IDA

Accessing Critical Skills in the Department of Defense

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Executive Summary

The 2018 National Defense Strategy highlights a security environment that is changing rapidly as a result of "relentless" development of new technologies[1] As these emerging technologies become increasingly central to the future of warfare, it is imperative for the U.S. national security community to invest in expanding the community of individuals with the critical skills necessary to meet the challenges of this new technology-centric environment. To achieve that goal, DoD operates a number of outreach programs that target students from elementary school through collegiate and graduate programs to encourage them to consider careers in science, technology, engineering, and mathematics (STEM) fields. Likewise, DoD has invested in numerous recruitment programs including internships, scholarships, and job fairs.[2] These investments in outreach, education, and recruitment of critical skills must also compete with the growing private sector demand for many of the same skills.

In recognition of the crucial importance of a highly skilled workforce to the national security mission, Senate Report 116-48 on the *National Defense Authorization Act for Fiscal Year (FY) 2020* mandates a report to the Committees on Armed Services of the Senate and the House of Representatives that assesses DoD programs to educate and recruit personnel with critical skills including cybersecurity, STEM, innovation, computer science, and critical languages. In response, the Director of Civilian Personnel Policy in the Office of the Under Secretary for Personnel and Readiness (OUSD(P&R)) asked the Institute for Defense Analyses (IDA) to identify common factors that contribute to the successes or failures of existing DoD recruitment and development programs targeted to improve the availability of critical skills in both the civilian and uniformed workforce. In addition, IDA was asked to recommend ways to improve current and future recruitment and education programs.

To complete this study, we conducted 62 interviews with 127 individuals including recruiters, hiring managers, and personnel specialists as well as a range of stakeholders including representatives from colleges and universities, research and development partners, and professional affiliation groups. We also examined existing data on DoD's outreach, education, and recruiting programs and other data on civilian employees and

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[1]   Jim Mattis, "Summary of the 2018 National Defense Strategy of the United States of America," Department of Defense, Washington, United States, 2018.

[2]   DoD also offers education and training programs in critical skills for current employees (military and civilian). In this paper, we focus primarily on outreach to potential employees, although we do provide a list of programs targeting current DoD civilian and military employees.

service member with critical skills. Since these data sources did not include costs of outreach and recruiting programs, and in most cases did not include objective metrics of the effectiveness of individual programs (e.g., number of leads generated, quality of hires, retention of hires), this study does not include a systematic assessment of the return on investment for individual programs. Instead, we look across the portfolio of programs that target critical skills and provide our observations on the factors that contribute to DoD's ability to effectively access individuals with critical skills.

A key point with important implications for DoD's ability to attract the skilled workforce it needs is its diametrically different approaches to civilian and military recruiting. Although military recruiting is addressed at a national level, with each of the military services fielding a nationwide recruiting force, the Department generally treats civilian recruiting as a local responsibility for individual commands and organizations.[3] As a result, civilian recruiting is under-resourced and too often a "pick-up game" with significant shortfalls in organization and planning. In addition, civilian requirements are almost always structured around the existing workforce rather than around a strategic analysis of the work that needs to be done and how it could best be performed. As a result, the civilian hiring process is generally reactive. The Department begins the process of looking for a replacement when a position becomes vacant; however, these positions may be vacant for many months before they are filled.

Military recruiting, by contrast, is very centralized and consciously focused on requirements. The weakness in this system is that requirements are based on existing career paths and skill sets, which may not adequately identify requirements for new and emerging STEM-related skills. Because the military services are meeting existing requirements for STEM, software, and other critical skills (to the extent that such requirements have been documented), their recruiting commands do not see a need for any special incentives or other measures to improve recruiting in these areas. The potential concerns raised by the military services' inadequate efforts to fully identify requirements for STEM-related critical skills may be partly mitigated by the military's approach of growing skills rather than recruiting for them. Each of the military services told us that their strategy is to recruit quality personnel and then train and educate the force to build the specialized skills each service needs.

Based on these and other insights provided in interviews and through data sources, we offer 12 recommendations—8 for the civilian workforce and 4 for the uniformed workforce—for how DoD can improve the effectiveness of its recruitment and education programs that supply mission-critical skills.

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[3] This study was conducted in conjunction with another study on cohort hiring (or hiring "talent pools"), which is one mechanism for centralizing elements of civilian hiring. Further discussion about the advisability of this approach to civilian hiring is available in a forthcoming IDA report.

Civilian recommendations

Recommendation 1: Develop a requirements process for hiring. The military departments and defense agencies should develop a requirements process to systematically assess civilian hiring needs, giving consideration to expected turnover; new skills that may be needed; the appropriate mix of military, civilian, and contractor personnel; and the balance between entry-level and experienced personnel. DoD organizations should assess hiring requirements at least annually and roll up these requirements to a sufficient level to ensure that they can be systematically addressed across the organization.

Recommendation 2: Broadcast a consistent message. The military departments and defense components should seek avenues through which to broadcast a consistent message to increase awareness of the Department as a civilian employer. DoD organizations recognize that they have difficulty competing on compensation alone. For this reason, the Department's effort to attract high-quality recruits should emphasize the quality of the work, the importance of the mission, the inclusiveness of the workplace, and other work-life balance issues.

Recommendation 3: Prioritize and balance funding. The Department should systematically collect and assess costs of major recruiting and hiring incentives, including internships; scholarships and fellowships; recruiting, relocation, and retention bonuses; and other forms of premium pay. The Department should use such cost data to identify gaps in funding for hiring incentives and to build the case for additional funding of cost-effective programs (including a dedicated source of funding like the Acquisition Workforce Development Account for critical STEM skills), if appropriate.

Recommendation 4: Develop metrics. DoD organizations should develop metrics; systematically collect and maintain data on outreach and recruiting efforts for new hires; and conduct periodic assessments of program performance. Metrics should include data on the cost of outreach and recruiting events, numbers of leads developed from such events, numbers of new hires resulting from such leads, sources of new hires, quality of hires, diversity of hires, and retention of hires. Metrics would likely be collected at the local level, but central guidance is needed to ensure that the data can be rolled up, compared across organizations, and used to guide resources and assess recruiting and hiring options.

Recommendation 5: Build recruiting relationships. DoD organizations should develop and cultivate systematic recruiting relationships with a diverse portfolio of colleges and universities. A core of professional recruiters for students with critical STEM skills may be needed to establish a campus presence beyond recruiting fairs and similar one-time events. These recruiters may also need to develop deeper relationships by reaching out to student organizations, interacting with STEM departments, sponsoring student competitions, capitalizing on sponsored research, assisting with resume writing, and helping students cut through the DoD hiring bureaucracy.

Recommendation 6: Develop best practices for virtual tools. The Department should systematically review how its organizations and private sector counterparts use virtual recruiting and hiring tools (such as Handshake, USAHIRE, LinkedIn, Salesforce, and TalentNeuron). DoD should then develop a set of preferred tools and best practices that are promoted across the Department. The Department should consider whether some of these tools could be funded more efficiently through bundled requirements or enterprise-wide licenses.

Recommendation 7: Develop best practices for direct hiring. The Department should develop best practices for using direct hire authorities to ensure that these authorities do not default to traditional methods or "doing the same thing faster." The best practices should be designed to provide flexibility and options that can be tailored to specific hiring needs rather than prescribed as a single preferred approach. These practices should also provide guidance on the announcement of job opportunities, tentative job offers, the use of virtual hiring tools, and methods for evaluating candidates (including resumes, interviews, SME evaluations, and hiring panels).

Recommendation 8: Address bureaucratic bottlenecks. The military departments and defense components should reduce bureaucratic bottlenecks in the hiring process by conducting root cause analyses and addressing process deficiencies. To achieve this goal, DoD could improve the relationship between hiring managers and personnel processing organizations by training staff in those organizations on using direct hire authorities or fielding specialized teams that are aligned with DoD organizations that have unique hiring authorities and strong demand for critical STEM skills.

Military recommendations

Recommendation 1: Assess and identify stem requirements. The military services should regularly and systematically assess their needs for cutting-edge STEM skills that are not included in existing military career fields. These skills include software development, digital engineering, machine learning, and artificial intelligence. Once the services have identified skills that are needed in uniform, the skills should be associated with career fields, career paths, and force requirements so that they can be communicated to recruiters.

Recommendation 2: Integrate stem outreach and recruiting. The military services should link STEM outreach efforts (including robotics events, eSports competitions, hacking events, and similar activities) to recruiting objectives, working to build a recruiting pipeline by maintaining continuous contact with potential recruits who are developing critical skills and show a propensity to military service. The Air Force appears to provide the best model for such integration through its effort to systematically track participants in events such as robotics programs, eSports competitions, and hacking events from secondary school through college and beyond.

Recommendation 3: Tailor stem outreach and recruiting approaches. The military services should develop targeted approaches to identify, motivate, and recruit individuals in career fields that require critical STEM skills (as identified pursuant to the previous recommendation). For example, military aptitude tests could be modified to identify potential software talent; separate advertising campaigns could be devised to reach out to talent in STEM fields; and specialized teams could be formed to systematically pursue STEM recruits. In some cases, it may be appropriate to seek recruits who have specific skills rather than look for overall "quality" and assume that skills can be built through in-service training programs. In any case, targeted recruiting for STEM skills should go beyond simply building technology imagery into broader advertising and marketing efforts.

Recommendation 4: Coordinate with civilian recruiting. The military services should coordinate military recruiting with civilian recruiting, at least in STEM fields. The services should extend their outreach and recruiting efforts to identify and pursue individuals with critical STEM skills, regardless of their ability to meet military fitness standards and propensity to military service. In addition, individuals who cannot complete a course of study in the ROTC or at a military academy, but have useful skills and a desire to serve, could be referred for possible civilian assignments.

Contents

1. Introduction

The 2018 National Defense Strategy highlights a security environment that is changing rapidly as a result of "relentless" development of new technologies in areas such as advanced computing, big data analytics, artificial intelligence, autonomy, robotics, directed energy, hypersonics, and biotechnology.[1] As these emerging technologies become increasingly central to the future of warfare, it is imperative for the U.S. national security community to invest in expanding the community of individuals with the critical skills necessary to meet the challenges of this new technology-centric environment.

The Department of Defense (DoD) has invested substantially in human capital development to meet the growing need for expertise in critical skills that are essential to U.S. national security objectives. These critical skills include science, technology, engineering, and mathematics (STEM) fields; cybersecurity; innovation; computer science; and critical languages. To encourage students to consider careers in STEM fields, DoD operates a number of outreach programs targeting individuals from elementary school through collegiate and graduate programs. Likewise, DoD has invested in numerous recruitment programs including internships, scholarships, and job fairs.[2] These investments in outreach, education, and recruitment of critical skills must compete with the growing private sector demand for many of the same skills. To access top talent, DoD must compete with technology companies such as Google, Snapchat, and Facebook, as well as other companies that traditionally have not been considered technology companies but are placing a growing emphasis on attracting talent with computer science skills such as General Electric, Target, and Visa.[3]

To recognize the crucial importance of a highly skilled workforce to the national security mission, Senate Report 116-48 on the *National Defense Authorization Act for*

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[1] Jim Mattis, "Summary of the 2018 National Defense Strategy of the United States of America," Department of Defense, 2018, https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf.

[2] DoD also offers education and training programs in critical skills for current employees (military and civilian). In this paper, we focus primarily on outreach to potential DoD employees. In Appendix A, we provide a list of critical skills programs, including those that are available to current DoD civilian and military employees.

[3] Defense Innovation Board, "People and Culture—Recommendation 2: Embed Computer Science as a Core Competency of the Department through Recruiting and Training," January 2017, https://dod.defense.gov/Portals/1/Documents/pubs/DIB_Recommendations_Executive_Summary_1701 06.pdf.

Fiscal Year (FY) 2020 mandates a report to the Committees on Armed Services of the Senate and the House of Representatives that assesses DoD programs to educate and recruit personnel with critical skills. In response, the Director of Civilian Personnel Policy in the Office of the Under Secretary for Personnel and Readiness (OUSD(P&R)), Civilian Personnel Policy asked the Institute for Defense Analyses (IDA) to assess the effectiveness of existing DoD recruitment and development programs targeted to improve the availability of critical skills in both the civilian and uniformed workforce. In addition, IDA was asked to recommend ways to improve current and future recruitment and education programs.

A. Approach

To better understand existing DoD efforts to educate and recruit personnel with critical skills, we interviewed recruiters, hiring managers, and personnel specialists. We also interviewed a range of stakeholders, including functional community leaders, college and university representatives, research and development partners, and professional affiliation groups. During 5 months in late 2020 and early 2021, we conducted 62 interviews with 127 individuals.

These interviews were conducted on a not-for-attribution basis, so the names and positions of individual interviewees are not included in this report. For the same reason, information provided by interviewees is referenced generically in this report—for example, "an Army official stated" or "an official with a defense agency told us." A complete listing of the organizational affiliations of individuals interviewed for the report is provided in Table 1.

Table 1. List of IDA Interviews

Army (14 interviews)	OSD (6 interviews)
– G1/HR Office	– DoD Comptroller's Office
– Army Office of Acquisition Career Management	– Laboratories Office, OUSD (Research and Engineering)
– Training and Doctrine Command	– Chief Information Officer/Cyber Workforce Office
– Army Futures Command (3)	
– Army Combat Capabilities Development Command (3)	– Human Capital Initiatives, OUSD (Acquisition and Sustainment)
– Army Test & Evaluation Command	– Defense Language and National Security Education Office
– Army Research Lab (3)	
– Army Manpower and Reserve Affairs	– Diversity Management Operations Center

Navy (8 interviews)	**Fourth Estate (7 interviews)**
– Navy Manpower & Reserve Affairs (2) – Naval Sea Systems Command – Naval Research Lab – Naval Education and Training Command – Navy Recruiting Command (3)	– Office of Acquisition Career Management for the 4th Estate – Joint Artificial Intelligence Center – Missile Defense Agency – Defense Contract Audit Agency (2) – Defense Contract Management Agency – Defense Logistics Agency
Marine Corps (5 interviews)	**Stakeholders (16 interviews)**
– Marine Corps HR (2) – Marine Corps Recruiting Command (2) – Department of the Deputy Commandant for Information	– Affinity Groups (3) – Universities (4) – Unions (2) – Defense Contractors (5) – Office of Personnel Management – State Veterans Affairs Office
Air Force (6 interviews)	
– Office of Acquisition Career Management – Talent Management Office – Air Force Personnel Center (2) – Air Force Recruiting Service – Air Force Materiel Command	

In addition to interviews, we also examined data from four main sources:

1. The Defense Civilian Personnel Advisory Service (DCPAS) provided responses from 10 organizations[4] to a recent questionnaire requesting information on the factors that contribute to the success and failure of critical skills programs. Our analysis excludes programs aimed at medical and financial skills or programs that were expired or proposed. The final sample includes 138 programs.

2. The 2020 Science and Technology Reinvention Labs (STRL) Demo Survey (Civilian) provides individual-level responses of civilians working at the STRLs.

3. We acquired tabulated responses to the 2019 Status of Forces (Active Duty) (SOFA) survey for active duty respondents that worked at the STRLs.

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[4] The 10 organizations that provided responses to the DCPAS request for information are Defense Finance Accounting Service (DFAS), Defense Health Agency (DHA), Defense Information Systems Agency (DISA), Defense Intelligence Security Enterprise (DISE), Defense Language and National Security Education Office (DLNSEO), Defense Threat Reduction Agency (DTRA), Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)), Missile Defense Agency (MDA), DoD Chief Information Officer (CIO), and Office of the Under Secretary of Defense for Acquisition and Sustainment (OUSD(AS)).

4. We acquired monthly personnel data files for individual civilians from April 2017 through June 2020 compiled by the Defense Manpower Data Center (DMDC). This agency is responsible for collecting personnel, manpower, and financial data at the individual level for the OUSD(P&R).

Each data source provides a different picture of the DoD workforce. In the DCPAS questionnaire, we observe program-level information. The key advantage of this data source is the ability to gain visibility into the factors that program managers view as key contributors to the success and failure of their programs. The results from this questionnaire should be interpreted with recognition that the data is self-reported. For example, although programs identified some hindrances, every program responded "yes" to the question "Was the program effective." These questionnaires do not provide sufficient data to reliably measure how well each program achieved its stated objectives.

The STRL Demo Survey and the SOFA survey enable us to understand some of the factors that affect the recruitment and retention of STEM employees from the perspective of civilians and uniformed personnel, respectively.

Finally, we use the civilian personnel file from DMDC to gain insights into how using a Direct-Hire Authority (DHA) has influenced the demographic characteristics of the STEM workforce.

Based on the insights provided in these interviews and data sources, in Chapter 6 we offer 12 recommendations for how DoD can improve the effectiveness of its recruitment and education programs that supply mission-critical skills.

B. Previous Research

There is a robust body of previous research relating to the development and recruitment of individuals with critical skills. In this section, we provide a brief overview of some of the themes and insights from this literature.

On the outreach side, extensive literature exists that examines what prompts students to pursue careers in STEM. Some factors that influence the choice of major include pay upon graduation, risk averse career opportunities, and heterogenous college costs by major (Stange, 2013; Angrist, Autor, and Pallais, 2020; Wiswall and Zafar, 2012; Altonji and Zimmer, 2017; Altonji et al., 2015). In many cases, universities charge more tuition for majors in STEM fields than for other fields, reducing the share of students choosing these majors. Scholarships can encourage more students to choose majors and increase college completion for marginal students (Stange, 2013; Angrist Autor Pallais, 2020). Advertising the availability of well-paying, stable, STEM-focused federal jobs could address risk-averse students' concerns over pay upon graduation (Wiswall and Zafar, 2012). However, students benchmark their expectations by major and expect higher wages for engineering and computer-science occupations (Gong and Stinebrickner, 2019; Wiswall and Zafar,

2012). The effectiveness of providing information about available federal jobs to encourage students to study majors in critical fields would be limited if the advertised positions do not meet students' pay expectations.

In addition to helping targeted students, Tillinghast et al. (2015) found that supporting a STEM outreach program increased job satisfaction and motivation for the current workforce of STEM employees as well. Tillinghast et al. hypothesized that participating in outreach programs improved job satisfaction because it reminds STEM employees why they chose their current careers. Balakrishnan et al. (2018) found that the Science, Mathematics, and Research for Transformation (SMART) scholarship-for-service program attracted high-quality students who would not have otherwise considered DoD employment. However, SMART scholars tended not to be as diverse and had shorter tenures than comparable DoD civilians. Balakrishnan et al. recommended that the SMART program be more proactive and develop a stronger brand by using SMART alumni to recruit students, having the components be more proactive in assessing their future demand for SMART scholars, and creating programming to help bring SMART scholars together.

Examining an outreach program that targets individuals before college, Wenger et al. (2018) evaluated the Science and Technology Academies Reinforcing Basic Aviation and Space Exploration (STARBASE) program. They found some evidence that the program successfully cultivated interest in STEM, and some weak statistical evidence that suggested that areas within STARBASE programs experienced an increase in applications to join the military. Wenger et al. suggested that DoD consider centrally managing their youth programs and proposed that separating youth outreach from other types of outreach programs could lead to more success.

Internships can be both a recruitment tool and an outreach tool. Margaryan et al. (2019) found that internships increase wages for students upon graduation, largely due to increases in skill. Employer investments in human capital are a combination of occupation, industry, and firm-specific capital; as a result, some of the human capital invested in the interns would not translate to non-federal employers (Sullivan 2008). However, some researchers have argued that occupation-specific capital makes up the majority, indicating that federal internships would increase a students' appeal to federal and non-federal employers equally (Kambourov and Manovskii, 2009).

Grober et al. (2020) examined demonstration projects throughout DoD. They found that aggressive outreach, use of DHAs, and providing tentative job offers were promising, while using internships and student employment was an innovative practice. They determined that the complexity of DoD's personnel system led to errors, and that there was no evidence of government- or agency-wide standards for identifying effective human resources (HR) practices.

Jones (2019) recommended that government agencies should recruit continuously, starting the hiring process early in the school year to best recruit graduating students. Other recommendations included writing user-friendly vacancy announcements, encouraging rotations and mobility opportunities, increasing support for inclusive work environments, and cultivating a diverse talent pipeline. For specific recruiting pitches, Jones recommended that organizations increase awareness of certain non-financial benefits, such as work-life programs, for which government employees have expressed high levels of satisfaction.

Gilroy et al. (2019) made the case for sustained military recruiting spending, noting that surges of funding were far less effective than consistent, long-term investments. They also noted the need to adapt to generational change and recommended the continued use of social media as a cost-effective recruiting tool. Additionally, they noted that enlistment bonuses for specific occupations were helpful in the short term but unhelpful in the long run. Asch (2019) found that an S-shaped curve represents the effectiveness of advertising budgets, suggesting that there is an optimal point for advertising spending in different media categories. Ashe also argued that return-on-investment information was critical to "staving off Congressional cuts" and suggested that the Army consider targeting older recruits to expand the eligible pool.

Several papers made the case that DoD needs to consider the effect of generational differences on their recruiting efforts. Namely, newer generations tend to value non-monetary workplace benefits such as training, development opportunities, intellectual engagement, and a sense of purpose and mission (Eley, 2018; Chase, 2020). This finding is especially relevant for the cyber workforce (Hardison et al., 2019; Yannakogeorgos and Geis II, 2016).

Recruitment efforts may struggle to compete with private sector pay, both perceived and actual. Recruiters could lean on literature showing that federal jobs pay more for those with bachelor's degrees or less throughout their careers, even controlling for education, experience, location, and occupation (Choi and Garen, 2020; Congressional Budget Office 2012 and 2017). However, when examining the wage gap between non-federal government employees and the private sector, Schanzenbach (2015) found that accounting for major narrows the gap significantly. If federal jobs have a similar relationship, the pay gap may not exist. It is important to note that these studies do not account for the non-wage monetary and non-monetary benefits of working in the public sector, which workers have been shown to value (Lindenlaub and Postel-Vinay, 2021). For pay comparisons between DoD and the private sector, McIntosh et al. (2020) found that DoD civilians with critical skills in demonstration projects generally have pay in line with or higher than the private sector, but income for DoD civilians in the standard General Schedule (GS) system tended to lag behind private industry.

Economic literature affirms the costs of having positions go unfilled for long periods of time (Brencic, 2010; Papay and Kraft, 2016). Unfortunately, technological changes that make it easy for applicants to apply to many positions, such as USAJobs, may increase the inefficiencies in the job search market (Arnosti et al., 2020). These losses may be mitigated by having a multistage review of applicants in which the first stages are automated screenings based on quantitative metrics identified by hiring managers (Carvalho et al., 2019).

The U.S. Merit Systems Protection Board (UMSPB) conducted a study on DHAs granted by the Office of Personnel Management (OPM) in Title 5 of the United States Code, Section 3304 (5 U.S.C. §3304). The UMSPB found that, generally, use of DHAs throughout government has risen since the 1990s, with DoD agencies being some of the leading users of this authority. They found that the complex HR system led to difficulties in executing the hiring process efficiently, though most of the chief human capital officers (CHCOs) that they interviewed had strategies to deal with this (UMSPB, 2021). The UMSPB also stated that the 3,304 DHAs resulted in comparable or greater racial and ethnic diversity and led to more female hires compared with other competitive procedures.

Yannakogeorgos and Geis II (2016) examined the Air Force cyber workforce and determined that the Air Force could benefit from a number of changes to the cyber career field. These changes include that a clear path to promotion be available, as anecdotal evidence suggested negative selection in attrition. The researchers recommended using the Air Force-developed cyber test as part of the Armed Services Vocational Aptitude Battery (ASVAB) generally, and that the Air Force use ROTC as their primary source of cyber accessions. Building on that work, Hardison et al. (2019) conducted interviews with stakeholders throughout the Air Force's cyber workforce. They reported that having a cyber-related degree was not the most important factor leading to success in the Air Force cyber workforce. They also noted that the Air Force faced a shortage of field-grade cyber officers, and that having a technical career track might be beneficial to retaining the right mix of experience.

Outside literature also recommends ways to improve diversity that are consistent with our analysis and interviews. For example, Gerhenson et al. (2018) found that Black teachers increase the probability that Black students graduate high school and enroll in college. Lim Meer (2017) found similar results with women in underrepresented fields: Work with affiliation groups as well as mentorship programs could provide similar role-model effects. When recruiting, emphasizing stability and work-life balance may help recruit women in underrepresented fields; Wiswall and Zafar (2016) found that women value these factors more than men do when deciding career paths. This preference grows significantly stronger after college, so emphasizing it may be particularly useful when targeting professionals (Zafar, 2010).

Ross et al. (2020) reported that the presence of female role models, a stereotype- and harassment-free work environment, family-friendly work policies, and opportunities for professional growth increased the productivity of women in STEM workforces. The team also found that workplaces that foster autonomy and collaboration and focus on substantive work and flexible work arrangements were more likely to recruit and retain high-quality STEM talent.

Shulker and Matthews (2018) found that gender diversity had been negatively impacted by the high number of veterans that DoD hires, but recommended further research into attributing this observation to veterans' preferences specifically. Abbe et al. (2019) found that veterans' preference requirements had a negligible impact on diversity, since DoD in general tends to hire veterans over non-veterans regardless of formal preference requirements. Shulker and Matthews did note that formal preference requirements can complicate hiring for critical skills, but noted that using a DHA has helped to diminished the negative impact on critical areas. By their estimate, 38 percent of DoD civilians are veterans' preference eligible, and DoD employs twice the proportion of preference-eligible individuals compared with other agencies.

Matthews (2017) examined ways to reduce barriers to Hispanic participation in the DoD workforce. She offered a number of points consistent with feedback from our interviewees. Specifically, she noted the importance of early, consistent, and extensive engagement to improve the participation rate of Hispanics in the DoD workforce. Further, she suggested DoD organizations attend job fairs, connect with relevant student organizations, and provide outreach to students early in their college careers via internships. She also recommended that DoD consider involving university alumni in recruiting and hypothesized that DoD-sponsored assistance workshops through USAJOBS could be a successful hiring practice. Additionally, she recommended increasing DoD presence in areas and universities with high Hispanic populations, and further recommended that DoD examine the State Department's Diplomat-in-Residence Program as a way to establish permanent relationships with universities.

C. Structure of this Report

The rest of this report consists of the following chapters:

- Chapter 2 describes DoD's STEM outreach programs.

- Chapters 3 details DoD recruitment and hiring practices for the STEM workforce.

- Chapter 4 provides insights on critical skills programs from the DCPAS questionnaire.

- Chapter 5 discusses the education and recruiting programs for individuals with skills in critical languages.

- Chapter 6 presents our recommendations for improving the education and recruitment of individuals with critical skills.

2.   DoD STEM Outreach Programs

Various organizations within DoD conduct outreach programs that connect with young people as early as elementary school and extend through high school (K–12). The mission of these programs is to build a talent pool and enhance the propensity of those students to someday seek DoD jobs in STEM fields, whether as civilian employees or as uniformed military personnel. For example, the Army Research Laboratory (ARL) has a comprehensive K–12 program that includes science fairs starting in elementary school and cyber programs beginning in middle school. The Navy and Marine Corps jointly run a science fair program in collaboration with local school districts.

Other DoD organizations in the "Fourth Estate" also run outreach programs.[5] The Fourth Estate Director, Acquisition Career Management (DACM) coordinates centralized outreach efforts among various defense agencies under its purview. Some agencies reported during interviews that they also operate their own outreach programs. For example, the Missile Defense Agency (MDA) conducts STEM outreach at the K–12 levels.

Some of the outreach programs are specifically designed to build a pipeline for future military personnel. Other programs are more agnostic between military and civilian careers but favor military careers because they are conducted at operational military installations (e.g., National Guard bases). Still others are hosted at the Department's Science and Technology Reinvention Laboratories (STRLs), allowing students to work with DoD civilian scientists and, probably, encouraging civilian careers to a greater extent. While recognizing the often-agnostic nature of many of the outreach programs, we organize our discussion based on whether the programs are more likely impact DoD's future civilian workforce or its future military workforce.

A. Civilian STEM Outreach

This section describes several DoD outreach programs that encourage both civilian and military STEM careers, with either equal or greater emphasis on the former.

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[5]   DoD's Fourth Estate includes organizations outside of the Departments of the Army, Navy (which includes the Marine Corps), Air Force (which includes the Space Force), and the National Guard. The Fourth Estate includes the Office of the Secretary of Defense (OSD), the Joint Staff, the Combatant Commands, and more than 30 defense agencies and field activities.

1. Army organizations

The U.S. Army Futures Command is a four-star command established under an Army reorganization in 2018 and located in Austin, Texas. Its mission is to "lead a continuous transformation of Army modernization in order to provide future warfighters with the concepts, capabilities and organizational structures they need to dominate a future battlefield."[6] Subordinate to the Futures Command is the U.S. Army Combat Capabilities Development Command (DEVCOM, also known as CCDC), a two-star command located at Aberdeen Proving Ground, Maryland. DEVCOM's mission is "to provide the research, engineering, and analytical expertise to deliver capabilities that enable the Army to deter and, when necessary, decisively defeat any adversary now and in the future."[7] One of the activities subordinate to DEVCOM is the Army Research Laboratory (ARL), which is led by a civilian scientist and headquartered at Aberdeen with seven other sites.

U.S. Army Futures Command is responsible for and funds for K–12 and STEM-focused outreach. The command has a coordination role, but it relies largely on the individual laboratories to develop most of the relationships with individual K–12 school districts and universities in order to attract talent.

DEVCOM has one of the largest and most successful outreach programs in the Army—some conducted jointly with the ARL. For the past several years, the command has engaged with the local communities, mostly those close to Aberdeen Proving Ground. DEVCOM holds assemblies at local schools and hosts summer camps where (prior to the coronavirus pandemic) they brought students into the labs and established mentoring relationships.

DEVCOM participates in various outreach programs that fall under the umbrella of the Army Educational Outreach Program (AEOP). The AEOP is designed to create an awareness of and enthusiasm for STEM with students at an early age, thereby building a pipeline that may lead to future civilian employees. Apprenticeship programs are open to current high school students who are U.S. citizens or permanent legal residents.[8] Some specific AEOP programs are tailored either largely or entirely toward underserved/underrepresented students.[9] (An Army variation on AEOP for undergraduate STEM students is discussed in section 3.A.1.)

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[6] *Source*: www.army.mil/futures#org-about

[7] *Source*: www.army.mil/devcom#org-about

[8] *Source*: www.usaeop.com/program/high-school-apprenticeships/.

[9] AEOP underserved populations include: "low-income students; students belonging to race and ethnic minorities that are historically underrepresented in STEM (i.e., Alaska Natives, Native Americans, Blacks or African Americans, Hispanics, Native Hawaiians and other Pacific Islanders, and Other); students with disabilities; students with English as a second language; first-generation college students; students in rural, frontier, or other Federal targeted outreach schools; and females in certain STEM

The ARL has dedicated two staff members to K–12 outreach. ARL has established relationships in both Harford County, Maryland, where it is headquartered, and the adjacent Cecil County, Maryland. ARL also performs outreach near its west coast location at Playa Vista in Los Angeles County, California. Again, prior to the COVID-19 pandemic, ARL would variously visit local classrooms as early as the 4th grade or host field trips at its Aberdeen facility.

Under the auspices of AEOP, ARL participates in the Gains in the Education of Mathematics and Science (GEMS) program, a summer STEM enrichment program. GEMS is available in selected areas of the country to rising 5th through 12th grade students who are U.S. citizens or permanent legal residents. GEMS "is based on a multi-disciplinary educational curriculum, and is focused on age and grade-appropriate hands-on activities, in areas such as science, engineering, mathematics, computational sciences, computational biology, biomedical sciences, chemistry and biology."[10] ARL particularly attempts to market GEMS to children in military families.

Other AEOP programs include the following:[11]

- Camp Invention, "a summer enrichment program that provides children with opportunities to bring their biggest ideas to life while developing essential 21st-century skills." (Grades K–5)

- eCYBERMISSION, "a web-based STEM competition that enables students to recognize real-life applications of STEM. Students form teams of three to four people and propose a solution to a real problem in their communities." (Grades 6–8 and 9–12)

- High School Apprenticeship Program, which "provides current high school juniors and seniors with authentic science and engineering research experience alongside university researchers. Students will learn research methods and develop skills in Army-critical research areas in a university lab setting, preparing them for the next steps of their educational and professional careers." (Grades 11–12)

- Junior Solar Sprint, "a free educational program for 5th- through 8th-grade students where students design, build, and race solar-powered cars using hands-on engineering skills and principles of science and math, particularly in alternative fuels, engineering design, and aerodynamics." (Grades 5–8)

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fields (e.g., physical science, computer science, mathematics, or engineering)."
Source: www.usaeop.com/wp-content/uploads/2019/01/AEOP-Strategic-Outreach-Initiatives-RFI-11.18.pdf.

[10] *Source*: www.usaeop.com/program/gems/.

[11] *Source*: www.DoDstem.us/participate/opportunities/.

- Research Engineering Apprenticeship Program, which "is a summer STEM program that places high school students, from groups historically underserved in STEM, in research apprenticeships at area colleges and universities where they receive mentorship and conduct a hands-on research project." (Grades 9–12)

- UNITE, "a 4- to 6-week, pre-collegiate summer experience for high school student from groups historically underrepresented and underserved in STEM. Held at higher education institutions across the country, UNITE encourages student to pursue college majors and careers in engineering and other STEM-related fields through a program of focused hands-on rigorous academics, enrichment, and career exploration." (Grades 9–12)

2. Navy organizations

The Naval Research Laboratory (NRL) is the Department of the Navy's corporate laboratory, reporting to the Chief of Naval Research (the two-star admiral who directs the Office of Naval Research, or ONR). The Commanding Officer of NRL is a Navy captain and the Director of Research is a civilian scientist. NRL is headquartered in Washington, D.C., and has four additional field sites near the Chesapeake Bay, Maryland; in Monterey, California; at the John C. Stennis Space Center in Bay Saint Louis, Mississippi; and the Scientific Development Squadron (VXS) 1 located at Patuxent River Naval Air Station, Maryland.

Several of NRL's outreach programs, which we describe next, begin at the high school level:

- *Student Volunteers*. Participants must be at least age 16. According to NRL's website, "Volunteer service is limited to services performed by a student as part of an agency program established for the purpose of providing educational experience for the student. The work is done strictly on an uncompensated basis. The acceptance of student volunteer services enables NRL to contribute to the enrichment of educational programs and provides exposure to the work environment for students. This is an excellent opportunity for students to make realistic decisions regarding their future careers. This program is conducted through a written agreement between NRL and the educational institution. If accepted, the NRL program coordinator will work with the student's school to prepare the agreement."[12]

- *Science and Engineering Apprentice Program (SEAP)*. This is a purportedly DoD-wide program that "places academically talented high school students with

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[12] *Source*: www.nrl.navy.mil/Careers/Students/Volunteers/.

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interest in science and mathematics as apprentices in DoD laboratories for eight weeks during the summer. These students work with scientists and engineers who act as mentors. The program offers a unique and positive experience in their fields of interest, thus encouraging them to pursue careers in science and engineering."[13] Although the program's website touts over 35 Navy and Army laboratories that participate in the program, a different source enumerates 29 U.S. Navy locations, one in the Marine Corps (Camp Pendleton, California), none in the Army, and two at the DoD-level (Armed Forces Radiobiology Research Institute, Bethesda, Maryland; and Defense Equal Opportunity Management Institute, Patrick AFB, Florida). Thus, SEAP is overwhelmingly a Navy outreach program.

- NRL's website provides additional details in its instantiation of the SEAP. "NRL participates in the Science and Engineering Apprentice Program during the summer in cooperation with the American Society for Engineering Education (ASEE) and as part of the Department of Defense SEAP. This program offers select high school students a unique opportunity to explore and pursue careers in science and technology by opening to them NRL's vast, varied resources and by allowing students to spend 8 weeks working full-time on unclassified tasks. Under the direction of NRL scientists and engineers, students actively engage in research problems, planning sessions, special program seminars, and writing and presentation of a final research paper."[14]

The Navy and Marine Corps run a science fair program, the Naval Science Awards Program (NSAP), by coordinating with local school districts and outside of the laboratories, but still under the auspices of ONR. The NSAP "encourages our nation's students to develop and retain an interest in science and engineering. NSAP recognizes the accomplishments of eligible students at regional and state science and engineering fairs and the International Science and Engineering Fair (ISEF) in producing and presenting quality science and engineering projects."[15] Senior-level projects are geared toward high school students in grades 9–12, who must be U.S. citizens or permanent residents. The program also includes some junior-level projects from students in grade 8 and below.

3. Air Force organizations

As confirmed by the recruiters from other service branches, the Air Force has the "high ground" in being popularly viewed as the most technical branch. (This perspective

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[13] *Source*: https://seap.asee.org/participating_labs.

[14] *Source*: www.nrl.navy.mil/Careers/Students/SEAP/.

[15] *Source*: www.onr.navy.mil/nsap/.

is conditioned on the current state of the new Space Force, which may be even higher tech but is initially filling its ranks with members transferred from the Air Force and other branches.) Interviewees expressed that the Air Force's youth outreach is designed to generate interest in the service as a whole, with no particular emphasis on civilian careers as opposed to uniformed service. These programs include the following:

- The Air Force Research Laboratory (AFRL) offers 9-week summer internships through the Wright Scholar Research Assistant Program (RAP). Applicants are accepted from high school juniors and seniors who are interested in a STEM career, are U.S. citizens, and have a grade point average (GPA) of at least 3.5. AFRL is located at Wright-Patterson Air Force Base (AFB), Ohio. The RAP is a collaboration with the Air Force Institute of Technology, the University of Dayton, Wright State University, and The Ohio State University. AFRL reports that "of students tracked through the years, 86 percent pursued or are pursuing science or engineering careers and 10 percent pursued or are pursuing medical careers, while 4 percent pursued other fields like finance or business."[16]

- Air Force Association's CyberPatriot, "the National Youth Cyber Education Program created by the Air Force Association to inspire K–12 students toward careers in cybersecurity or other STEM disciplines critical to our nation's future. At the core of the program is the National Youth Cyber Defense Competition, the nation's largest cyber defense competition that put high school and middle school students in charge of securing virtual networks."[17]

The Air Force partners with FIRST®, an organization established by Dean Kamen (inventor of the Segway and many other items) with a mission to "inspire young people to be science and technology leaders and innovators, by engaging them in exciting mentor-based programs that build science, engineering, and technology skills, that inspire innovation, and that foster well-rounded life capabilities including self-confidence, communication, and leadership."[18] Among the several programs offered by FIRST®, the Air Force partners in the FIRST® Robotics Competition, where "under strict rules and limited time and resources, teams of high school students are challenged to build industrial-size robots to play a difficult field game in alliance with other teams, while also fundraising to meet their goals, designing a team 'brand,' and advancing respect and appreciation for STEM within the local community."[19]

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[16] *Source*: www.afrl.af.mil/About-Us/Fact-Sheets/Fact-Sheet-Display/Article/2329031/wright-scholar-research-assistant-program/.

[17] *Source*: https://www.uscyberpatriot.org/.

[18] *Source*: www.firstinspires.org/about/vision-and-mission.

[19] *Source*: www.firstinspires.org/robotics/frc.

The FIRST® Robotics Competitions are widely attended. Most of the competitors are ages 16 to 18, and most of the coaches are younger than age 24. The competitors tend to be good students (high school GPAs in the range 3.0 to 4.0) and interested in STEM. About 30 percent are female and 80 percent plan to attend college. The Air Force sends recruiters to engage with students and their influencers (primarily parents and teachers). The program generates about 600 high-quality recruiting leads per year: students who show interest in the Air Force, have a propensity to serve, and will talk face-to-face to a recruiter. Through 2019, the program was geared almost exclusively to recruiting for the active Air Force. When in-person robotics events resume after the COVID-19 crisis abates, the Air Force intends to broaden its recruiting to a total force perspective, including the Air Force Academy; the Air Force Reserve and Air National Guard, including Reserve Officer Training Corps (ROTC) programs; and civilian service. The Air Force plans to bring representatives of the Air Force Civilian Service to these events (most of the engineers in the Air Force are civilians), and to develop a "warm hand-off" whereby active Air Force recruiters can steer prospects with a lower propensity for military service to the civilian service instead.

4. DoD agencies and DoD-wide

Several STEM outreach programs are conducted either by defense agencies that operate independently of the military services or on a DoD-wide basis:

- The MDA's STEM Initiative is designed to "implement signature programs that fill STEM education gaps based on national defense needs; and to collaborate in STEM-supported events that inspire, cultivate, and enhance STEM-supported engagement across a three-tiered target group (K–12, college, and educators) to prepare the next generation of STEM professionals."[20] In addition to running several programs for students, the STEM Education Development Summer Workshop is a week-long summer workshop for K–8 educators ordinarily (prior to COVID-19) held in Huntsville, Alabama.

- The National Math + Science Initiative (NMSI) is designed to "increase student access and achievement in rigorous math, science, and English to prepare them for the 21st-century economy. In partnership with DoD STEM, NMSI has [among other achievements] formally served schools that educate the children of uniformed active-duty military personnel since 2010, currently reaching more than 215 military-connected high schools across 31 states and serving 93 installations and all four [*sic*] military services."[21] The program reports: "After one year in NMSI's College Readiness Program, students at military-impacted

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[20] *Source*: www.mda.mil/about/STEMoutreach.html.

[21] *Source*: www.DoDstem.us/participate/opportunities/. The Space Force is the fifth military service.

schools average a 45 percent increase in mastery of college-level concepts in math and science—compared to the national average increase of 5.6 percent. That increase is 81.5 percent for Black students, 34 percent for Latinos, and 38.4 percent for females."[22]

- The Junior Science and Humanities Symposia (JSHS) Program is a "tri-service—U.S. Army, Navy, and Air Force—sponsored STEM competition that promotes original research and experimentation in STEM at the high school level and publicly recognizes students for outstanding achievement. By connecting talented students, their teachers, and research professionals at affiliated symposia and by rewarding research excellence, JSHS aims to widen the pool of trained talent that is prepared to conduct research and development vital to our nation."[23]

- The Joint Science and Technology Institute West is "a 2-week, fully-funded, residential STEM research experience for current high school students in the United States. Participants will engage in research projects mentored by the Department of Defense, Los Alamos National Laboratory, and Sandia National Laboratory research scientists and other subject matter experts. The purpose of the institute is to inspire and encourage students to pursue careers in STEM fields, increase STEM literacy, and expose students to the importance of STEM through hands-on, relevant research."[24]

5. Challenges

Although the programs just described and others are meritorious, they do pose some challenges. The military services and defense agencies are confident that their programs build an awareness of their organizations, identify youth with an inclination toward STEM and perhaps a propensity to serve in the military, and enhance that propensity. However, other than the Air Force's participation in FIRST® Robotics, it is difficult to quantify the number of recruiting leads generated from these outreach efforts and even more difficult to track forward from student participants to future employees. The career statistics offered earlier for the Wright Scholar Research Assistant Program are the exception rather that the rule. An alternative approach might be to track backwards from current military service members or STEM civilians to their initial exposure to military STEM events, although that does not seem to be done systematically.

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[22] *Source*: www.nms.org/Our-Programs/Teachers/AP-Courses/Military-Mission.aspx.

[23] *Source*: www.jshs.org/about-jshs/.

[24] *Source*: https://orise.orau.gov/jstiwest/.

As mentioned earlier, STEM events sponsored by laboratories such as ARL or NRL make it clear to students that opportunities are available to serve as STEM civilians among those who may lack a propensity for uniformed service. However, service-level events such as FIRST® Robotics can attract students to civilian service only if either representatives of the civilian workforce community attend, or active-branch military recruiters have a mechanism to hand students off to the civilian workforce community as appropriate.

Outreach events are also hampered by federal laws that limit the military's ability to acquire and retain the names, addresses, telephone numbers, and other private information on youth of various ages. Sections 8025 and 9215(uuu)(1) of the Every Student Succeeds Act (Public Law 114-95, enacted December 10, 2015) specified limits as codified at 20 U.S.C. §7908 (Armed Forces recruiter access to students and student recruiting information) and 10 U.S.C, §503 (Enlistments: recruiting campaigns; compilation of directory information).

B. Military STEM Outreach

This section describes several DoD outreach programs that encourage both civilian and military STEM careers with greater emphasis on the latter. Then, we turn to the unique challenges faced by each of the service branches.

1. Outreach programs

Unlike the often-fragmented approach of various DoD organizations to civilian outreach, DoD's outreach to potential uniformed service members is generally conducted centrally by the Department or nationally by each of the military services.

For example, DoD's STARBASE Program is sponsored by the Office of the Assistant Secretary of Defense for Manpower and Reserve Affairs. The program is intended to reach youth with potential interest in STEM careers as either DoD civilians or uniformed military. The goal of the program is "to expose our nation's youth to the technological environments and positive civilian and military role models found on Active, Guard, and Reserve military bases and installations, nurture a winning network of collaborators, and build mutual loyalty within our communities, by providing 25 hours of exemplary hands-on instruction and activities that meet or exceed the National Standards."[25] STARBASE provides 25 hours of exposure on military bases, primarily to 5th grade students. The program targets students who are socio-economically disadvantaged, low in academic performance, or have a disability. The data do not appear to be tracked. However, the program is hosted mostly at operational military (including National Guard) bases rather

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[25] *Source*: https://DoDstarbase.org/.

than at laboratories and may be more of a lure to the uniformed military rather than civilian employment.

a. Army

The United States Military Academy (USMA) operates a Center for Leadership and Diversity in STEM with a mission to "increase the recruitment and retention of underrepresented minorities and disadvantaged youth populations in Science, Technology, Engineering, and Mathematics."[26] The center conducts mobile STEM workshops at middle schools across the country, emphasizing diverse student populations and students from low-income families. Topics include designing bridges, building robots, and flying drones. The center also runs a week-long summer STEM workshop at its West Point, New York, campus for middle and high school students (grades 6–9). Participants must be U.S. citizens with strong academic performance and an expressed strong interest in pursuing college.

b. Navy

The United States Naval Academy (USNA) conducts a variety of outreach programs to youth interested in STEM. USNA faculty and midshipmen reach out to local and national communities to engage with both students and teachers. The following are among the recent events that they sponsored or in which they participated:[27]

- Family STEM Day
- FIRST® Robotics Regional Competition
- Girls Only STEM Day workshops
- Maryland Mathematics Engineering Science Achievement (MESA), Interactive STEM Day
- Mini-STEM events
- National Initiative for Cybersecurity Education (NICE) K12 Cybersecurity Education Conference
- Pre-Service STEM Educator Workshop
- Science and Engineering Festivals
- Science Fair Judging
- SeaPerch Programs, involving underwater remotely operated vehicles

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[26] *Source*: www.westpoint.edu/centers-and-research/center-for-leadership-and-diversity-in-stem.

[27] *Sources*: www.usna.edu/STEM/index.php and https://www.usna.edu/STEM/outreach.php.

- STEM Outreach Trips
- Summer Heroes Youth Program
- Summer STEM Program

c. Air Force

The United States Air Force Academy (USAFA) conducts a STEM outreach program to "engage, inspire and attract the next generation of STEM talent through K–12 programs. Faculty and cadets work with the local community, schools and teachers to provide outreach and increase the effectiveness of the Air Force's investment in STEM. Cadets have the opportunity to mentor the next generation of potential cadets through involvement in these efforts."[28]

USAFA conducts STEM Friday lessons at local classrooms during which staff and faculty provide a hands-on science, robotics, and engineering experience for elementary school students. Recent topics include avalanche protection, bridge design, light or thermal energy, solar cars, and windmills, among others. The academy also provides on-site tours of several of its facilities, including its Aeronautics Research Center, Chemistry Research Center, Computer Science Research Center, Electrical and Computer Engineering Research Center, and Human Performance Lab.

ARL New Mexico (White Sands) operates the La Luz Academy on Kirtland AFB, New Mexico (about 4 hours driving distance away). The academy provides STEM education opportunities for students in grades 5 to 12, reaching 10,000 students and 150 teachers in a typical year. Their programs include a simulated Mission to Mars, TECH Flight (alternating between rocketry and satellites), Robotics Challenge, and STEM Challenge. They also participate in DoD STARBASE.[29]

AFRL offers STEM programs at several other locations, including Eglin AFB, Florida; Maui Optical and Supercomputing Site, Hawaii; and Rome Laboratory, New York—a facility devoted to Command, Control, Communications, Computers, and Intelligence (C4I) and cyber technologies.

d. Junior Reserve Officers' Training Corps (JROTC)

The JROTC is a high school program sponsored by DoD "to instill in students in United States secondary educational institutions the values of citizenship, service to the United States, and personal responsibility and a sense of accomplishment."[30] The JROTC

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[28] *Source*: www.usafa.edu/research/stem-outreach/.

[29] *Source*: www.afrlnewmexico.com/afrl-stem-academy.

[30] 10 U.S.C. §2031 (Junior Reserve Officers' Training Corps).

is not formally a recruiting program and does not obligate graduates to enlist in the military. However, the program does expose high school students to the possibility of a military career. High schools can choose whether to offer a JROTC program, and students can choose whether to participate.

The JROTC curriculum includes classes on topics such as leadership, civics, and health and wellness as well as service-specific topics such as meteorology and aerospace science. In addition, the FY 2020 NDAA authorizes the JROTC to conduct additional training in computer science and cybersecurity,[31] and the FY 2021 NDAA authorizes grants to support the development of STEM education in the JROTC program.[32]

The JROTC program is jointly funded by DoD ($390 million in FY 2020) and local school districts. In FY 2020, more than 3,400 JROTC units represented every state as well as DoD schools overseas and served about 550,000 cadets mostly in 9th through 12th grade (with fewer numbers in 8th grade).[33] However, under current congressional caps, DoD is limited to between 3,000 and 3,700 JROTC units.[34] Some high schools on the waiting list cannot be offered JROTC programs because of either funding limitations or nearing the congressional cap.

An IDA study in 2018 examined the factors correlated with the number of enlisted accessions into the active military as a percentage of the youth population in a county or small collection of contiguous counties (the denominator being the number of youth ages from 18 to 24). Two measures of JROTC density were found to be positively associated with recruiting success: the number of high schools that offer a JROTC program per youth population and the number of JROTC cadets per youth population. Based on those two measures, JROTC programs were most highly concentrated throughout the southeast, Arizona, Nevada, portions of Texas, and especially in New Mexico.[35]

2. Challenges

Next, we turn to the unique challenges faced by each of the service branches.

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[31] Public Law 116-92, *National Defense Authorization Act for Fiscal Year 2020*, Section 516, "JROTC Computer Science and Cybersecurity Program."

[32] Public Law 116-283, *National Defense Authorization Act for Fiscal Year 2021*, Section 513, "Grants to Support STEM Education in the Junior Reserve Officers' Training Corps."

[33] Congressional Research Service, "Defense Primer: Junior Reserve Officers' Training Corps (JROTC),"IF-11313, updated December 2, 2020.

[34] Public Law 112-239, *National Defense Authorization Act for Fiscal Year 2013*, Section 553, "Modification of requirements on plan to increase the number of units of the Junior Reserve Officers' Training Corps."

[35] Matthew S. Goldberg et al., "Geographic Diversity in Military Recruiting," IDA Paper P-9079 (Alexandria, VA: Institute for Defense Analyses, November 2018).

a. Army

The Army has relied on virtual recruiting since the COVID-19 outbreak of March 2020. In response to disappointing recruiting performance during the middle months of FY 2020, the Army conducted National Hiring Days from June 30 to July 2, 2020. During that 3-day period, Army leaders met with community and industry partners and with the Army's Partnership for Youth Success (PaYS). The latter is a "strategic partnership between the U.S. Army and a cross-section of corporations, companies, and public sector agencies. The Program provides America's youth with an opportunity to serve their country while they prepare for their future. PaYS Partners guarantee Soldiers an interview and possible employment after the Army. This unique Program is part of the Army's effort to partner with America's business community and reconnect America with its Army."[36] Army leaders from general officers to battalion commanders (lieutenant colonels) engaged in a social media blitz that was viewed by an estimated 112 million Americans, and boosted recruiting totals that eventually achieved the Army's year-end goal of 62,150.

Even in the best of times, the Army finds it difficult to balance the service's image of kinetic warfare and "breaking down doors" with its need to fill technical jobs with soldiers who are, if not already trained in STEM to some degree, amenable to such training. The Air Force has always held the "high ground" in being viewed as the most technical of the service branches. However, the Army's main recruiting website now declares that "The Army STEM program (Science, Technology, Engineering and Math) offers jobs that will put your analytical and technical abilities to the test" and delineates occupations in the categories of Science, Technology, Engineering, Mathematics, and Cyber.[37]

The Army is generally very successful in recruiting a diverse officer force, especially Black officers. Indeed, in FY 2018, the Army's *officer gains* included 10.4 percent Blacks (highest among the four services) and 8.6 percent Hispanics (essentially tied for last place with the Air Force). The Army's *officer inventory* told roughly the same story, with 11.2 percent Blacks (again highest among the four services) and 7.7 percent Hispanics (just ahead of the Air Force at 7.1 percent).[38]

The picture is less favorable when considering diversity among officers trained with a STEM background. The Army recruits at affinity events; i.e., events that feature minority or underrepresented groups, such as the National Society of Black Engineers. However, interviewees indicated that the number of candidates at those events was too small to enable the Army to meet its diversity goals.

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[36] *Source*: www.armypays.com/.

[37] *Source*: www.goarmy.com/careers-and-jobs.html.

[38] CNA Corporation, *Population Representation in the Military Services: Fiscal Year 2018*, Table B-50, www.cna.org/pop-rep/2018/contents/contents.html.

The Army also recruits officers from Historically Black Colleges and Universities (HBCUs) and Minority Serving Institutions (MSIs). IDA's research has identified more than 30 Army ROTC programs at HBCUs. However, one Army representative stated that it would be difficult to expand that footprint because many of the other HBCUs are underfunded and shrinking and would not be able to support an ROTC program.

b. Navy

Navy interviewees reported that recruiting in some areas of the United States is difficult because of geography and population density. According to one anecdote, a Navy recruiter in northern Michigan might have to drive 2 hours to visit a high school with a graduating class of only 30 seniors. The other services may face similar challenges but did not express them during our interviews.

The Navy does attempt to recruit veterans from the other services, though with apparently mixed success. Some soldiers become disenchanted in the Army and decide that they would prefer the lifestyle offered by the Navy. However, the Air Force has higher retention so there are fewer opportunities for the Navy to recruit former airmen. Much like the Army, the Navy competes against the Air Force's reputation as the most technical of the service branches. The Navy's main recruiting website enables an interested person to explore up to two career fields at a time, among which the following four promise STEM training:[39]

- Communications

- Cyber and IT

- Engineering

- Weapons and electronics

On the officer side, Navy recruiters adjust their efforts to the numbers of engineering students at a university (or geographic cluster of universities). Their assignment algorithms favor areas where they have been successful in the past, but also consider data from the U.S. Census and from OSD's Joint Advertising Marketing Research and Studies (JAMRS) office to help identify new geographic areas with recruiting potential.

Navy representatives also discussed the issue of placing ROTC units at HBCUs and MSIs. They spoke proudly about some of their ROTC programs, such as the one at Georgia Tech—neither a HBCU nor an MSI—which was recently ranked the number 8 engineering school in the U.S.[40] They expressed that it is difficult to relocate ROTC units currently

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[39] *Source*: www.navy.com/careers.

[40] *Source*: www.usnews.com/best-graduate-schools/top-engineering-schools/georgia-institute-of-technology-02049.

hosted at lower ranked institutions—even for as noble a goal as attracting more diverse students—because a member of Congress representing the state of the "losing" location would likely protest.

In late January 2021, the Navy released a report entitled "Task Force One Navy."[41] The report was accompanied by a statement from Chief of Naval Operations (CNO) Admiral Michael Gilday:

> As a Navy—uniform and civilian, active and reserve—we cannot tolerate discrimination of any kind, and must engage in open and honest conversations with each other and take action. That is why we stood up 'Task Force One Navy'—to identify and remove racial barriers, improve inclusion efforts, create new opportunities for professional development, and eliminate obstacles to enter the Navy…

> We have fallen short in the past by excluding or limiting opportunity for people on the basis of race, sexual orientation, sexual identity, gender, or creed. Our Navy must continue to remove barriers to service, and most importantly, be a shining example of a workforce centered on respect, inclusive of all. Simply put, all Sailors—uniformed and civilian—and applicants for accession to the Navy must be treated with dignity and respect above all else.[42]

The Navy's report contains 56 recommendations along 5 lines of effort. The lines of effort and corresponding responsible organizations are:

1. Recruiting—Navy Recruiting Command

2. Talent Management/Retention—Navy Personnel Command

3. Professional Development—Naval Education and Training Command/Naval Service Training Command

4. Innovation and Science, Technology, Engineering, and Mathematics—Office of Naval Research

5. Additional Recommendations

In particular, along the lines of Innovation and STEM, the report contained six recommendations accompanied by a few paragraphs of specific guidance:

- Determine the navy's military/civilian population associated with fraternities, sororities, and affinity groups

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[41] *Source*: https://media.defense.gov/2021/Jan/26/2002570959/-1/-1/1/TASK percent20FORCE percent20ONE percent20NAVY percent20FINAL percent20REPORT.PDF, released January 28, 2021.

[42] *Source*: www.navy.mil/Press-Office/News-Stories/Article/2490996/task-force-one-navy-completes-report-to-enhance-navy-diversity/, posted February 3, 2021.

- Review and clarify guidance for outreach to affiliated professional groups

- Incentivize inclusive participation and leadership

- Develop public affairs campaign to increase visibility of minority affinity groups

- Construct diverse military and civilian network to increase the awareness of navy steM

- Enhance and develop stem outreach programs

c. Marine Corps

The Marines refer to themselves as an "all-recruited force" as opposed to an "all-volunteer force." They actively seek candidates who possess the qualities necessary to make a good Marine. Each Marine Corps recruiting substation is responsible for recruiting both officers and enlisted Marines. An enlisted recruiter who encounters a promising candidate for an officer position will steer that candidate to an officer selection team if that seems more appropriate.

The Marines strongly emphasize and are proud of the way they train their recruiters. One representative noted that JAMRS administers a recruiter quality-of-life survey. By his account, Marine Corps recruiters reported the highest level of satisfaction in their training for that job among the five services (including Coast Guard). Their recruiters also felt the most likely to meet their recruiting targets, even though they believed their own targets to be the most challenging among the services.[43]

The Marine Corps pursues Black officers using the Frederick C. Branch Scholarship. This Naval ROTC (NROTC) scholarship is available to men or women who attend one of 17 participating HBCUs. The scholarship pays for tuition and academic fees, a book allowance, and a monthly subsistence allowance that increases for upperclassmen. After graduating from college and further completing Officer Candidate School, the midshipman is appointed a second lieutenant in the Marine Corps.[44]

Marine Corps representatives noted that they do not rely exclusively on HBCUs; they can recruit excellent Black officers from many other colleges and universities. Even though the recruiting focus is "on the Marine" and not necessarily on STEM, they do successfully recruit officers with STEM backgrounds from engineering schools with large NROTC

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[43] Office of People Analytics (OPA), *DoD Recruiter Quality of Life Survey (2018): Overview Report*, Report No. 2019-074, November 2019. The responses to the training questions are summarized in Figures 2.9 and 2.10. The responses to the goal questions are summarized in Figures 2.1 and 2.2.

[44] *Sources*: www.military.com/education/2016/07/07/marine-corps-announces-three-scholarships.html; and www.netc.navy.mil/Commands/Naval-Service-Training-Command/NROTC/MSI/.

programs (such as Virginia Tech and Texas A&M), and from the other so-called Senior Military Colleges such as The Citadel and Virginia Military Institute.

The Marine Corps describes itself as very successful in recruiting a diverse enlisted force, especially Hispanics. Indeed, in FY 2018, the Marine Corps' non-prior service enlisted accessions included 27.0 percent Hispanics, the largest percentage among the four services and contrasted to the DoD average of 20.0 percent. Conversely, the Corps' enlisted accessions included only 9.4 percent Blacks, lowest among the four services and trailing the DoD average of 17.4 percent and especially the Army at 21.2 percent.[45]

d. Air Force

Both the U.S. Air Force and the new U.S. Space Force report to the Department of the Air Force. As mentioned earlier, U.S. Air Force has traditionally occupied the "high ground" as the most technical branch of service, though it may face competition from the U.S. Space Force. At present, the main Air Force recruiting website includes a link to the Space Force.

The Air Force attempts to maintain its high ground by featuring STEM technology in its commercials, career videos, and social media postings. Further, its main recruiting website features specific career fields, among which the following groupings promise STEM training to airmen:[46]

- Aircraft and flight

- Computers and computer science

- Electronics and electrical

- Engineering and applied science

- Future technologies

- Natural science

- Space

Somewhat parallel to Task Force One Navy, the Department of the Air Force (embracing both constituent service branches) established a Diversity and Inclusion Task Force in July 2020, which it describes as follows:

> The task force is charged with identifying and changing policies, procedures, barriers, and other practices that may be unfairly impacting underrepresented Air and Space Professionals. It is postured to identify

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[45] CNA Corporation, *Population Representation in the Military Services: Fiscal Year 2018*, Table B-3, www.cna.org/pop-rep/2018/contents/contents.html.

[46] *Source:* www.airforce.com/careers, and www.airforce.com/careers/browse-careers/.

near-term problems and solutions that will have immediate benefits for members, with a focus on policies particularly impacting minority members. It has been tasked to be mindful of not impacting or assuming results from the IG's [Inspector General's] review [of the service's record on military discipline as well as leader development opportunities for Black/African American Airmen and Space Professionals], and is therefore focused on immediate actions versus identification and action toward longer term systemic and cultural issues the IG might identify.[47]

Among its early actions, the Task Force announced that:

In conjunction with the Jeanne M. Holm Center for Officer Accessions and Citizen Development, the task force is working to increase and offer scholarships for nearly 300 current and future ROTC cadets attending Historically Black Colleges and Universities or Hispanic-Serving Institutions. The qualified recipients will receive a full-ride scholarship with full tuition and fees paid starting in the 2020–21 school year. The move is intended to increase minority representation in the officer ranks, something the Air Force has struggled with. Currently, racial and ethnic minorities make up 40 percent of the U.S. population but only 24 percent of the officer corps.[48]

Other announcements were less germane to our analysis, including revised dress and appearance regulations and improved shaving waiver procedures for airmen with certain skin conditions.

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[47] www.af.mil/News/Article-Display/Article/2267953/department-of-the-air-force-stands-up-diversity-and-inclusion-task-force/, posted July 8, 2020. The Task Force was formed in anticipation of the findings of the *Independent Racial Disparity Review*, The Inspector General, Department of the Air Force, December 2020, www.airforcemag.com/app/uploads/2020/12/IRDR.pdf.

[48] www.af.mil/News/Article-Display/Article/2267953/department-of-the-air-force-stands-up-diversity-and-inclusion-task-force/. The Jeanne M. Holm Center for Officer Accessions and Citizen Development, which manages the Air Force's ROTC program, is located at Air University, Maxwell AFB, AL.

3.   Recruiting and Hiring DoD's STEM Workforce

A. Civilian STEM Recruiting and Hiring

1.   Recruiting

During 5 months in late 2020 and early 2021, we interviewed representatives of the military departments, defense agencies, OSD, colleges and universities, affinity groups, and private sector competitors about DoD civilian outreach and recruiting efforts. One consistent theme emerged from these interviews: DoD civilian outreach and recruiting are systematically under-resourced. While robust funding of marketing and recruiting efforts by private sector entities and the military services (for uniformed personnel) reflect their priority of accessing new talent, DoD civilian outreach and recruiting typically function on a meager budget.

a. Underfunding

With almost no budget for marketing and (with rare exceptions) no professional recruiting force, civilian recruiting has been characterized as a "pick-up game," staffed as "other duties assigned" by employees with other professional responsibilities. The director of human resources for one defense agency told the us that although the DoD mission relies heavily on the Department's 750,000 civilian employees, civilian personnel programs are always short of staff and resources. Similarly, the director of civilian human resources policy for one of the military services told us that her organization is in a never-ending battle for resources and falls short in its mission primarily because of a lack of staffing. Although her service has roughly four times more civilian employees than Amazon Web Services (AWS), she indicated that AWS has 1,300 full-time employees devoted to recruiting, while she has virtually no full-time recruiters.

A civilian human resources manager for another military service told us that underfunding of civilian outreach and recruiting is symptomatic of broader neglect that undermines the Department's marketing message. If the Department wants to recruit a talented workforce in the rising generation, he indicated, training and development is at least as important as recruiting. According to this individual, the civilian workforce wants to have three questions answered: (1) am I valued? (2) am I growing? and (3) am I having an impact? If the answers to these questions are not favorable, the Department is likely to have problems not only with retention but also with sending a positive recruiting message.

b. Market competition

Representatives of colleges, universities, affinity groups, and private sector competitors told us that although DoD is frequently represented at job fairs and similar events, it is not perceived as an effective competitor in the market for critical STEM skills. A senior human resources official for the Air Force told us that his department sees itself as being in competition with major defense contractors for STEM talent. However, the Air Force cannot match the contractors' aggressive recruiting programs. At one recent recruiting event, for example, the Air Force was limited to collecting resumes, while the contractor at the next booth over conducted interviews and hired people on the spot, ringing a bell for each new hire. The Air Force team had to listen as needed talent slipped away from them with each ring of the bell.

c. Lack of organization and planning

The problems caused by inadequate funding are compounded by shortfalls in organization and planning. For example, the Army recently published a comprehensive "People Strategy" that at least nominally covers civilian employees as well as military personnel. However, Army interviewees told us that the Army does not yet have an integrated strategy for recruiting and hiring scientists and engineers in a competitive job market. Centrally funded STEM apprenticeship and outreach programs are administered as disparate activities rather than as part of a coherent recruiting plan. Local activities work in a fragmented system, different parts of the system do not communicate with each other, and there is little cooperation among local Army entities.

d. Lack of centralization

Although military recruiting is addressed at a national level, with each of the military services fielding a nationwide recruiting force, the Department generally treats civilian recruiting as a local responsibility for individual commands and organizations.[49] Army officials told us that although the Department has adopted a comprehensive Army People Policy that covers both military and civilian employees, civilian recruiting activities continue to be managed at the local level.[50] Air Force officials told us that although the Air Force Personnel Center has a small recruiting team (discussed later), most civilian recruiting is conducted at a local level. Additionally, in some cases multiple bases or commands compete with each other for the same talent. Navy officials reported that local organizations are in charge of managing recruiting programs and posting their own job

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[49] This study was conducted in conjunction with another study on cohort hiring (or hiring "talent pools"), which is one mechanism for centralizing elements of civilian hiring. Further discussion about the advisability of this approach to civilian hiring is available in a forthcoming report.

[50] Similarly, although the Army Education Outreach Program (AEOP) is a nationwide program, it is managed on a distributed basis by local commands.

announcements; for major commands, this responsibility is frequently delegated to individual field activities. The message from the Marine Corps was much the same: civilian recruiting is not a coordinated or consolidated effort, leaving each command to look for talent on its own.

Even the defense agencies, which are much smaller and more reliant on civilian personnel than the military departments, appear to delegate large parts of their civilian recruiting efforts to local units. The Defense Logistics Agency (DLA) publishes national job announcements, but most hiring is local, with hiring managers in individual units conducting interviews and making hiring decisions. The Defense Contract Management Agency (DCMA) reports that it has a very decentralized workforce and relies on local offices to make their own hiring decisions and build their own recruiting relationships with local colleges and universities. Like the Air Force, DCMA reports that there are many cases in which several of its local organizations compete for the same talent.

e. Passive recruiting

Much of this recruiting is passive in nature, with local commands releasing job announcements or attending job fairs and waiting for recruits to come to them, rather than actively seeking out talent. For example, Marine Corps officials told us that recruiting duties are often imposed on employees as additional assignments on top of their full-time jobs. Some of these recruiters can barely keep their heads above water as they struggle with the "crisis de jour" in their day jobs—resulting in a haphazard approach to recruiting and hiring that is less successful than it should be. Similarly, Army human resources managers told us that the Department's efforts to modernize civilian talent acquisition will require new funding for marketing and recruiting (including resources needed for job fairs and other hiring events) to enable a more proactive approach.

f. Lack of brand identity

One result of these shortcomings in funding, staffing, and organization is that DoD civilian service generally lacks a "brand" identity in the marketplace for talent. Officials at the Army Futures Command, which was established 4 years ago, reported that many potential recruits do not even know that the command exists and that "people don't know that they can do this kind of work for the Army." Navy officials told us that the association of Navy careers with uniformed service is a major barrier in their outreach and recruiting efforts, particularly in minority communities. Potential recruits frequently have no idea that Navy civilian careers exist, let alone that they may provide attractive opportunities. Human resources officials from the Marine Corps told us that most job candidates do not even realize they are looking for civilians—they hear Marine Corps and assume that the jobs are military. Similarly, a senior Air Force manager reported that "when you say Air Force,"

most potential recruits think of uniformed personnel and do not even realize that civilian careers are possible.

Outside entities we interviewed confirm the problem. One interviewee spoke of Army recruiters showing up at job fairs in camouflage uniforms and heavy boots; at that point, most women engineering students were not going to get close enough to find out whether they were recruiting for military or civilian positions. Another made a similar point about a Navy robotics demonstration: the majority of personnel present were in uniform, leading potential recruits to believe that you had to be a military officer to work in the Navy. A representative of one affinity group told us that there is limited knowledge of DoD careers in college engineering departments, and most associate the Department with military service. Another stated that individuals in the minority community often do not even know what the initials "DoD" stand for, let alone what kinds of jobs the Department has to offer. The consensus was that DoD civilian recruiting is undermined by the Department's failure to successfully communicate the availability of challenging and rewarding civilian careers in areas like programming and engineering,

The problem of brand identity can be even more problematic for defense agencies. Most college students and recent graduates have at least heard of the Army, Navy, Air Force, and Marine Corps. One Marine Corps official told us that the Marine Corps brand actually helps sustain the civilian workforce, because it is attractive to many who choose not to serve in uniform.[51] By contrast, few people outside the Department have ever heard of even large defense agencies, such as DCMA, DCAA, and DLA. Recruiters at one defense agency told us of a recent survey that indicated that 70 percent of recent college graduates did not even know that the Department has a civilian workforce.

In the face of these obstacles, DoD human resources officials recognize that they need to find channels to broadcast a consistent message about the civilian workforce. Our interviewees were fairly clear about the content of the desired message: it should focus on the importance of the mission, the challenge of the work and, to a lesser extent, issues of work-life balance.

- With regard to mission, an interviewee from the Missile Defense Agency (MDA) told us that the best recruiting tool the agency has is its unique mission—"most people want to work for them because of the mission." Similarly, an interviewee from the Army Futures Command stated that "pulling on national heartstrings" is a major part of the command's recruiting message. Outside interviewees confirmed that this is a sound approach, telling us that

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[51] On the other hand, one Army interviewee told us that some potential civilian recruits are discouraged by the idea that any DoD employment is contributing to "killing machines." This official stated that press reports about "killer robots and drones" are not helpful for recruiting efforts with the younger generation.

many young people today want to contribute to a greater purpose, and that commitment to the national security and to the health and safety of men and women in uniform is often seen as helping to fill that need.

- With regard to challenging work, representatives of the defense laboratories specifically emphasized the challenging issues that they work on and the lack of similar work elsewhere in the country. Other interviewees spoke of internships and fellowships as an opportunity to show off the exciting work that they do. Even the DCMA points to the variety and complexity of its work as a major recruiting incentive, pointing out that the agency works around the world with a huge variety of product areas, a factor that is seen as a big selling point for millennials. Again, outside interviewees confirmed that although many students focus on starting salaries, the quality and interest of the work are also important selling points.

With regard to work-life balance, DoD interviewees told us that they know they are unable to out-compete the private sector on salary, but believe that they have an attractive package to offer when working hours and non-salary benefits are considered. A Naval Sea Systems Command (NAVSEA) representative said that the command tries to communicate the work-life advantages afforded by a 40-hour workweek, overtime, and paid time off available through federal employment. Other DoD officials pointed to education benefits and industry rotation programs as potentially attractive recruiting tools.[52] Outside interviewees stated that family-friendly policies—along with health and retirement benefits—can make a difference with some young recruits, although many focus their attention more narrowly on salary.

g. Effective recruiting activities

We did find a number of brighter spots, with small pockets of more active and better-funded recruiting activities. For example:

- The Air Force has developed a small corps of full-time recruiters in the Talent Acquisition Division (TAD) of the Air Force Personnel Center (AFPC). Multiple sources told us that the TAD conducts proactive recruiting for mission-critical occupations like cyber and acquisition and hard to fill locations, and to foster diversity in the Air Force workforce. When requested by local commands, TAD can provide proactive workforce planning, media outreach, online recruiting tools, digital virtual events that mimic brick-and-mortar job fairs, and other resources needed to actively pursue critical skills. AFPC believes that this

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[52] On the other hand, several interviewees pointed to deteriorating physical facilities and obsolete systems and equipment as a turn-off for potential recruits (and a negative factor in civilian retention).

is the only centralized team in the Department that proactively searches out talent in this way.

- Five Navy Commands, including NAVSEA, Naval Air Systems Command (NAVAIR), and Naval Facilities Engineering Systems Command (NAVFAC), have formed a recruiting consortium to better leverage their recruiting resources. By combining their limited resources, these commands can establish a more effective presence at college job fairs and national recruiting events. Several outside sources told us that the Navy consortium was far more visible and effective than other DoD recruiting efforts.

- The Missile Defense Agency (MDA) conducts regular data calls with hiring managers to roll up critical hiring needs across the agency. A centralized human resources group then conducts recruiting activities on an agency-wide basis. Attendance at recruiting events is enhanced by the presence of professional recruiters, functional managers, and recent graduates.

- The Defense Logistics Agency (DLA) recognizes that although passive recruiting through USAJOBS may work for routine hiring, more active recruiting is needed in areas such as data science and cyber skills. Direct-hire authority (DHA) in these areas has enabled DLA to invest in connecting with local schools and universities, targeting the handful of highly-skilled recruits that the agency needs to accomplish its mission.

h. Next steps

Despite these pockets of excellence, most of the DoD representatives we interviewed recognize that the Department has a great deal of room for improvement. Army human resources professionals told us that they want to have a future recruiting approach that is more proactive and responds to emerging needs; they plan to focus on the Department's STEM needs in FY 2021. Navy interviewees reported that their central human resources system has a significant role in the hiring process but not in recruiting or outreach. They see challenges in further centralization because many relationships are best addressed at the local level, but told us that they would like to develop a professional recruiting capability. Marine Corps officials told us that they have tried unsuccessfully to sell their leadership on the Air Force approach to civilian recruiting and career management, but the function remains balkanized and under-resourced.

Even the Air Force, which has a state-of-the-art (for DoD) recruiting capability in the TAD, sees a continuing challenge to professionalize recruiting across the workforce. A senior Air Force official told us that the resources available to the TAD remain limited, and local organizations use the TAD recruiting cell exclusively on a voluntary basis. Many local organizations resist any surrender of authority or responsibility to what they see as a

central bureaucracy. The result is that poorly staffed local hiring managers bypass professional recruiters, using local (part-time) resources to carry on outreach efforts, conduct interviews, and maintain local control over the full hiring process.

A senior manager of one of the Department's high-skill functional communities told us that DoD needs to learn from the private sector. Posting on a website does not work for accessing specialized talent; a three-way partnership is needed among hiring managers, human resources staff, and recruiters. The senior manager stated that, as in the private sector, recruiters should be full-time, professional, and independent from hiring managers and human resources staff. They should have the time and the skills to run the recruiting process "from cradle to grave," helping the potential employee every step of the way. This approach would enable the Department to guide high-skill recruits through the hiring process, making them feel that DoD really wants them rather than leaving them to navigate the bureaucracy on their own.

i. Recruiting approaches

1) Building a connection over time

A recurring theme during our interviews was that "drive-by" recruiting events— where a DoD organization episodically visits a college or university—are generally ineffective. Instead, the organization needs to build and maintain a permanent connection with the educational institution. We heard this perspective not only from DoD organizations that we interviewed, but more pointedly and unfailingly from the colleges and universities that we contacted. The placement director for the engineering school at one large state university told us that the best way to recruit their students is through consistent outreach, not just periodic career fairs. Several placement directors indicated that their students crave regular forms of contact, such as presentations and question-and-answer sessions at student club meetings. Another encouraged earlier outreach, including summer internships and part-time employment during the school year, to begin building a pipeline that can culminate in a job offer upon graduation.

An Air Force organization emphasized the importance of having influencers steer students to their organization, even during the months between face-to-face engagements. The corps of influencers would include recent alumni, school placement directors, and professors who have successfully recommended their graduating students for positions in that organization in the past.

Several university representatives described the essentiality of having a responsive and *stable* counterpart on the DoD side. We heard of a number of strong relationships that persisted until the DoD person turned over, followed by long silences when the replacement on the DoD side did not initiate contact or even respond to forays initiated by the university. The problem was exacerbated when the DoD person was a military officer,

because they generally turn over more frequently than civilian scientists. One large university engineering department suggested to us that DoD hiring organizations designate a backup point of contact to smooth over transition periods. Several departments praised two Navy commands, NAVAIR and NAVSEA, as being especially diligent in maintaining good contacts on campus. Conversely, because DoD masks the identities and contact information for most of its employees, placement directors do not know whom to "cold call" to establish new connections with DoD commands they view as likely to hire in STEM.

A representative of an engineering school with a very diverse student population told us that the most successful employers have dedicated university recruiting teams. The exemplary employers that were mentioned include Johns Hopkins University/Applied Physics Laboratory (a university-affiliated research center, or UARC) and the National Security Agency, plus a few well-known commercial firms in banking, consulting, and defense manufacturing. She also emphasized the important of a diverse recruiting team with whom the students could identify.

A national leader at a major STEM affinity group told us that drive-by recruiting events often fail because there is too little time for students to ascertain the culture of the recruiting organization. Many students are attracted by the science or engineering challenges or by a desire for (non-uniformed) national service that DoD laboratories and related organizations can provide. However, the private sector firms against which DoD competes for talent will spend more time discussing their work climate and their corporate culture, including work-life balance issues. Female and minority students are particularly concerned about how they will be perceived and treated by various potential employers. Testaments by recently hired employees, especially alumni of the same college or university, are useful to quell students' apprehensions.

2) Job fairs and other physical events

The placement director at one large engineering school told us that job fairs are not dead, as often depicted; they are "wildly popular" because students crave face-to-face contact. However, there was some sentiment that virtual job fairs, which have been necessitated by the COVID-19 crisis, are not as effective as in-person events.

One message we heard consistently was that the composition of the recruiting team matters to students. The three groups in play consists of the following:

- Human resources (HR) staff

- Hiring managers

- Technical experts (e.g., working engineers)

The advantage of HR staff is that they understand their organization's hiring processes. They also work in their primary area as opposed to hiring managers or technical experts for whom recruiting is an additional duty. Hiring managers have some degree of decision authority that they might be reluctant or unable to delegate to either HR staff or technical experts, so their presence can be essential as well. However, according to the university placement directors with whom we spoke, students derive the most value from speaking with technical experts. Those experts can inspire students by discussing (within the limits of classification) the science and engineering projects on which they work. They can also address the work climate and cultural issues described earlier. A placement director at a nationally ranked engineering school went so far as to say that many students are indifferent between a live conversation with an HR official and an online visit to the employer's website (which is where HR officials often direct them).

University personnel noted that their students are not always aware that working for DoD as a civilian is even a viable option. Only the Army and Air Force mention the possibility of civilian service at their main recruiting websites, in both cases toward the bottom of the screen.[53] Civilian employees are seldom depicted in network television shows or in major movies about the U.S military.[54] Further, some DoD organizations send uniformed military personnel in the role of either hiring manager or technical expert. Although the contributions of technically trained military officers cannot be disputed, their presence tends to amplify the misconception that there are no civilian opportunities within DoD. Further, we were told that many students are too intimidated to approach a group of large, muscular, and largely male officers in full uniform.

Conversely, military recruiters told us that they do not have the resources and cannot afford to rent the physical space to compete effectively at job fairs against the well-funded defense contractors (who have a similar mission) and commercial firms in other areas such as banking, consulting, or health care. Some of those firms also hold clinics on resume-writing that forge relationships with individual students and provide a bank of (albeit sometimes preliminary) resumes. The firms find those early relationships useful in establishing a pipeline, including with underclassmen who are not about to graduate at the end of the current school year.

Expedited hiring practices enable DoD to compete with private sector employers. The ability to make a tentative job offer on the spot (conditional on a background check) goes a long way toward making DoD competitive. Still, some university placement directors had mixed feelings about spot offers. On the one hand, students often feel a sense of

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[53] Civilian careers are mentioned at www.goarmy.com/ and www.airforce.com/ but not at www.navy.com/ or www.marines.com/.

[54] One notable exception was actress Kelly McGillis playing civilian scientist Charlotte "Charlie" Blackwood in the 1986 film *Top Gun*.

extreme loyalty to the employer who provides their first job offer. Sometimes placement officers have to work hard to convince students to even consider later job offers from other employers. Conversely, other students react negatively to the pressure of accepting, even tentatively, their first job offer. Or, students might interpret spot offers as a sign of desperation. The placement directors also recommended that the hiring organization assign one person *by name* to maintain continuous contact with students who are under consideration.

3) Online and virtual events

The military departments and defense components are starting to use virtual platforms for marketing and recruiting. This shift began even before the COVID-19 crisis and trails what has been considered best practice in private industry for several years. Virtual events are much less costly than in-person events but lack the face-to-face contact that only in-person events can provide. The DoD organizations that we interviewed would generally prefer a mixture of the two modalities.

One large private contractor that does a lot of work for DoD told us that the digital transformation of talent acquisition is no longer just an option—it has become a necessity to remain competitive. This contractor focuses on having a constant presence in social media, and they structure their job requisitions so that they can be proliferated across multiple platforms. Additionally, they have developed separate tools for applicant tracking, customer relationship management, and candidate engagement. They reach out to candidates they have identified as though the candidates were *customers* rather than passively waiting for the candidates to apply to specific positions. They also partner with recruiting and marketing firms as well as a diversity firm that reaches out to women, veterans, and individuals with disabilities. Their marketing partner manages relationships with most of the large job boards and search tools, especially Glassdoor's inclusion and diversity pages. They also claimed the ability to target candidates who had visited their company's Glassdoor page, even if the candidates did not sign in at that site. Finally, they use other recruiting platforms such as LinkedIn, Indeed, ClearanceJobs, and ClearedJobs.[55]

DoD organizations are joining these trends, but due to a combination of lower awareness and much more constrained resources, not as rapidly, broadly, or deeply as private industry. For example, the Army Futures Command has started using online recruiting tools, notably the premium version of LinkedIn. Because some managers have direct hire authority, they can hire an identified candidate by name. We discuss the use of direct hire authority in more depth later in section 3.A.2.b.

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[55] *Source:* www.glassdoor.com/, www.linkedin.com/, www.indeed.com/, www.clearancejobs.com/, and www.clearedjobs.net/.

The Navy has embraced the Handshake recruiting platform by which they can communicate job openings to the roughly 100 colleges and universities that also have accounts.[56] Among the institutions from which the Navy has successfully recruited in this manner are the flagships at University of Florida, University of Virginia, and University of Tennessee at Knoxville. The Navy can narrow their search to students with a particular degree and field and with a minimum GPA.

The Navy has also developed a method to mine the data at the USAJOBs government site. The Navy's method allows them to identify any candidate who has submitted a resume, for any position, as long as the candidate's qualifications match on a specified set of keywords. They can then reach out to the identified candidates with reference to the current position of interest. Navy representatives described this process as a "game changer."

The Air Force uses a variety of tools and techniques. The Air Force Personnel Center posts on the widely followed social media platforms of Facebook, Instagram, Twitter, and YouTube. Their message is that the service employs a robust workforce of 170,000 civilians. In addition, the center contracts with Talent Neuron for labor market analysis.[57] They also use the recruiting platforms ClearanceJobs, Dice, and LinkedIn for general positions; and HospitalJobs, PracticeLink, and NurseJobs for medical positions.[58]

The Air Force Personnel Center runs its own public website, which again touts the workforce of 170,000 civilians and pronounces that "We [the Air Force civilian workforce] contribute to the well-being of every American in remarkable and even life-changing ways. We're the team who developed and maintain GPS, the Global Positioning System that has revolutionized the way we live and communicate."[59] The website offers background information to potential candidates and allows them to opt-in to email lists. The center also uses contact information garnered from its website to distribute more than 800,000 emails per month. Additionally, the website provides direct links for candidates to apply for positions on USAJobs.

The Marine Corps has recently purchased a new, online talent matching system for recruiting and hiring. The system addresses the perceived inflexibility of human classifiers and categorizes positions with greater flexibility and much more rapidly using artificial intelligence. The system also informs the HR staff and hiring managers on which hiring authorities are available to help fill a particular position.

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[56] *Source:* https://joinhandshake.com/.

[57] *Source:* www.gartner.com/en/human-resources/research/talentneuron.

[58] *Source:* www.clearancejobs.com/, www.hr.com/buyersguide/company/dice/, www.linkedin.com/, www.hospitaljobs.com/, www.practicelink.com/, and www.nurse.com/jobs/.

[59] *Source:* https://afciviliancareers.com/.

DoD's Office of Civilian Personnel Policy shares the Marine Corps' enthusiasm for its new system, and has encouraged both the Army and the Space Force to adapt it for their own use. Paradoxically, though, interviewees at one of the Marine Corps organizations that hires actively in STEM were not aware of it.

The Joint Artificial Intelligence Center (JAIC) has developed its own public website, *Careers: Find Your Future at the JAIC*.[60] Every open position in the JAIC is listed at that site and described in language that avoids "federal-speak" and is closer to that used by industry. Job candidates have the option to upload their resumes and transcripts into the "hiring box." Candidate materials in the hiring box are automatically matched on a daily basis for fit against one or more positions. Hiring managers can manually check the hiring box as well.

DCAA requires in-person interviews of job candidates. However, in the COVID-19 environment, virtual interviews are now deemed as meeting that requirement. To conduct its virtual interviews, DCAA uses the GoToMeeting platform,[61] and all DCAA auditors and other staff involved in the recruiting effort are trained to use that platform. DCAA recently adopted the USAHire Test/Assessment to help assess candidates who apply for auditor positions.[62] That tool is viewed as improving the quality of their assessments and of candidates hired.

j. Recruiting tools

DoD organizations have several tools at their disposal in their effort to build recruiting pipelines for STEM talent with colleges and universities, including (1) internship programs, in which the Department provides temporary employment to students; (2) scholarship and fellowship programs, in which the Department pays for a student's education, sometimes in exchange for a service obligation; and (3) research collaboration, in which the Department pays for research conducted at a college or university, building a direct relationship with students and professors.

1) Internship programs

The Department currently has multiple internship programs. Each program offers temporary employment to students and recent graduates, with the potential for full-time employment following successful completion of the program:

- The government-wide **Pathways Internship Program**, managed by the Office of Personnel Management, is designed to provide "students in high schools,

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[60] *Source:* www.ai.mil/careers.html.

[61] *Source:* www.gotomeeting.com/.

[62] *Source:* https://usahire.opm.gov/assess/default/sample/Sample.action.

colleges, trade schools, and other qualifying educational institutions with paid opportunities to work in agencies and explore Federal careers while completing their education."[63] This program is complemented by a parallel program for recent graduates (within 2 years of completing a degree program).

- The **DoD Centralized Intern Program (DCIP)** provides paid internships for college students from 2- and 4-year accredited institutions of higher education with a goal of exposing participants to real-world experience in multiple disciplines that support the Department's national security mission.

- The **College Acquisition Internship Program (DCAIP)** for the DoD acquisition community is a 10-week paid summer internship program that targets college sophomores and juniors with a focus on STEM for "hands-on, practical experience in analysis, research, report writing, oral briefings, policy development, program analysis, and computer applications."[64] This national program aims to place at least 5 students in each participating activity to ensure a critical mass of students at each location. Students are recruited for the summer but may return for additional work during the school year and school breaks.

- The **Army STEM Student Employment Program (SSEP)** provides mixed periods of formal education and employment over 1 to 4 years for students in STEM fields. Participants may work full-time or part-time, year-round or during summers between academic terms. Students must be able to meet OPM's professional and scientific requirements.[65]

- The **Army Education Outreach Program Undergraduate Research Apprenticeship Program (AEOP-URAP)** provides an educational stipend for undergraduate STEM internships mentored by scientists and engineers at Army Research Laboratories and Centers across the country.[66]

- The **Air Force Premier College Internship Program (PCIP)** offers 500 full-time, 10- to 12-week summer positions at Air Force locations around the country to college juniors and graduate students with solid academic records who pursue degrees in accredited colleges and universities.[67] PCIP provides opportunities in

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[63] https://www.opm.gov/policy-data-oversight/hiring-information/students-recent-graduates/reference-materials/pathways-programs-handbook.pdf; https://www.dcpas.osd.mil/EC/DoDPathwaysPrograms.

[64] https://www.hci.mil/DoDcareers/internship.html.

[65] https://armyciviliansandtcareers.recsolu.com/external/requisitions/P7DN359MJugDLdmhNjI_WQ. In addition, individual Army commands offer their own internship programs, such as the Innovative Student Internship Program (ISIP) offered by the Army Combat Capabilities Development Command Chemical Biological Center. See https://www.cbc.devcom.army.mil/careers/internships/.

[66] https://www.usaeop.com/program/undergraduate-apprenticeships/.

[67] Paid full-time summer internships; https://afciviliancareers.com/student-roa/.

functional areas from personnel to logistics but focuses particularly on recruiting students in science and engineering.

- The **Air Force Research Laboratory (AFRL) scholars program** offers stipend-paid internship opportunities "working with full-time AFRL scientists and engineers on cutting edge research and technology" projects for undergraduate and graduate students who pursue STEM degrees.[68]

- The **Naval Research Enterprise Internship Program (NREIP)** is a 10-week, paid internship program for undergraduate and graduate students to participate in research, under the guidance of an appropriate research mentor, at a participating Navy laboratory.[69]

- The **National Security Innovation Network (NSIN) X-Force Fellowship** program places undergraduate and graduate students with demonstrated technical or entrepreneurial experience on military bases for 3 months of applied problem-solving on technical, strategy, and research issues with the objective of delivering prototype capabilities by the end of the summer.[70]

These programs are complemented by a handful of high-school-level internship programs and graduate-level fellowship programs that extend the work-study pathway to full-time employment in both directions. High school programs include apprenticeships offered by the Army's Educational Outreach Program, the Navy's Science and Engineering Apprenticeship Program, and the Air Force's Wright Scholar Research Assistant Program that we discussed earlier. Post-graduate fellowship programs, such as National Defense Science and Engineering Graduate fellowships, generally provide scholarships as well as temporary employment and are separately addressed in the section on scholarships.

Each internship program is designed to offer a pipeline to full-time employment, providing access to young people with critical skills that the Department might otherwise have difficulty accessing. One group of Army interviewees explained that internships are a critical tool to build relationships with potential recruits before graduation, reaching people while they are young and impressionable and still considering a wide variety of options for the future. Interviewees from colleges and universities confirmed this point, telling us that internships are offered by a wide variety of employers in the public and

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[68] *Source:* https://afrlscholars.usra.edu/.

[69] *Source:* https://nreip.asee.org/details. In addition, individual Navy commands sponsor their own internship programs, including the NAVAIR internship program, the NAVWAR cybersecurity/information assurance program, the NAVSUP internship program, and the NRL internship program. *See* https://www.onr.navy.mil/en/Education-Outreach/HBCU-MI-Historically-Black-Colleges.

[70] *Source:* https://www.nsin.us/x-force/.

private sectors and that over 80 percent of students engage in at least one such program before graduation.

2) Advantages of internship programs

DoD officials and other stakeholders we interviewed confirm several significant advantages of internship programs.

First, internship programs expose students to the work and the mission of the Department, making them aware of civilian employment and career development opportunities of which they would otherwise be unaware. One interviewee told us that an internship may be the first exposure to the Air Force for a student who does not have family members who have served in uniform. Another stated that internships provide the Army with an opportunity to impress the student—to show that the Army is a place to learn and grow and has a mission to be excited about. A third explained that internships create a link between a student and the Department, giving students a better feel for what they want in the workplace.

Interviewees from colleges, universities, and affinity groups confirmed that exposure to the work environment is a key element of the internship experience. One interviewee told us that the better the internship experience, the more likely that a student will stay with federal employment in the face of higher salary offers from private sector competitors. A second stated that students want to optimize their work experience, and that students who get to do real technical work with deliverables are much more likely to return on a full-time basis. Another interviewee told us that the best internships involve actual job practice, because many interns have no idea what type of job they will like until they try doing it.

Second, internship programs allow the Department to assess the talent and the fit of potential recruits before they are hired on a full-time basis with civil service job protections. One DoD interviewee characterized internships as a "try before you buy" approach, providing an extended period in which to evaluate a candidate before offering full-time employment. A second stated that internships provide an opportunity not only to find out whether a student is a good fit in the organization, but also to place the student in various jobs and determine where he or she is the *best* fit. Interviewees from private sector organizations confirmed that internships provide an opportunity to identify the best talent, and not all interns get permanent job offers.

Third, internship programs enable the Department to train and educate students before they begin full-time employment, making them better prepared and more productive employees. Several DoD interviewees told us that their internship programs include training features that play an important role in developing capable employees. In addition, early employment through internship programs enables many students to obtain security clearances before they start full-time work, enabling them to engage in productive work

from day one. Both DoD interviewees and outside stakeholders confirmed that the ability to obtain a security clearance at an early stage is helpful to both employer and employee and can be a major selling point for an internship program.

DoD officials we interviewed reported both a high level of satisfaction with the quality of participants in internship programs and a high percentage of interns returning as full-time employees. For example, the Air Force reported a return rate of 80 to 85 percent for participants in its PCIP program, while the Missile Defense Agency told us that its return rate was close to 90 percent. Interviewees from colleges and universities confirmed that a very high percentage of their students who participate in internship programs receive permanent job offers and that most (but not all) students accept those offers. One university official reported that more than half of the university's students had previously worked as interns for the organization that hired them full-time. In the absence of systematic data collection, however, we could not assess the overall employment rate for participants in DoD internship programs.

3) Drawbacks of internship programs

Internship programs appear to be an extremely effective recruiting tool, but they are expensive. Not only does the Department have to pay salaries and/or stipends for interns, but participating organizations have to spend resources to manage the interns by providing them with needed training, guidance, and mentorship. Some programs are centrally funded, like the acquisition community's DCAIP (funded through the Defense Acquisition Workforce Development Account (DAWDA)), the Army SSEP (funded by "Big Army"), and the Air Force PCIP (centrally funded by Headquarters, Air Force). Because of budget limitations, however, such centrally funded programs generally have a limited number of slots, which must be rationed among participating organizations.[71] This problem is likely to be exacerbated as headquarters budgets, central funds like DAWDA, and local operating budgets are all squeezed in an era of tight budgetary pressure.

In addition, the large number of internship programs, each with its own funding structure and participation rules, means that gaps and overlaps likely exist among programs, with some organizations well-resourced and others underserved. For example, the funding flexibility afforded to the Department's Science and Technology Reinvention Laboratories (STRLs) appears to ensure that the defense laboratories can maintain robust internship and fellowship programs, while organizations like Army Futures Command

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[71] In addition, program-specific rules may impede participation. As discussed in the section on hiring, few DoD organizations participate in the government-wide Pathways internship program, because the program precludes the use of DHAs. Similarly, the ARL apparently chooses not to participate in the Army SSEP program (despite the fact that the internships are centrally funded), because SSEP internships are hired into GS positions, which are inconsistent with the pay-banding in ARL's unique personnel system.

struggle to find funding for similar programs. The Department has not engaged in any systematic planning for its internship programs and does not even appear to systematically collect and assess data to understand what populations these programs serve and how well the programs work. In the absence of such data, it will be difficult for the Department to determine whether existing money is being spent well and where additional investments would be beneficial.

Finally, DoD internship programs do not always compete well with top-line private sector programs, many of which are better funded and appear to provide better facilities, better training opportunities, and more extensive broadening experiences. Interviewees from colleges and universities told us that DoD internships are often publicized and sometimes are announced too late in the year to be useful for students. Some outside organizations, including defense contractors, appear to have better visibility in college STEM programs than DoD. Others, like Google, Amazon, Microsoft, and Facebook, carry more prestige and cache. Perhaps for this reason, interviewees from the Missile Defense Agency (MDA) told us that they do not even try to offer internships in computer science. Rather than trying to build their own talent, they assume that they will have to contract with industry partners for software development work.

4) Scholarships and fellowships

The Department uses scholarships and fellowships to pay for the undergraduate or graduate education of students working to acquire critical skills. Some scholarships and fellowships require a service obligation—i.e., a commitment to serve in a federal job for a designated period—in exchange for tuition and other benefits.[72] Other scholarships and fellowships are offered to promote research of interest to the Department and do not include service obligations. However, both types of scholarships serve as pipelines to full-time employment.

Two scholarship programs that interviewees consistently referenced are the Department-wide Science, Mathematics, and Research for Transformation (SMART) program, which is targeted largely at undergraduates, and the National Defense Science and Engineering Graduate (NDSEG) fellowship program, which covers graduate students:

- The SMART program pays all educational expenses, including tuition, fees, books, laboratory fees, and room and board for students studying STEM disciplines that, as determined by the Secretary of Defense, "are critical to the national security functions of the Department of Defense and are needed in the

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[72] IDA examined scholarship-for-service programs in two recent papers: Pena et al., "A Comparison of Federal Scholarship-for-Service Programs," IDA Document D-8276 (November 2016); and Pena et al., "Proceedings from the Second Annual Workshop on Federal Scholarship-for-Service Programs," IDA Document NS D-9028 (March 2018).

Department of Defense workforce."[73] Over a 10-year period, from 2006 to 2016, more than 2,000 SMART scholarships were awarded.[74] SMART scholars are expected to work as summer interns for DoD organizations while they are in school. For each year of scholarship provided, the student incurs a 1-year service commitment.[75]

- The NDSEG program pays tuition and fees and a monthly stipend of $3,200 to graduate students pursuing doctoral degrees in 15 science and engineering disciplines of military importance. Since its inception in 1989, NDSEG has awarded roughly 3,600 fellowships in response to almost 60,000 applications.[76] NDSEG Fellowships are administered by the American Society for Engineering Education (ASEE) and sponsored by the Under Secretary of Defense for Research and Engineering and the DoD laboratories. Unlike SMART scholarships, NDSEG fellowships do not carry a service obligation.[77]

The Department also benefits from a handful of more specialized scholarship and fellowship programs, including the following:

- The government-wide CyberCorps scholarship for service (C:SFS) provides scholarships of up to 3 years for undergraduate and graduate education of information technology and information assurance professionals in exchange for an equal period of government service after graduation.[78]

- The National Security Education Program (NSEP) awards Boren scholarships and fellowships of up to $25,000 to undergraduate and graduate students who are "committed to long-term, overseas immersive" study of "the languages and

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[73] *National Defense Authorization Act for Fiscal Year 2005*, Public Law 108-375 (October 28, 2004), Section 1105, E:\PUBLAW\PUBL375.108 (congress.gov).

[74] Pena et al., "A Comparison of Federal Scholarship-for-Service Programs," IDA Document D-8276 (Alexandria, VA: Institute for Defense Analyses, November 2016); and Pena et al., "Proceedings from the Second Annual Workshop on Federal Scholarship-for-Service Programs," IDA Document NS D-9028 (Alexandria, VA: Institute for Defense Analyses, March 2018).

[75] IDA evaluated the SMART program in Balakrishnan et al., "Science, Mathematics & Research for Transformation (SMART) Outcome Evaluation Report," IDA Document D-9262 (Alexandria, VA: Institute for Defense Analyses, September 2018).

[76] https://www.ndsegfellowships.org/about.

[77] The National Science Foundation offers similar graduate fellowships in STEM fields, but they are not tailored to research areas with military applications. https://www.nsfgrfp.org/.

[78] https://www.sfs.opm.gov/. The C:SFS program is similar to the SMART program in that participating students are linked to particular DoD organizations where they work off their service obligation after graduation. Both programs receive strong positive reviews from sponsoring organizations.

cultures most critical to our nation's security."[79] Boren scholarships come with a 1-year service commitment.

- The Naval Sea Systems Command (NAVSEA) scholarship program for outstanding college freshmen studying STEM fields at accredited Hispanic-serving institutions offers benefits including a one-time $10,000 scholarship and student summer employment at NAVSEA.[80]

- The Stokes Educational Scholarship program pays tuition and fees up to $30,000 per year and provides a year-round salary for full-time college students in computer science and related fields who work for a minimum of 12 weeks during the summers at the National Security Agency (NSA).[81]

Our interviewees reported that DoD scholarship programs enable the Department to access critical skills that would otherwise not be available to it.

One interviewee told us that the SMART program is the most effective tool the Department has to access top-tier STEM talent. He asserted that the program is able to be "incredibly selective" because paid tuition is such a big draw for many students. Interviewees from one military department reported that SMART is a "great program" that consistently gets good, high-quality applicants. An official from a different military department stated that "the cream of the crop come out of that program," and that he had never heard a negative statement about anybody coming out of SMART. "People always want more SMART scholars," he concluded. These anecdotal statements are consistent with IDA's findings from previous research that the SMART program attracts students who had not previously considered DoD as a STEM employer, and has improved the quality of the DoD workforce.[82]

Interviewees also told us that the required service commitment does not appear to be a significant deterrent to student participation. Not only is the quality of the applicants extremely high, but interviewees stated that most program participants—roughly 70 percent according to one interviewee—remain with the Department even after the completion of their mandatory service period. The keys, according to another interviewee, are ensuring that students have a choice of where they want to go, putting them in a functional area that they want to work in, and keeping them engaged with the organization

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[79] *Source:* https://www.nsep.gov/content/david-l-boren-scholarship.

[80] *Source:* http://www.greatmindsinstem.org/scholarships/navsea.

[81] *Source:* https://www.intelligencecareers.gov/NSA/nsastudents.html.

[82] Asha Balakrishnan et al., "Science, Mathematics & Research for Transformation (SMART) Outcome Evaluation Report," IDA Document D-9262 (Alexandria, VA: Institute for Defense Analyses, September 2018), iv, vi.

and their cohort. SMART scholars who do challenging work and buy into the mission of the Department are most likely to stay in the long run.

Unfortunately, previous IDA research on this issue shows that although 84 percent of SMART scholars are satisfied with the program and would recommend it to others, the SMART program does not do as well as it should at retaining scholars after the completion of their service commitment.[83] IDA's research indicates that some managers may take SMART scholars for granted because of their service commitment. As a result, some scholars are hired into the civil service at lower salaries than non-SMART new hires in the DoD civilian workforce.[84] Even though higher retention rates would be desirable, there appears to be little doubt that the Department benefits by bringing on talent that it would not otherwise be able to access.

A bigger problem with the SMART program appears to be that it simply is not large enough to meet DoD demand. The Department receives several thousand applicants every year and is able to accept only 300 or 400—a small number to spread across a Department with 750,000 civilian employees—around 160,000 of which are in a STEM occupation. Several interviewees told us that most STEM scholars end up in the defense laboratories, which have more flexibility to pay for them and find it easier to sponsor their research and summer work, leaving a significant gap in other organizations that need STEM talent. As one interviewee explained, "we don't place students where they don't want to be." The challenge facing the Department is whether it can expand the program to meet the need without making it prohibitively expensive and without diluting the talent that has made it so successful.

The NDSEG is a smaller program, tailored to graduate students pursuing doctoral degrees in scientific fields of interest to the Department. Unlike SMART scholars, NDSEG award recipients incur no service obligation. Rather, the Department finds value in its ability to direct research and build the academic community in key STEM fields with military applications. To some extent, the various scholarship programs can be synchronized. For example, Army officials reported that some students move from the SMART program to the NDSEG program and on to research fellowships before joining the laboratory workforce. Overall, however, the number of DoD employees hired directly from the NDSEG program appears to be small. An IDA expert tracked 360 NDSEG recipients 10 years after their program participation. This researcher determined that only 7 percent of recipients were employed by the Department and 30 percent worked for

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[83] Ibid, vi–vii.

[84] Ibid, v.

defense contractors, with an even smaller number taking jobs elsewhere in the Federal Government.[85]

The overwhelming issue with scholarships is that although they can be an effective recruiting tool, they are expensive, costing the Department on the order of $50,000 to $70,000 per student per year for tuition, fees, room and board, and stipends. While this expense may be necessary for the Department to access talent in some highly competitive or specialized fields, these programs are beyond the budget of most DoD components, and cost precludes expansion of these programs to a significantly larger share of the defense civilian workforce.

In 2019, Congress directed the Secretary of Defense to establish a new Defense Civilian Training Corps (DCTC), modeled on the ROTC, to train students for public service in STEM positions in the Department.[86] DoD officials told us that the Department is currently planning for the new program by selecting participating colleges and universities and establishing parameters for students and their studies. These officials expect that the curriculum for the program will focus on STEM applications and challenges of importance to the Department, and that participants will be required to work in paid internships with DoD organizations during summer breaks between semesters. In theory, DCTC scholarships should cost no more than SMART scholarships and should produce equally positive results. The challenge will be developing a course of study that attracts students of the same caliber as the SMART program, and the major limitation will remain its high cost of scholarships.

5) Research collaboration

DoD funding for science and technology research helps build relationships with colleges, universities, and key academic communities, serving as a pipeline for potential future employees. The Department's university research initiatives include a wide range of educational partnerships and cooperative agreements with universities, as well as programs like the Multidisciplinary Research Program of the University Research Initiatives (MURI), the Defense University Research Instrumentation Program (DURIP), the Defense Enterprise Science Initiative (DESI), the Laboratory University Collaboration Initiative (LUCI), and the Bilateral Academic Research Initiative (BARI).[87] They also include numerous cooperative research and development agreements (CRADAs) with partners in industry and academia that specialize in fields such as electronics, cyberspace, sensors,

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[85] Interview with James Belanich, IDA Research Staff Member, October 1, 2020.

[86] Public Law 116-92, *National Defense Authorization Act for Fiscal Year 2020*, Section 860, December 2019.

[87] *Source:* https://basicresearch.defense.gov/.

ordnance, chemical and biological defense, mobility, spectrum, and hypersonics.[88] All of these programs help build relationships that may serve as pipelines for future recruiting efforts. For example, one interview reported a case in which a CRADA relationship with a faculty member at a prestigious university led to meetings with one of her graduate students, resulting in a summer internship followed by a full-time hire.

The Department also funds or participates in a number of targeted collaborative research programs that bring professors and graduate students at colleges and universities into direct partnerships with their DoD counterparts, providing a firm basis for recruiting pipelines. These include the following:

- The government-wide National Research Council (NRC) Research Associateship Programs (RAP), including an associated Air Force Science and Technology Fellowship Program, which offer graduate, postdoctoral, and senior-level research opportunities in scientific and technical fields at sponsoring federal laboratories and affiliated institutions.[89]

- The government-wide Oak Ridge Institute for Science and Education (ORISE) internship and fellowship program, which offers undergraduate and graduate internships and fellowships at the Department of Energy National Laboratories and other federal research facilities (including the defense laboratories).[90]

- The DoD-wide Vannevar Bush Faculty Fellowship (VBFF), formerly known as the National Security Science and Engineering Faculty Fellowship, which awards 5-year fellowships with up to $3 million in funding for senior academics pursing out-of-the-box ideas "where researcher creativity intersects with the unknown."[91]

- The Army's Oak Ridge Affiliated Universities (ORAU) Research Associateship Program (RAP), which partners scientists and engineers from academia and industry with their counterparts at the ARL to pursue technological advances in scientific fields of interest to the Army.[92]

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[88] *Source:* https://aida.mitre.org/ota/existing-ota-consortia/.

[89] *Source:* https://sites.nationalacademies.org/PGA/RAP/index.htm; https://www.nationalacademies.org/our-work/air-force-science-and-technology-fellowship-program.

[90] *Source:* https://orise.orau.gov/internships-fellowships/index.html.

[91] *Source:* https://basicresearch.defense.gov/Programs/Vannevar-Bush-Faculty-Fellowship/#:~:text=The percent20Vannevar percent20Bush percent20Faculty percent20Fellowship percent20(VBFF) percent20is percent20the,ideas percent20where percent20researcher percent20creativity percent20intersects percent20with percent20the percent20unknown.

[92] *Source:* https://www.orau.org/arlfellowship/#:~:text=The percent20U.S. percent20Army percent20Research percent20Laboratory percent20(ARL) percent20Research percent20Associateship

- The Naval Research Laboratory (NRL) Summer Faculty Research Program, which awards 10-week fellowships to work at NRL as summer faculty fellows, senior summer faculty fellows, or distinguished summer faculty fellows. The program specifically anticipates that program participants will "have an opportunity to establish continuing research relationships with the R&D personnel of the host laboratories, which may result in sponsorship of the participant's research at their home institutions."[93]

- The Navy's Rickover Fellowship Program in nuclear engineering, which offers cutting-edge research assignments at Navy laboratories to graduate students majoring in nuclear, electrical, mechanical, and materials engineering or other related fields.[94]

- A number of specialized or local fellowship programs, including the Autonomy Technology Research Center Summer Program at Wright Patterson AFB,[95] the Southwestern Ohio Council of Higher Education Student Research Program at the Air Force Research Laboratory,[96] and the Consortium Research Fellows Program at the Army Research Institute for Behavioral and Social Sciences.[97]

Officials at the defense laboratories told us that these programs not only provide high-quality research partners, they also provide a direct pathway to DoD employment.

Programs that are focused on faculty members build relationships that provide the laboratories an entry into universities that might not otherwise be available. For example, a Navy interviewee reported that professors who work in NRL's summer faculty program often take information back into the classroom that will get students excited about NRL opportunities. Similarly, an Army interviewee reported that faculty relationships enable the laboratories to interact with science and engineering departments at events such as evening receptions in which graduate students participate significantly. University interviewees explained that most faculty do not want to participate in recruiting events of any kind, but

percentC2 percentA0Program,areas percent20of percent20interest percent20and percent20relevance percent20to percent20the percent20Army.

[93] *Source:* https://www.onr.navy.mil/en/Education-Outreach/faculty/summer-faculty-research-program#:~:text= percent20Summer percent20Faculty percent20Research percent20Program percent20 percent201 percent20Levels,and percent20legal percent20permanent percent20residents percent20who percent20hold... percent20More.

[94] *Source:* https://navalnuclearlab.energy.gov/careers/fellowship-programs/.

[95] *Source:* https://www.wright.edu/autonomy-technology-research-center.

[96] *Source:* https://www.soche.org/dagsi/internships/.

[97] *Source:* https://www.consortium-research-fellows.org/about-us#:~:text=The percent20Consortium percent20Research percent20Fellows percent20Program percent20(CRFP) percent20began percent20in,Consortium percent20of percent20Universities percent20of percent20the percent20Washington percent20Metropolitan.

when the faculty themselves are engaged in research partnerships, they become much more open to discussing research opportunities and recommending students from their classes and laboratories.

Other programs focus on academics who are doing post-doctoral research, bringing them on as guest researchers in the defense laboratories, paid through stipends, to work on technological issues that are priorities to the Department. This relationship then works as an on-ramp to full-time employment. The laboratories often look for highly specialized expertise and will often help shape undergraduate theses and doctoral dissertations to advance research in areas of interest to the Department. In some cases, scholarship and fellowship programs give DoD components the flexibility to target students in particular fields, and even to direct their research along paths beneficial to the Department. Employment in the defense laboratories is a logical next step for many program participants, although the laboratories cannot afford to hire them all.

The Army uses this approach to target individuals with specific skills. In many cases, program participants are specifically identified by ARL researchers based on their past work or their association with a professor who has worked with the laboratory in the past. "If ARL wants them, they usually manage to get them," an Army interviewee told us.[98] Army interviewees also described these programs as "good workhorse programs" that have a "good bang for the buck," having shown an ability to bring in top-tier talent over many years. Former post-doctoral students now working for ARL have won awards or been part of teams that have won awards, helping keep ARL research vibrant, we were told.

Similarly, Navy interviewees reported success in attracting students who are then hired as full-time employees. NRL brings students in, provides them experience working with world-renowned engineers and scientists, and then they are "hooked," we were told. According to the interviewees, "the building might be crumbling around them," but the work they are doing is so incredibly important and interesting that they do not want to go anywhere else. The NRL research fellowship programs are not necessarily intended as a pipeline—there is no guarantee that fellows will be hired—but its role as a source of full-time employees is an important side benefit.

University interviewees confirmed that funded work in DoD facilities and on DoD-funded research builds strong relationships and is widely seen as a path to full-time employment. Students love having these opportunities, we were told, and this is a rare area where the Department appears to have an edge over private sector employers. While private sector entities finance some basic research, they do not have as many programs or spend as much money as DoD. The Department faces a major limitation, however, in that many

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[98] Army interviewees told us that the percentage of graduate fellows hired as full-time employees at ARL has ranged from a low of 35 percent to a high of almost 80 percent annually and that these programs are the largest source of the laboratories' new hires.

students pursuing advanced degrees and research in scientific and technical fields are international students who are ineligible for required security clearances.

Other DoD organizations have had mixed results replicating the laboratories' success in building research relationships with universities as a pipeline for new talent. Interviewees at several commands reported that they have been more successful building relationships with local universities than with building a national network. Officials at DEVCOM and NAVSEA told us that they engage with universities through CRADAs. Both commands use these engagements as recruitment venues, in some cases even sending recruiters to research briefings and technical exchanges. These connections have led to some new hires but are not a major source of employees.

However, most non-laboratory commands have limited research budgets and very little funding for scholarships and fellowships. For example:

- Interviewees from Air Force Materiel Command (AFMC) told us that scholarships and fellowships are generally reserved for the laboratories. Because AFRL is subordinate to AFMC, AFMC does get some SMART scholars, but the command has a lot more requirements than it can fill, and "the labs tend to snatch up the best candidates."

- Interviewees from Army Futures Command reported that the laboratories have "home grown" their own university networks and partnerships over several years. Futures Command would like to build a similar network or draw on the ARL network (ARL is subordinate to Futures Command), but it remains a work in process.

- Interviewees from NAVSEA stated that they are trying to get better at hiring post-doctoral students for the warfare centers, but are constrained. Unlike the laboratories, which have direct hire authority and pay flexibility under their laboratory demonstration programs, other NAVSEA components generally must bring new employees into job classifications that do not appropriately acknowledge academic expertise, at GS salaries, and through the clunky USAJOBS hiring system.

- Interviewees from Marine Corps Systems Command reported that they have not yet developed CRADAs or other research partnerships with universities and cannot leverage research to bring on STEM hires. Similarly, an interviewee from Marine Corps headquarters told us that the Marine Corps simply does not have the relationships with academia that it would need to persuade university deans and professors to send potential recruits their way.

- Interviewees from the Joint Artificial Intelligence Center (JAIC) told us that they face challenges as a new organization without established relationships

with universities. The JAIC has tried to build bridges to potential recruits by bringing on a strategic recruiter and using JAIC employees to build relationships with industry and academia. To date, the JAIC appears to have done little to leverage research partnerships and has had little success bringing on employees with technical expertise.

In short, research partnerships are an important recruiting tool that have enabled the defense laboratories to bring on specialized technical talent that they might not otherwise be able to access. However, it is not at all apparent that this tool can be easily transitioned to other DoD commands and activities.

k. Effectiveness of various recruiting methods at the STRL Labs

Although we do not have the data to evaluate how many STEM employees are hired each year through each outreach and recruiting method, the STRL Demo Survey does allow us to see how influential these alternatives are for civilian workforce at the STRLs. Respondents were asked whether any of four DoD outreach or recruiting methods influenced their education or career choices. The options were not mutually exclusive, so STRL employees could respond "Yes" to just one of the options, to all four options, or to any combination of options; 66 percent of respondents answered "No" to all four options. Figure 1 shows the percentage of positive responses for each outreach/recruiting method by education level. We observe that the effectiveness of each method varies by education level. For example, career fairs, websites, and marketing campaigns are most influential for employees with a Bachelor's degree or less: 19 percent acknowledged these programs' influence on their education in career choices. In contrast, only 10 percent of PhD holders thought that career fairs, websites, or marketing campaigns influenced their decisions to join. For Master's students, internship and scholarship programs such as Pathways, SMART, the Student Career Experience Program (SCEP), and Co-Ops are the most influential (14 percent) followed closely by career fairs, websites, and marketing campaigns (13 percent). For PhD holders, STEM education and outreach programs were the most influential (18 percent) followed by scholarship and internship programs (17 percent). Notably, while these amounts are small, there is not enough information to evaluate the return on investment for these programs in terms of the number of STEM employees hired and their tenure relative to the size and cost of these programs.
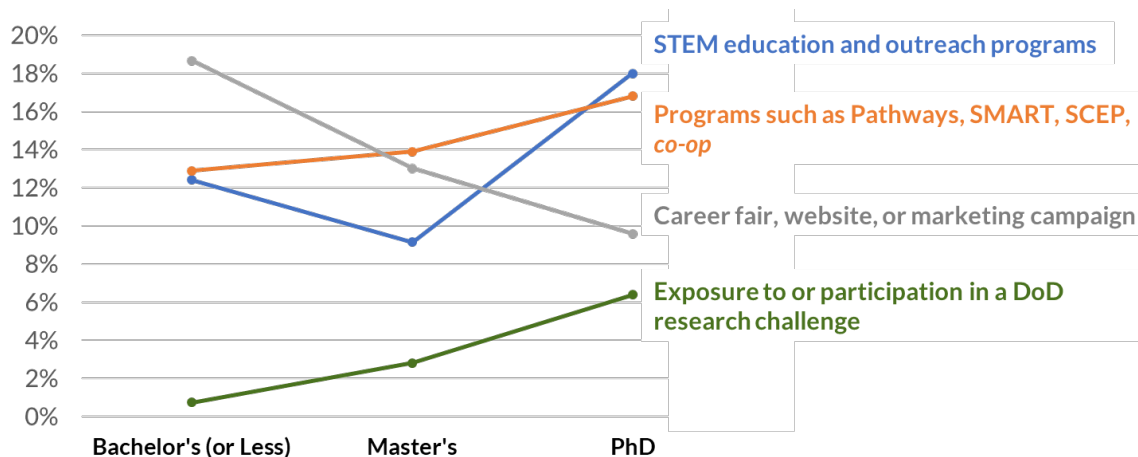
Figure 1. Share of STRL Hires within Past 5 years Answering "Yes" to "Did any of the following [outreach/recruiting methods] influence your education and/or career choices?"

2. Hiring

Private sector employers constantly search for new talent. Continuous turnover in the workforce is both anticipated and planned for: model human capital programs anticipate attrition and begin the hiring process before positions become vacant. One private sector interviewee told us that "if you wait until someone quits to start, you're too late." The key to a compressed hiring schedule is being aware of the talent that is available before the need develops. To this end, one company seeks to build "talent pools" of potential new hires that they can tap into as needed. A second described its investment in "proactive pipelining" for high-demand talent. When individuals with exceptional talent are identified, they may be hired even before a position becomes vacant. One company reports that it has over a million potential job candidates in its database at any given time.

Private sector employers do not limit their "talent pipelines" to recruiting for entry-level positions—they appear to focus at least as heavily on experienced candidates for mid-level positions. One company told us that only 40 percent of its new hires are for entry-level positions. Another reported that it focuses almost exclusively on hiring recruits with work experience and established expertise (and who already have security clearances). This company estimated that only about 5 percent of its new hires come to the job straight out of school.

By contrast, DoD must have a requirement to hire a civilian employee. Requirements are almost always structured around the existing workforce rather than a strategic analysis of the work that needs to be done and how it could best be performed. One DoD interviewee told us that the Department has a limited number of billets, so it cannot build up new positions and capabilities without downsizing in other areas. A second stated that "DoD doesn't do workforce planning well for civilians." The Department has started to assess

new skills and capabilities that it would like to have in its workforce, including cyber workforce competencies, software development roles, and acquisition workforce skills. However, the Department has yet to begin the kind of strategic workforce analysis necessary to assess how much of these skills and capabilities it needs, where they are needed, and what billets should be created or modified to make room for them.

The DoD hiring process is generally reactive: when a position becomes vacant, the Department begins looking for a replacement. A Navy interviewee told us that the Department has no systematic approach to refresh the workforce, with any succession planning depending largely on local managers. An Air Force interviewee reported that the Air Force Personnel Center had asked major commands to identify new requirements and anticipate workforce turnover to generate lead-time for hiring. However, the process did not work well, because the commands could not effectively predict workforce turnover. The result is that positions may be gapped for many months before they are filled. We were told that DoD components do not budget for the full authorized size of their civilian workforces, because they know, based on historical experience, that not all positions will be filled. Even so, funds are often reallocated away from the civilian workforce by appropriators or comptrollers because of "civilian under-execution"—i.e., a failure to fill positions at even the anticipated rate.

Many DoD components seek to mitigate the length and impact of vacancies in senior positions by hiring from within, reducing the time needed for outreach and evaluation of talent. As a result, most outside hiring in the Department appears to focus on entry-level talent. One DoD interviewee told us that entry-level positions are the "main thrust of hiring." A second expressed concern about a "military mindset" of solely focusing on entry-level positions in career fields, stating that the Department needs new talent in mid-level positions, but has not sought such talent efficiently or strategically. A third reported that even where a DoD component decides to fill a senior position from outside, the most likely recourse is to retired military personnel who are already familiar with and to the organization.

The Department's tendency to default to promoting individuals already in the Department's workforce fits well with the traditional model of 20-, 30-, or even 40-year civil service careers. However, it is not clear whether this approach works as well with an emerging-skills workforce that reportedly expects a more diverse set of job experiences. A non-DoD interviewee told us that it really is not possible to fill all needs in complex skill areas like cyber by hiring new employees directly out of school. DoD's tendency to try to "grow everybody" is problematic, meaning that the Department is "throwing people with no background" into complex issues, this individual stated, concluding that the Department needs to develop a better way to access mid-level skills.

Nonetheless, most DoD officials we interviewed expressed satisfaction with the quality of new hires. An Air Force interviewee stated that despite the challenges faced by

the Department, the Air Force seems to get the talent that it needs—even in leading-edge digital skills. A Navy interviewee reported that most hiring managers are satisfied with the quality of job candidates, and that retention has been a greater problem than recruiting. Similarly, an interviewee from the Missile Defense Agency expressed satisfaction with existing hiring flexibilities and stated that hiring managers are generally happy with the quality of new hires. No DoD interviewees expressed a contrary view.

a. Competitive examination hiring and USAJOBS

The default method for hiring new federal employees is through the competitive examination process pursuant to "delegated examining authority" granted by the Office of Personnel Management (OPM). Once a hiring requirement has been identified and a job analysis has been conducted (if necessary), the hiring manager formally requests action from the appropriate delegated hiring manager.[99] The delegated hiring manager then notifies OPM of the job opportunity and provides for its publication through USAJOBS.[100] The job opportunity announcement is required to include the following information:

- Name of the issuing agency

- Announcement number

- Position title, series, pay plan, grade, and starting salary

- Job type

- Duty location

- Number of job openings

- Opening and closing dates for applications

- Qualification requirements, including competencies/knowledge, skills, and abilities (KSAs) or job elements required for successful performance

- Brief description of duties

- Basis for ratings and evaluation of applications

- Description of materials that should be filed

- Description of how to apply

- Information on the application of the veterans' preference

- Definition of "well-qualified" for the purpose of applying preferences

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[99] *Source:* https://www.opm.gov/forms/pdfimage/sf39.pdf.

[100] *Source:* https://www.usajobs.gov.

- Contact person or contact point with a telephone number or e-mail address[101]

An OPM guidebook provides detailed guidance on how to accept and review applications, assess applicants, and certify eligible candidates for selection by the hiring manager.[102]

A Presidential memorandum dated May 11, 2010, established "category rating" as the preferred method for ranking eligible candidates for selection by hiring managers in the competitive examination process.[103] Under this approach, all applicants are grouped into two or more categories in accordance with the evaluation methodology described in the job announcement. The hiring manager may then select any applicant in the highest quality category, except that a "preference eligible" veteran in the top category may not be passed over in favor of another applicant without a detailed justification. Any qualified veteran with a service-connected disability of 10 percent or more must be included in the highest quality category.[104]

The competitive hiring system has been characterized by outside experts as being fundamentally broken. Jeff Neal, the former Chief Human Capital Officer of the Defense Logistics Agency recently wrote that the delegated examining process is "absolutely miserable, and has no room for innovation," characterizing the OPM guidebook as "a good example of taking a statutory requirement to extremes."[105] Multiple independent commission reports share the same conclusion:

- In 2019, the National Commission for Military, National, and Public Service reported that the federal hiring system poses a "formidable barrier to increasing American's participation in public service." The Commission explained:

  Competitive examining, the standard, merit-based hiring process for Federal agencies, is too slow—with an average time-to-hire nearly triple that of private industry—and often fails to advance and hire highly qualified candidates. ...For hiring managers, ineffective qualification and assessment mechanisms often fail to deliver candidates that meet agency needs. These problems are compounded by the current application of veterans' preference, which in some cases allows an individual who was initially rated as 'minimally qualified' to move to the top of the 'best qualified' pool of candidates. According to governmentwide OPM hiring data, more than half of all competitive examining certificates are returned without a hire being

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[101] *Source:* https://www.opm.gov/policy-data-oversight/hiring-information/competitive-hiring/deo_handbook.pdf, 3-11 to 3-12.

[102] Ibid., 4-1 to 6-54.

[103] *Source:* https://www.whitehouse.gov/wp-content/uploads/2017/11/IFRHP.pdf.

[104] 5 U.S.C. §3319.

[105] *Source:* Administrative Changes are the First Step in Civil Service Modernization – ChiefHRO.com.

made—demonstrating the process' inefficiency and its systematic failure to elevate qualified candidates.[106]

- In 2018, the National Academy of Public Administration (NAPA) stated that the system is "increasingly encrusted with regulations, like barnacles on a ship,"[107] provides limited avenues through which to actively recruit and screen talent, and has become "a source of immense frustration to the agencies and to the public and to the Congress." NAPA explained:

Agencies can be inundated with applications to fill a few positions. Spending the resources needed to cope with using USAJOBS can severely limit a human capital office's investment in the many promising talent management practices. ...USAJOBS does not effectively support [the principle of merit hiring], especially because its use can produce a torrent of applications from all over the country, with many if not most coming from unqualified jobseekers.[108]

DoD interviewees uniformly characterized the delegated examining process as an ineffective hiring tool. One Air Force interviewee told us that USAJOBS is a "post-and-pray" approach that uses 1980s technology and does not enable the Department to compete for talent. A second Air Force interviewee stated that the Department is trying to compete with top defense contractors and others in the private sector for high-skill recruits in areas like cyber, and being stuck with clunky and bureaucratic hiring processes does not help. A Navy interviewee said that by the time DoD gets through the competitive selection process, the desired candidate has often moved on and the Department has to find an alternative selection or start the process over again. Similarly, a Marine Corps interviewee reported that it can take well in excess of 6 months to bring a recruit on board under the competitive hiring process and, as a result, top talent is frequently lost to nimbler employers.

Interviewees from private sector employers and from colleges and universities confirmed that DoD has difficulty competing for top talent because it is so slow.[109] One

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[106] Report to Congress of the National Commission on Military, National, and Public Service (inspire2serve.gov), https://www.inspire2serve.gov/sites/default/files/final-report/Final percent20Report.pdf, 64.

[107] NAPA, "No Time to Wait, Part 2," https://www.napawash.org/uploads/Academy_Studies/NTTW2_09192018_WebVersion.pdf, 1.

[108] Ibid., 43.

[109] This finding is consistent with the report of the second Volcker Commission on Public Service, which stated: "Complex and contorted entry procedures stop too many potential applicants in their tracks. Those who apply for jobs in the private sector typically find the application process much simpler and more streamlined and they get responses to their applications much more quickly. Faced with a job offer from a private sector employer in one hand and the prospect of many months of tedious review of their government job application in the other, they make the rational choice to take the sure thing." "Urgent Business for America: Revitalizing the Federal Government for the 21st Century," Brookings Institution Reports (January 2003), 9.

college interviewee told us that nobody wants to look at USAJOBS, calling it a "no-go platform." A second stated that students at career fairs are discouraged when DoD organizations say that they cannot take resumes and that applications have to be submitted through a website that is seen as a "black hole."[110] Perhaps as a result, one DoD organization reported that its most recent class of summer interns were all in their forties and fifties, and multiple interviewees told us that they had stopped using the OPM "Pathways" internship program, which relies upon competitive hiring.[111]

To some extent, the Department has been able to mitigate the time-consuming nature of the traditional hiring system by initiating the hiring process early for graduating students. Interviewees from both Army and Navy commands told us that they begin their recruiting efforts for May graduates in the early Fall, and for December graduates in the early Spring. This 9-month lead time makes it possible to get through all of the hiring hoops on time to bring students on-board soon after they graduate. Even so, multiple interviewees reported that the paperwork required by the competitive hiring process is a "turn-off" for job candidates and that delays in sending offers can result in top prospects taking jobs elsewhere.

Even an OPM representative acknowledged that USAJOBS needs a more user-friendly approach to turn it into a career tool that is favorably viewed by students and other applicants for employment. This individual also reported that OPM research shows that the competitive hiring process is susceptible to being "gamed" by job candidates who are familiar with the occupational questionnaire and know that by exaggerating their experience and providing the right answers, they can place themselves into the highest quality category. A Navy interviewee confirmed that mediocre candidates often rate themselves as experts, placing themselves in the top competitive category even though they are not well-qualified for a position.

The result, confirmed by several DoD interviewees, is that highly skilled candidates may be "blocked" by less qualified candidates with job preferences. Although it is possible to disqualify candidates who have exaggerated their experience, this is a time-consuming process and skilled candidates have often moved on before it can be completed.[112] In some

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[110] This individual also stated that DoD efforts at data mining through USAJOBS can be counterproductive, as students are taken aback when the Department seeks to interview them for jobs for which they never applied.

[111] OPM has suggested making the Pathways program more user-friendly for college students by allowing regional job announcements in lieu of national announcements. However, it is not clear that this change would fully address the concerns expressed by our interviewees.

[112] Interviewees identified preferences for veterans and for service-disabled veterans as the primary remaining "blockers," reporting that recent changes to the Priority Placement Program have provided alternative ways to address other preference categories, such as military spouses and non-displaced overseas employees.

cases, there are so many candidates with preferences in the top category that hiring managers never even get to see other candidates.[113] The assessment process has become so encrusted with counterproductive routine in many agencies that in 2016, OPM felt compelled to issue a "Mythbuster" document refuting widely held beliefs that rating and ranking applicants may be conducted only by OPM-certified examiners, that subject matter experts may not be consulted during the process, and that occupational questionnaires are the only effective tools for ranking large numbers of applicants.[114]

OPM has sought to address this problem by developing new tools to screen employees that go beyond candidates' self-evaluations and require applicants to "clear other assessment hurdles in order to be certified for consideration."[115] These tools include USA Hire online assessments that combine multiple choice and simulation-based tests to identify critical competencies[116] and subject matter qualification assessments such as those piloted by the U.S. Digital Service.[117]

DoD officials who have used USA Hire told us that OPM has an extensive library of occupational and grade-based assessment tests that effectively screen out unqualified applicants and compare favorably to private sector tools. Unfortunately, agencies have to pay OPM to use USA Hire tools, and many components lack funding for this purpose. An OPM interviewee stated that the agency would love to be able to provide these tools at no expense but does not currently have funding to do so. The use of subject matter experts to rank applicants is also an effective approach, but is rarely used—in part because it is so labor-intensive that it is impractical to apply to any but the most skilled positions.

b. Direct hire authority

The new tools developed by OPM to improve the competitive hiring process are underutilized by DoD mainly because Congress has provided the Department with an easier solution to its hiring problems in the form of "direct hire authority" (DHA). DHA is

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[113] NAPA explained this problem: "Applying veterans' preference today can seem like a mechanical procedure. ...As a result, agency managers often believe that they must choose a veteran applicant who they may not be the best-qualified applicant. ...Many managers and human resource staffs have spent considerable time and energy to recruit applicants only to have individuals they have sought to attract be 'blocked' from selection by the presence on the certificate of eligible applicants of a disabled veteran. The tension between the goals of employing veterans and accomplishing the mission has become increasingly sharp."
https://www.napawash.org/uploads/Academy_Studies/NTTW2_09192018_WebVersion.pdf, 44.

[114] *Source:* https://web.archive.org/web/20170209190127/https://www.opm.gov/policy-data-oversight/hiring-information/hiring-excellence/tools-resources/hiring-excellence-mythbusters.pdf.

[115] *Source:* https://www.federalregister.gov/documents/2020/07/01/2020-14337/modernizing-and-reforming-the-assessment-and-hiring-of-federal-job-candidates.

[116] *Source:* https://smeqa.usds.gov/toolkit/getting-started/sme-qa-1-pager.pdf.

[117] *Source:* https://smeqa.usds.gov/toolkit/getting-started/sme-qa-1-pager.pdf.

the authority to appoint candidates directly into the federal civil service without regard to the requirements of the laws and regulations governing the competitive hiring process. Agencies with DHA must comply with the merit systems principles and appoint qualified candidates, but are not required to follow OPM procedures related to ratings, assessments, and certifications. In particular, neither the veterans' preference nor category-rating procedures apply to direct hiring.[118]

Under longstanding federal law, OPM may authorize an agency to exercise DHA after determining that there exists a severe shortage of candidates or a critical hiring need.[119] OPM policy requires that an agency application for DHA include workforce planning and analysis, assess employment trends, identify nationwide or geographic skills shortages, and document recruiting efforts and other agency efforts to address a shortage.[120] Over the years, OPM granted DHA to federal agencies for categories of employees including economists, biologists, physical scientists, mathematicians, and actuaries. More recently, OPM has granted DHA for several categories of STEM and acquisition positions, including computer scientists and cyber professionals.

Nonetheless, OPM is widely perceived as having been slow to respond to critical hiring needs in federal agencies.[121] As a result, Congress has become impatient with the federal hiring process and has increasingly bypassed OPM to authorize DoD and other federal agencies to exercise DHA without prior approval.[122] By 2019, so many separate provisions had been enacted providing DHA for parts of the DoD workforce that Congress decided to consolidate them into a single legislative provision.[123]

DoD interviewees reported that the Department now has DHA for up to 90 percent of STEM positions, enabling components to develop streamlined procedures for most critical skills hiring. Several defense agencies told us that they use DHA for almost all outside hires, reserving traditional competitive processes for internal promotions. Interviewees from the military departments took note of numerical or percentage limitations on some

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[118] There is some variation between different DHA authorities—for example, some forms of DHA require the publication of job announcements in USAJOBS, while others do not. However, DoD officials we interviewed did not see confusion over these variations as a significant impediment to the use of the authority.

[119] 5 U.S.C. §3304(a)(3).

[120] Title 5 of the Code of Federal Regulations (C.F.R.), §337.204.

[121] OPM pointed out to us that it can grant DHA only for existing occupational series, so it is not well-positioned to respond to emerging needs for STEM skills in areas like software engineering, artificial intelligence, and data science.

[122] For example, 10 U.S.C. §1705(h) as added by Section 833 of the *National Defense Authorization Act for Fiscal Year 2009* (direct hire authority for defense acquisition workforce).

[123] 5 U.S.C. §9905.

forms of DHA, but indicated that DHA is the predominant mechanism for hiring STEM professionals. Some said that they rarely use USAJOBS for any hiring actions anymore.

1) Advantages of DHA

The overwhelming consensus among DoD officials we interviewed is that DHA has substantially expedited the hiring process and made the Department more competitive in the market for STEM and other critical skills.

Army interviewees reported that they are now able to make on-the-spot tentative job offers during recruiting activities such as career fairs, affinity group events, and even virtual events undertaken during the pandemic. The Army now sends teams including human resources professionals, hiring managers, and subject matter experts to some of these events to ensure that prompt action can be taken. In many cases, a final offer can then be made within a week or so after the recruit provides the required paperwork. One Army interviewee characterized DHA as a "godsend," because the Army can expedite the evaluation process and actively recruit through Facebook, Linked In, and other commercial platforms, rather than relying on passive posting in USAJOBS. A second told us that his organization uses DHA all of the time because flexibility is critical and DHA is "the fastest in the federal government." A third stated that DHA makes the hiring process several months faster and that without it the Army could not compete with the private sector at all. "We'd be in real trouble," the interviewee concluded.

Navy interviewees also reported that verbal tentative offers have become much more common as DHA authority has expanded. With the delegated hiring process, it could take more than 6 months to make a tentative offer, making the offer largely worthless. Under DHA, hiring managers and subject matter experts work directly with HR offices to identify a candidate, provide a letter of intent, and start the paperwork within a few days. These tentative offers almost always turn into formal offers unless a problem is encountered in the security clearance process. One Navy interviewee told us that DHA had reduced hiring times in her command from 120 days to just 57 days. A second called DHA a "gamechanger," because it empowers front-line organizations to engage in targeted recruiting and build relationships and pipelines with promising recruiting sources. Others stated that DHA is particularly effective for younger employees and may be the difference between a candidate accepting a Navy position or going to one of its competitors.

Similarly, Air Force interviewees told us that DHA hires are roughly 30 percent faster than traditional hires through USAJOBS. Marine Corps interviewees stated that DHA provides flexibility to hold local hiring events and actively recruit for civilian positions rather than going through USAJOBS. As a result, the Marine Corps can move faster and hire candidates that it could not previously get. Finally, an interviewee from a defense agency reported that the agency can now on-board new employees within 37 days after the

point of selection, because formal processes have been streamlined and the agency can negotiate job offers in-house.

Representatives of colleges, universities, and affinity groups generally agreed that DHA makes the Department a more effective competitor in the student job market. One interviewee told us that first offers tend to have the greatest weight with most students. At the least, job candidates tend to feel loyalty to the first employer to offer a job; some will take the first job that they can get. A second agreed that students are often primed to accept the first job offer that they get and often have to be coached to be more deliberate. A third stated that students tend to be risk averse and are often reluctant to wait on a potential employer to respond when they already have a job offer in hand.

2) Drawbacks of DHA

Despite these reported advantages, there were indications that the Department is not yet taking full advantage of DHA authorities.

Some organizations have started to use DHA without fundamentally changing their hiring processes—just "doing the same thing faster." For example, a Navy interviewee told us that many hiring managers do not know how to look for new hires without advertising through USAJOBS, so they do pretty much the same thing that they did before, using the same processes to identify job candidates and process applications. An Army interviewee reported that hiring through USAJOBS is cumbersome with a lot of time-consuming bureaucracy, but that DHA (at least as applied) is not necessarily much better. Similarly, an interviewee from a defense agency reported that even with DHA, the agency takes an average of 150 days to make a job offer. Hiring officials are risk averse, the interviewee explained, so they still make job announcements through USAJOBS. In these cases, DHA may be used to avoid veterans' preferences, but the overall time to bring a candidate on board remains about the same.

Other organizations may be reluctant to use DHA at all. For example:

- An OSD functional community manager told us that many human resources professionals do not know how to execute DHA and are "terrified" to use it. As a result, they often veto the use of DHA, claiming that it does not apply. Since hiring managers do not know the authorities either, they may just give up and agree to a traditional hiring approach. Similarly, an interviewee from a defense agency told us that some agency officials "are very used to looking at USAJOBS" and use it in hiring for both technical and non-technical positions.

- One Army interviewee told us that many hiring managers are "old school," with deep experience with delegated examining authority that leaves them skeptical of new hiring flexibilities and makes it a challenge to sell them on DHA. A second reported that his command routinely defaults to delegated examining

authority for most new hires, utilizing DHA only on a case-by-case basis for a handful of positions. A third stated that DHA is sometimes used for "by-name requests" for particular skill sets, but is otherwise rarely applied.

- An Air Force functional manager told us that neither hiring managers nor human resources professionals know how to attract talent. They are comfortable with the old system, so they still default to it, relying on delegated examining authority and "post-and-pray" methods. Recent guidance from senior leadership has directed maximum use of DHA, but it remains a challenge, with only a handful of tentative job offers made over a period of several years. An Air Force human resources professional reported that the use of DHA is generally up to the individual manager, and she generally opts to utilize traditional competitive hiring processes.

- Navy interviewees were generally more positive about their commands' use of DHA. However, interviewees from the Naval Research Laboratory, which should have had access to DHA for 2 decades pursuant to their authority for laboratory demonstration projects, reported that they are only starting to phase in DHA over the last few years as new, broader authorities have been enacted by Congress. A Marine Corps interviewee stated that DHA is an effective tool, but the Marine Corps does not yet use it widely.

One potential problem with DHA is that if it is misused, it may undermine the merit principles that serve as the basis for federal employment. For example, an OPM interviewee expressed concerns about the potential for misuse of DHA, not only to avoid the veterans' preference but also to target hiring to specific candidates without providing a fair opportunity to others.

Representatives of the federal employee unions were particularly outspoken on this issue, pointing to transparency and process measures like public announcement of job openings and the formal rating and ranking steps required in the delegated examination system as being vital to avoid abusive practices. One union representative expressed concern that DHA may undermine the ability of the veterans' preference to carry out our societal commitment to take special care for those who have served in the military. Another raised the risk of nepotism, pointing to a case in which a senior official in a non-defense agency had used DHA to hire his girlfriend into a senior position. If DHA is misused in just a small percentage of cases, the interviewee stated, it could still lead to thousands of bad hires.

Even the use of DHA to compete effectively at college job fairs and make on-the-spot offers came in for criticism from union representatives, who asked why one college was chosen for such treatment and not another, and why current members of the federal workforce were not given an opportunity to compete for the positions. Officials who want

to hire quickly are likely to follow their gut instincts, one interviewee stated. This means that they are likely to give in to subjective intuition and prioritize personal connections to colleges and other sources of recruits, hiring people who look like them but not necessarily the best qualified. As a result, a second interviewee concluded, the use of DHA for on-campus recruiting and hiring "completely circumvents the merit system."

DoD interviewees reported that DHA is generally handled by broad agency teams, including human resources professionals, to guard against individual biases and inappropriate hiring practices. Even so, our interviews provided evidence that the union concerns are not entirely unfounded. One Army interviewee reported that DHA is sometimes used when a hiring manager already has someone in mind to hire. A second stated that DHA can be used for "by-name requests." Similarly, a Navy interviewee reported that DHA candidates may be identified through transparent mechanisms like public postings and job fairs, but they can also be identified through collaboration with individuals in the academic community, referrals from coworkers, connections made at conferences, and other personal connections. While these targeted hiring approaches were reported to have been used to identify individuals with highly specialized technical skills in areas like quantum technology and artificial intelligence, there remains a potential for misuse.

On the other hand, numerous interviewees stated that DHA is used as a conscious tool to build diversity in the workforce. In particular, many DoD components use DHA to make targeted job offers at affinity events sponsored by groups like the Society of Hispanic Professional Engineers and the Society of Women Engineers, or at job fairs held by Historically Black Colleges and Universities (HBCUs) and other minority-serving institutions (MSIs). For example, our interviewees reported that:

- The Army Combat Capability Development Command does extensive recruiting at affinity events and at HBCUs and MSIs.

- The Army Research Laboratory has dedicated funds to conduct recruiting activities at HBCUs and MSIs and at affinity group events.

- The Naval Research Laboratory has been able to hire significantly more women and minorities with DHA than through traditional competitive hiring procedures.

- The Naval Sea Systems Command makes extensive use of DHA to enhance diversity by hiring at affinity events.

- Most of the recruiting budget of the Naval Education and Training Command goes to diversity efforts, targeting MSIs.

- The Air Force Material Command uses DHA to make tentative job offers at minority job fairs and other affinity events.

- The Air Force Personnel Center puts significant efforts into building enduring relationships with HBCUs and MSIs.

As a result, NRL interviewees reported that the percentage of women hired as interns went from 17 percent to 29 percent, and the percentage of minority hires went from 20 percent to 26 percent in just 2 years after NRL transitioned to DHA. Other interviewees indicated that the change for the Navy as a whole has been much more limited, with female hires up by less than 1 percent and veterans' hires down by several percent (but still robust), since DHA has become more widespread. More importantly, it appears that more positions are being filled—and more quickly—with quality candidates.

To gain a better understanding of how much DHA is being used in the DoD and its effects on diversity, we used monthly civilian personnel data files from April 2017 to June 2020 compiled by the Defense Manpower Data Center (DMDC). In these data, we are able to identify the employee's occupation, gender, veteran status, occupation, and the legal authority code under which the employee was hired.[124] We identified STEM hires according to the fields documented by the National Science Foundation (NSF) as STEM fields of study.[125] Since we are most interested in recent trends in STEM hiring, we restricted the dataset to include individuals who were hired since April 2017.[126]

Figure 2 and Figure 3 show the percentage of STEM occupations and the percentage of non-STEM occupations that were hired with DHA. DoD organizations have increased their usage of DHA for both STEM and non-STEM new hires from FY 2017 to FY 2020. However, the share of STEM hires using DHA is about twice as high as the share of non-STEM hires using DHA.

Figure 4 shows the share of new STEM hires that are direct hires by gender. Overall, we see that the share of direct hires increased for both genders from 2017 to 2020. While the overall growth is substantially similar between the two genders, we do observe that the

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[124] DMDC codified legal authority information using a three-digit alphanumeric string based on OPM data standards (i.e. BAC, P2M). Of the many three-digit alphanumeric string values, two of them specifically identify direct hire authorities: AYM (direct hires according to OPM authorization) and Z5C (direct hires according to DoD authorization). Given that understanding, we classified direct hires as individuals who have AYM or Z5C in their legal authority data fields.

[125] Namely, chemistry, computer and information science, engineering, geosciences, life sciences, materials research, mathematical sciences, physics and astronomy, psychology, and social sciences (i.e., archeology, economics, geography, and political science). https://btaa.org/docs/default-source/diversity/nsf-approved-fields-of-study.pdf NSF Approved STEM Fields.

[126] We identified the hire date based on service computation date, which OPM identifies as a date "used to determine benefits and is generally based on how long the person has been in the Federal Service." Office of Personnel Management, *OPM: Policy, Data, Oversight – Personnel Documentation*, Chapter 6: Creditable Service for Leave Accrual, https://www.opm.gov/policy-data-oversight/data-analysis-documentation/personnel-documentation/servicecreditleave.pdf, accessed February 2, 2021,

use of DHA grew a bit faster for women (from 27 percent to 58 percent) than for men (from 31 percent to 56 percent) over that time period.
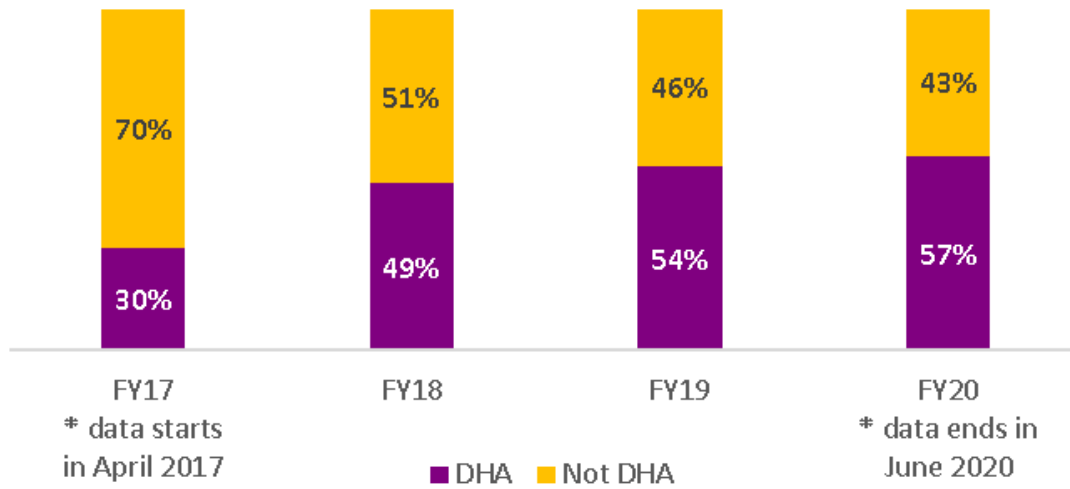

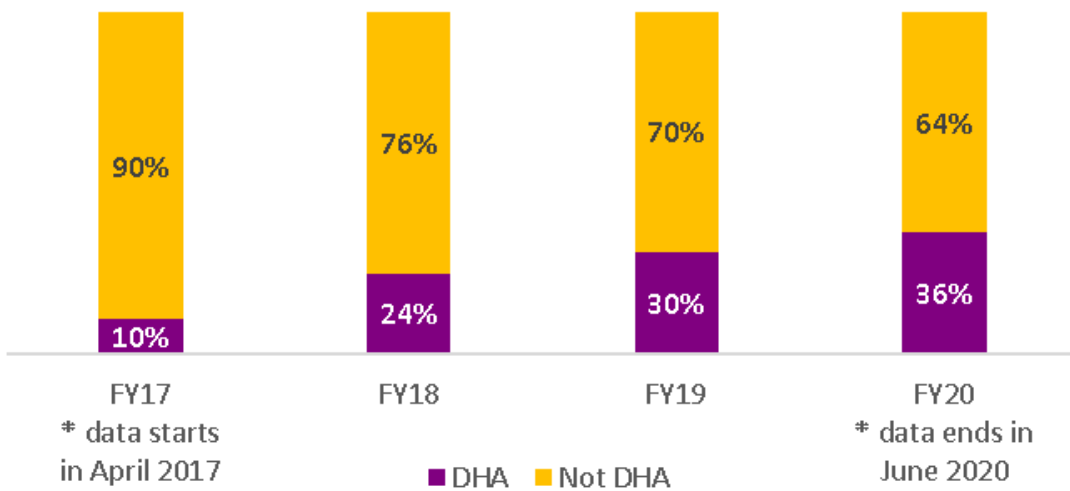
Figure 2. Use of DHA in STEM Occupations

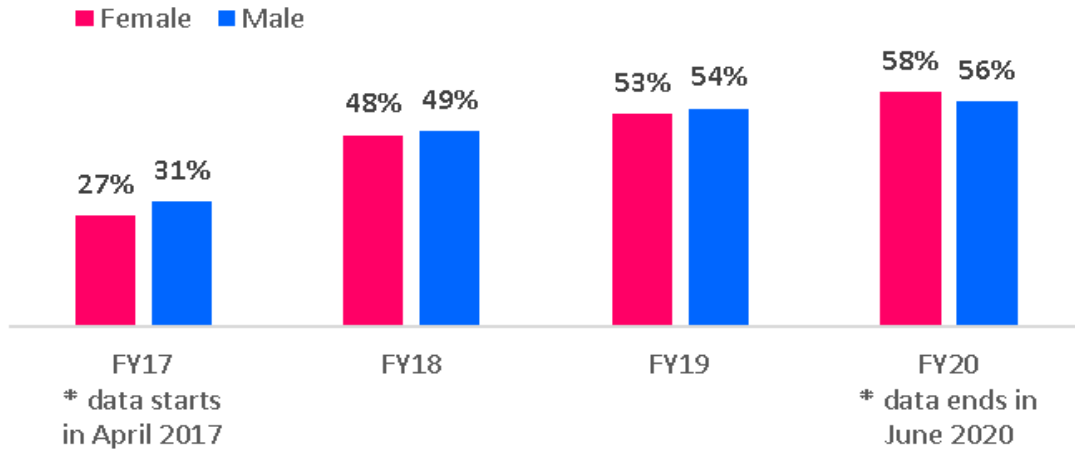**Figure 3. Use of DHA in Non-STEM Occupations**

Figure 4. Percent of Female STEM New Hires Who Are Direct Hires vs. Percent of Male STEM New Hires Who Are Direct Hires

We also see interesting trends when we sort the data by fiscal year and by service. As depicted in Figure 5, if we examine the percentage of STEM direct new hires by fiscal year and by service, the Fourth Estate does not appear to show any conclusive percent increase from FY 2017 to FY 2020. In contrast, each of the Departments, on average, show an observed increase in the percent of STEM direct hires from FY 2017 to FY 2020. However, as Figure 6 shows, if we look at the share of STEM direct new hires who are female by fiscal year and by service, it appears that the Fourth Estate agencies have shown a marked percent increase in utilizing direct hire authorities for hiring female STEM workers from FY 2017 to FY 2020. On the other hand, in the case of the services, the percent in utilizing direct hire authorities for hiring female STEM workers remains constant from FY 2017 to FY 2020.
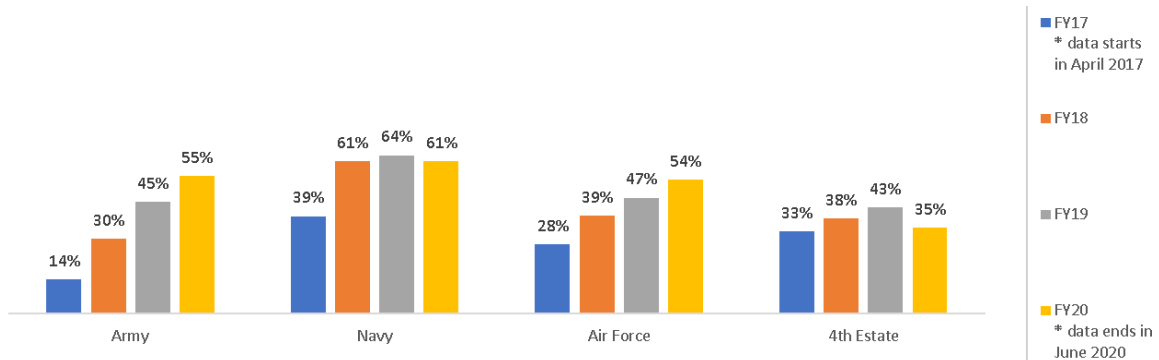
Figure 5. Percent of STEM Hires Who Are New Direct Hires, by Fiscal Year and Department
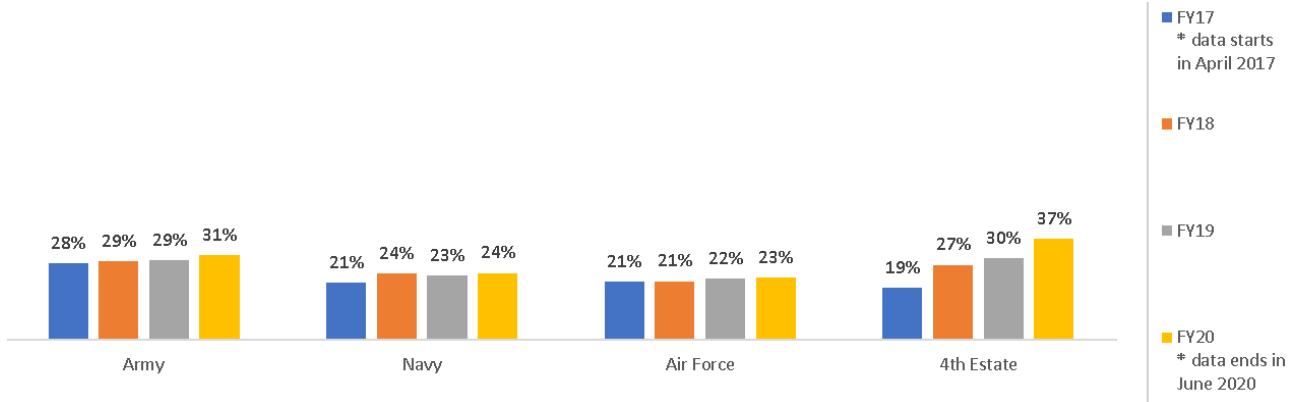
Figure 6. Percent of STEM Direct New Hires Who Are Female, by Fiscal Year and Department

Finally, we examined the use of DHA among veterans and non-veterans. Figure 7 shows that non-veterans are much more likely to be hired using DHA than veterans are. Likewise, in Figure 8 we see that veterans make up a larger share of non-direct hires than they do direct hires. For example, in the first half of 2020, veterans were 10 percent of non-direct hires but only 4 percent of direct hires.

Figure 7. Percent of Vets Who Are New Direct Hires vs. Percent of Non-Vets Who Are New Direct Hires

3% 7%   3% 8%   3% 10%   4% 10%

FY17   FY18   FY19   FY20
* data starts   * data ends in
in April 2017   June 2020

Figure 8. Percent of Direct Hires Who Are Vets vs. Percent of Non-Direct Hires Who Are Vets

c. DoD hiring challenges

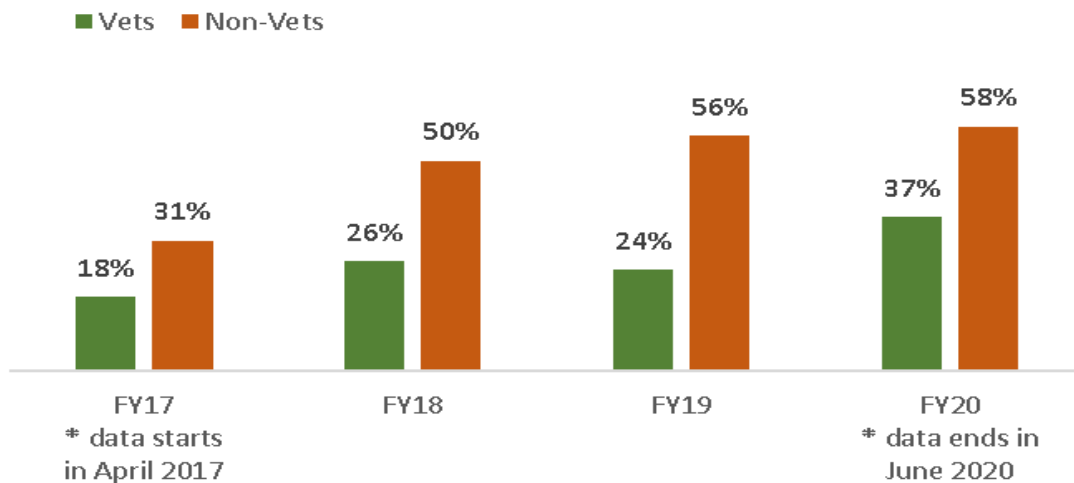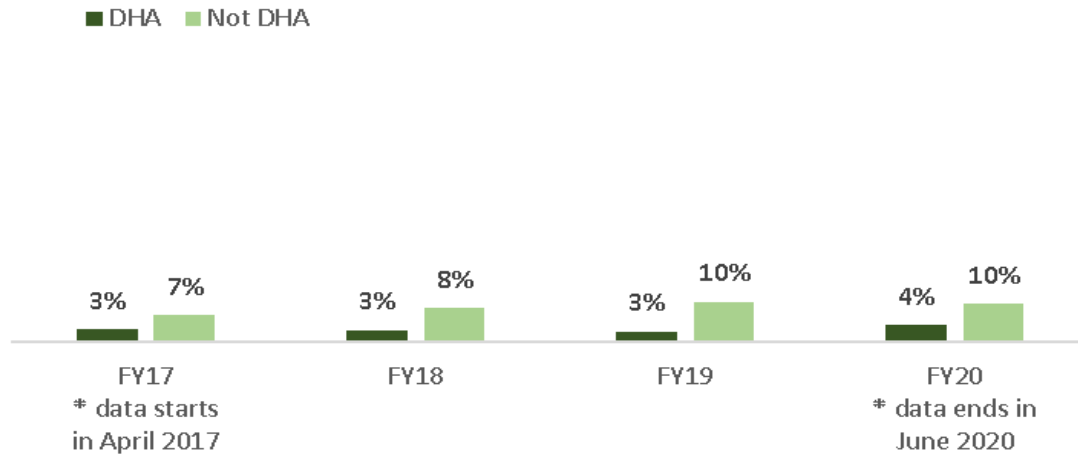DoD officials we interviewed identified three significant hurdles they face in trying to keep pace with their competitors in the search for talent: (1) bureaucratic delays and inefficiencies; (2) security clearances and related issues; and (3) the difficulty of competing on salary. Each of these is discussed in turn.

1) Bureaucratic obstacles

The federal civil service system has been characterized by many outside observers as a bureaucratic morass. The National Commission on Military, Public, and National Service reported in 2019 that "For many applicants, the experience of applying for a job at a Federal agency differs substantially from that at private-sector employers, and too frequently those who may be most qualified are deterred by bureaucratic requirements and processes."[127] Non-DoD interviewees with a stake in the hiring process concurred that paperwork requirements and administrative delays may discourage students from looking for federal jobs.

Army officials expressed particular frustration at bottlenecks in the hiring process. Hiring managers in one command told us that hiring individuals with critical skills has been undermined by apathy in the HR processing staff, siloed communications, and the overall lack of an integrated human capital strategy. For example, problems have arisen with outdated job descriptions when HR people say that the applicants do not match the

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[127] Report to Congress of the National Commission on Military, National, and Public Service (inspire2serve.gov), https://www.inspire2serve.gov/sites/default/files/final-report/Final percent20Report.pdf, 64.

job description, leading to wasted time and effort. In some cases, it can take 6 months just to process the paperwork for a new hire, and top candidates will not wait 6 months. As a result, the command has resorted to work-arounds, such as "parking" qualified candidates with contractors as a holding place while their paperwork is processed.

Part of the problem appears to be that the Army Civilian Personnel Advisory Centers (CPACs), which process the hiring paperwork, are chronically underfunded and understaffed. Interviewees in one command reported that the CPACs have been understaffed for as long as they can remember, leading to routine 3- to 4-week delays in the processing of new hires. These officials stated that their local CPAC has all that they can handle and are doing the best that they can. An interviewee at a different command attributed processing delays to the fact that the CPACs in general are under-resourced and over-worked. An interviewee at a third command stated that processing requests may sit untouched for 2 or 3 weeks at the local CPAC, because there are so many applications and competing priorities.

Other interviewees attributed delays to a lack of expertise in the CPACs, especially when it comes to accessing critical skills with unique hiring authorities. One interviewee reported that the CPACs are "lacking in knowledge" and need better training on how the staffing process works. Others stated that employees at the CPACs are well-versed in the standard competitive hiring process, but do not have good awareness of special authorities available to the defense laboratories and the defense acquisition workforce. This lack of training and education on special pay and hiring authorities has led to pushback against direct hiring and delays in salary negotiations, resulting in months of delays and losing out on quality candidates. Some interviewees stated that the Army is working to address at least part of this problem through the creation of a separate cell that will specialize in unique acquisition workforce authorities. Others, however, expressed frustration at the apparent inability of some CPACs to prioritize critical hires.

Navy officials told us that the paperwork steps required to process an application take so long that a candidate has often moved on to other opportunities by the time they have gotten to the point of a job offer. However, Navy officials asserted that their customer-centric civilian human resources operations centers are better attuned to functional needs and authorities than the Army's more centralized CPACs. For example, the paperwork processing for cyber hiring is now concentrated in a single group at the Norfolk operations center, while laboratory hiring is concentrated at the Silverdale, Washington, operations center. This structure enables the operations centers to work closely with hiring managers to keep abreast of developments and come up with creative hiring solutions. Backlogs remain a problem, but interviewees indicated that the operations centers have prioritization systems and workload-sharing protocols to ease bottlenecks.

Air Force officials reported that delays in the processing of their hiring requests have been significantly alleviated by realigning the work so that employees processing the

requests would be familiar with the unique requirements and authorities of a specific command. Other frustrations remain, however. One Air Force interviewee told us that the Department remains resistant to online recruiting tools, discouraging approaches that offer access to needed talent because of concerns about hacking issues that are reinforced by a change-resistant culture. Others stated that rigid classification requirements for jobs in the government-wide General Schedule (GS) system remains a significant impediment to critical skills hiring. In particular, outdated OPM requirements for course and credit hours for certain grade levels pose an obstacle to hiring STEM candidates with needed technical skills at appropriate pay levels.

Marine Corps officials reported similar problems with GS classifications that do not align well with job requirements, particularly in emerging areas like software development, software engineering, and computer science. The Marine Corps has also experienced issues with HR processing organizations that did not have a full understanding of the flexibilities available under the acquisition demonstration program and other unique hiring authorities. However, interviewees stated that the Marine Corps is in the process of standing up organization-specific human resources teams that will work directly with hiring managers to understand existing flexibilities and expedite the hiring process.

The larger defense agencies, which have the ability to process their own hiring actions, did not report major backlogs or delays to us. However, smaller defense agencies echoed concerns heard from the military departments about both classification issues and bottlenecks in HR processing. One Fourth Estate interviewee reported that the problem is exacerbated by the need for defense agencies and field activities to compete with each other for attention from outside HR processing authorities.

2) Security clearances and related issues

When asked about sources of frustration in the hiring process, numerous interviewees referred to security clearance issues as "agonizing" and "persistent" despite multiple efforts over a period of decades to streamline the clearance system.

Officials from multiple Army commands told us that the security clearance process remains their biggest obstacle to a timely hiring process. One command stated security clearances are "where the hang-ups are" for STEM students, many of whom are likely to have had extensive foreign contacts that must be addressed. A second reported that a large number of their positions require top secret (TS)/sensitive compartmentalized information (SCI) clearances, which can take as long as 1 year to complete. A third reported that it had lost good candidates as a result of delays in the security clearance process—and that the problem is particularly acute for candidates with critical skills who can make more money in the private sector. Once a security clearance has been completed, one official noted, there do not tend to be a lot of other "long poles in the tent."

Army officials have taken multiple steps to try to work around the security clearance problem. Several officials stated that they have started to use more interim clearances, accepting some risk to bring new hires on before a full review can be completed. Several more told us that they see internship programs as opportunities to get security clearances in place prior to an offer for full-time employment. One command will sometimes hire an individual into a temporary position that can be performed with a lesser clearance as a holding strategy until a TS/SCI review can be completed. Another command tries to pare down clearance issues and weed out potentially problematic candidates by having HR managers conduct their own reviews prior to initiating the formal security clearance process.

Interviewees from defense agencies also reported significant hiring problems attributable to the security clearance process. One defense agency official characterized the clearance process as "unpredictable," a second called it "cumbersome," a third stated that it remains the "main impediment" to STEM hiring, and a fourth expressed disappointment with security officials who have been unable to significantly streamline the system. Bottlenecks can be even worse, one interviewee noted, when a polygraph is required.

Our other interviewees were more optimistic about the difficulties caused by the security clearance process. One Navy official stated that security clearances are not a huge impediment to hiring, although it is important to maintain a good relationship with the security department to ensure that the process runs as smoothly as possible. An Air Force official reported that fingerprinting, drug testing, and physical examinations have been a higher hurdle than security clearances. One Marine Corps official told us that the security clearance process remains "a choked system," but another stated that his command has not lost any job candidates because of the security clearance process (although some have started work without the ability to do the full scope of their jobs due to lack of clearances).

3) Competing on salary

Finally, DoD officials reported that federal pay scales make it difficult for the Department to compete with private industry salaries—particularly for employees with critical STEM skills in areas like software development, data science, artificial intelligence and cyber. For example:

- One Army official told us that just hiring anybody in fields like artificial intelligence and machine learning is difficult, and the Department cannot hope to match the $150,000 to $180,000 salaries that Google is offering for top college graduates. A second Army official noted that pay issues are exacerbated for facilities in expensive urban areas that have high concentrations of potential private sector employers. A third stated that salary is the reason most frequently cited for declining job offers. All agreed that the Army will never be able to

compete on salary alone, and that those who accept offers do so in significant part because they want to contribute to the mission.

- Navy officials at two different commands reported that it is difficult to recruit civilians in fields like artificial intelligence and cyber, where private sector competition is most acute. Regional issues exacerbate these problems, as potential job candidates in Keyport, Washington, have to compete with big-name organizations that are 30 minutes away in Seattle; a narrow talent base makes it difficult to recruit engineers for Pearl Harbor; and a high cost of living makes it difficult to hire and retain even lower-grade employees in New York City.

- Air Force officials reported that pay differential is an issue and that even organizations with flexible pay authorities cannot match private industry salaries.

- A Marine Corps official stated that the GS system is not built to compete for critical skills in the current economic environment. Employees in fields like software and cyber who view pay as an important consideration are likely to go the private sector; even if the Department is able to hire them, they are at risk of being "poached" once they have shown a capacity for performance.

- An official from a defense agency with a high-tech workforce stated that the Department is not able to compete with private sector salaries. In some highly competitive fields, job candidates have turned down significant recruiting bonuses, because they do not want to make even a 6-month commitment to stay in a DoD position.

As they try to cope with salary competition that they cannot match, some DoD officials express the view that the traditional federal model of hiring employees for a 30- or 40-year career is unlikely to work in cutting-edge STEM fields. One DoD official told us that "most kids are not interested" in a long career, but they may be enticed to work on an interesting project, then work on the next one, perhaps staying for 3 to 5 years. A second stated that his organization is "not trying to sell a career." Rather, he hopes to persuade candidates to stay for 2 years, building their credentials and their qualifications before moving on.

Most interviewees took a more optimistic position, asserting that available pay flexibilities enable compensation levels that can, in combination with non-pay factors, attract new hires into the Department's STEM workforce. Once in the workforce, these new hires may be enticed to stay by challenging assignments, belief in the mission, and a favorable work environment. These officials told us that pay flexibilities such as alternative pay authorities and bonus authorities are an essential ingredient in any effort to access critical skills in the civilian workforce.

Officials across the Department reported that they have successfully used supplemental compensation incentives such as recruitment, relocation and retention bonuses, student loan repayments, and advanced education programs to attract new hires with critical STEM skills. For example, multiple Air Force officials told us that GS salaries are not competitive at the entry level, but start to catch up with industry in about 3 years. To bridge this gap, the Air Force may offer to repay up to $30,000 in student loans, provide recruitment bonuses of up to 100 percent of a new hire's first-year salary, and pay relocation costs.[128] This package, which comes with a significant service obligation, makes Air Force compensation competitive with industry and draws much better candidates for critical STEM positions.

Similarly, officials from a defense agency with a high-tech workforce reported that they have a budget of up to $40,000 that they can use for recruitment, relocation, and retention bonuses to attract talent in hard-to-fill positions. Army officials reported that they have gotten a good "bang for the buck" on recruiting efforts by using student loan repayment authority and authorities to pay for advance degrees (both of which come with service commitments) to attract recruits in key career fields. One Navy official told us that the student loan repayment program can be an important recruitment incentive, but it has to be targeted because the Navy cannot afford repayment for all new hires. A second Navy official stated that her organization's higher education, sabbatical, and rotational programs are important tools for both recruiting and retention. Interviewees from outside the Department agreed that the federal student loan repayment program can be an attractive recruiting tool for debt-burdened students.

Unfortunately, a squeeze on civilian personnel funding, led by dramatic reductions in the Defense Acquisition Workforce Development Account (DAWDA), has made it increasingly difficult for DoD components to fund these needed recruiting incentives. An Army official told us that the DAWDA has been an essential tool for bringing new talent into the workforce, and his biggest concern is whether the Department will be able to continue to make progress without this funding source.[129] Air Force officials in two different organizations stated that the Department had used millions of dollars of DAWDA funds to pay for recruiting and relocation bonuses, as well as student loan repayments, necessary to recruit engineers and other critical skills. The recent cuts to DAWDA will mean that there will not be as many dollars available as in the past, decreasing recruiting

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[128] These officials noted that they do not have the authority to pay recruitment or relocation costs for summer interns, a factor that discourages students who cannot afford to move across the country and pay for rental housing to participate, and makes it challenging to maintain geographic and racial diversity.

[129] Several Army officials told us that reductions in funding are leading them to hire more term appointments and rely more heavily on contractors, rather than committing to full-time career employees.

flexibility. Similarly, a Marine Corps official stated that the Department could use more funding for retention, relocation, and recruiting bonuses, but the DAWDA reduction is likely to cramp available funding.

Some DoD components use an alternative route to close the pay gap through special pay authorities that give them broad latitude to pay higher starting salaries for new recruits with critical skills. These include organizations that participate in the laboratory demonstration ("Lab Demo") program, the acquisition demonstration ("AcqDemo") program, and the cyber excepted service. These organizations are authorized to establish "pay banding" systems with flexible pay ranges for employees at varying professional levels.[130] DoD has generally used pay bands to promote "pay-for-performance," which rewards employees who receive better ratings. However, pay bands also enable "market-based pay," which offers higher pay to employees with hard-to-recruit skills.

Army interviewees told us that the GS system is "the elephant in the room," and organizations that have Lab Demo and AcqDemo authority have a significant advantage in accessing talent over other organizations. One interviewee stated that under Lab Demo and AcqDemo, interns in STEM fields can be hired in a DB-1 pay band at $45,000 a year and can be offered relocation bonuses. Recent graduates can be hired in a DB-2 pay band with offers of $75,000 a year common and up to $95,000 a year possible. By contrast, these individuals would be offered a salary in the area of $50,000 a year (GS-7, Step 10) under the GS system. This pay flexibility has made all the difference between competing for top job candidates and losing them to Lockheed and Boeing every time, raising the level of talent by "orders of magnitude."

Other interviewees told a similar story. One stated that when he was hired into a defense laboratory 30 years ago, he had to take a pay cut despite being a top student in his class. Now, the same laboratory can match external offers for new PhDs. Another reported that pay flexibility has meant that the laboratories are able to get the talent they need. A Navy official told us that several employees have moved from commands that lack pay banding authority to commands that have such authority and are able to offer them $5,000 to $10,000 more. An Air Force official stated that the Department would like to extend AcqDemo to additional commands to take advantage of pay flexibility for entry-level hires. Similarly, a defense agency official reported that GS pay levels remain the biggest impediment to hiring, so her agency is trying to move as many positions as possible into the AcqDemo program.

We can observe generally high pay satisfaction among respondents to the STRL Demo Survey who are part of Lab Demo. Figure 9 summarizes how civilian STRL hires within the past 5 years answered the question "Considering everything, how satisfied are

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[130] *Source:* https://acqdemo.hci.mil/initiatives.html.

you with your pay?" About 70 percent of STRL civilian hires within the past 5 years reported that they are either "satisfied" or "very satisfied" with their pay. While this is an indication of a high level of satisfaction, it is important to note that the nature of this survey means we only see responses of individuals who accepted positions at the STRLs. We do not know how satisfied the broader labor market of individuals with these skills would be with pay levels at the STRLs. A better estimate of the effectiveness of STRL pay would require modeling recruiting and retention outcomes—which is beyond the scope of this study.
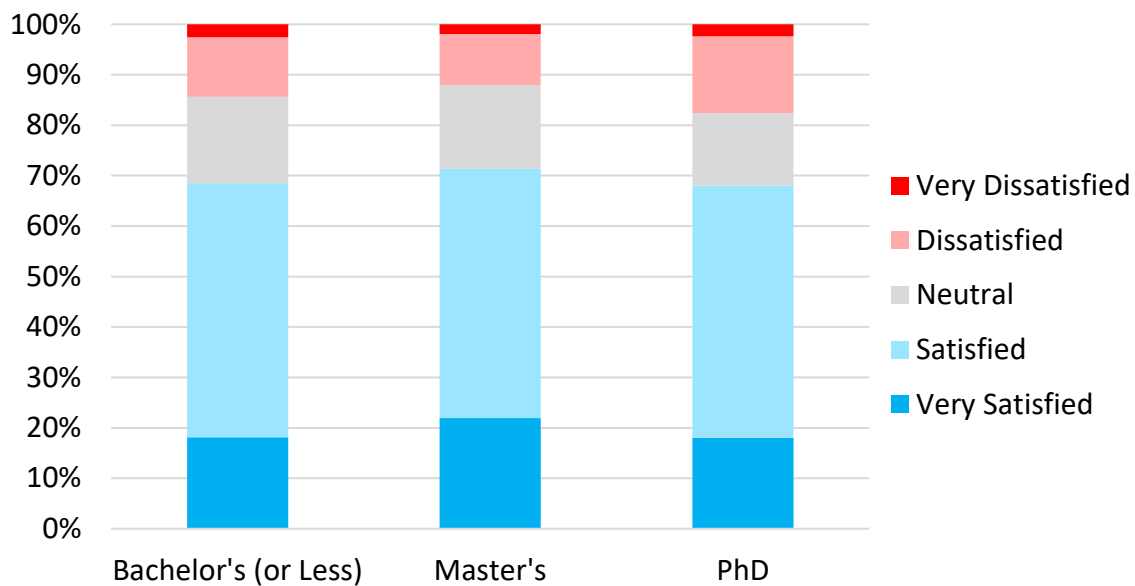
Figure 9. STRL Hires' within the Past 5 Years Responses to "Considering everything, how satisfied are you with your pay?"

From the supervisors' perspective, we observe mostly positive responses to the Lab Demo authorities. For example, Figure 10 shows that slightly more than half of supervisors at the STRLs agree or strongly agree that they have "enough authority to hire people with the right skills when [they] need them" and about 60 percent agree or strongly agree that they are satisfied with the STRL DHAs. Only 20 percent of STRL supervisors believe they do not have enough authority to hire the people they need, and only 10 percent are not satisfied with the STRL DHAs. Likewise, Figure 11 shows that a bit more than half of STRL supervisors agree that they are able to attract and retain high-quality candidates while about one-sixth (16 percent) disagree or strongly disagree that they are able to attract and retain high-quality candidates.
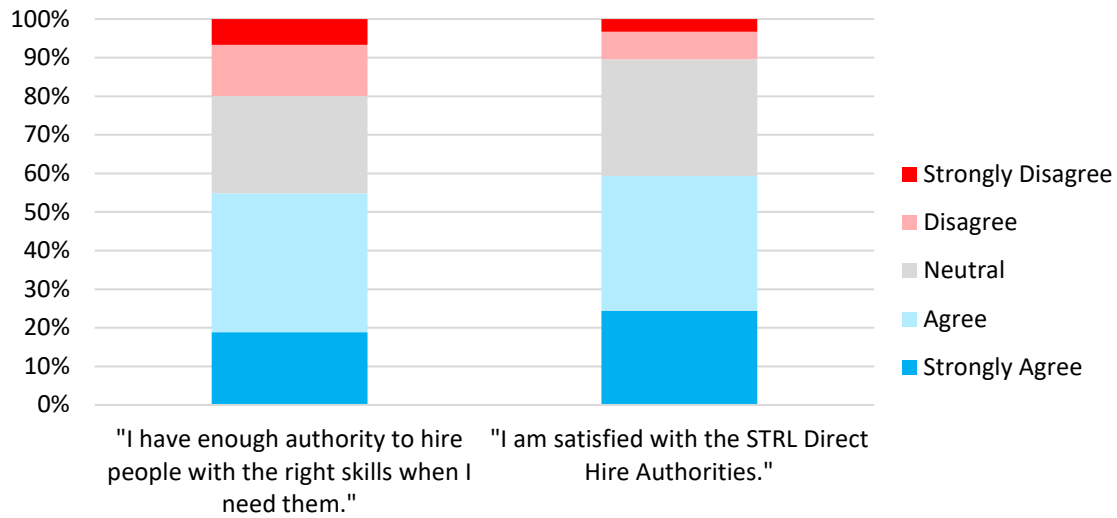
Figure 10. STRL Supervisor Responses to Questions about Hiring Authorities
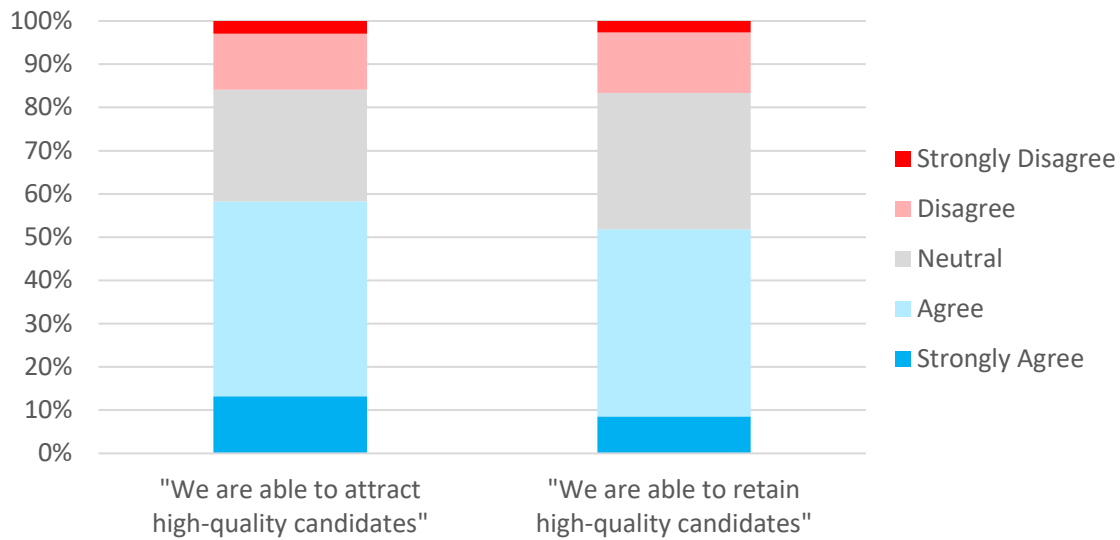
Figure 11. STRL Supervisor Responses to Questions about the Ability to Attract and Retain High-Quality Candidates

The federal employee unions have strongly opposed pay banding systems, limiting the expansion of these programs to the Department's unionized workforce.[131] The unions

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[131] Former Under Secretary of Defense for Acquisition, Technology, and Logistics Jacques Gansler complained more than 15 years ago: "The law allowed me to have a much larger experiment, but because of union opposition it ended up being a much smaller number. ...They lobbied very strongly against even the experiment and lobbied their people against joining the experiment." Tim Kauffman, "Union-Busting, DoD Style," *Federal Times,* February 16, 2004, 1.

have historically opposed pay-for-performance systems because they pit employees against each other to compete for limited salary resources. Union representatives we interviewed reported that the problem with flexible pay systems is the potential for abuse, with higher pay rates awarded to friends, cronies, and employees who tell managers what they want to hear.

However, the union representatives we interviewed emphasized that they are not opposed to higher pay for some categories of federal employees, including entry-level employees, where such pay is needed for recruitment and retention. Representatives of one union indicated that it is open to consideration of market-based pay approaches for critical skills. Representatives of a second union acknowledged that DoD has experienced hiring problems as a result of inadequate pay levels, but asserted that the Department does not need any new authorities to address these problems, because OPM can establish special rates of pay for categories of GS positions when requested by an agency to address difficulties in recruiting or retaining well-qualified employees.[132] The union asserted that DoD has not sought to use this authority to address its recruiting problems.

In fact, it appears that OPM's special pay rate authorities have been used by DoD and other federal agencies primarily to address recruiting and retention problems in areas like Alaska, Hawaii, and overseas locations, as well as specific shortfalls in medical and security positions.[133] It appears that the Department has almost never used special pays to address STEM shortfalls, although government-wide special pays have been approved for computer engineers, computer science specialists, and information technology management specialists.[134] OPM has issued guidance on additional compensation flexibilities available to retain professionals in these areas.[135] DoD interviewees did not reference these authorities, however, so we were not able to determine how widely they are known or how effective they are.

3. Diversity considerations

Maintaining diversity will likely require long-term effort in the form of building relationships with a wide range of organizations. This endeavor will take time but is ultimately essential if DoD is to develop and cultivate a diverse civilian workforce. DoD will face stiffer competition with the private sector for quality diverse candidates with critical skills, making it even more essential to follow recruiting best practices for DoD

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[132] 5 U.S.C. §5305.

[133] *Source:* https://apps.opm.gov/SpecialRates/2020/AllSRTables.aspx.

[134] Special pay rate tables 999B to 999F, https://apps.opm.gov/SpecialRates/2020/AllSRTables.aspx.

[135] *Source:* https://www.opm.gov/policy-data-oversight/pay-leave/reference-materials/handbooks/compensation-flexibilities-to-recruit-and-retain-cybersecurity-professionals.pdf.

recruiting success. The strategies that affinity groups laid out for recruiting a diverse population were consistent with effective strategies to recruit talent in general.

Nearly all of the DoD components we interviewed acknowledged the importance of having a diverse workforce, and most have dedicated resources to that end. Organizations differed in their self-assessments of how well they currently met their diversity objectives, with opinions varying from adequacy to recognitions that specific areas of gender and/or racial makeup were problematic. Gender diversity seemed to be a relatively pervasive issue for DoD, which is consistent with the broader literature.[136]

One organization revealed that OSD has invested almost $50 million for outreach to HBCUs, and almost all organizations had some portion of their recruiting budget dedicated to outreach and recruiting of underrepresented groups. Several organizations mentioned that they spend most of their recruiting resources in some way ensuring diversity targets, whether that was from attending job fairs targeted towards underrepresented groups or through formal outreach programs to HBCUs or MSIs. Further, most community outreach programs run by DoD are in some way aimed at reaching traditionally marginalized groups.

a. Focus on HBCUs, MSIs, and affinity events

The most common line of effort for DoD components that we talked to was attendance at large, nationwide recruiting events for minority candidates, with the National Society of Black Engineers (NSBE) Black Engineer of the Year Award (BEYA) event coming up consistently in our interviews, along with the national conference of the Society of Women Engineers (SWE), Great Minds in STEM Hispanic Conference, and the Women of Color STEM conference. DoD organizations tend to recruit aggressively at these events, frequently using DHAs and making on-the-spot, tentative job offers.

Organizations noted success at these conferences, though some have occasionally experienced low acceptance rates of their job offers to candidates, and a few organizations have had problems with U.S. citizenship. Some organizations had issues with intra-DoD competition, which has led some similar DoD organizations to pool resources and share recruiting teams to reduce competition and present a consistent message. In a similar vein, certain service commands have implemented command-wide diversity strategies to better coordinate efforts.

b. Searching in many ponds

Like recruiting generally, recruiting for diversity requires long-term effort and attention; success comes from building relationships in as many places as possible and

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[136] Shirley M. Ross, Rebecca Herman, Irina A. Chindea, Samantha E. DiNicola, and Amy Grace Donohue, *Optimizing the Contributions of Air Force Civilian STEM Workforce*, Santa Monica, CA: RAND Corporation, 2020, 32, https://www.rand.org/pubs/research_reports/RR4234.html.

building up diversity at the applicant pool level, rather than focusing on hiring minorities for specific positions. There is some evidence internal to DoD that their diversity shortfalls are due to a homogenous talent pipeline. An interviewee from a Naval Command told us that they were hiring Hispanic applicants, for example, at a level above their representation in the applicant pool (3 percent hiring rate versus 2 percent in the applicant pool). They concluded that a lack of diversity in their talent pipeline, rather than systemic bias in their hiring process, was to blame for an overall lack of Hispanic representation.

DoD organizations with more involved efforts to shape their pool of applicants thought about individual outreach as part of a broader diversity portfolio, with visits to the national affinity group events like BEYA comprising just one portion. Other parts of organizations' portfolios include outreach to faculty, career offices, and STEM-related student organizations at HBCUs and MSIs, as well as outreach to the American Indian Higher Education Consortium and specific affinity groups (Society of Women Engineers, Society of Hispanic Professional Engineers, National Society of Black Engineers, and so on).

A leading private sector organization had a similar way of structuring its efforts, ensuring the diversity of its overall pipeline by recruiting from a wide variety of sources. They supplemented this approach with a set of online referral networks for minority candidates provided to them by an external search firm. Some DoD organizations have had success in using outside talent search firms to recruit for hard-to-recruit positions as well, with one organization reporting that nearly all of their minority hires were through an external firm. The Air Force has recently brought that capability in-house via their Talent Acquisition Division, which has been helpful in some cases to find diverse candidates.

Some DoD organizations had extensively put this portfolio approach into practice. One official at a service command mandated that half of their college recruiting be to minority-serving organizations (though this was subsequently pushed down to a third due to service opposition). He also supplemented this method with targeted outreach to a program at a local university that offers scholarships to people with physical disabilities. That being said, this approach was not a universal norm; some other DoD organizations would attend just a few national events to try to recruit the candidates that they needed.

c. Need to remain merit-based

By keeping the focus on building diversity in the pipeline, rather than at the individual level, DoD is likely to have greater success in keeping the process merit-based. This focus on the pipeline is important to the job candidates, as one of our interviewees noted, because people do not want to be hired just because they are part of a minority group; they want to get hired because they are a quality candidate. Having diversity baked into the pipeline also likely precludes several possible issues that arise when organizations apply short-term solutions that fail to consider systemic recruiting shortcomings.

d. Diversity leadership is more important than procedures

Having a diverse cadre of leaders at all levels can help prevent inequities from developing in the hiring process and throughout the organization. As one of our interviewees pointed out, all people have biases; the key is that having a wide range of perspectives, backgrounds, and thinking styles can ensure that no particular bias causes long-term inequities. Diverse leadership, particular at the senior level, has been shown to have other benefits for lower-level employees from underrepresented groups as well.[137]

A former senior executive at a large corporation told us about his company's attempt to diversify its board of executives. The company spent hundreds of millions of dollars cultivating a diverse set of candidates to become the next generation of senior leaders, but were not promoting them to senior positions. Further examination by the company revealed that personal recommendations by the existing, non-diverse executives carried a large weight in the promotion process. The newer cadre of diverse candidates lacked personal relationships with the executives and were not advancing in the executive process. Removing personal recommendations and mandating recruiting from across the enterprise led to substantially increased success in integrating the senior leadership core. The senior executive, however, argued that personal recommendations do not need to be eliminated for a company to successfully diversify, but that the people making these personal recommendations had to be diverse themselves.

Similarly, he noted that most candidates will not have a problem with talent evaluation tools and tests designed to gauge fitness for positions as long as the process is transparent. Rather, the key is to ensure that the people developing and implementing tools are from a wide range of backgrounds. People from varied upbringings do genuinely have different ways of looking at things. If DoD has homogenous groups developing hiring tests, then DoD is likely to screen out people that do not think like existing DoD employees.

e. Barriers to recruiting and retention

There are still a number of barriers to recruiting diverse hires with critical skills into DoD. Some of these are outside of scope for what DoD can be reasonably expected to change, such as an overall lower level of diversity in the STEM field. Some of the problems are within the scope of possible DoD actions and might require just tweaks in DoD recruiting messaging.

First, the STEM field as a whole remains demographically unrepresentative of our country as a whole, and thus diverse candidates are in shorter supply.[138] A number of organizations made this point in our interviews, arguing that diversity targets for DoD

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[137] Ibid., 34.

[138] *Source:* https://ncses.nsf.gov/pubs/nsb20201/u-s-s-e-workforce.

components should be compared to the field more broadly instead of to the U.S. population writ large. However, as one interviewee stated, DoD should not use this justification as an excuse to hold back efforts to build a representative civilian force.

A barrier to diversity in the overall STEM field tends to be completion of the degree itself. Our interviewees stated that women and minorities tend to drop out from STEM programs at higher rates than men and non-minorities. She said that a possible culprit here was imposter syndrome, with minorities and women being more likely to blame themselves for common initial failures such as a poor grade in a difficult early class; some will subsequently not complete the program or will change fields as a result. SWE and other groups assist and support people finishing their degrees; it might help DoD organizations to structure their internship and outreach programs to provide similar support to women and minorities.

Second, some of our interviewees revealed that challenges in the workplace environment can be a major deterrent to candidates from underrepresented groups. SWE found that the top reason that employers do not retain women is because of issues in the workplace climate. Women specifically tend to be less tolerant of misalignment between their own personal values and those of employers. This lower tolerance for misaligned values can be an issue for DoD specifically, as previous research has suggested that female civilians in parts of DoD have experienced challenges with workplace norms.[139] Additionally, some of the interviewees noted that DoD's mission tends not to resonate as strongly with women. Effective messaging highlighting the ways that DoD's mission helps people could prove beneficial with recruiting women, but also with recruiting members of the younger generation (who have expressed similar moral concerns).[140]

Other factors that SWE found include bias and discrimination in the workplace. Overt discrimination broadly is likely underreported but decreasing, though covert discrimination is likely taking its place to some extent. Some examples of potential bias cited by our interviewees include a lack of flexibility to deal with family and home life, unfairness in future opportunities and promotions, and an unwillingness of employers to deal with poor performers. Affinity groups support individuals experiencing these types of issues, with local chapters of SWE and other affinity organizations supporting individuals facing workplace issues, in addition to offering broader networking resources.

An additional source of support in the workplace is employer-sponsored minority clubs. One of our private sector affinity contacts talked about the clubs his corporation started for different underrepresented groups. In the long term, these organizations helped women and minorities develop as leaders, as the clubs offered individuals networking

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[139] Ross et al., 33.

[140] Panayotis A. Yannakogeorgos and John P. Geis II, *The Human Side of Cyber Conflict*, 2016, 104.

resources and initial leadership experience that they might not have received elsewhere. He observed similar effects with student leadership of campus organizations; grooming student leaders can be an effective way of building future leaders. DoD might consider engaging student leadership of minority and STEM organizations at HBCUs and MSIs as a fruitful way to develop future minority leaders.

Internships are another practice that can help women and minorities become accustomed to the work environment at DoD organizations. Specifically, internships with quality work that mirrors the type of work that the students could be doing in future full-time roles are particularly helpful in building early success and confidence. Additionally, supportive mentorship, common activities for the interns, and interactions with leadership have all been anecdotally seen as being beneficial for students.

Ultimately, all of these efforts help to create a culture of inclusion, where people feel valued as individuals. Organizational cultural traits, like a cultural openness to new employees asking questions, can go a long way in helping welcome and integrate people from backgrounds less familiar with DoD culture or white-collar work environments. Other inclusive workplace characteristics include policies that help promote a life outside of work, including flexible hours, telework, and parental leave, which can be beneficial to reducing inequity in the workplace. Having leaders in the workplace who are able to talk about their personal lives, and specifically how they take advantage of family-friendly policies, is important as well. If there is an implicit recognition that using flexible time or other benefits will be a barrier to promotion, retention of women is likely to be an issue, and there will likely continue to be issues with leadership diversity.

f. Strategic picture

Efforts to improve the recruitment and retention of a diverse workforce are not important just for their own sake, as the overall STEM candidate pool continues to diversify.[141] Anecdotally from our interviews, university engineering programs that had one or two Black or Hispanic students now are nearly one-third Hispanic, with gender integration making gains as well. With a critical mass of like peers, these students are able to form communities and networks, both formal and informal, and share information, positive and negative, regarding opportunities and internships. If DoD is to successfully recruit critical skills writ large, it will be at a serious disadvantage if its workforce does not mirror the demographics of the field as a whole.

Universities are cognizant of these changes to the field and are making serious efforts to recruit traditionally marginalized communities into their STEM programs. Some universities offer pre-college programs to bring women and minorities into STEM; some

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[141] *Source:* https://ncses.nsf.gov/pubs/nsb20201/u-s-s-e-workforce.

colleges are going as far as to aim for half of their students being from underrepresented groups. The private sector is taking notice. University career offices reported to us that employers all are coming to their career fairs looking to recruit a diverse pool of students; employers are willing to invest large amounts of resources to have consistent campus presence with minority groups.

In contrast, DoD organizations' strategies are often poorly coordinated and not integrated with the rest of their human capital strategy. Running diversity efforts like special programs, as some DoD organizations tend to do, limits their success. One DoD organization lamented that a poorly integrated diversity program had an exceptionally low return on investment (ROI) of 1 or 2 percent. DoD could benefit from strategically integrating diversity into all of its recruiting efforts rather than attending the national-level affinity career fairs in response to poor annual metrics.

B. Military STEM Recruiting

Unlike civilian hiring, military recruiting is consciously requirements-based. Each of the military services routinely assesses its personnel needs across a period of years, measures attrition, and projects future requirements. These requirements are transmitted to recruiting commands and to recruiters in the field as numerical objectives. Recruiters are not only provided overall recruiting targets, they are also provided high-priority recruiting targets for skills that are in short supply.

The weakness in this system is that requirements are based on existing career paths and skill sets, which may make them backward-looking by omitting emerging new skill requirements. With regard to enlisted recruiting, for example:

- The Army annually prioritizes recruiting for ten high-demand military occupational specialties (MOSs) based on an analysis of attrition and vacancies, and provides special incentives for recruiters in these areas. However, out of more than 150 Army MOSs, only a handful are highly STEM-focused. The Army does not have any MOSs for software development, artificial intelligence, robotics, or hypersonics; some of these skillsets exist in the Army, but they are labelled as something else. As a result, the only STEM categories on the shortage list are cyber and intelligence positions. Army recruiters say that they meet the STEM requirements that they are given, but they cannot meet targets that they do not have. One interviewee told us that the current talent management system constrains the Army's ability to recruit for technical competencies that will be needed in the future: "right now, coders could go into the infantry."

- Navy recruiting is also requirements-focused, based on the Navy's system of "ratings." The Navy has ratings for aviation electronics technicians, cryptologic

technicians, and information systems technicians. Like the Army, however, it lacks ratings for emerging software-related specialties. As a result, the Navy identifies shortages in information warfare and nuclear specialists, but it cannot identify a shortage for a position or skill that does not exist.

- Unlike the other military services, the Air Force has identified a requirement for computer programmers. However, this requirement was identified in the early 1960s based on a specific need for 200 coders for strategic systems and does not appear to have been significantly modified since. Consequently, the Air Force currently identifies an annual need for 220 computer coders, which it is able to meet.

- The Marine Corps recruiting force addresses the requirements that it is given, but all Marines are infantry, and only a few MOSs—such as communications— are tied to STEM, electronic warfare, and software-type skills. Marine Corps recruiters told us that they meet current requirements. However, they cannot say that they fall short of requirements for critical skills because there really is not much of a requirement.

Because the military services are meeting existing requirements for STEM, software, and other critical skills (to the extent that such requirements have been documented), their recruiting commands do not see a need for any special incentives or other measures to improve recruiting in these areas. An Army interviewee told us that under current demands, they do not see STEM as a huge problem because they are "filling the seats." A Navy interviewee stated that they are "content with the technical talent that they have" and do not see a need for special incentives or bonuses. Similarly, an Air Force interviewee did not see a need for specialized bonuses or targeted recruiting for software, because the Air Force gets a lot of interest in the 217 positions it currently offers and does not have a problem meeting the target.

The potential concerns raised by the military services' inadequate efforts to fully identify requirements for STEM-related critical skills may be mitigated at least in part by the military's approach of growing skills rather than recruiting for them. Each of the military services told us that their strategy is to recruit quality and then train and educate the force to build the specialized skills that they need. For example:

- The Army People Strategy states that the Army "must ensure it continually develops its Soldiers and Civilians, not only to place them in positions of greater responsibility but also to ensure their fluency with emerging technology." The Army Futures Command is now developing a 36-month program of training and guided problem-solving to develop software coding talent.

- Navy recruiters reported that they try to sell recruits on the Navy in general rather than on specific jobs, because ratings are not assigned until after

accession and are outside the recruit's control. In general, the Navy looks for the highest quality recruits that they can get, including recruits who score well for STEM on the Armed Services Vocational Aptitude Battery (ASVAB) test. They do not establish requirements for specific skills because they expect to grow those skills once the recruit enters the service.

- The Air Force views itself as the technology service and looks for STEM capabilities in all of its recruits. The Air Force also has a unique Electronic Data Processing Test, which is designed to test for coding skills. However, this test is applied only to a limited number of recruits to fill the small number of coding positions that were identified by the Air Force decades ago.

- Marine Corps recruiters reported that they are focused on recruiting high-quality individuals who want to be Marines and then shaping them into the roles that they will need to serve. With rare exceptions, Marines do not get an MOS assigned until after they have gone through accessions and agreed to serve. Even assessment for skills is mostly done post-accession; it is the training experience, not the selection process, that is expected to provide special skills.

The model of growing skills after accession can be limited by the amount of time available for training. For example, most Marines serve only a single tour, so training requirements must always be balanced against time in the field. Marine Corps officials reported that "Marines Awaiting Training" has been a long-running problem. As a result, the Corps is trying to get away from its model of 180-days of required training and move toward more of a learner-based training model, with more training provided online rather that in brick-and-mortar facilities. While this may be a more efficient approach, it is likely to put increased strain on a system that places maximum emphasis on training rather than recruiting to produce critically needed skills.

The military services generally seek to grow their own skills for officers as well, looking for the best talent that they can find and then building skills through education and training. Almost all officers go through extensive education programs before serving in the field, providing ample time for the development of critical skills. Officers accessing through the military Service Academies and ROTC receive specially tailored training alongside a 4-year undergraduate education, while 3-month Officer Candidate School provides an intensive course of study for those who have already served or have already completed their undergraduate degrees. These programs are complemented by requirements for additional training and continuing military education throughout an officer's career.

However, it does not appear that the military services take full advantage of the opportunity provided by officer training programs to build specialized STEM skills in

emerging areas of need, such as software development, artificial intelligence, and the like. For example:

- Army interviewees reported that 80 percent of West Point cadets are required to specialize in combat arms. In the past, this rule may have forced some officers who were inclined to cyber and other technical specialties to commission in combat arms instead. The definition of combat arms was recently broadened to include officers who commission in military intelligence, cyber, and signals, possibly alleviating this problem. However, most STEM officers come from traditional ROTC programs around the country. While the Army has robust ROTC programs at top engineering schools, it does not generally require undergraduate participants to pursue a particular major or develop a required specialty. Moreover, the Army does a poor job of allocating career fields based on expertise developed through undergraduate study: interviewees told us that performance in 6 weeks of training camp ends up being a more important determinant of an officer's career field than academic performance during 4 years of college.

- The Navy may look at an officer candidate's undergraduate courses and expertise, and sometimes has specific courses that they would like their students to take. In general, however, specialized skills are looked upon as a bonus, not a requirement, except in a few highly specialized areas like cyber warfare, nuclear engineering, and medical professions. Navy interviewees reported that they get more than enough entry-level officer candidates to meet demand, so they get the quality that they need to build required skills in the force. The Naval Reserve is an exception to this rule, generally looking for specific skillsets in new recruits.

- Marine Corps officials reported that they are focused on "raising all boats" by seeking overall qualifications rather than specialized skills in new officers. The expectation is that officers, like enlisted Marines, will develop the appropriate skills training based on the needs of the service once they are in the force. However, the Marine Corps does not drive the coursework of students in the ROTC, because its focus remains more on the overall quality of the force than the development of specific skills. Moreover, advanced training assignments tend to be made on the basis of who applies, while others are made without regard to educational background and aptitude, so the Marine Corps does not necessarily take full advantage of existing talent.

Officials in the military services reported that they face a number of impediments in their search for talent in STEM and other critical skills. An Army interviewee reported that antiquated security clearance regulations raise issues about drug use that may drive away some quality recruits (even though prior drug use is no longer a bar to military service). A Navy interviewee reported it can still be difficult to get access to the names of graduating

high school seniors, and that draft registration is a problematic source since it provides only male names. An Air Force interviewee noted that access to some marketing tools has been limited by legal interpretation of limitations on the use of personally identifiable information. A Marine Corps interviewee reported that the security clearance backlog continues to be problematic, particularly for positions that require a top secret clearance.

In general, however, interviewees expressed greater concern about the difficulty of retaining STEM talent than of recruiting such talent. This may be a natural outcome of a system in which the military services seek to build critical skills in the existing workforce rather than recruit for them. Army officials told us that retention rates for STEM positions are poor: The Army invests significant resources into the development of soldiers, and as soon as they finish their initial contracts, they leave for the private sector where they can make five times as much. Navy officials reported that they are challenged in their effort to retain mid-grade officers with technical skills, because they are always competing with higher paying jobs in private industry. Marine Corps officials stated that the service finds it difficult to retain people with technical expertise who "could get paid a whole lot more without a uniform." Retention bonuses are not large enough to offset the salary advantages the private sector offers, and that situation appears unlikely to change for the next decade or more.

To address this issue, the services must consider their force mix requirements for military, civilians, and contractors with high-tech STEM skills. However, multiple sources report that the Department does a poor job of integrating its military and civilian recruiting efforts to maximize its access to civilian talent. A DoD official told us that there is very little cooperation between military and civilian recruiting programs. An Army official reported that there is a tremendous divide between military and civilian accessions processes, which the Army has tried to bridge without success. An Air Force official stated that the recruiting team is "working towards" a total force recruiting effort in which military, civilian, active, and reserve recruiting forces will develop a strategic partnership and has taken a first step by inviting civilian representatives to speak at some military recruiting events. As of now, however, the Air Force military and civilian marketing and recruiting efforts remain separate.

DoD officials we interviewed noted that military veterans and retirees are a major source of talent for the Reserve elements, the civilian workforce, and the contractor community. However, the Department is not as systematic as it could be in reviewing critical skills among departing members of the military, matching them with DoD needs, and assessing opportunities to retain needed skills in other capacities. Similarly, cadets, midshipmen, and ROTC students who have been educated at DoD expense but are unable to serve for medical or other reasons do not appear to be systematically reviewed to determine whether they could meet their service obligations through civilian service. As a

result, the Department may miss out on a significant source of talent from skilled individuals with a proven propensity to serve.

As the DoD competes with the private sector, the Status of Forces Survey for active duty personnel (SOFA) provides some insights on what factors induce individuals with STEM skills to join the military. Specifically, the SOFA asked service members to "Think back to when you first entered active duty. How much did each of the following contribute to your decision to join?" For this question, service members could answer on a 5-point scale from "Not at all" to "Very Great Influence." We assigned a numerical value to each option with 1 representing the least amount of influence and 5 the greatest[142] and then averaged the responses for service members assigned to the labs and for the total DoD average. While we do not have the answer to the SOFA responses broken out by STEM- and non-STEM occupations, we were able to receive SOFA data with population working at the defense labs separated out. Table 2 summarizes the average influence level for the defense lab population and the DoD average. The first four rows (bolded) in Table 2 are the reasons the Lab population identified as most influential for joining the military; all four have higher average influence scores for the lab population than for DoD more broadly. Notably, these top four rows suggest the factors that most influenced the defense lab population's decision to join the military were intrinsic motivators such as a desire for new experiences, an interest in the mission, challenging and interesting work, and educational opportunities. Monetary benefits such as military pay and signing bonuses were the least influential, and were less influential for the defense lab population than for the DoD population as a whole. While the overall differences between the scores of the lab population are not substantially different than the scores of the DoD population as a whole, the overall pattern suggests that the importance of DoD's mission and interesting work opportunities may be more important in attracting STEM talent than it is for the DoD population as a whole.

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[142] Specifically, we assigned a response of "Not at all" a value of 1 point, "Little influence" a value of 2 points, "Some influence" a value of 3 points, "Great influence" a value of 4 points, and "Very great influence" a value of 5 points.

Table 2. Averaged 2019 SOFA Responses to "Think back to when you first entered active duty. How much did each of the following contribute to your decision to join?"

Reasons for Joining	Defense Lab Average	Total DoD Average
Travel and new experiences	**4.3**	**4.0**
Desire to serve your country	**4.2**	**3.9**
Challenging or interesting work	**4.0**	**3.8**
Money for college, college repayment, education benefits, and opportunities	**4.0**	**3.7**
Security and stability	3.9	3.9
Personal development, growth, and maturity	3.9	3.9
Healthcare benefits	3.4	3.7
Retirement pay	3.1	3.3
Military tradition in family	2.8	2.9
Military pay	2.5	2.8
Signing bonus	2.1	2.2

4. Insights on Critical Skills Programs from the DCPAS Questionnaire

In the DCPAS questionnaire conducted in 2020, respondents were asked to identify the factors that contributed to the success of their programs and the factors that hindered the success of their programs. Categorizing the open-ended responses is a subjective exercise; we formed the categories to capture as many of the applicant's responses as possible. Figure 12 shows the factors that respondents most commonly cited as contributing to the success of these programs, and Figure 13 shows the factors that respondents most commonly cited as hindering the success of programs. The first thing to notice between the two charts is that programs reported many more positive factors (i.e., contributed to success) than negative factors (i.e., hindered success). For example, the most commonly mentioned positive factor—marketing and outreach—was mentioned by 47 programs, whereas the most commonly mentioned negative factor—lack of public awareness—was mentioned only by 7 programs. It is possible that programs targeting critical skills are much less likely to mention any hindrances because these factors are not significant challenges to most programs. However, recall that all programs in the questionnaire answered "Yes" to the question "Was the program effective?" It is plausible, then, that in the absence of objective measurable standards for evaluating the success of these programs, the program managers may be more likely to evaluate any outcome as successful. (Notice, for example, that only three programs cited program monitoring and evaluations as a positive factor.)
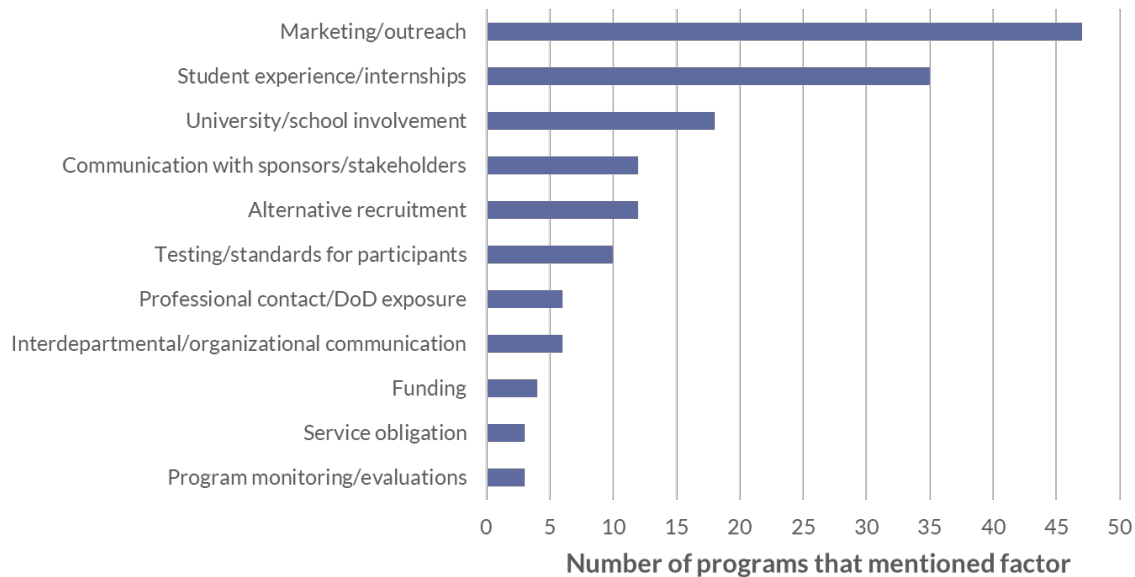
Figure 12. Factors Commonly Identified in DCPAS Questionnaire as Contributing to Success of Programs that Target Critical Skills
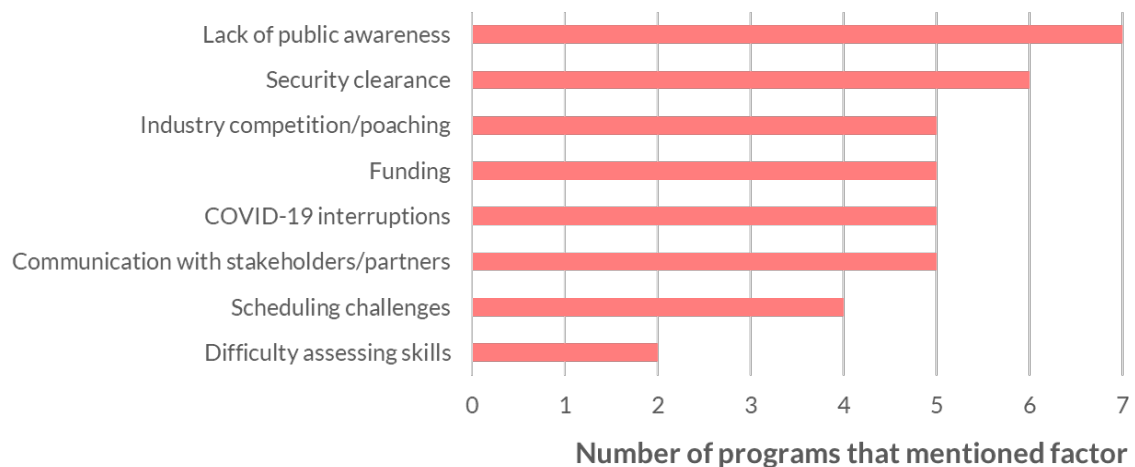
Figure 13. Factors Commonly Identified in DCPAS Questionnaire as Hindering the Success of Programs that Target Critical Skills

Regardless of the frequency with which hindrances are reported, we do see that the factors, positive and negative, cited in the questionnaire are broadly consistent with the themes we heard in the interviews. The three most commonly cited factors that contribute to the success of the organization—market and outreach, student experience and internships, and university and school involvement—highlight the importance of building and sustaining relationships with students and outside stakeholders. The two most commonly cited hindrances—a lack of public awareness and the challenges of acquiring security clearances—were both likewise important insights from our interviews.

The questionnaire also asked respondents to suggest "opportunities to facilitate, enhance, streamline, or enable the program." These responses were again open-ended and can be broadly summarized into six themes:

1. Increase use of and establish best practices for virtual technology

2. Collaborate with other agencies

3. Automate part of the application process

4. Educate stakeholders

5. Clearance help/process immediately

6. Digital marketing campaigns

These responses are also generally consistent with the themes from the interviews and highlight the increasing importance of digital and virtual technology in outreach and recruiting programs. These responses also highlight the importance of building relationships with stakeholders inside and outside the Department.

5.   Special Issues—Languages

In the previous chapters, we assessed DoD's education and recruitment training programs that target STEM skills. In this chapter, we turn our attention to the ability of DoD to recruit individuals with skills in critical languages.

A. Civilian

Foreign language capabilities are a national security imperative that have been historically difficult to address. In 1991, the National Security Education Program (NSEP) was established by the David L. Boren National Security Education Act.[143] The goal of the program was developing a strategic partnership between the national security community and higher education to address needs for critical languages and cultural expertise. Currently, NSEP is the only federally funded effort focused on language proficiency, national security, and the needs of the federal workforce. As such, NSEP is essential in the national security strategy to address language needs in the Federal Government.

Unfortunately, the expertise gaps in critical languages and regions were made salient before September 11, 2001, (9/11)[144] and were a major concern to DoD.[145] In 2005,[146] the Defense Language Office (DLO) was established within the Office of the Under Secretary of Defense for Personnel and Readiness to provide a strategic focus on language needs and capabilities. NSEP and DLO were combined as the Defense Language and National Security Education Office (DLNSEO) to give a single office the ability to address "at a DoD and a national level, the entire linguistic, regional, and cultural spectrum of activity— from public school education to initial foreign language training for civilian and military populations; assessment, enhancement, and sustainment of that training; and the leveraging

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[143] *Intelligence Authorization Act for Fiscal Year 1992*, Title VII of Public Law 102-183.

[144] Office of Inspector General, "CIA Accountability with Respect to the 9/11 Attacks," June 2005, approved for release August 2007, v-xii. This document lead to the Intelligence Reform and Terrorism Prevention Act of 2004.

[145] Prior to the launching of Operation Iraqi Freedom, the Army expected the need for Arabic speakers to be in the hundreds; when 140,000 soldiers initially deployed, only about 20 were found to have a professional mastery of Arabic (John W. Davis, MAJ(R)), "Our Achilles Heel: Language Skills," *Military Review*, March–April 2006.

[146] The 2005 *National Defense Authorization Act House Report 108-491* directed the Secretary of Defense to establish DLO "to ensure a strategic focus on meeting present and future requirements for language and regional expertise among military personnel and civilian employees of the Department."

of international partners."[147] To achieve its mission to lead the nation in recruiting, training, sustaining, and enhancing language and culture capabilities to ensure national security and defense readiness, DLNSEO engages in the following activities:

- Builds a highly qualified pool of U.S. citizens with foreign language and international expertise committed to public service through programs and policies

- Leads the Department's strategic policy planning regarding foreign language, culture, and regional expertise for DoD personnel

- Provides programmatic oversight of high-value national security and Defense training and education initiatives

- Ensures national and Departmental governance through the National Security Education Board and the Defense Language Steering Committee, as well as other organizational and professional bodies[148]

In higher education, DLNSEO's efforts currently include multiple competitive programs to address the language needs of federal agencies: the David L. Boren Programs,[149] the Language Flagship,[150] the ROTC Project Global Officer (Project GO),[151] and the Regional Flagship Languages Initiative (RFLI).[152]

David L. Boren scholarships offer funding (up to $20,000 for 1 academic year) to undergraduate students committed to public service in an overseas immersive language study. David L. Boren fellowships offer funding (up to $24,000 over 2 years) to graduate students committed to public service to develop overseas projects that combine language and culture studies with professional practical experiences. Boren Scholars and Fellows must agree to use the acquired language skill within the government by seeking and securing federal employment for a period of at least 1 year.[153]

The Language Flagship offers grants to U.S. institutions of higher education recognized as leaders in language education[154] in order to provide undergraduate

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[147] *Source:* https://dlnseo.org.

[148] *Source:* www.dlnseo.org.

[149] *Source:* https://www.borenawards.org/.

[150] *Source:* https://www.thelanguageflagship.org/.

[151] *Source:* https://www.rotcprojectgo.org/.

[152] *Source:* https://www.borenawards.org/initiatives.

[153] Of note to increase diversity in the Boren applicant pool, Boren outreach efforts included 200 institutions in 2019 (*National Security Education Program 2019 Annual Report*, 21).

[154] Currently, the Language Flagship offers grants to 31 programs at 21 universities.

students[155] with the opportunity to study one of seven languages.[156] After completing their studies in the United States, recipients participate in a year-long intensive study program that requires language instruction and enrollment at an overseas partner institution, as well as an international internship or work experience. In each of the past 5 years, The Language Flagship has been mostly successful in its goal of graduating awardees with language proficiency at Interagency Language Roundtable (ILR) Level 3 in speaking and IRL Level 2+ in reading and listening.[157]

Project GO offers grants to U.S. institutions of higher education in order to provide language education, regional expertise, and intercultural communication to ROTC students with a focus on languages and countries that are critical to national security. Project GO works closely with Army, Air Force, and Naval ROTC Headquarters. ROTC awards a yearly $18,000 tuition-and-fees scholarship for up to 4 years, and DLNSEO can provide funding for a fifth-year Capstone program overseas and an intensive summer language program to eligible ROTC cadets. In 2019, over 400 ROTC students participated in Project GO.

For use in learning targeted critical languages, the Boren programs and the Language Flagship join efforts in RFLI to offer students the opportunity to be proficient in a critical language through an 8-week domestic summer language study program, followed by an intensive semester-long overseas program.[158]

In the domain of professional education, DLNSEO has a two-pronged approach. The English for Heritage Language Speakers (EHLS) program[159] provides U.S. citizens who are native speakers of critical languages[160] an 8-month long opportunity to achieve both professional-level proficiency in English and the analytical and critical skills commonly needed as a federal employee. This program is very competitive; in the past 3 years, between 16 and 18 participants were selected from a pool ranging between 177 and 330 applicants. Unfortunately, according to one of our interviewees, an ongoing problem resides in the ability of EHLS participants to obtain security clearances.

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[155] Unlike Boren scholarships and fellowships, DLNSEO does not select the awardees. In the Language Flagship program, the higher education institution awarded a grant selects the participants.

[156] Arabic, Chinese/Mandarin, Korean, Persian, Portuguese, Russian, and Turkish.

[157] National Security Education Program (NSEP), *2019 Annual Report*, https://nsep.gov/sites/default/files/NSEP%202019%20Annual%20Report.pdf.

[158] As with Bolen scholars and fellows, students must agree to utilize the acquired language skill within the government by seeking and securing deferral employment for a period of at least 1 year.

[159] https://www.ehlsprogram.org/.

[160] In addition, participants must also a) have obtained at least a bachelor's degree or equivalent, b) have their native language proficiency at ILR Level 3 or higher, as verified through formal testing, c) have an English language proficiency at ILR Level 2, and d) have the intention to work for the Federal Government.

Language Training Centers (LTC) constitute DLNSEO's other prong in the domain of professional education,[161] providing opportunities for current DoD personnel to develop expertise in critical languages, cultures, and regions. Currently, LTCs are located at California State University-Long Beach, Concordia College, George Washington University, Indiana University, San Diego State University, University of Kansas, University of Montana, and University of Utah. In 2019, LTCs trained about 700 DoD personnel in 15 languages.[162]

Recognizing its difficulty in responding swiftly to language needs, DoD pursued an approach adopted and employed by the CIA for other skills after 9/11.[163] As a result, in 2007 DoD launched the National Language Service Corps (NLSC),[164] a readily available group of language volunteers who can provide foreign language services to DoD; in 2018, that support extended to all U.S. federal agencies. The program today can help any U.S. federal agency meet surges in foreign language needs with readily available multilingual U.S. citizens. In FY 2019, NLSC members completed 72 missions representing 34 languages, which represented an increase of 300 percent and 213 percent from FY 2018, respectively.[165]

To overcome difficulties in determining future needs for language capabilities, the Defense Language Steering Committee (DLSC)[166] is tasked with not only recommending and coordinating language policy, but identifying present and emerging language needs, language training, education, personnel, and financial requirements. In the past, language shortages were compounded by difficulties identifying and systematically tracking the DoD inventory of existing language capabilities for both military[167] and civilian personnel.[168] DLSC established[169] the DoD Language, Regional Expertise, and Culture (LREC) Program, whose contributions include asset tracking in Language Readiness Index

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[161] *Source:* https://www.DoDltc.org/.

[162] NSEP, *2019 Annual Report*.

[163] Steve Hirsch, "CIA Effort to Beef up Recruiting Begins to Pay Off," *Government Executive*, August 29, 2003, http://www.govexec.com/dailyfed/0803/082903nj2.htm.

[164] 50 U.S.C. §1913, National Language Service Corps.

[165] NSEP, *2019 Annual Report*.

[166] DLSC is chaired by the DoD Senior Language Authority. Its key stakeholders include the Joint Staff, Military Services, Combatant Commands, Defense Agencies, and OSD Staff.

[167] Post 9/11, certain military schools (e.g., USMA, USAFA, the Air Force Officer Accession and Training Schools) started administering self-assessment surveys, and the results were entered into the Military Personnel Data System.

[168] Until its cancellation, there was hope that the Defense Integrated Military Human Resources System would include that capability.

[169] Under DoD Directive 5160.41E.

(LRI), capability requirements matched to Combatant Command mission essential tasks,[170] and both data standardization and policy synchronization. Of specific use in the Defense Readiness Reporting System, LRI captures warfighters' LREC capability requirements; tracks the DoD foreign language capability;[171] functions as the DoD linguist finder for surge requirements; provides interactive, multiple-criterion, analytic search capabilities for readiness assessment, capability requirements, and inventory holdings; and prepares data systems and users to accomplish regional proficiency analysis.

In exchange for funding support through NSEP, recipients must agree to serve in qualifying national security positions,[172] thereby generating a pool of secondary and tertiary education graduates with competencies in critical languages and regional and cultural studies.[173] Since 2008, NSEP award recipients are required to first seek employment within DoD, the Department of Homeland Security, the Department of State, or any element of the intelligence community. To NSEP awardees, this service obligation also constitutes a career pathway to join the federal workforce. Indeed, as described in the NSEP Student Guidebook,[174] each awardee is offered support from the NSEP Office, tools,[175] and opportunities for service in the Federal Government. In 2019, NSEP scholars and fellows logged 328 service placements, including 85 in DoD. However, an interviewee told us that since NSEP scholars have 3 years to find a position and NSEP fellows have 2 years, it is labor-intensive to manage them to maintain a less than 2 percent default rate.

All recipients of Boren Scholarships, Boren Fellowships, Language Flagship scholarships, and EHLS Scholarships are eligible for non-competitive hire into Federal Government positions. NSEP award recipients with remaining service requirements retain special hiring authorities under Schedule A (Title 5 C.F.R. Part 213.3102 (r)) or NDAA FY 2013 (Section 956 of H.R. 4310-26).[176] Further and at no cost to the hiring organization,

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[170] The Capability-Based Requirement Identification Process (CBRIP) is a standardized methodology for DoD Components to identify LREC capability requirements to inform force development. This methodology allows combatant commands to express their LREC capabilities needs.

[171] For Active, Reserve, National Guard, and DoD Civilians.

[172] These positions can be in the Department of Defense, the Intelligence Community, or the Departments of Commerce, Energy, Homeland Security, Justice, or State.

[173] It is worth noting the large number of Boren and Flagship awardees also studying in STEM fields.

[174] *Source:* https://www.nsep.gov/sites/default/files/NSEP percent20Student percent20Guidebook.pdf.

[175] To include NSEPnet, a web portal used to track awardees' Service Agreement Reports (SARs) and connect awardees with NSEP staff for consultations and support. NSEPnet also offers unique access to search jobs and post one's resume.

[176] Unlike the NDAA for 2013, which offers a conversion option, Schedule A can be used only to appoint to a term position NTE 4 years.

the NSEP office can manage all non-competitive appointments from start to finish.[177] The NSEP office can also advertise both competitive and non-competitive federal job announcements to the pool of more than 5,000 NSEP awardees.

In terms of hiring events, NSEP hosts an annual interagency career fair. In 2019, NSEP awardees were offered the opportunity to liaise or interview with 20 agencies.[178] An interviewee shared that a particularly effective outreach consisted in bringing past Boren awardee hires to job fairs to speak with current Boren scholars.

B. Military

For service members, the Defense Language Institute Foreign Language Center (DLIFLC) constitutes the primary foreign language school, offering resident and nonresident language training on behalf of DoD and the services.[179] Managed by the Army under the U.S. Army Training and Doctrine Command (TRADOC), about 3,000 to 3,500 service members study foreign languages each year at highly accelerated paces in courses ranging from 24 to 64 weeks.

DLIFLC, headquartered at the Presidio of Monterey in California, has a total of eight undergraduate education schools[180] with a satellite office (DLI-Washington) in the District of Columbia. Training at DLI-Washington is conducted through five commercial foreign language schools in the metropolitan Washington, D.C. area, with the office serving three primary functions: (1) to manage the Contract Foreign Language Training Program (CFLTP),[181] (2) to represent the DLIFLC Commandant in the National Capital Region, and (3) to provide training and certification for presidential translators who serve the Washington-Moscow Direct Communications Link (MOLINK).

DLIFLC also offers nonresident training, which consists of classroom training or distributed learning and associated material provided by DLIFLC or non-DLIFLC instructors at a location not designated for resident training. DLIFLC nonresident training

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[177] A hiring guide (*Hiring an NSEP Awardee – Step-by-Step Guide*) is available through www.NSEP.gov. The NSEP Office, however, also offers guidance through the job search, reviews of job application material, workshops, and webinars.

[178] NSEP, *2019 Annual Report*.

[179] Management of Defense Foreign Language Training, Army Regulation 350–20, OPNAVINST 1550.13, AFI 35–4004, MCO 1550.4E, 2018, https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN2627_AR350_20_Web_FINAL.pdf.

[180] They include Middle Eastern Schools, Asian Schools, the European & Latin American School, the Persian Farsi School, and a Multi-language School (created in support of DoD to provide a quick response in establishing new language programs in low-density languages).

[181] CFLTP provides full-time resident instruction for (1) military linguists in low enrollment languages, (2) all Defense Attaché System (DAS) personnel, and (3) language training requirements that cannot otherwise be met through the standard curriculum at DLIFLC.

is conducted via Language Training Detachments (LTDs), Mobile training Teams (MTTs), distributed learning, or contracted instruction.[182] An LTD consists of one or more language education specialists from DLIFLC who advise and support the Component in all matters relating to the conduct of nonresident language programs.[183]

One challenge identified during an interview relates to return on investment. Training a linguist at DLI is both costly and takes time. By the time a linguist acquires all the necessary skills, he or she may be able to leave or may not have much time remaining in service.

To identify language requirements, according to one interviewee, services use a structured review process that often takes 2 to 3 years to complete, a rigorous process to ensure that the students are well-selected and that they study the needed languages. This lengthy process, unfortunately, appears to often cause a mismatch between what is needed and what was requested.

Another problem was identified through the post-9/11 surge in the need of linguists. LT. Gen. Hayden, serving at the time as National Security Agency (NSA) director, raised the ILR Level standard for Cryptologic Language Analysts to 3/3. As the services had at the time a level 2 requirement, this demand required DLI to be resourced for an increase in graduate standards, and time for plan implementation. Nearly 2 decades later, DLI is still trying to raise its ILR Level standards from 2 to 2+.[184]

According to one interviewee, a new program for students of Chinese languages places NSEP awardees in the Language Flagship program at DLI for intensive language training instead of spending a year in Taiwan. Doing so allows parallel processing of TS/SCI clearances, reducing the time to employment. According to one interviewee, the NSA has not yet confirmed whether civilian linguists will serve its needs over time.

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[182] Ibid.

[183] Instruction may include language acquisition for Special Operation Forces and refresher, maintenance (sustainment), enhancement (including intermediate or advanced courses), and familiarization training (Army Regulation 350–20, OPNAVINST 1550.13, AFI 35–4004, MCO 1550.4E).

[184] According to an interviewee, only 36 percent of DLI graduates are IRL Level 2+.

6.   Recommendations

A. Civilian Recommendations

Recommendation 1: Develop a requirements process for hiring. The military departments and defense agencies should develop a requirements process to systematically assess civilian hiring needs, giving consideration to expected turnover; new skills that may be needed; the appropriate mix of military, civilian, and contractor personnel; and the balance between entry-level and experienced personnel. DoD organizations should assess hiring requirements at least annually and roll up these requirements to a sufficient level to ensure that they can be systematically addressed across the organization.

Recommendation 2: Broadcast a consistent message. The military departments and defense components should seek avenues through which to broadcast a consistent message to increase awareness of the Department as a civilian employer. DoD organizations recognize that they have difficulty competing on compensation alone. For this reason, the Department's effort to attract high-quality recruits should emphasize the quality of the work, the importance of the mission, the inclusiveness of the workplace, and other work-life balance issues.

Recommendation 3: Prioritize and balance funding. The Department should systematically collect and assess costs of major recruiting and hiring incentives, including internships; scholarships and fellowships; recruiting, relocation, and retention bonuses; and other forms of premium pay. The Department should use such cost data to identify gaps in funding for hiring incentives and to build the case for additional funding of cost-effective programs (including a dedicated source of funding like the Acquisition Workforce Development Account for critical STEM skills), if appropriate.

Recommendation 4: Develop metrics. DoD organizations should develop metrics; systematically collect and maintain data on outreach and recruiting efforts for new hires; and conduct periodic assessments of program performance. Metrics should include data on the cost of outreach and recruiting events, numbers of leads developed from such events, numbers of new hires resulting from such leads, sources of new hires, quality of hires, diversity of hires, and retention of hires. Metrics would likely be collected at the local level, but central guidance is needed to ensure that the data can be rolled up, compared across organizations, and used to guide resources and assess recruiting and hiring options.

Recommendation 5: Build recruiting relationships. DoD organizations should develop and cultivate systematic recruiting relationships with a diverse portfolio of colleges and universities. A core of professional recruiters for students with critical STEM

skills may be needed to establish a campus presence beyond recruiting fairs and similar one-time events. These recruiters may also need to develop deeper relationships by reaching out to student organizations, interacting with STEM departments, sponsoring student competitions, capitalizing on sponsored research, assisting with resume writing, and helping students cut through the DoD hiring bureaucracy.

Recommendation 6: Develop best practices for virtual tools. The Department should systematically review how its organizations and private sector counterparts use virtual recruiting and hiring tools (such as Handshake, USAHIRE, LinkedIn, Salesforce, and TalentNeuron). DoD should then develop a set of preferred tools and best practices that are promoted across the Department. The Department should consider whether some of these tools could be funded more efficiently through bundled requirements or enterprise-wide licenses.

Recommendation 7: Develop best practices for direct hiring. The Department should develop best practices for using direct hire authorities to ensure that these authorities do not default to traditional methods or "doing the same thing faster." The best practices should be designed to provide flexibility and options that can be tailored to specific hiring needs rather than prescribed as a single preferred approach. These practices should also provide guidance on the announcement of job opportunities, tentative job offers, the use of virtual hiring tools, and methods for evaluating candidates (including resumes, interviews, SME evaluations, and hiring panels).

Recommendation 8: Address bureaucratic bottlenecks. The military departments and defense components should reduce bureaucratic bottlenecks in the hiring process by conducting root cause analyses and addressing process deficiencies. To achieve this goal, DoD could improve the relationship between hiring managers and personnel processing organizations by training staff in those organizations on using direct hire authorities or fielding specialized teams that are aligned with DoD organizations that have unique hiring authorities and strong demand for critical STEM skills.

B. Military Recommendations

Recommendation 1: Assess and identify stem requirements. The military services should regularly and systematically assess their needs for cutting-edge STEM skills that are not included in existing military career fields. These skills include software development, digital engineering, machine learning, and artificial intelligence. Once the services have identified skills that are needed in uniform, the skills should be associated with career fields, career paths, and force requirements so that they can be communicated to recruiters.

Recommendation 2: Integrate stem outreach and recruiting. The military services should link STEM outreach efforts (including robotics events, eSports competitions, hacking events, and similar activities) to recruiting objectives, working to build a recruiting pipeline by maintaining continuous contact with potential recruits who are developing critical skills and show a propensity to military service. The Air Force appears to provide the best model for such integration through its effort to systematically track participants in events such as robotics programs, eSports competitions, and hacking events from secondary school through college and beyond.

Recommendation 3: Tailor stem outreach and recruiting approaches. The military services should develop targeted approaches to identify, motivate, and recruit individuals in career fields that require critical STEM skills (as identified pursuant to the previous recommendation). For example, military aptitude tests could be modified to identify potential software talent; separate advertising campaigns could be devised to reach out to talent in STEM fields; and specialized teams could be formed to systematically pursue STEM recruits. In some cases, it may be appropriate to seek recruits who have specific skills rather than look for overall "quality" and assume that skills can be built through in-service training programs. In any case, targeted recruiting for STEM skills should go beyond simply building technology imagery into broader advertising and marketing efforts.

Recommendation 4: Coordinate with civilian recruiting. The military services should coordinate military recruiting with civilian recruiting, at least in STEM fields. The services should extend their outreach and recruiting efforts to identify and pursue individuals with critical STEM skills, regardless of their ability to meet military fitness standards and propensity to military service. In addition, individuals who cannot complete a course of study in the ROTC or at a military academy, but have useful skills and a desire to serve, could be referred for possible civilian assignments.

Appendix A.
Inventory of Critical Skills Outreach, Education, Recruiting, and Training Programs

Table A-1. Inventory of Critical Skills Outreach, Education, Recruiting, and Training Programs

Program	Department/ Program Administrator	Description
Academic Call	National Reconnaissance Office	Offers select employees the ability to pursue part-time or full-time study for academic-level courses that supports the NRO strategic goals and performance objectives; improves an employee's job performance; allows for expansion of an employee's current job, and/or enables an employee to perform needed duties outside their current job.
Academic Semester Internship Program (ASIP)	Defense Intelligence Agency	Provides promising undergraduate and graduate students within commutable distances to DIA locations the opportunity to gain practical, on-the-job experience working side-by-side with intelligence, technology, human resources, and other professionals in their field of study while providing support to DIA's mission. ASIP interns work as part-time temporary employees (between 16 and 20 hours a week)
Advanced Course in Engineering (ACE)	Air Force Research Laboratory, Information Directorate	Seeks to produce the next-generation cyber security leaders from the top students at U.S. colleges and universities, targeting the best in computer engineering, electrical engineering, computer science, mathematics and physics. A 10-week tradecraft curriculum and a capstone exercise provide the forum for the cadets to use the educational concepts learned in the course, to test state-of-the-art tools, and to gather data for use in ongoing activities.
AEOP - College Qualified Leaders	Army Educational Outreach Program	Longer-term internship program that matches practicing DoD scientists with talented college students to create direct mentor-student relationships; participants can potentially receive stipends and participate year-round.

Program	Department/ Program Administrator	Description
AEOP - ECYBERMISSION	Army Educational Outreach Program	Web-based science, technology, engineering, and mathematics (STEM) competition for students in grades 6 through 9 that promotes self-discovery and enables all students to recognize the real-life applications of STEM. Teams of three or four students are instructed to ask questions (for science) or define problems (for engineering), and then construct explanations (for science) or design solutions (for engineering) based on identified problems in their communities.
AEOP - Gains in The Education of Mathematics And Science	Army Educational Outreach Program	Summer STEM enrichment programs for middle and high school students located at Army labs; focus on hands-on STEM activities
AEOP - High School Apprenticeship Program	Army Educational Outreach Program	Provides high school juniors and seniors with an authentic science and engineering research experience alongside university researchers sponsored by the Army.
AEOP - Junior Solar Sprint	Army Educational Outreach Program	Free educational program for 5th- through 8th-grade students where students design, build, and race solar powered cars .
AEOP - Research Engineering Apprenticeship Program (REAP)	Army Educational Outreach Program	Summer STEM program that places talented high school students, from groups historically underrepresented and underserved in STEM, in research apprenticeships at area colleges and universities. REAP apprenticeships are 5 to 8 weeks long (minimum of 200 hours), and apprentices receive a stipend.
AEOP - Unite	Army Educational Outreach Program	Four-to-six week, pre-collegiate summer experience for talented high school students from groups historically underrepresented and underserved in STEM, held at higher education institutions across the country to encourage major selection in STEM.
AEOP - University Research Apprentice Program	Army Educational Outreach Program	Provides undergraduate students with an authentic science and engineering research experience alongside university researchers sponsored by the Army Research Office.
AFRL Scholars	Air Force Research Lab	Offers stipend-paid summer internships to undergraduate and graduate university students pursuing STEM degrees, as well as upper-level high school students; select locations also offer internships to university students pursuing education-related degrees and K–12 professional educators. The selected interns gain valuable hands-on experiences working with full-time AFRL scientists and engineers on cutting-edge research and technology and are able to contribute to unique, research-based projects.

Program	Department/ Program Administrator	Description
AFRL/DAGSI Ohio Student-Faculty Research FELLOWSHIP PROGRAM	Air Force Research Lab	Fellowship supporting students and faculty that aims to deepen AFRL's research ties to Ohio universities and develop research talent to meet AFRL and Ohio high-tech needs.
Air Command & Staff College	Air Force Personnel Center	To educate mid-career officers and civilians in developing, leading, advancing, and applying air and space power across the spectrum of service, joint, and combined military operations.
Air Command & Staff College On-Line Master's Program	Air Force Personnel Center	To educate mid-career officers and civilians in developing, leading, advancing, and applying air and space power across the spectrum of service, joint, and combined military operations.
Air Force Institute of Technology	Air Force Personnel Center	Provides defense-focused graduate and professional continuing education and research.
Air Force National Labs Technical Fellows Program	Air Force Personnel Center	Develops a cadre of nuclear, environmental, energy, or cyber experienced personnel to shape and influence a future that is flexible and responsible in various specified fields.
Air Force Quality of Analysis	AF A2/6 -intelligence, surveillance, reconnaissance and cyber effects operations	Allows the selected analysts to receive funding to further their training, attend conferences, and better themselves to be more effective at the jobs they do.
Air War College	Air Force Personnel Center	Focuses on military strategy/employment of air and space forces, including joint operations in support of national security.
Barry M. Goldwater Scholarship and Excellence in Education Program	Barry Goldwater Scholarship and Excellence in Education Foundation partnered with National Defense Education Programs (NDEP)	Gives scholarships to STEM undergraduate students of up to $7,500 per year. Factors that determine winners are field of study, career objectives, commitment, and potential to make a significant professional contribution.
CAE-Cyber Operations Summer Intern Program	National Security Agency	Targets graduate and undergraduate students in Computer Sciences, Computer/Electrical Engineering, and Cybersecurity. This internship is NSA's premier outreach program for students enrolled in the Cyber Operations specialization at NSA-designated universities.
Civil Liberties, Privacy, and Transparency (CLPT) Summer Intern Program	National Security Agency	Targets undergraduate and graduate students in International Affairs, Intelligence Studies, Regional Studies, Economics, Psychology, and Statistics to study government transparency while helping the NSA achieve the right balance between privacy and national security.

Program	Department/ Program Administrator	Description
Civilian Academic Studies Program (CASP)	Defense Intelligence Agency	Provides DIA employees an opportunity to attend civilian academic institutions in order to expand their knowledge, abilities, and skills in support of the DIA and Intelligence Community (IC) mission.
Code Breaker Challenge	National Security Agency	Targets undergraduate and graduate students for a Computer Network Operations/Crypt-themed challenge similar to those that routinely threaten national security. Challenge entails a series of problems that touch on skills like software engineering, cryptanalysis, exploit development, block chain analysis, and more.
College of Information & Cyberspace	Air Force Personnel Center	Educates and prepares military and civilian leaders through a joint senior-level course of study in the use of the Information Instrument of power and the Cyberspace Domain.
Colorado College Summer Internship Program	National Security Agency	Targets graduate and undergraduate students in Computer Sciences, Engineering (other), Mathematics, Cybersecurity, Political Science/Global Studies, Law/Criminal Justice, and Social Sciences. Internship positions are offered in software engineering and target analysis.
Computer Science Intern Program (CSIP)	National Security Agency	Targets graduate, undergraduate, and post-graduate students and provides internships during the summer(s) between their sophomore to senior years. Summer interns actively participate in or support ongoing S&CI mission activities in such areas as personnel security investigations, security clearance adjudications, physical security and access control, antiterrorism/force protection, and/or counterintelligence.
Consortium Research Fellows Program	Partnership between U.S. Army Research Institute for the Behavioral and Social Sciences and consortium of DC-area universities	Partnership between the Consortium of Universities of the Washington Metropolitan Area and several DoD agencies, offering fellowships at the undergraduate and graduate levels. The CRFP fosters a strong relationship between the higher education community and DoD.
Cooperative Education Program	Defense Intelligence Agency (DIA)	DIA's Cooperative Education Program (CO-OP) provides a select number of talented undergraduate and graduate students the opportunity to gain valuable work experience in combination with their academic studies. Four-month internship from January to May. Offers Analysis, Human Intelligence, Counterintelligence, and Science and Technology programs. Also includes critical languages.

Program	Department/ Program Administrator	Description
Cooperative Education Program	National Security Agency	Rotational program for college students alternating semesters of full-time work with full-time study, with rotations designed to reveal areas where students might want to work for a career.
Cooperative Education Program (NSA) – Hawaii	National Security Agency	Targets undergraduate students in Computer Sciences, Computer/Electrical Engineering, Cybersecurity, and Foreign Language programs.
Copper Cap (COP) Program	Air Force Personnel Center	Four-year internship program that funds education; prefers business/engineering majors.
Cryptanalysis and Signals Analysis Summer Program (CASA SP)	National Security Agency	Targets undergraduate students for internships. Gives mathematician and computer science students work to transform collected data into a format that analysts can readily consume for intelligence purposes by analyzing signals and protocols and overcoming security measures. Problems involve applications of math, statistics, computer science, reverse engineering, and software development.
Cyber Scholarship Program (CySP)	National Security Agency	Offers recruitment and retention scholarships.
Cyber Summer Program (CSP)	National Security Agency	Targets graduate, undergraduate, and post-graduate students. Targets Computer Sciences, Mathematics, Cybersecurity, Computer/Electrical Engineering, Engineering (other). Says that interns will work on "a broad range of problems of [their] choosing."
CyberCorps Scholarship for Service (SFS)	Office of Personnel Management (OPM)	Gives scholarships to information technology professionals, industrial control system security professionals, and security managers to meet the needs of the cybersecurity mission for federal, state, local, and tribal governments. Must work for 1 year for each year of scholarship.
CYBERPATRIOT	Air Force Association	National Youth Cyber Education Program, also known as CyberPatriot, established by the Air Force Association (AFA) to give K–12 students an opportunity to develop skills and explore careers in cybersecurity or other STEM disciplines. Involved in the CyberPatriot program are the National Youth Cyber Defense Competition, AFA CyberCamps, and the Elementary School Cyber Education Initiative.
Data Center Management Intern Program	National Security Agency	Targets undergraduate students. Interns gain experience through a hands-on approach to managing a data center, from deployments of new systems and their associated mechanical, electrical, and IT requirements.
Defense Civilian Training Corps Program (DCTC)	Office of the Under Secretary of Defense for Acquisition & Sustainment	Scholarship that targets undergraduate students in STEM fields.

Program	Department/Program Administrator	Description
Defense STEM Education Consortium (DSEC)	Under Secretary of Defense for Research and Engineering	Targets K–12 students with 5 fundamentals: 1) engage students with meaningful STEM experiences; 2) serve military-connected and underrepresented students; 3) connect to the DoD STEM workforce; 4) leverage the network as a force multiplier; 5) evolve the approach based on data.
Department of Defense Cyber Scholarships Program (CySP)	National Security Agency	Scholarship program for various components and agencies in DoD (1-year commitment for each year of scholarship).
Director's Summer Program	National Security Agency	Targets undergraduate students for internships. Students will solve problems in mathematics, cryptology, and communications technology in support of national security. These problems often involve applications of abstract algebra, geometry, number theory, analysis, probability, statistics, combinatorics, graph theory, algorithms, and computer science.
Diversity Internship at DTRA (DID)	Pacific Northwest National Laboratory (PNNL) partnered with Defense Threat Reduction Agency (DTRA)	Actively recruits from minority-serving institutions, which include historically Black colleges and universities, tribal colleges, and Hispanic-serving institutions to offer educational and career development opportunities to students in STEM and political science programs. Offers 8- to 12-week internships.
DoD Acquisition Internship Program	National Reconnaissance Office	Targets college sophomores and juniors with skills in Engineering, Contracting, Logistics, Business - Financial Management, Business - Cost Estimating, Information Technology, Test & Evaluation, Industrial Contract Property Management, Purchasing, Science and Technology, Production, Quality and Manufacturing, Facilities Engineering, and Program Management for summer internships.
DoD College Acquisition Internship Program (DCAIP)	Office of the Under Secretary of Defense for Acquisition and Sustainment (A&S)	Targets full-time second- and third-year students currently enrolled in an undergraduate program at an accredited college or university. Interns receive hands-on, practical experience in analysis, research, report writing, oral briefings, policy development, program analysis, and computer applications. Student interns gain experience in career fields available within the acquisition workforce such as: Engineering, Contracting, Logistics, Business - Financial Management, Business - Cost Estimating, Information Technology, Test & Evaluation, Industrial Contract Property Management, Purchasing, Science and Technology, Production, Quality and Manufacturing, Facilities Engineering, and Program Management.

Program	Department/ Program Administrator	Description
DoD Information Assurance Scholarship Program	National Security Agency	Scholarship program seeking to increase the number of entrants to DoD who possess key information assurance and IT skillsets and build up related educational programs via grants.
DOD STARBASE	DoD-wide; administered by Office of the Assistant Secretary of Defense for Reserve Affairs	After-school STEM program for underserved elementary school students.
Education with Industry	Air Force Personnel Center	Offers 10-month rotation with industry for civilian or military personnel. Focuses on, but not limited to, STEM skills.
English for Heritage Language Speakers (EHLS)	Defense Language and National Security Education Office (DLNSEO) and Office of the Under Secretary of Defense for Personnel and Readiness	Targets native speakers of Arabic, Korean, Somali, Azerbaijani, Kurdish, Tajik, Balochi, Kyrgyz, Tamashek, Bambara, Mandarin, Thai, Dari, Pashto, Turkish, Hausa, Persian, Farsi, Urdu, Hindi, Punjabi, Uzbek, Kazakh, Russian, and Vietnamese who are not sufficiently proficient at English for full scholarships (including tuition and living expenses) to pursue English language studies.
Experiential Learning (Live Case Activity)	National Security Agency	Targets K–12, undergraduate, and graduate students. Challenges students to wrestle with complex real-world problems and deliver innovative solutions through co-educating with professors. Increases awareness of NSA's mission and career opportunities.
Field Site Internship Programs	National Security Agency	12-week internships at NSA field sties in Georgia, Hawaii, Colorado, or Texas.
First Robotics	Non-profit; DoD orgs will sponsor teams	Robotics competition program that inspires young people to build science, engineering, and technology skills. More than 500 DoD-sponsored teams, ranging from ages 6–18, compete in competitions that inspire innovation and build leadership skills.
Gifted and Talented Language Program	National Security Agency	Targets high school students for a summer internship after graduation from high school. Program is designed for high school students with an aptitude for critical languages. Requires completion of the relevant AP language course or proctored examination results demonstration equivalent.
Gifted and Talented STEM Program	National Security Agency	Targets U.S. citizen high school seniors who have completed AP/IB physics, calculus, and a CS/engineering class by their senior year for a 10- to 12-week summer internship following senior year.

Program	Department/ Program Administrator	Description
Graduate Fellowships for Science, Technology, Engineering, and Mathematics Diversity, or GFSD. (formerly National Physical Science Consortium (NPSC))	National Security Agency	Targets predoctoral STEM students, covers full tuition and fees. Gives allowance of up to $20,000 a year in expenses. Provides mentor and paid summer internship. Targets minorities and women.
Graduate Mathematics Program (GMP)	National Security Agency	Targets graduate and post-graduate students for internships. Mathematics and statistics graduate students will work directly with NSA mathematicians and statisticians on mission-critical problems involving math, statistics, data analysis, cryptology, and communications technology.
Griffiss Institute Summer Internship Program	Air Force Research Lab Rome Site	Paid summer internship opportunity for students currently enrolled in an accredited college or university at the freshman level through PhD level (U.S. CITIZENS ONLY) to work on-site with AFRL researchers on a wide variety of research projects. Open to high school students as well as undergraduate and graduate students.
Hawaii Summer Technical Intern Program	National Security Agency	Targets graduate and undergraduate students in Computer Sciences, Engineering (Other), and Mathematics.
High School Work Study (HSWS) Program	National Security Agency	Targets high school students for part-time employment in their senior year of high school. Skills targeted include STEM and foreign languages.
Installation and Logistics Summer Intern Program	National Security Agency	Targets undergraduate; intended for students interested in project management and electrical, power, mechanical, or civil engineering fields, and supply chain and business management operations.
Joint Science and Technology Institute	Defense Threat Reduction Agency	Internships for students from HBCU/MI universities for work under the Naval Research Lab staff.
JUNIOR SCIENCE AND HUMANITIES SYMPOSIUM	Air Force/National Science Teachers Association (NSTA)	Collaborative effort with the research arm of the Army, Navy, and Air Force and administered by the National Science Teachers Association (NSTA). The program aims to prepare and support students to contribute as future scientists and engineers, conducting STEM research on behalf of or directly for the Department of Defense, the Federal research laboratories, or for the greater good in advancing the nation's scientific and technological progress.
K-12 Language Education Advancement Program (LEAP)	National Security Agency	Aims at inspiring K–12 students to study critical languages and inform said students of language career fields.

Program	Department/ Program Administrator	Description
K-12 STEM outreach	National Security Agency	Works with K–12 in a number of ways to help STEM and foreign language education. Methods include tutoring, computer help, help with extracurricular activities, STEM and language fair competition judges, and speakers on STEM and foreign language subjects.
Louis Stokes Educational Scholarship	Defense Intelligence Agency	Needs-based program offering tuition assistance to CS and EE students enrolled at accredited colleges or universities, while also providing challenging summer work (Fort Meade) and guaranteed employment in their field of study upon graduation. Students attend classes full-time during the academic year, and work at DIA during the summer in positions related to their course of study. Tries to target minority students. Has a 1.5-year service commitment for each year of aid.
Manufacturing Engineering Education Grant Program	Office of the Under Secretary of Defense for Research and Engineering	Gives grants to support relevant engineering training at U.S. institutions of higher education, universities, industry, and non-profit organizations.
Master of Science of Strategic Intelligence (MSSI)	Defense Information Systems Agency (DISA)	Educates students on the components that the Intelligence Community comprises, the environment in which it functions, and the nature of the threats facing the United States.
MathCounts	DoDSTEM (support to external non-profit)	Non-profit organization that provides teacher support via engaging math programs for U.S. middle school students of all ability levels in order to build confidence and improve attitudes towards math and problem-solving.
MDA Engineering in Art: 3-D Art in Motion	Missile Defense Agency	Third- and fourth-graders participating in summer programs at Girls Inc. and Boys and Girls Club's study and create kinetic sculptures by applying the engineering design process and learning basic scientific concepts (e.g., force, mass, friction, weight, and balance).
MDA STEM Education Development (STEM ED)	Missile Defense Agency	Professional development program for K–8 educators aimed at improving STEM education.
Military Child Pilot Program (MCPP)	Under Secretary of Defense for Research and Engineering	Enhances the preparation of dependents of members of the armed forces for careers in STEM, and assists STEM teachers at elementary or secondary schools at which a significant number of military dependents are enrolled.

Program	Department/ Program Administrator	Description
NASA Pathways Internship Program	National Reconnaissance Office in partnership with the National Aeronautics and Space Administration (NASA)	Targets high school, undergraduate, and graduate students, as well as educators, for internships. Provides students opportunities to transition to NRO Cadre Undergraduate and Graduate Student Internship Program in subsequent summers or to the NRO Developmental Career Path Program upon graduation.
National Defense Science and Engineering Graduate Fellowship	DDR&E	Highly competitive, portable fellowship that is awarded to those pursuing a doctoral degree in 1 of 15 supported STEM disciplines of interest to the DoD; 3,400 fellowships have been offered since its inception in 1989; mostly used by DoD labs.
National Defense University	Joint Chiefs of Staff	Higher education institution that delivers targeted education and professional development programs to more than 3,300 graduate-level students. Students are selected by their service, agency, department, or country to attend National Defense University programs.
National Intelligence University	AF A2/6 - intelligence, surveillance, reconnaissance, and cyber effects operations	Masters and Bachelors education in intelligence. Offers Master of Science and Technology and Intelligence, Master of Science of Strategic Intelligence, and Bachelor of Science in Intelligence.
National Intelligence University: Master of Science in Technology Intelligence (MSTI)	National Intelligence University	Follows a designed concentration of study to focus students' education on their areas of thesis research. The five concentrations are Weapons of Mass Destruction (WMD), Information Operations and Cyber, Emerging and Disruptive Technologies, Geostrategic Resources and the Environment, and Foreign Denial and Deception.
National Language Service Corps	Defense Language and National Security Education Office (DLNSEO) and Office of the Under Secretary of Defense for Personnel and Readiness	NLSC goals are to: (1) Provide the Federal Government with U.S. citizens who possess high levels of foreign language proficiency to fulfill short-term temporary assignments, and (2) foster a large, global cadre of linguists by identifying and recruiting highly qualified individuals and providing educational resources and opportunities to further enhance and sustain their language skills.
National Math + Science Initiative	Member of DoD STEM Education Consortium	Outreach program that brings together external support with local school districts to promote student access and achievement in STEM and English.

Program	Department/ Program Administrator	Description
National Nuclear Security Administration (NNSA) Graduate Fellowship Program (NGFP)	Administered by Pacific Northwest National Laboratory and sponsored by National Nuclear Security Administration (NNSA)	Gives year-long fellowships to graduate students or recent graduates of advanced degrees who can acquire clearance. About half of the fellows have technical backgrounds.
National Security Education Program (NSEP) through Boren	Defense Language and National Security Education Office (DLNSEO)	NSEP targets critical language skills. Provides scholarship and then one full-time internship program.
Naval Research Enterprise Internship Program	Navy/Marine Corps	10-week undergraduate and graduate research opportunity at one of 41 Naval laboratories or warfare centers.
Naval Science Awards Program	Office of Naval Research (ONR)	Navy/Marine Corps awards program at state science/engineering fairs and the Intel International Science and Engineering Fair.
NGA Tuition Assistance Program	National Geospatial-Intelligence Agency	Pays tuition at accredited colleges or universities for approved mission-related courses for NGA employees.
NGIC College Recruiting Program	National Ground Intelligence Center (NGIC)	Internal program that recruits nationwide with special emphasis on academic institutions in the Commonwealth of Virginia, HBCUs, and targeted college ambassador programs.
NGIC studINT Program	National Ground Intelligence Center (NGIC)	Recruits 2nd- and 3rd-year undergraduate students in a variety of STEM and GMI disciplines for a one-time, paid internship NTE 14 weeks.
NRC Research Associateship Programs	DoD-wide/National Academies of Science Engineering and Medicine	Administers programs offering fellowships to graduate and postgraduate researchers at sponsoring federal labs and affiliated institutions, including DoD.
NRO Cadre Undergraduate and Graduate Student Internship Program	National Reconnaissance Office	Targets graduate and undergraduate students with STEM and related skills for a summer internship. Requires the ability to get a clearance.
NRO Developmental Career Path	National Reconnaissance Office	Targets college seniors, recent graduates, and early career degree professionals. Provides guided career pathway that typically takes 3–5 years to a full performance set of duties. Development Career Path positions are available in Technical (STEM positions including Operations Research), Contracts, Security, Finance, and Mission Support (HR).

Program	Department/ Program Administrator	Description
NSA Georgia Summer Internship Program	National Security Agency	Targets graduate and undergraduate. Internship positions are offered in science and technology, applied mathematics, computer/systems engineering, electrical and mechanical engineering, computer science, computer forensics, cyber intelligence and security, information assurance, information technology, and information security.
PALACE Acquire (PAQ) Program	Air Force Personnel Center/Manpower, Personnel, and Services (AF/A1)	Offers full-time position after 2- to 4-year formal training program. Mainly focused on STEM.
Partnership for Public Service: Federal IT Leaders	Defense Information Systems Agency (DISA)	Empowers participants to manage inevitable IT complications and drive vital innovations to strengthen agency operations.
Pathways Internship Program	Office of Personnel Management (OPM)	Internships may be full-time or part-time, but should not interfere with students' academic schedules. Students are eligible for non-competitive conversion to a term or permanent position in the civil service. Does not explicitly target critical skills. This program replaced Student Career Experience Program (SCEP) and Student Temporary Employment Program (STEP).
Pathways Recent Graduates Program	Office of Personnel Management (OPM)	1-year developmental program that promotes careers in the Federal Government to recent graduates. Individuals must apply within 2 years of graduation (6 years if veteran). Allows those with STEM degrees to start at GS-11. Allows those with STEM PhDs (or equivalent) to start at GS-12.
Premier College Internship Program (PCIP)	Air Force Personnel Center	1-year internship focused mainly on STEM. Successful completion is a pathway to Palace Acquire program.
Presidential Management Fellowship (PMF) under OPM Pathways Program	Office of Personnel Management (OPM)	2-year leadership development program for advanced degree candidates who demonstrate academic excellence, possess management and leadership potential, and have a clear interest in and commitment to public service. Individuals must apply within 2 years of receiving a qualifying advanced degree. Students may also apply in the fall of their final year of graduate school. Participants in the program take part in an orientation session, receive training and professional development, complete an IDP, are assigned a mentor, and have at least one developmental assignment. PMF Fellows2 who successfully complete program requirements may be eligible for non-competitive conversion to a term or permanent position in the civil service. Has a STEM track.

Program	Department/ Program Administrator	Description
Professional Analyst Career Education (PACE)	Defense Intelligence Agency	Training program for defense intelligence analysts.
RAND Air Force Fellows Program	Air Force Personnel Center	Employs advanced research techniques while working on Air Force-sponsored research. RAND provides an important cross-flow of information between the Air Force and a major research institution.
Science And Engineering Apprenticeship Program	Navy/Army Labs	Gives high school students an opportunity to participate for 8 weeks in a paid summer research project at various Department of Navy laboratories. Students gain real-world, hands-on experience and research skills while being exposed to DoD science and technology.
Science Mathematics and Research for Transformation (SMART)	Office of the Under Secretary of Defense for Research and Engineering	Full scholarship for STEM degrees. Requires a one-to-one DoD employment commitment for each year of funding.
Science of Security Summer Intern Program (SOS)	National Security Agency	Targets undergraduate and graduate Computer Sciences, Cybersecurity, Information Technology, Mathematics, and Psychology students for summer internships.
Section 219 Defense Labs Program	Air Force Research Authority	Gives funding to Air Force Labs, including funding to recruit and retain researchers.
Security and Counterintelligence Summer Intern Program (SCSIP)	National Security Agency	Targets undergraduate and graduate students for summer internships to protect NSA personnel, facilities, and operations worldwide.
Signals Intelligence Collection Program (SICP)	National Security Agency	Targets graduate and undergraduate. Gives TS/SCI-cleared college students the opportunity to support the SIGINT service as a salaried intern during the summer following their freshmen, sophomore, and/or junior years.
Southwestern Ohio Council for Higher Education	Air Force Research Lab	Regional program that provides research internships for undergraduate and graduate science and engineering students. Students work at Wright-Patterson Air Force Base at either the Air Force Institute of Technology (AFIT) or the Materials and Manufacturing Directorate at the Air Force Research Laboratory (AFRL).
STEM+M	Air Force Acquisition Career Management (SAF/AQH)	Competitive program for identifying high-potential scientists and engineers and developing them to provide expertise in essential areas. Funding for second Master's degree or PhD.

Program	Department/ Program Administrator	Description
Stokes Educational Scholarship Program (NSA)	National Security Agency	Targets high school students, particularly minority students, planning to major in CS or computer/electrical engineering. Students will attend college full-time, then work during the summer at Fort Meade. Transitions to full-time job.
STOKES Scholarship Program	National Security Agency	Targets critical language students for summer internships.
Summer Faculty Fellowship Program	Air Force Research Lab	Program offers hands-on exposure to Air Force research challenges through 8- to 12-week research residencies at participating Air Force research facilities for full-time science, mathematics, and engineering faculty at U.S. colleges and universities. Available to: undergraduates, graduate students, and faculty members.
Summer Intern Program for Information Assurance (SIPIA)	National Security Agency	Targets graduate, undergraduate, and post-graduate. Work includes system/network administration and operations; systems security engineering; information assurance systems and product acquisition; cryptography; threat and vulnerability assessment, including risk management and cybersecurity; operations of computer emergency response teams; information assurance training, education, and management; computer forensics; and defensive information operations.
Summer Intern Program for Science and Technology (SIP/ST)	National Security Agency	Undergraduate internship. Targets Computer Sciences, Computer/Electrical Engineering, and Engineering (other).
Summer internship program	Defense Intelligence Agency	Provides promising undergraduate and graduate students the opportunity to gain practical, on-the-job experience working side-by-side with intelligence, technology, human resources, and other professionals in their field of study while providing support to DIA's mission. While at DIA, interns gain insight into a career in the Intelligence Community (IC), what it takes to support the warfighter, and how to become a permanent employee at DIA.
Summer Language Program	National Security Agency	Internships for graduate, undergraduate, and postgraduate students. Targets foreign languages in critical languages (Arabic, Chinese, Farsi, Korean, and Russian). Other languages will be considered on a case-by-case basis.

Program	Department/ Program Administrator	Description
Summer Program for Operations Research Technology (SPORT)	National Security Agency	Targets graduate and postgraduate for internships. Offers students in Mathematics, Computer Sciences, Cybersecurity, Computer/Electrical Engineering, Engineering (other), Business, and Statistics to work side-by-side with analysts in NSA's Enterprise Operations Research Division to apply state-of-the-art scientific and quantitative methods, which employ applied mathematics and data science techniques.
Summer Program for Operations Research Technology (Sport)	National Security Agency	12-week internship for graduate students enrolled in an MS (combined BS/MS also accepted) or PhD program who have experience with one or more of the following: Applied Mathematics, Data Science and Statistics, Mathematical Programming and Optimization, Modeling and Simulation, Computer Networking, or Computer Programming languages.
Team America Rocketry Program	Air Force is one of several sponsors	Extra-curricular, hands-on, project-based learning program modeled on the aerospace industry's design, fabrication, and testing processes.
Tech Talks	National Security Agency	Engages students with desired degrees and skillsets at universities across the nation; positively brands NSA, generates awareness and excitement about career and internship opportunities at the Agency. Experts from the front lines address interesting and relevant topics with students who learn more about the unclassified, cutting-edge skills and challenges that they will face in the workplace. Students glean sage advice about working at the agency, and the education and career pathways available to them.
Texas Summer Intern Program	National Security Agency	Targets graduate and undergraduate. Seeks students in Computer Sciences, Computer/Electrical Engineering, Mathematics, Social Sciences, Political Science/Global Studies, and International Affairs.
The Language Flagship	Defense Language and National Security Education Office (DLNSEO) and Office of the Under Secretary of Defense for Personnel and Readiness	U.S. universities receive funding to design and implement language programs in Arabic, Chinese, Korean, Portuguese, Persian, and Russian for undergraduate students of all majors. The goals are to improve the teaching and learning of critical languages in the United States and to create a pool of global professionals with proficiency in languages important to U.S. national security.
The Pathways Program	Washington Headquarters Service	Offers federal internship and employment opportunities for current students, recent graduates, and those with an advanced degree. There are three different paths available: Internship Program, Recent Graduates Program, and Presidential Management Fellows (PMF) Program.

Program	Department/ Program Administrator	Description
USNA Stem Summer Program	U.S. Naval Academy	Week-long STEM summer camps hosted by the United States Naval Academy (USNA); designed to encourage students to pursue a course of study in engineering and technology.
Virginia Tech Systems Engineering Master's Program	National Reconnaissance Office	Virginia Tech Systems Engineering Master's Program, available to government civilian and military personnel directly supporting the NRO, is tailored to the NRO's specific systems engineering needs.
Visiting Scientist Program	Geospatial Intelligence Agency	Recruitment program for relevant subject matter experts to complete studies at NGA; provides a stipend.
Volunteer Student Internship Program	Washington Headquarters Service	Program offering volunteer opportunities to students enrolled in an accredited high school, trade school, college, and/or university. These opportunities allow students to explore career options in their field of study and develop personal and professional skills. Volunteer students are exposed to the work environment while learning about the DoD missions and responsibilities.
Workforce Recruitment Program (WRP)	Department of Labor's Office of Disability Employment Policy (ODEP) and the U.S. Department of Defense's (DoD) Diversity Management Operations Center (DMOC)	Targets students with disabilities in high-need areas (including languages) for defense jobs. Once selected for the program, students connect with an employee mentor. Mentors assist disabled students selected for employment under the WRP with interviewing techniques, goal setting, the federal application process, and other workplace challenges. Students are eligible to work full-time for up to 14 weeks or part-time for up to 28 weeks.
Young Investigator Research Program	Air Force Office of Scientific Research	Grants that support younger PhDs' (PhD later than April 2012) research at nonprofits or academic institutions.

Illustrations

Figures

Tables

References

Abbe, Allison, Jacqueline DuBois, David Graham, Nate Latshaw, Ethan Novak, and George Tolis. "Veterans' Preference in the Department of Defense Workforce." (Alexandria, VA: Institute for Defense Analyses, 2018).

Altonji, Joseph G., and Seth D. Zimmerman. "The Costs of and Net Returns to College Major." *National Bureau of Economic Research*. 2017.

Altonji, Joseph G., Peter Arcidiacono, and Arnaud Maurel. "The Analysis of Field Choice in College and Graduate School: Determinants and Wage Effects." *National Bureau of Economic Research*. 2015.

Angrist, Joshua, David Autor, and Amanda Pallais. "Marginal Effects of Merit Aid for Low-Income Students." *National Bureau of Economic Research*. 2020.

Arnosti, Nick, Ramesh Johari, and Yash Kanoria. *Managing Congestion in Matching Markets*. Working Paper. 2015.

Asch, Beth J. "Navigating Current and Emerging Army Recruiting Challenges: What Can Research Tell Us?" Santa Monica CA: RAND. 2019.

Balakrishnan, Asha et al. "Science, Mathematics & Research for Transformation (SMART) Outcome Evaluation Report." IDA Document D-9262 (Alexandria, VA: Institute for Defense Analyses, September 2018).

Basit, Zafar. "College Major Choice and the Gender Gap." *Journal of Human Resources* 48: 545–95. 2013.

Brenčič, Vera. "Do Employers Respond to the Costs of Continued Search?" *Oxford Bulletin of Economics and Statistics* 72 (2): 221–45. 2010. https://doi.org/10.1111/j.1468-0084.2009.00573.x.

Carvalho, José Raimundo, Thierry Magnac, and Qizhou Xiong. "College Choice, Selection, and Allocation Mechanisms: A Structural Empirical Analysis." *QE* 10 (3): 1233–77. 2019. https://doi.org/10.3982/QE951.

Chase, Eric. "Revitalizing and Reshaping the Air Force Research Laboratory Workforce." Toffler Associates, Inc. 2020.

Choi, Sun-Ki, and John Garen. "The Federal-Private Wage Differential: How Has It Evolved?" *Applied Economics* 53 (5): 536–54. 2021. https://doi.org/10.1080/00036846.2020.1808572.

Congressional Budget Office (CBO). "Comparing the Compensation of Federal and Private-Sector Employees." 2012.

_____. "Comparing the Compensation of Federal and Private-Sector Employees, 2011 to 2015." 2017.

Curtis, Elizabeth Clelan, Josh Horvath, and Christopher Gonzales. "The All-Volunteer Force and the Need for Sustained Investment in Recruiting." Arlington VA: Center for Naval Analyses. 2020.

Eley, Paul S. "Zero Angle on the Bow: Where Millennials and STEM Collide within the Department of Defense." Air Command and Staff College. Air University Maxwell AFB United States. 2018.

Gershenson, Seth, Cassandra M. D. Hart, Joshua Hyman, Constance Lindsay, and Nicholas W. Papageorge. "The Long-Run Impacts of Same-Race Teachers." *National Bureau of Economic Research*. 2018.

Gilroy, Curtis, Elizabeth Clelan, Josh Horvath, and Christopher Gonzales. "The All-Volunteer Force and the Need for Sustained Investment in Recruiting." Arlington VA: Center for Naval Analyses. 2020.

Gong, Yifan, Ralph Stinebrickner, and Todd R. Stinebrickner. "Uncertainty About Future Income: Initial Beliefs and Resolution During College." *National Bureau of Economic Research*. 2018.

Groeber, Ginger, Paul W. Mayberry, Brandon Crosby, Mark Doboga, Samantha E. DiNicola, Caitlin Lee, and Ellen E. Tunstall. "Federal Civilian Workforce Hiring, Recruitment, and Related Compensation Practices for the Twenty-First Century: Review of Federal HR Demonstration Projects and Alternative Personnel Systems to Identify Best Practices and Lessons Learned." Santa Monica CA: RAND Corporation. 2019.

Hardison, Chaitra M., Leslie Payne, John Hamm, Angela Clague, Jacqueline Torres, David Schulker, and John S. Crown. *Attracting, Recruiting, and Retaining Successful Cyberspace Operations Officers: Cyber Workforce Interview Findings*. Santa Monica CA: RAND Corporation. 2019.

Jagadeesan, Ravi. "Cadet-Branch Matching in a Kelso-Crawford Economy." *American Economic Journal: Microeconomics* 11 (3): 191–224. 2019. https://doi.org/10.1257/mic.20170192.

Jones, Yvette. "Human Capital: Improving Federal Recruiting and Hiring Efforts." U.S. Government Accountability Office, Washington, DC. 2019. www.gao.gov/products/gao-19-696t.

Kambourov, Gueorgui, and Iourii Manovskii. "Occupational Specificity of Human Capital." *International Economic Review*. 2009.

Lim, Jaegeum, and Jonathan Meer. "Persistent Effects of Teacher-Student Gender Matches." *National Bureau of Economic Research*. 2017.

Lindenlaub, Isle, and Fabien Postel-Vinay. "The Worker-Job Surplus." *National Bureau of Economic Research*. 2021.

Margaryanm, Shushanik, Nils Saniter, Mathias Schumann, and Thomas Siedler. "Do Internships Pay Off? The Effects of Student Internships on Earnings." *Institute of Labor Economics*. 2019.

Matthews, Miriam. *Hispanic Representation in the Department of Defense Civilian Workforce: Trend and Barrier Analysis.* RAND National Defense Research Institute. 2017.

McIntosh, Molly, Patricia K. Tong, Hannah Acheson-Field, Noah Johnson, Norah Griffin, and Joshua Russell-Fritch. "Monetary and Nonmonetary Compensation for High-Value U.S. Department of Defense Civilian Skill Sets." Santa Monica CA: RAND Corporation. 2020.

Papay, John P., and Matthew A. Kraft. "The Productivity Costs of Inefficient Hiring Practices: Evidence from Late Teacher Hiring." *Journal of Policy Analysis and Management.* 791–817. 2016.

Ross, Shirley M., Rebecca Herman, Irina A. Chindea, Samantha E. DiNicola, and Amy Grace Donohue. "Optimizing the Contributions of Air Force Civilian STEM Workforce." RAND Corporation. 2020.

Schanzenbach, Max. "Explaining the Public-Sector Pay Gap: The Role of Skill and College Major." *Journal of Human Capital* 9 (1). 2015.

Schulker, David, and Mirriam Matthews. "Women's Representation in the U.S. Department of Defense Workforce: Addressing the Influence of Veterans' Employment." Santa Monica CA: RAND. 2018.

Stange, Kevin M. "Differential Pricing in Undergraduate Education: Effects on Degree Production by Field." *National Bureau of Economic Research.* 2013.

Sullivan, Paul. "Empirical Evidence on Occupation and Industry Specific Human Capital." *Bureau of Labor Statistics.* 2008.

Tillinghast, Ralph C., Edward A. Petersen, Samantha Rizzuto, Shahram Dabiri, and Maria C. Gonzalez. "Utilizing Science and Engineering Professionals in the Classroom: How Your Workforce Can Positively Impact STEM and Your Company's Bottom Line." In *2015 IEEE Integrated STEM Education Conference*, 171–77: IEEE. 2015.

U.S. Merit Systems Protection Board. "OPM-Granted Direct-Hire Authority: Usage and Outcomes." 2021.

Wenger, Jennie W. *DoD Starbase: Improved Measures for Participation, Outreach, and Impact.* Santa Monica Calif. RAND National Defense Research Institute. 2018.

Wiswall, M., and B. Zafar. "Determinants of College Major Choice: Identification Using an Information Experiment." *The Review of Economic Studies* 82 (2): 791–824. 2015. https://doi.org/10.1093/restud/rdu044.

Wiswall, Matthew, and Basit Zafar. "Preference for the Workplace, Human Capital, and Gender." *National Bureau of Economic Research.* 2016

Yannakogeorgos, Panayotis A., and John P. Geis. *The Human Side of Cyber Conflict: Organizing, Training, and Equipping the Air Force Cyber Workforce.* Maxwell Air Force Base Alabama: Air University Press Air Force Research Institute. 2016.

Abbreviations

AcqDemo — Acquisition Demonstration

AEOP — Army Educational Outreach Program

AEOP-URAP — Army Education Outreach Program Undergraduate Research Apprenticeship Program

AFB — Air Force Base

AFMC — Air Force Materiel Command

AFPC — Air Force Personnel Center

AFRL — Air Force Research Laboratory

ARL — Army Research Laboratory

ASEE — American Society for Engineering Education

ASVAB — Armed Services Vocational Aptitude Battery

AWS — Amazon Web Services

BARA — Bilateral Academic Research Initiative

BEYA — Black Engineer of the Year Award

C:SFS — CyberCorps scholarship for service

CCDC — U.S. Army Combat Capabilities Development Command

C.F.R. — Code of Federal Regulations

COVID-19 — Coronavirus Disease 2019

CPAC — Civilian Personnel Advisory Center

CRADA — Cooperative Research and Development Agreements

DACM — Director, Acquisition Career Management

DAWDA — Defense Acquisition Workforce Development Account

DCAA — Defense Contract Audit Agency

DCAIP — DoD-Wide College Acquisition Internship Program

DCIP — DoD Centralized Intern Program

DCMA — Defense Contract Management Agency

DCPAS — Defense Civilian Personnel Advisory Service

DCTC — Defense Civilian Training Corps

DESI	Defense Enterprise Science Initiative
DEVCOM	U.S. Army Combat Capabilities Development Command
DHA	Direct Hire Authority
DLA	Defense Logistics Agency
DLI	Defense Language Institute
DLIFLC	Defense Language Institute Foreign Language Center
DLNSEO	Defense Language and National Security Education Office
DLO	Defense Language Office
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DURIP	Defense University Research Instrumentation Program
EHLS	English for Heritage Language Speakers
FY	Fiscal Year
GEMS	Gains in the Education of Mathematics and Science
GPA	Grade Point Average
GS	General Schedule
HBCU	Historically Black Colleges and Universities
HR	Human Resources
IDA	Institute for Defense Analyses
ILR	Interagency Language Roundtable
ISEF	International Science and Engineering Fair
JAIC	Joint Artificial Intelligence Center
JAMRS	Joint Advertising Marketing Research and Studies
JROTC	Junior Reserve Officers' Training Corps
JSHS	Junior Science and Humanities Symposia
KSAs	Knowledge, Skills, and Abilities
Lab Demo	Laboratory Demonstration
LREC	Language, Regional Expertise, and Culture
LRI	Language Readiness Index
LTC	Language Training Centers
LTD	Language Training Detachment
LUCI	Laboratory University Collaboration Initiative

MDA	Missile Defense Agency
MSI	Minority Serving Institution
MURI	Multidisciplinary Research Program of the University Research Initiatives
NAPA	National Academy of Public Administration
NAVAIR	Naval Air Systems Command
NAVFAC	Naval Facilities Engineering Systems Command
NAVSEA	Naval Sea Systems Command
NDSEG	National Defense Science and Engineering Graduate
NLSC	National Language Service Corps
NMSI	National Math + Science Initiative
NRC RAP	National Research Council Research Associateship Programs
NREIP	Naval Research Enterprise Internship Program
NRL	Naval Research Laboratory
NROTC	Naval Reserve Officer Training Corps
NSA	National Security Agency
NSAP	Naval Science Awards Program
NSBE	National Society of Black Engineers
NSEP	National Security Education Program
NSIN	National Security Innovation Network
ONR	Office of Naval Research
OPM	Office of Personnel Management
ORAU RAP	Oak Ridge Affiliated Universities Research Associateship Program
ORISE	Oak Ridge Institute for Science and Education
OSD	Office of the Secretary of Defense
OUSD(P&R)	Office of the Under Secretary for Personnel and Readiness
PaYS	Partnership for Youth Success
PCIP	Air Force Premier College Internship Program
Project GO	Project Global Officer
RAP	Wright Scholar Research Assistant Program
RFLI	Regional Flagship Languages Initiative
ROTC	Reserve Officer Training Corps

SCEP	Student Career Experience Program
SEAP	Science and Engineering Apprentice Program
SMART	Science, Mathematics, and Research for Transformation
SOFA	Status of Forces Survey (Active)
SSEP	Army STEM Student Employment Program
STARBASE	Science and Technology Academies Reinforcing Basic Aviation and Space Exploration
STEM	Science, Technology, Engineering, and Mathematics
STRL	Science and Technology Reinvention Laboratories
SWE	Society of Women Engineers
TAD	Talent Acquisition Division
TRADOC	U.S. Army Training and Doctrine Command
TS/SCI	Top Secret/Sensitive Compartmentalized Information
UMSPB	U.S. Merit Systems Protection Board
USAFA	United States Air Force Academy
U.S.C	United States Code
USMA	United States Military Academy
USNA	United States Naval Academy
VBFF	Vannevar Bush Faculty Fellowship

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