leave the companies four times faster than the national average of company attrition rates. This will be discussed in more detail later in this report.



Figure 6: A notional eVTOL concept (courtesy of Shutterstock: Photo ID 763362202)

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<sup>21</sup> A&D LEADERS WORK TO MANAGE MULTIPLE GENERATIONS; SURVEY RESPONSES CALL FOR REBRANDING OF INDUSTRY, 2017

## THE ROOT CAUSE — WORKPLACE OSTRACISM

Although some harassment and bullying are blatant and explicit, employees from underrepresented groups often experience subtle social cues suggesting they are devalued and excluded from the workplace culture. Workplace ostracism, an insidious act of mistreatment, is much more prevalent than overt offenses<sup>22</sup>. Some examples of ostracism include:

- Not including all team members in relevant emails
- Not inviting all relevant people to meetings
- Dismissing someone's credible expertise
- Singling someone out to perform menial tasks outside of their role
- Not sharing documents pertinent to fulfilling a role with all team members
- Failure to acknowledge women in leadership roles by emailing male counterparts rather than or in addition to the woman lead

These acts of ostracism, often referred to as microaggressions, can be unintentional or malicious. Regardless of intent, ostracism has devastating effects on the victim's psyche and the company's bottom line. Victims experience extreme psychological trauma when attempting to make sense of the mistreatment, which occurs on a continuous basis. Compared to harassment, many employees think ostracism is more socially acceptable, less psychologically damaging, and less likely to impede the organization<sup>23</sup>. To the contrary, workforce ostracism is actually more harmful than harassment to both the victim and the organization. Assessing ostracism within an organization can predict employee turnover for three years, which can be mediated by cultivating a sense of belonging. Assessing harassment cannot predict employee turnover<sup>23</sup>.

Part of what makes workplace ostracism so dangerous is that it can seem trivial, ambiguous, and even invisible to onlookers. As a result, victims of workplace ostracism may question their own experience with counter-productive thoughts. If a victim does gain the courage to discuss their experience with leadership, they are often told that they have imagined it, it was an accident, the perpetrator isn't "like that," they are being "too sensitive," are overreacting or have misunderstood. This invalidating response, often referred to as gaslighting, is also a microaggression. Unfortunately, the victim can get stuck in a re-traumatizing loop of microaggressions that becomes unbearable<sup>24</sup>.

An 800-participant Harvard Business Review study reported that 48% of people who did not feel included were intentionally less productive<sup>25</sup>, or quiet quitting<sup>26</sup>. In addition, 38% reduced their quality of work, 27% called in sick more frequently and 12% left the company altogether<sup>24</sup>. According to a 2020 study published in the European Journal of Management and Business Economics, workplace ostracism and perceived organizational support are inversely correlated<sup>27</sup>. Data shows that perceiving more organizational support can mitigate the negative effects from workplace ostracism. Therefore, minimizing workplace alienation to create a healthy workplace requires structural and organizational change from the top down.

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<sup>22</sup> WORKPLACE OSTRACISM: PEOPLE'S PSYCHOLOGICAL ATTRIBUTIONS AND COPING STRATEGIES, 2020

<sup>23</sup> IS NEGATIVE ATTENTION BETTER THAN NO ATTENTION? THE COMPARATIVE EFFECTS OF OSTRACISM AND HARASSMENT AT WORK, 2014

<sup>24</sup> THE LINK BETWEEN RACIAL DISCRIMINATION AND SOCIAL EXCLUSION, 2020

<sup>25</sup> THE PRICE OF INCIVILITY, 2015

<sup>26</sup> WHAT IS 'QUIET QUITTING,' AND HOW IT MAY BE A MISNOMER FOR SETTING BOUNDARIES AT WORK, 2022

<sup>27</sup> A STUDY OF THE INFLUENCE OF WORKPLACE OSTRACISM ON EMPLOYEES' PERFORMANCE: MODERATING EFFECT OF PERCEIVED ORGANIZATIONAL SUPPORT, 2020

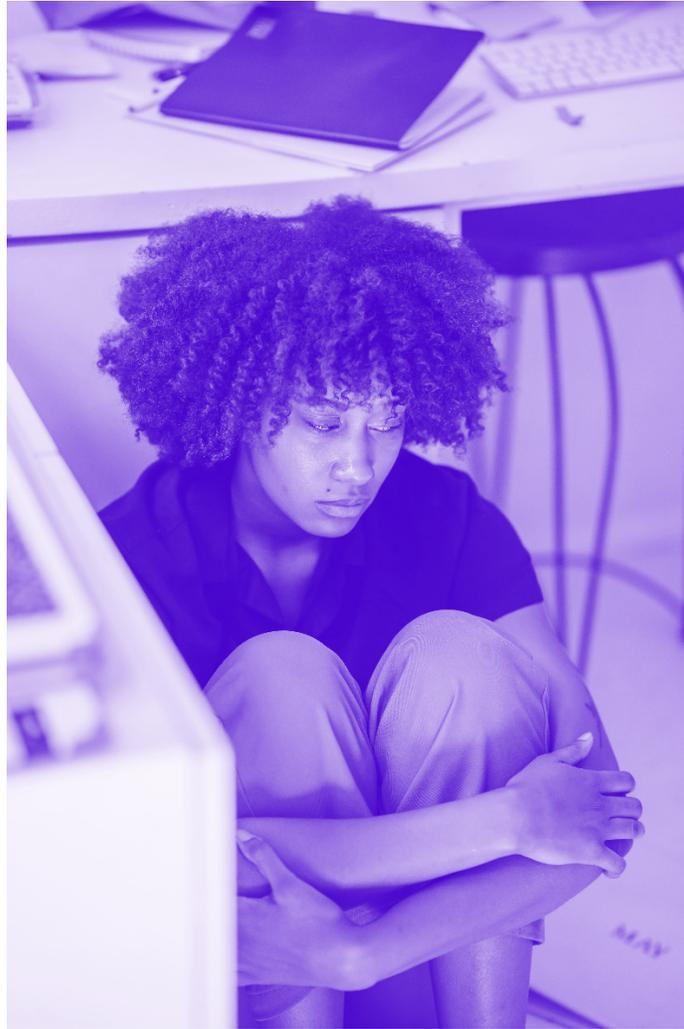


Figure 7: Workplace Ostracism (courtesy of Pexels: Photo ID 12911298)

## QUIET QUITTING & THE GREAT RESIGNATION

Though it is not known where the term “quiet quitting” was first used, it has become a global revolt for workers against employers with thousands of viral videos on TikTok. The concept is to show up for work, get paid, but work as little as possible.

Whether you agree or disagree with the movement, it is something to be taken seriously. Today’s world offers limitless ways of earning a living. Fiverr and Upwork are just two of dozens of online freelance marketplaces where anybody — especially engineers with desirable skills — can do contract work. Freelancers can set their own rate and hours. Companies in every industry that are not supporting their workers can expect to lose a significant number of employees as people take control over their careers. So, companies that have “quiet quitters” need to reflect, and take radical action, on what caused people to become so unhappy.

Executives must take a long, hard look in the mirror. Everything is online. People are connecting and sharing stories. CEO's salaries are known. Abusive people are discussed in private online chats. Stories are validated. People have learned to document their experiences. HR departments can no longer brush mistreatments under the rug.

Many people don't feel valued, don't see a way to advance, feel overworked, and haven't seen results from their HR interactions. Meanwhile, top executives earn astronomically high salaries. That is not a situation that anyone (other than the executives) wants to be in and, with today's technology and opportunities (and record low levels of unemployment), they don't have to.

People, especially aerospace engineers, are not lazy. eVTOL executives need to ask themselves why they experience four times higher attrition rates than the national average. The Great Resignation, an economic trend that began in 2021, is a movement in which employees quit their jobs in mass numbers<sup>28</sup>. While many theories exist on why people began quitting en masse, one thing holds true: people will do what makes them happy. COVID didn't make employees suddenly realize that they wanted to work remotely; rather, they likely were already miserable at their jobs.

The problem is not that people don't want to work. People don't want to work for companies that they believe are toxic. Executives know this. They have (or should have) known that employees, especially underrepresented people, are not happy because people have been speaking out about it for decades. The information is not new. The consequences are.

People do not need employers. Employers need people. And people have choices.

## TYPES OF WORKPLACE CULTURES

Companies typically fall into one of three cultural categories: monocultural, transitional and multicultural. In monocultural companies, a majority group consciously or unconsciously dictates the company's decisions while underrepresented groups must assimilate to the predominant culture. In transitional organizations, decision-making is sprinkled with individuals from underrepresented groups and some differences are tolerated. Multicultural organizations have a diverse set of people that come from various groups and embrace differences as their majority<sup>29</sup>.

Becoming a multicultural organization requires intention, introspection, and tough conversations. One of the most difficult challenges in the US is the polarized political climate and the perception that embracing different viewpoints is equivalent to converting to a specific political party. An employee's value in the workplace must only be measured on their work. A person's religion, political affiliation, physical abilities, views on LGBTQ, personal gender standards, opinions on skin color, immigrants' culture or country of origin, and/or socioeconomic status do not have a place in a thriving workplace. A healthy workplace consists of people of all walks of life that form a community. Intentionally seeking out differences and embracing them, shown in the far-right column of the table below, is the only way to truly eradicate workplace ostracism. Eradicating workforce ostracism is key to creating a community.

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<sup>28</sup> THE GREAT RESIGNATION, 2021

<sup>29</sup> DEVELOPING MULTICULTURAL ORGANIZATIONS: A CHANGE MODEL, 2008

THE MULTICULTURAL ORGANIZATION DEVELOPMENT MODEL					
MONOCULTURAL		TRANSITIONAL		MULTICULTURAL	
Exclusionary	Passive Club	Compliance	Positive Action	Redefining	Multicultural
Committed to the dominance, values and norms of one group. Actively excludes in its mission and practices those who are not members of the dominant group.	Actively or passively excludes those who are not members of the dominant group. Includes other members only if they "fit" the dominant norm.	Passively committed to including others without making major changes. Includes only a few members of other groups.	Committed to making a special effort to include others, especially those in designated protected "classes." Tolerates the differences that those others bring.	Actively works to expand its definition of inclusion, diversity and equity. Tries to examine and change practices that may act as barriers to members of non-dominant groups.	Actively includes a diversity of people representing different groups' styles and perspectives. Continuously learns and acts to make the systemic changes required to value, include and be fair to all kinds of people.
Values and promotes the dominant perspective of one group, culture or style.		Seeks to integrate others into systems created under dominant norms.		Values and integrates the perspectives of diverse identities, cultures, styles and groups into the organization's work and systems.	

Figure 8: The Multicultural Organization<sup>29</sup>

## INTERSECTIONALITY

Intersectionality, a term coined by Kimberlé Crenshaw in 1989, is a metaphor for understanding the ways that multiple forms of inequality or disadvantages overlap and create obstacles that are not always understood within the conventional context of racism or feminism<sup>30</sup>. While it is true that both white women and Black men are part of marginalized groups and will likely face microaggressions in the workplace, this is an oversimplification that will not capture everyone's experience nor yield meaningful data. Therefore, it is important that we use intersectionality to capture the experiences of people who are part of more than one underrepresented group. For example, Black women in A&D must additionally maneuver carefully through a predominantly white culture as well as a male-dominated space. Black women who are part of the LGBTQ community experience another layer of discrimination, with each layer presenting more boundaries, as visualized by the Intersectionality Venn Diagram below<sup>31</sup>.

<sup>30</sup> KIMBERLÉ CRENSHAW: WHAT IS INTERSECTIONALITY? 2018

<sup>31</sup> CONCEPTS IN RACIAL EQUALITY, 2022

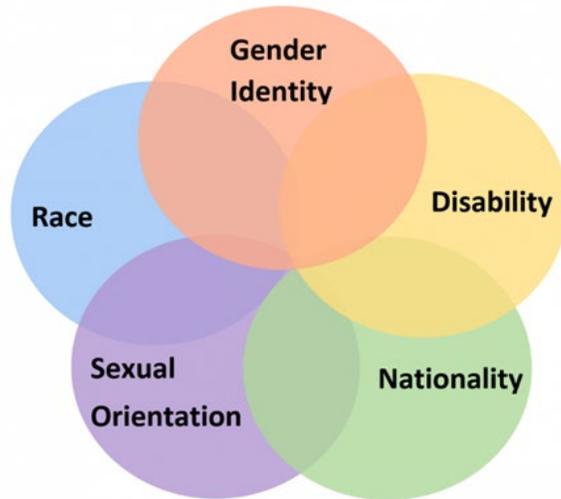


Figure 9: Intersectionality<sup>31</sup>

### CAUSE OF HIGH ATTRITION IN ADVANCED AIR MOBILITY

As mentioned previously in this report, eVTOL companies are likely experiencing attrition rates four times greater than those of the national average. This is likely due to the nature of how startups are formed, which is typically done with established professional relationships. Considering that only 2% of women founders obtain funding<sup>32</sup>, with Black women founders accounting for only 0.27% of this figure<sup>33</sup>, it is not surprising that eVTOL companies are white male dominated.

It is impossible to create an inclusive environment when it is not reflected in leadership. Regardless of how much empathy and effort humans have, it is in our nature to be biased. Harvard University’s Project Implicit explains that even if someone says they believe women and men should both be equally associated with science, many of our unconscious biases - that we may not even know we have - typically reflect a stronger association between men and science<sup>34</sup>. This is true for race, ethnicities, abilities, etc.

What gets a startup to funding faster (established relationships between white men) could be the very thing that causes the company to flounder in coming years. In order to avoid high attrition rates in an organization, the incorporation of diversity into boards, cap tables, investors, and founders must happen prior to hiring diverse talent. Otherwise, the attrition costs will grow exponentially with U.S. demographics and become unsustainable.

### DIVERSITY: A MATTER OF NATIONAL SECURITY

The US A&D industry leads the world in technology innovation, but that will change without radical action. In addition to aggressively investing in their own A&D technology, competing nations are also investing in advanced workplace studies to attract

<sup>32</sup> WHY AREN'T FEMALE FOUNDERS GETTING A BIGGER PIECE OF THE PIE? THEORIES ABOUND, 2022

<sup>33</sup> VCS MUST DO A BETTER JOB OF SUPPORTING BLACK WOMEN FOUNDERS, 2021

<sup>34</sup> PROJECT IMPLICIT, 2011

and retain talent. It is essential that the U.S. improve diversity metrics and eradicate preventable attrition in order to remain the global leader. US dominance in technology, especially in A&D, ensures the country's national security. Industry, policy makers, academia, charities, states and municipalities must work together to immediately address the forecasted workforce demands for AAM, FVL and all of A&D developments.

Other developed countries like China and South Korea, who are active players in AAM, have state-funded research on workplace ostracism, the number one predictor of attrition rates, and how to mitigate it<sup>35</sup>. Even though the US A&D industry suffers from high attrition rates and shameful diversity numbers, there has not been any significant mention of workforce ostracism within the A&D sector.

According to the US Census Bureau, multiracial and multiethnic Americans under 18 have surpassed the number of white people and become the "majority minority." By 2044, the entire U.S. population and its workforce are projected to reach the same milestone; white people are forecasted to make up just 43% of the population by 2060<sup>36</sup>. The future workforce will have a diverse profile of role models and companies with no majority group on their board. Companies that fail to innovate their culture are already being overlooked by the workforce; aviation, being one of the least diverse industries, is likely to experience this even more acutely in the upcoming years. Neglecting to address workforce ostracism is quite literally handing over the U.S. A&D dominance to other global competitors who are aggressively tackling workforce ostracism.

Lonnie Garris, III, a retired U.S. Air Force colonel and a cybersecurity executive, has aptly summarized that a major lesson from World War II is that many demographic groups were needed to secure victory, despite the fact that there was minimal inclusivity in major US institutions<sup>37</sup>.

In these times, the need for cohesion is even greater and that can only be achieved by incorporating diversity. The protests after George Floyd's death in May 2020, the Jan. 6, 2021, attack on the U.S. Capitol, and the disproportional effect that Covid-19 has on underserved communities all show how quickly social and economic divides escalate exponentially and threaten the entire nation's security.

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<sup>35</sup> DIVERSITY & INCLUSION AWARENESS IN WORKPLACE HELPS BOOST INNOVATION, CHINA UNDERSTANDS THIS BEST IN ASIA, 2019

<sup>36</sup> THE FUTURE WORKFORCE: MORE DIVERSE THAN EVER, 2021

<sup>37</sup> DIVERSITY & INCLUSION: A NATIONAL SECURITY IMPERATIVE, 2021

## CURRENT INITIATIVES FOR DIVERSITY & AAM WORKFORCE GROWTH

### VERTICAL LIFT RESEARCH CENTERS OF EXCELLENCE (VLRCOE)

The U.S. Army Combat Capabilities Development Command (DEVCOM) Aviation & Missile Center (AvMC) leads an initiative to fund university research and train the next generation of rotorcraft scientists and engineers through its Vertical Lift Research Centers of Excellence (VLRCOE) program<sup>38</sup>.

The program, which began in 1982, consists of a partnership between the Army, Navy and NASA. This program, competitively awarded every 5 years, has been, for the past 15 years, won by three multi-university teams: Georgia Institute of Technology, Pennsylvania State University, and the University of Maryland. The university teams, often referred to as centers, train students to incubate the next generation vertical lift workforce. The centers, which were renewed in fiscal year 2022, have teamed with over a dozen other academic institutions to execute more than 30 technical projects over the next five years.

Government subject matter experts remain actively involved over the entire life of the research projects to ensure alignment with the program's broad technical goals. The program has proven to be sustainable, effective, and scalable. Graduates of VLRCOE have gone on to become the Chief of Staff of the Army, astronauts, VPs at leading VTOL manufacturers, a C-Suite executive at a top eVTOL developer, and many other leaders in government, academia, and industry.

### DIVERSIFLITE

In 2021, the Vertical Flight Society (VFS) formed the DiversiFlite team to build top-down momentum to amplify the need to attract and most importantly retain diverse talent. This built on several years of conference panels and sessions on the needs for the future vertical workforce, a series of talks for the US Air Force Agility Prime program, as well as a number of commentaries published in the Society's *Vertiflite* magazine.<sup>39</sup>

DiversiFlite began by hosting a series of webinars including:

- January 2022 – A talk with the Vertical Flight Society's Executive Director, Mike Hirschberg, to discuss vertical flight workforce demands, how diversity improves the bottom line, and his commitment to pioneering the future workforce.
- February 2022 – A talk with Dawn Zoldi, founder and CEO of P3 Tech Consulting, to discuss the strategic alliance between the Vertical Flight Society and Women & Drones, collaboration with Diversity Development Network of Canada, Women to Watch Global Awards, and more.
- March 2022 – A talk with Mark Moore, founder and CEO of Whisper Aero to discuss lack of women in the eVTOL industry.

The series of webinars was followed by the VFS DiversiFlite Scholars Program<sup>40</sup>, an award that funds students from a US-recognized Minority-Serving Institution (MSI), such as Historically Black Colleges and Universities (HBCUs) for an all-expenses paid trip to the Society's Annual Forum and Technical Display. Students are paired with mentors and can attend Forum courses, invited special sessions and technical sessions, connect with industry leaders and peers, and lay the foundation for a successful vertical flight

<sup>38</sup> VERTICAL LIFT WORKFORCE: GRADUATE RESEARCH AND EDUCATION, 2020

<sup>39</sup> CREATING THE FUTURE VERTICAL WORKFORCE, 2022

<sup>40</sup> VFS ANNOUNCES 2022 SCHOLARSHIP RECIPIENTS, 2022

career. The DiversiFlite Scholars Program is an addition to the Society’s philanthropic arm which includes the Vertical Flight Foundation (VFF) merit-based scholarship program that awards \$100,000 in scholarships each year.

## WOMEN AND DRONES

Sharon Rossmark, CEO of Women and Drones, coined the phrase, “If you can see me, you can be me,” a message critical to attracting people from underrepresented groups. In 2021, Women & Drones launched its first UAS/AAM Industry Diversity, Equity and Inclusion (DEI) Survey<sup>41</sup> to establish an UAS/AAM industry DEI baseline. Over 1,000 individuals responded to the 2021 survey during the six-week open period, with VFS sponsoring gift cards for random winners. In August 2022, Women and Drones launched its second annual UAS/AAM DEI survey, which is key to developing AAM-focused DEI strategies.

Women and Drones holds the annual Global Women to Watch Awards Ceremony every year at the Consumer Electronics Show (CES) where top women in the eVTOL and drone communities are recognized for their achievements. The 2021 awards ceremony featured keynotes from Huy Tran, Director of Aeronautics at NASA Ames Research Center and Lori DeMatteis, VP of Sales, Marketing, & Customer success at Iris Automation.



Figure 10: Sharon Rossmark (Women & Drones), Lori Dematteis (Iris Automation), Dawn Zoldi (P3 Tech)<sup>42</sup>

<sup>41</sup> THE 2022 UAS/AAM INDUSTRY DIVERSITY, EQUITY AND INCLUSION (DEI) SURVEY HAS LAUNCHED!, 2022

<sup>42</sup> 2021 WOMEN TO WATCH AWARDS CEREMONY



Figure 11: Women & Drones Micro Grants<sup>42</sup>



Figure 12" Huy Tran, NASA<sup>42</sup>

The Women and Drones Global Awards event is one of the most inclusive and diverse industry gatherings to date. People of all backgrounds are celebrated. Women and Drones is an exemplary example of an organization with inclusive values and diverse people, **represented at the highest level**, necessary for longevity in A&D.

The ability to join communities and connect with like-minded people can be empowering to overcome many of obstacles in one's career.

Women and Drones is an ideal model of an organization with inclusive values and diverse people, **represented at the highest level**, necessary for longevity in A&D.

## SUMMARY

### A THREE-PRONGED APPROACH

A proposed three-pronged approach is recommended to grow the vertical flight workforce. The first prong is to conduct a government-funded study on workforce ostracism in the A&D industry with extreme focus on intersectionality. This must be done first; otherwise newly trained talent may enter an organization that they will leave shortly after. Without workforce ostracism being mitigated, investments for developing talent will see little to no return for underrepresented groups. The second prong is to obtain industry funding for the current initiatives to allow programs like VLRCOE and Women and Drones to scale up the number of experts they train and highlight. The final prong is to focus on pairing talent to companies with equitable representation at the highest level.

### CONCLUSION

Companies that haven't taken DEI data seriously yet are not likely to do so until it's too late. That's why it's important for people to find each other. Together, we can build a community of people and companies who value aviation, people, and the future.

This report has summarized the greatest impediments to a thriving vertical flight workforce. Diversity, equity and inclusion is vital to achieving the goals of transformative civil (e.g., AAM) and military (e.g., FVL) VTOL aircraft development and fielding. The data clearly show the need to address the issues in the workplace today and for the future. Companies that haven't taken DEI data seriously yet may fail to do so until it's too late for them.

Together, we must build a community of employees and employers who value people and harness their talent and diversity to transform vertical flight for the betterment of society.

**“THE SECRET OF CHANGE IS TO FOCUS ALL OF YOUR ENERGY, NOT ON FIGHTING THE OLD, BUT ON BUILDING THE NEW.”** *Socrates*

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