

U.S. ARMY Office of the Deputy Assistant Secretary of the Army for Research and Technology

2022 Report on the U.S. Army's Scientific and Engineering Workforce

Army Science & Technology, By People for People





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A Science & Technology Workforce to Support Army Modernization

The Army has a robust enterprise of laboratories powered by a diverse, technically competent, and highly educated workforce of civilian scientists and engineers. This science and technology (S&T) workforce conducts world class scientific basic and applied research forming the institutional backbone of Army research and development and is an integral part of the Army S&T enterprise.

It is vital to the Army's mission and the health of the Army S&T enterprise to develop and retain a knowledgeable, high performing S&T workforce as the Army seeks to modernize and maintain its technological advantage. The Army's six modernization priorities (i.e., Long Range Precision Fires (LRPF); Next Generation Combat Vehicle (NGCV); Future Vertical Lift (FVL); Network; Air and Missile Defense (AMD); and Soldier Lethality) will drive materiel development for the Multi-Domain Operations (MDO) capable force. Eight Army priority research areas advance Army modernization through discovering, developing, and proving state of the art technologies. These priority research areas include: disruptive energetics; Radio Frequency (RF) electronic materials; quantum; hypersonic flight; artificial intelligence (AI); autonomy; synthetic biology; material by design; and science of additive manufacturing. Key to developing the technologies necessary to meet Army modernization goals is in house, relevant, transformative research focused on discovery, innovation, and transition to deliver S&T solutions and the Army S&T workforce provides the expertise to develop these game changing technologies.



Army Science & Technology Enterprise

The Army's S&T enterprise, includes a network of twelve synchronized laboratories and engineering centers located across the country under the U.S. Army Futures Command (AFC), the U.S. Army Combat Capabilities Development Command (DEVCOM), the U.S. Army Medical Research Development Command (MRDC), the U.S. Army Corps of Engineers (USACE), the Space and Missile Defense Command (USASMDC), and Department of the Army, G-1. Together with partners from the other Services and the Office of the Secretary of Defense, Army laboratories and centers are working with academia and industry to develop new technology that is driving near and mid-term modernization to equip the Army of 2030, and performing the fundamental research driving the discoveries that will enable the Army of 2040 and beyond.

The Deputy Assistant Secretary for Research and Technology (DASA(RT) supports the Assistant Secretary of the Army for Acquisition, Logistics, and Technology (ASA(ALT)) as the Army Chief Scientist and the Service S&T Executive. DASA(RT) provides Army Headquarters oversight of Research, Development, Test, and Evaluation (RDTE) budget activities (BA) 1 -3 (i.e., 6.1-6.3, basic and applied research), develops policies to enable successful management of S&T laboratories, personnel, infrastructure and technology transfer, governs the RDTE BA 3 to BA 4 transition process, and develops and defends Army S&T investment strategy.



The Army Director for Laboratory Management resides in the office of the DASA(RT) and serves as the Army agency representative in all matters concerning the S&T workforce. The Director for Laboratory Management provides policy guidance on S&T personnel authorities, and presides over the Army Laboratory Quality Enhancement Program (A-LQEP) Workforce subpanel. The A-LQEP Workforce subpanel is chartered to provide a forum to establish Army-level advocacy for issues impacting the Army S&T workforce and provide governance and oversight for workforce initiatives. This subpanel focuses on workforce and



personnel policies to attract, recruit, and retain elite S&T talent and shares best practices to optimize the impacts of unique workforce flexibilities on Army modernization. The A-LQEP Workforce and Personnel subpanel leverages the various Army and DoD personnel authorities in order to most efficiently meet the needs of the S&T enterprise.

POLICY, BUDGET AND OVERSIGHT



OPERATIONAL AND PROGRAM EXECUTION



The Army S&T Enterprise spans across four Major Army Commands (MACOM): U.S. Army Futures Command, U.S. Army Corps of Engineers, U.S. Army Space and Missile Defense Command (SMDC), and Headquarters, Department of the Army, G-1 (HQDA G-1). The Army laboratories reach across 27 U.S. states. The 12 Army Science and Technology Reinvention Laboratories (STRLs) are: AFC Headquarters, DEVCOM Army Research Laboratory (ARL), DEVCOM Armaments Center (AC), DEVCOM Aviation and Missile Center (AvMC), DEVCOM Command, Control, Communication, Computer, Cyber, Intelligence, Surveillance, and Reconnaissance Center (C5ISR), DEVCOM Chemical Biological Center (CBC), DEVCOM Ground Vehicle Systems Center (GVSC), DEVCOM Soldier Center (SC), U.S. Army Medical Research and Development Command (MRDC), U.S. Army Research Institute for Behavioral and Social Sciences (ARI), USASMDC Technical Center (SMDTC), and the U.S. Army Engineer Research Development Center (ERDC).



Army S&T Workforce

In FY22, Army civilians worked across the Army STRLs in a variety of positions, including scientists and engineers (S&Es), technicians, business and administrative support, and general support. Mechanical Engineers are the largest S&E occupational series. Additionally, in house contractors and students make up a large percentage of the workforce at Army laboratories. DEVCOM AC employs the most Army civilian S&Es. DEVCOM AvMC has the largest total workforce when counting contractors. The labor populations vary greatly between the twelve STRLs due to the difference in mission sets and budgetary restrictions.

Due to the large, diverse mission across the Army S&T enterprise, Army laboratories employ S&Es in virtually every science, technology, engineering, and mathematics (STEM) occupation. The top STEM occupations at Army laboratories include General Engineer, Computer Scientist, and Mechanical Engineer; however, the need for more specialized talent has increased. The Army is shifting to employ more S&Es that specialize in arti icial intelligence, machine learning, autonomy, cyber, quantum theory, and hypersonics.



Top Army S&E Occupations





Science and Technology Reinvention Laboratories

STRL Designation

The twelve Army STRLs have been specially designated by Congress or by the Office of the Under Secretary of Defense for Research and Engineering (USD(R&E)). STRL designation provides Laboratory Directors numerous special authorities and opportunities unique to STRLs, including implementing Personnel Demonstration Projects. Personnel Demonstration Projects, also known as Lab Demo, allow STRLs to waive certain Federal laws and Federal and Department of Defense (DoD) policies in order to dynamically shape their workforce, allowing STRL Directors to experiment with new and different personnel management concepts to determine whether such changes in personnel policy or procedures would result in improved personnel management. A key recommendation for the demonstration projects was to implement personnel practices that promote scientific competence and renewal in the workforce.

Prior to Lab Demo, Army STRLs faced numerous challenges surrounding the recruitment and retainment of top talent. First and foremost, is the pay differential for S&Es between Army STRLs and industry. Industry is not constrained to Federal laws or salary guidelines and is often able to pay higher wages, provide a higher overall benefits package, and make counter offers. Additionally, Federal employment traditionally has a significantly longer time to hire than the private sector. Thus, Congressionally-provided special personnel hiring authorities have been critical for Army laboratories to remain agile and competitive with the private sector. STRLs with a published Personnel Demonstration Project in the Federal Register (FR) are allowed to implement these unique flexibilities to better attract, retain, and manage the civilian S&T workforce.



Pay for Performance

Most Lab Demo systems have implemented an alternative contribution-based pay system known as pay for performance. Pay for performance and contribution-based systems create pay bands that span several traditional General Schedule (GS) grades and steps. Unlike the traditional GS pay systems, employees that perform highly in their career field are rewarded accordingly. These systems give STRLs the ability to offer more competitive compensation which has improved recruitment and retention efforts. This is especially true in starting salaries for new employees. Through Lab Demo, most Army STRLs are now able to pay out annual bonuses and offer differential pay if an employee expresses intention to leave for a high paying job which are more robust and effective than traditional Federal retention incentives.

Above GS-15 Pay Scales

DoD STRLs, through Lab Demo, are authorized a pay scale above the GS-15 grade. These professionals are known as Senior Scientific Technical Managers (SSTM). The purpose of SSTMs are to properly classify and compensate senior scientific talent who are engaged in or managing state-of-the-art research and development. SSTMs carry out technical supervisory responsibilities at their STRLs. As of the end of FY22, more SSTMs were employed by Army laboratories as compared to FY21. STRLs also have the ability to bring in extremely specialized talent at the pay rate of 150% of Level 1 of the Executive



Schedule using Enhanced Pay Authority. These individuals are responsible for managing and performing complex, high-cost, research and technology development efforts at STRLs.

Direct Hire Authority

Another challenge that STRLs face is the time to hire a candidate. Traditionally, STRLs were required to follow Office of Personnel Management (OPM) guidelines by posting and hiring candidates through USAJobs. This can be a very lengthy process and steers away some candidates, especially when S&E positions have already become hard to fill. Congress provided STRLs the authority to directly hire (i.e., Direct Hire Authority (DHAS&Es at STRLs. DHA allows STRLs to directly hire qualified candidates outside of USAJobs which has streamlined the hiring process and significantly decreased the time to hire candidates. Across the STRLs, 70% of the new hires in 2022 were hired using DHA. To illustrate the impact of DHA, prior to the implementation of DHA, DEVCOM ARL has closed the vacancy gap by 75%.



Traditional Hire

Tentative Offer: 50 Days Firm Offer: 60 Days Entrance on Duty: 91 Days



Direct Hire

Tentative Offer: 22 Days Firm Offer: 54 Days Entrance on Duty: 65 Days



Manage to Budget

Traditionally, Army STRLs have been constrained to the Tables of the Distribution and Allowances (TDA) for allotment of personnel billets. STRL Directors have more tools to manage to budget rather than manage to the TDA. One example is Flexible Length and Renewable Term Technical appointments. These appointees do not count against the laboratory TDA. This authority provided by Congress has been a constructive mechanism for workforce and talent management allowing the laboratory to be agile and flexible just like our academic and industrial partners. Laboratory Directors may extend these positions indefinitely in up to six-year increments. STRLs may at any time convert term employees into permanent employees, if stated in the original hiring action. In 2022, Army STRLs hired nearly 600 personnel into Flexible Length and Renewable Term positions. Prior to the usage of this authority, these positions would not have existed. These positions also help promote the laflow of talent between the federal government and academic and industry partners. While permanent positions provide better job security for each individual employee, Flexible Length and Renewable Term positions are great for getting new young S&E's feet in the door of Army STRLs.



The authorities granted to Army STRLs greatly increase the Army's competitive edge; however, there is still a gap with the private sector. Army STRLs often lose candidates to private industry especially in certain highly skilled positions such as cyber, quantum, computer and computation sciences, mechanical engineering, and electrical engineering. The main competitive gap factor with private industry is that they are not constrained by law to rates at which they can pay their employees. While Lab Demo has shortened the pay gap, a large disparity still exists.





2022 Policy Updates

Section 233, FY17 National Defense Authorization Act

In 2017, Congress established a pilot program in Section 233 of the National Defense Authorization Act (NDAA, which allows Army Laboratories to demonstrate innovative methods for more effective development of technology and management of functions. STRL directors may propose to waive any regulation, restriction, requirement, guidance, policy, procedure, or departmental instruction detrimental to the implementation of innovative business practices, unless such implementation would be prohibited by a federal statute or common law. Since inception of the pilot program, Army STRLs have submitted 10 Section 233 pilot program waiver proposals. Approved waivers include personnel, physical security, and information technology-related policy waivers.

In 2022, Army STRLs submitted four Section 233 pilot program waiver proposals. One proposal submitted by DEVCOM GVSC grants Army STRLs elevated access to personnel data. Prior to this proposal, STRLs could not retrieve certain personnel data to include workforce demographics. This waiver will allow STRLs to quickly identify and analyze trends, forecast personnel growth areas, succession planning, improve the distribution of manpower authorizations, identify areas of concern, conduct outreach initiatives to increase underrepresented communities, provide qualitative research to determine resource needs, and more. Army STRLs approved to participate in the Section 233 pilot program may request to adopt approved waivers. The 2022 DEVCOM GVSC Section 233 pilot program waiver was adopted by two other Army STRLs.

The Section 233 pilot program has been well received by the Army S&T community and the innovative methods being demonstrated have benefited the Army STRLs overall; however, implementation has been a challenge in some cases. Many stakeholder organizations that are the proponent for a regulation, requirement, policy, etc. that an Army STRL Director has received approval to waive to implement an innovative method, have delayed, and in some cases stopped, implementation by Army STRLs. The DASA(RT), the Director for Laboratory Management, and the Army STRLs continue to educate stakeholder organizations on the pilot program.

Federal Register Notices

When a DoD laboratory is newly designated as an STRL, an FRN must be published to implement the Personnel Demonstration Project. The FRN describes flexibilities and fully documents waivers to Title 5, United States Code (USC), or Title 5, Code of Federal Regulations (CFR). Although the AFC-HQ STRL has been designated as an STRL by the USD(R&E), AFC-HQ cannot implement STRL authorities and flexibilities without a published FRN. In 2022, AFC-HQ began drafting their first FRN. AFC-HQ successfully published their draft notice to the FR and received numerous comments from the public. In 2023, AFC-HQ plans to address all public comments with the goal of publishing a final FRN.

FRNs are also used to implement changes to existing Personnel Demonstration Projects. Waivers are required when a flexibility conflicts with Title 5, U.S.C., or Title 5, CFR, provisions. For individual STRL requests for publication of an FRN, the STRL works with the DoD Component S&T and human resources (HR) representatives and the Director, USD(R&E) Laboratories and Personnel Office (L&PO), to prepare and coordinate the FRN. DoD may also publish omnibus FRNs, which may be adopted by any DoD STRL with an already approved Personnel Demonstration Project FRN. DoD published two FRNs in 2022. The Reduction in Force (RIF) procedures FRN ensures employees involuntarily separated through a RIF are separated primarily based on performance, as determined under any applicable performance management system. The STRL Supplemental Pay FRN allows DoD STRLs to implement the flexibility of a supplemental pay provision based on criteria as defined by the STRL director. This supplemental pay flexibility permits STRLs to independently establish supplemental pay rates based on market conditions to help STRLs attract, recruit, and retain a high caliber workforce.



Developing the Future Army S&T Workforce – STEM Education

The mission at Army laboratories requires a significant amount of the workforce to have advanced degrees. Army laboratories use various programs and mechanisms to attract and retain S&Es with advanced degrees. Army laboratories have a variety of programs to bring in students to work at the laboratories during degree pursuit and to expose the next generation (K-12) to the careers in science and technology. Programs such as the Army Educational Outreach Program (AEOP) work to create a STEM pipeline. Annually, AEOP reaches over 16,000 students and educators. Army laboratories also participate the Department of Defense (DoD) Science, Mathematics, and Research for Transformation (SMART) Scholarship-for-Service Program, which funds student degrees in STEM undergraduate and graduate programs in return for a service commitment at their DoD laboratory. The SMART Program aims to bring more highly-skilled STEM professionals into the DoD civilian workforce. This competitive scholarship sponsors students in one of 24 national security-critical STEM fields. Selected students are matched with a relevant Army facility and awarded a full-tuition scholarship. Each summer, they intern at that Army facility. Upon graduation, they go work at this Army facility for a period commensurate to their scholarship: One year of scholarship is one year of paid service. In 2022, the Army awarded 140 SMART scholarships. Army laboratories have also developed organic internship programs. A majority of the new positions added at Army STRLs were S&Es with advanced degrees thus, the demand for highly skilled STEM talent steadily increases.



Army SMART Scholarships



- Over 90% of SMART scholars successfully complete their sponsored degree and service requirement.
- Over 50% of Army SMART scholars have remained in Army employment after their service requirement ended.

SMART

SCIENCE, MATHEMATICS, AND RESEARCH FOR TRANSFORMATION

PART OF THE NATIONAL DEFENSE EDUCATION PROGRAM





Army S&E Recognition, DoD Laboratory Scientists of the Quarter

The Laboratory Scientist of the Quarter Award recognizes a subject matter expert that demonstrates exceptional work on behalf of the DoD across the science and technology spectrum. These individuals go above and beyond their expected roles and responsibilities to advance the mission of the DoD, and increase the impact of research and development programs.

Dr. Darin Sharar

Dr. Darin Sharar of DEVCOM ARL was named DoD Laboratory Scientist of the Quarter for FY 2022 quarter one. Dr. Sharar's accomplishments are in the areas of thermal materials, solid-solid phase change, thermal energy storage, and advanced heat transfer programs. Sharar has made several novel and impactful contributions to the science and technology community which made him worthy for this award. He has lead a variety of scientific projects that have rapidly advanced the DoD's ability to design, tailor, fabricate, and apply new technologies.

When asked what winning the award meant to him, Dr. Sharar said, "Winning this award is extremely special for myself, my organization, and my friends/ collaborators at Naval Surface Warfare Center (NSWC) Dahlgren, Air Force Research Lab (AFRL), Army Research Office (ARO), Office of Naval





Army S&E Recognition, DoD Laboratory Scientists of the Quarter

Research (ONR), industry, and academic institutions - without the team/community, none of this would be possible. We're only as good as the company we keep. But more importantly, this award marks the development and transition of significant technological overmatch for our military and country with state of the art thermal management technologies. I'm very proud of this accomplishment".

https://www.army.mil/article/256465/army scientist named dod laboratory scientist of the guarter

Dr. David Baker

DoD named Dr. David Baker DEVCOM ARL as the Department's Laboratory Scientist of the Quarter for quarter 3 of FY 2022. Dr. Baker is recognized for his pioneering research that has enhanced renewable energy technologies constrained by size and weight and is critical to the U.S. Army and the Department. He led efforts that created a remarkable paradigm shift in fuel cell conversion efficiency by illuminating metal nanoparticles to catalytically oxidize alcohols, which enabled the full conversion of alcohols for fuel cells thus extending operating lifetimes of future powered devices. In addition, he developed new water-splitting catalysts made of Earth-abundant materials demonstrating higher activities than expensive and rare state-of-the-art metals. Dr. Baker's leadership and expertise in research and development, coupled with inspiring the next generation of scientists, have greatly advanced the Department's mission.



Dr. Peter Gadfort

Dr. Peter Gadfort, a DEVCOM ARL electrical engineer, received the award for the 4th quarter of FY 2022 for his accomplishments in advanced microelectronics. Dr. Gadfort discovered and devised a new approach to microelectronics design that enables the Army to develop artificial intelligence (AI) at the tactical edge for dismounted Soldiers and small platforms with limited power and a contested network. Dr. Gadfort conceived, designed, and prototyped the Army's most complex Al microelectronics: a reconfigurable Al microchip with 450-million transistors that exceeds state of the art by an order of magnitude. By These accomplishments will reduce the power burden deploying AI will have on dismounted Soldiers from 70% of the battery supply for a 72-hour mission to less than 2%. Dr. Gadfort's most recent impact for the Army and DoD goes beyond Al-revolutionizing microelectronics design. He worked directly with electronic design automation (EDA) tool



engineers to provide a solution that enables the parallel evaluation of thousands of designs to optimize microelectronics performance in a matter of hours rather than in a multimillion-dollar, multiyear design cycle.

