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The Criticality of Defense-Focused Technical Education

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with
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The United States Air Force is a service born of technology, and throughout its history, technology has remained central to its identity and power. From the start, visionary leaders realized the importance of technologically focused education to advancing airpower. Consequently, through the years, institutions of higher learning such as the Air Force Institute of Technology (AFIT), as well as the civilian institution program it administers, have continued the meaningful work of developing the technology and organic human capital to sustain the Air Force's edge as a fighting force. As advances in technology have led the Air Force into the new domains and challenges of space and cyberspace, the role of delivering defense-oriented technical education has become even more critical. In this process, leveraging our network of science and technology partners to produce technically educated and operationally focused Airmen has proved as significant as the advances themselves. Because demand for these graduates continues to increase, deliberate investment in science, technology, engineering, and mathematics (STEM) education must also increase. Today, as yesterday, experienced Air Force leaders with a defense-focused technical education are essential to maintaining our military supremacy, and

AFIT continues to meet that need—as it has since its inception in 1919.

In the Beginning

Even during the early days of aviation in Dayton with the Wright brothers—a time marked by fledgling, primitive technology (wood, wire, and fabric)—the miracle of powered flight inspired leaders to think of military applications and the transformational effect they could have. From that time to the present day, the education and research conducted at Wright-Patterson AFB, Ohio, have been instrumental in setting the course for the development of air, space, and cyberspace power. One of the visionary leaders present at the beginning, Col Thurman H. Bane, led the way in creating the Air School of Application, the forerunner of AFIT. Bane realized that technology lay at the core of the new Air Service's identity and capability; thus, technologically focused education for Airmen was central to the service's effectiveness. Bane wrote to the director of military aeronautics in Washington, DC, emphasizing the importance of education in support of the emerging airpower domain, observing that “no man can efficiently direct work about which he knows nothing.”¹ The school's first class, led by Lt Edwin Aldrin (father of

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astronaut Edwin “Buzz” Aldrin Jr.), graduated in 1920. Since that time, AFIT has produced a string of senior leaders whose technical education and foundation have shaped the Air Force and its progress.

Two other airpower giants came to AFIT before they became legends. Future generals George Kenney and Jimmy Doolittle graduated in the classes of 1921 and 1923, respectively. Both went on to establish themselves as technical innovators as well as visionary leaders. Consider the relatively small investment made in the technical education of General Kenney between 1920 and 1921. The technical background he gained in school allowed him to push the known envelope of airpower as well as test new concepts such as mounting guns on the wings of aircraft and developing the tactic of skip bombing. The latter key innovation contributed to the total destruction of Japanese supply ships in the Battle of the Bismarck Sea.²

Doolittle’s story also provides a classic illustration of innovation backed by strong technical education. A pioneer of instrument flying and the holder of multiple air-speed records, he consistently took calculated risks to advance the limits of flight. Doolittle graduated from AFIT with an aeronautical engineering degree in 1923 and from the Massachusetts Institute of Technology with a PhD in 1925. His famed raid on Tokyo in 1942 demonstrated both his leadership and his technical understanding of the requirements for doing something few people thought possible: launching B-25s from the deck of a carrier and hitting Japan before recovering to China.

Note another case in point: Gen Bernard A. Schriever, the “Father of the Air Force Space and Missile Program,” whose story Neil Sheehan tells in his book *A Fiery Peace in a Cold War*, used his technical education in engineering from AFIT to lead the Air Force into the domain of space.³ A shrewd and experienced leader who knew how to navigate the halls of Washington, he also understood the science and engineering required to engage with civilian scientists, en-

gineers, contractors, and decision makers to shepherd the US intercontinental ballistic missile (ICBM) program from an idea to operational reality in a few short years. Schriever epitomized the scholar-leader who relies upon experience and education to lead in a dynamic environment and push the limits of the possible.

These individuals are but a few of the more prominent leaders who used their advanced technical education to achieve greatness. However, thousands of less well known graduates have made important contributions to developing the technology and science behind our ability to dominate each new mission area.

New Domains, New Challenges

As the Air Force mission expands, the breadth and depth of technical education requirements for our leaders continue to grow as well. Just as Schriever led the Air Force into space, so is a new generation of leaders pointing the way into cyberspace. This new war-fighting domain needs enormous amounts of STEM investment at all ranks and skill levels. Unlike air and space domains, the cost of entry to exploit cyberspace is low, yet the potential damage to the national security and economy is enormous. The complex cyberspace domain evolves at an astonishing pace.⁴ Training is essential but not sufficient to ensure success. Therefore, we must also educate our force to anticipate, evaluate, and develop solutions to unforeseen problems in order to guarantee superiority in cyberspace. In response to the demands of Air Force Space Command, AFIT expanded its frontline role in educating these rising technical leaders by adding cyber professional continuing education to cyber graduate education and developmental education. This targeted, multitiered education delivers cyber-focused research projects and, more importantly, degree- or certificate-holding graduates who are technically prepared to move the Air Force into the cyber domain.

The Air Force continues to face difficult challenges as well as ever-growing pressure to become more efficient. One area of renewed focus stems from the Air Force's prioritization of its nuclear enterprise. Air Force Global Strike Command leads the charge but receives support from numerous entities that have an interest in the nuclear arena. The Secretary of Defense Task Force on Department of Defense (DOD) Nuclear Weapons Management singled out the underlying importance of education and training as key tools for generating a culture of nuclear excellence.⁵ AFIT responded by revitalizing its nuclear engineering programs and offering certificate programs in addition to traditional graduate degrees with a revamped curriculum. It remains the sole source for defense-focused graduate degrees in nuclear engineering for both the Air Force and Army. Unlike civilian nuclear engineering programs that emphasize power generation or medical applications, those offered by AFIT address the essential task of solving unique defense problems. Besides safety and security of nuclear materials, the DOD has special requirements to study nuclear weapons' effects and their applications. Those demands drive the need for the corresponding defense-focused education and research readily available at AFIT.

Globalization, accompanied by reliance on resources, solutions, and human capital outside our borders, increasingly challenges our effort to maintain technical dominance. Technical innovation is at risk unless we continue to develop an indigenous pool of scientists and engineers from which the DOD and Air Force can draw to meet their needs.⁶ Along with the Air Force Research Laboratory, AFIT serves as an organic source for STEM personnel and a place where the connection among applied research, education, and the mission is immediately apparent. In addition to their contributions as students, our graduates quickly find themselves in positions where they can put their advanced academic degrees to good use in

service of Air Force and DOD priorities. The investments in their education have both immediate and long-lasting effects throughout their careers and beyond.

It Takes a Network

Keeping pace with technology requires a network of educators, researchers, and operational organizations that rely on technology to perform their missions. Active interactions among organizations that produce and need technical leadership supply the right leader at the right time in the right place. Leveraging partnerships and collaborations is essential to enhancing the educational experience and expanding research opportunities. AFIT is uniquely positioned at Wright-Patterson AFB to benefit from the proximity to its neighbors, all of them focused on science and technology: the Air Force Research Laboratory, Air Force Materiel Command, and National Air and Space Intelligence Center. Furthermore, AFIT partners with many institutions nationwide, such as the National Security Agency, Department of Homeland Security, and National Reconnaissance Office, to share expertise, laboratories, and resources for a common objective—advancing air, space, and cyberspace power for the Air Force and the United States. Long-standing partnerships among a multitude of defense, academic, and government stakeholders build an essential framework for delivering winning capability during times of war, changing missions, and fiscal uncertainty. The ultimate objective is to meet the war fighter's needs by ensuring that our graduates stay connected and attuned to current operations across the globe.

Natural career progression and the professional network inherent in the Air Force continue to create opportunities for partnering. Such partnerships are most critical and valuable when they respond to an immediate mission need. Through its connections to students' gaining and losing commands as well as its alumni, mission



partners, and deployed faculty and staff, AFIT frequently becomes aware of urgent, developing requirements. In these cases, military organizations can respond with unmatched speed and flexibility without the need for complicated government-to-civilian contractual agreements. In 2009, when tasked by US Central Command to monitor the progression of the Afghan Air Force, NATO Training Mission–Afghanistan turned to AFIT for development of an automated tool kit that for the first time enabled the use of comprehensive data collection and regression routines to track key indicators. Within three months, AFIT had made available the first tool kit prototype. Also at the request of Central Command, AFIT is designing 22 logistics and acquisition courses for the Iraqi military, scheduled for delivery starting this year. AFIT possesses the invaluable organic capability to rapidly generate not only technical leaders but also science and technology innovations in a systematic way.

These kinds of examples show the value of a core technological education capability and of highly educated technical graduates in ensuring that the modern Air Force remains on the edge of innovation. Their research and classroom projects feed into war-fighting operations and research programs around the country. At the same time, state-of-the-art research reaches back to inform and refresh the classroom. This symbiotic relationship between research and curriculum requires a *critical mass* of students, faculty, and funding to thrive and generate the intended results. A robust technical program will produce capable technical leaders and show the way to potentially game-changing technology. Without a steady stream of defense-focused, technically educated individuals, every aspect of the technologically demanding Air Force mission will suffer. With graduates in such high demand, AFIT has transformed our educational methods by using Internet and satellite technology to bring itself to the Airman in addition to bringing the Airman to AFIT. These efforts produced 28,000

graduates of professional continuing education last year alone, in addition to 320 graduates with MS degrees, 31 with PhDs, and 2,600 from civilian institutions.

The Future

A recent report by the National Research Council of the National Academies identified the loss of technical competence within the Air Force as an underlying problem in several areas of science, engineering, and acquisitions.⁷ At the same time, the *Report on Technology Horizons*, Headquarters US Air Force's vision for science and technology, recognizes that the capabilities we need also lie within the reach of potential adversaries because of their access to the same science and technology.⁸ In the midst of budgetary constraints, advances in technology are imperative to increase manpower efficiencies as well as enhance the Air Force's capabilities. Several areas in which AFIT research and education directly support the *Report on Technology Horizons* vision include cyber resilience, adaptable autonomous systems, operating in an environment without benefit of the Global Positioning System (GPS), rapidly composable satellite systems, and improvement of space situational awareness. In the spirit of the *Report on Technology Horizons*, this edition of *Air and Space Power Journal* contains a small sampling of articles covering critical areas of research in cyberspace, energy and fuels, GPS alternatives, and technology that can improve wartime effectiveness and operational efficiencies.

As was the case with General Schriever and development of the ICBM force, these advances can occur efficiently and effectively only with the guidance and vision of leaders who have a solid grounding in science and technology that includes technologically focused education. Early on, Gen Henry "Hap" Arnold realized that scientists and engineers were the kind of people who would bring him the ideas he needed.⁹ According to the *Air Force Science and Tech-*

nology Strategy, which serves as the cornerstone of all of the service's science and technology activities, maintaining our technological dominance faces a challenge from globalization and other nations' ready access to the technology and human capital that make possible the development of advanced capabilities. Furthermore, innovation is at risk unless the United States can develop scientists and engineers well grounded in STEM and attract them to careers in the Air Force.¹⁰ AFIT serves as a key resource in meeting the need for well-qualified STEM professionals.

A defense-focused technical education can make no greater contribution than its graduates. These technically smart, savvy leaders are ready to tackle difficult problems. They make their presence felt even during their time as students conducting research relevant to today's problems as well as tomorrow's challenges. In the long term, their influence grows as their responsibilities increase, whether in the military or in industry. For example, AFIT's most recent distinguished alumnus, Dr. Ray O. Johnson, currently serves as senior vice president and chief technology officer for Lockheed Martin Corporation. His MS and PhD in electrical engineering from AFIT gave him the solid technical foundation he needed to succeed in the Air Force and, subsequently, in the defense industry. He is not alone, but we must produce more George Kenneys, Jimmy Doolittles, Bennie Schrievers, Lew Allens, and Ray Johnsons if we wish to maintain and sustain our technological edge as an Air Force and a country.

To this end, institutions must broaden their reach by increasing the diversity of sources for their STEM students. Although AFIT's primary student population consists of Air Force officers, military officers from all services attend, as well as those from many partner nations. Moreover, since 2004, 75 enlisted personnel have graduated from AFIT with MS degrees. These warrior-scholars have distinguished themselves in their studies and demon-

strate once again how much we as an Air Force depend upon an educated and technically capable noncommissioned officer corps to succeed. Government civilians from the Wright-Patterson AFB community also attend AFIT, and within the last several years, the civilian student population has increased through sponsorship programs such as those of the National Science Foundation and the DOD's Science, Mathematics, and Research for Transformation (SMART) scholarships. The Dayton Area Graduate Studies Institute (DAGSI), another avenue for civilian students, emerged as a consortium among local graduate engineering schools to leverage resources and offer crosstown enrollments. Since DAGSI's inception, AFIT has graduated 119 STEM students out of the more than 700 DAGSI scholarship recipients; most of those students eventually secured government employment within the Wright-Patterson community.

One can make a strong argument that, despite these many efforts, we simply are not producing enough Air Force leaders with advanced STEM capability and degrees—in part because the current personnel model does not accurately reflect and manage the demand. Under discussion is a proposal to mitigate this problem by using an inventory management system, similar to the one used to manage the rated force. Such a system would capture the true demand and guarantee a sufficient pool of military leaders educated in defense-related technology.¹¹ It would also allow the limited number of technical PhD officers to expand their horizons and have more of an impact in operational and staff assignments, rather than find themselves rotating between faculty jobs at the Air Force Academy and AFIT because of the lack of other qualified officers available to fill those positions.

Back to 1919 . . . and Beyond!

Technology is part of Airmen's DNA. Our first leaders realized that fact even when



the technology of flight was in its infancy. They also understood the importance of defense-focused technical education to carrying out our mission and to sustaining the Air Force our nation needs to attain its strategic goals. Advances in science and technology that have led us into new domains confirm the wisdom of that vision and the necessity of doing even more in this regard to preserve our edge and competitiveness.

When a corporation needs a new executive officer, it may promote from within or hire one with the desired experience from another organization. Military organizations, however, must grow their own. This pyramid of progression accentuates the ne-

cessity of investing in our Airmen to ensure that future leaders have the education and technical foundation to develop the capabilities demanded by our Air Force and country. At AFIT we prepare those leaders while advancing air, space, and cyberspace power for the nation, its partners, and our armed forces. We do so by offering relevant, defense-focused technical graduate and continuing education, research, and consultation. As Gen Charles A. Gabriel, former Air Force chief of staff, once said, "The AFIT of today is the Air Force of tomorrow."¹² That statement was true in 1919—and it's even truer today. ✪

Notes

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2. Sam McGowan, "General George C. Kenney: Pioneer of Aerial Warfare Strategy and Tactics in World War II's Pacific Theater," *World War II* 11, no. 2 (July 1996): 10.

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6. Office of the Chief of Staff of the Air Force, *Air Force Science and Technology Strategy, 2010* (Washington, DC: Office of the Chief of Staff of the Air Force, 2010).

7. National Research Council of the National Academies, *Examination of the U.S. Air Force's Science, Technology, Engineering, and Mathematics*

(*STEM*) *Workforce Needs in the Future and Its Strategy to Meet Those Needs* (Washington, DC: National Academies Press, 2010), http://download.nap.edu/cart/deliver.cgi?record_id=12718.

8. United States Air Force Chief Scientist (AF/ST), *Report on Technology Horizons: A Vision for Air Force Science and Technology during 2010–2030*, vol. 1, AF/STTR-10-01-PR (Washington, DC: Headquarters US Air Force, Office of the USAF Chief Scientist, 15 May 2010), http://www.aviationweek.com/media/pdf/Check6/USAF_Technology_Horizons_report.pdf.

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10. Office of the Chief of Staff of the Air Force, *Science and Technology Strategy*.

11. Lt Col Raymond W. Staats, Lt Col Marty Reynolds, and Maj Aaron D. Troxell, "Inventory Management of Officers with Advanced Academic Degrees: The Case for a New Approach," *Air and Space Power Journal* 21, no. 2 (Summer 2007): 42–52, <http://www.airpower.au.af.mil/airchronicles/apj/apj07/sum07/sum07.pdf>.

12. Gen Charles A. Gabriel (speech, AFIT Association of Graduates Banquet, Wright-Patterson AFB, OH, 15 December 1983), in History, Air Force Institute of Technology: First Sixty Years, 1919–1979, 7-2.



Maj Gen Walter D. Givhan, USAF

General Givhan (BA, University of the South; MS, Troy State University; MAAS, School of Advanced Air and Space Studies; MS, Industrial College of the Armed Forces) is commandant of the Air Force Institute of Technology (AFIT) at Wright-Patterson AFB, Ohio. AFIT's mission is to advance air, space, and cyberspace power for the nation, its partners, and our armed forces by providing relevant defense-focused technical graduate and continuing education, research, and consultation. A native of Safford, Alabama, General Givhan received his commission through Officer Training School. He served as the US air liaison officer to the commanding general, French ground forces, for Operations Desert Shield and Desert Storm. The general has commanded a combat training squadron, an operations group, an air base wing, and an air expeditionary wing. Prior to his AFIT assignment, he was the commanding general, Combined Air Power Transition Force, Combined Security Transition Command–Afghanistan, Kabul, Afghanistan. A command pilot with more than 2,500 flying hours in the T-37, T-38, T-1, AT-38, F-15, and A-10, he was a National Security Fellow at the Massachusetts Institute of Technology. General Givhan's military awards and decorations include the Legion of Merit with two oak leaf clusters and the Bronze Star.



Maj Eric D. Trias, USAF

Major Trias (BS, University of California–Davis; MS, Air Force Institute of Technology [AFIT]; PhD, University of New Mexico) is the director, Commandant's Action Group, and an assistant professor of computer science at AFIT, Wright-Patterson AFB, Ohio. He enlisted in 1988 and was a finalist for the Air Force Twelve Outstanding Airmen of the Year award in 1994. In 1998 he received his commission through the Airman's Education and Commissioning Program and Officer Training School. As a cyber operations officer, he has served operationally at Osan AB and Camp Humphreys Army Installation, Republic of Korea, and at the Distributed Mission Operations Center, Kirtland AFB, New Mexico. His research interests include knowledge discovery and data mining, information systems security, digital forensics, and various cyberspace-related topics. Major Trias is a graduate of Squadron Officer School and Air Command and Staff College.



Maj William H. Allen, USAF

Major Allen (BS, Christian Brothers University; MS, Air Force Institute of Technology [AFIT]) is the executive officer at AFIT, Wright-Patterson AFB, Ohio. He received his commission in 2000 through the University of Memphis ROTC program. As an engineer, he has served in several disciplines, including munitions test, rocket propulsion design, and evaluation and systems engineering. Major Allen is a graduate of the Aerospace Basic Course, Squadron Officer School, and Air Command and Staff College.