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## Closing the Gap: Officer Advanced Education STEM+M (Management)

Leon L. Robert Jr. and Carl J. Wojtaszek

**ABSTRACT:** The Army has made insufficient progress in arming its officers with science, technology, engineering, mathematics, and management (STEM+M) knowledge. The contemporary battlefield is faster paced, technologically enabled, and data driven, requiring officers to possess more skills, knowledge, and experience. We examine the Army's history with STEM education and show that, in terms of education, the current Army officer corps has fallen behind its requirements for technology-enabled forces and modern society. We conclude with recommendations on how the Army can close the STEM+M education gap through advances in higher education and adopting talent management practices.

**Keywords:** STEM+M, education, technology, human capital, higher education

**S**ince the 1980s, America's world ranking in science, technology, engineering, and mathematics (STEM) has declined, placing our once unquestioned supremacy in technological innovation and application on par with or behind those of our economic and military adversaries. A recent warning from the Office of the Secretary of Defense Acquisition and Sustainment Industrial Policy declared the paucity of STEM-educated Americans may lead to a "permanent national security deficit." The lack of STEM education extends to Army officers. In 2018, the *Army Strategy* assessed the strategic environment to include partners, allies, and adversaries leveraging "advanced capabilities" such as cyber, counter space, electronic warfare, robotics, and artificial intelligence (AI). This assessment has proven true in the Russia-Ukraine War, an artillery-heavy war interwoven with the burgeoning development and implementation of new and evolving technologies that demand innovative thinking, alliances, and strategy informed by STEM+Management (STEM+M).<sup>1</sup>

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"If you don't like change, you're going to like irrelevance even less."

—Army Chief of Staff General Eric K. Shinseki, 2001<sup>2</sup>

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Meanwhile, the evolving character of the American workforce demands greater proficiency in STEM+M, from the mechanic repairing a hybrid car with the aid of a computer and the IT professional building web applications to the general manager or military commander employing data-driven decision making. The decline in STEM+M education, as determined by the Department of Defense (DoD) and national education organizations, is not just a national security problem but one shared by US industry and business leaders. Both sectors recognize the significant gap between the number of jobs requiring a STEM+M background and education and the number of laborers possessing these skills—a shortfall set to exceed one million jobs this decade.<sup>3</sup>

The president, Congress, the Department of Education, the Department of Defense, and the Army have acknowledged this trend and instituted programs to build, support, and partner with educators to increase primary and secondary school STEM+M participation and engagement. While these and other programs (the most recent example being the Biden-Harris administration’s Department of Education “Raise the Bar: STEM Education for all Students”) exist to change the long-term trajectory of national STEM+M education over decades, the Army should not overlook emerging opportunities to solve its current STEM+M gaps internally.<sup>4</sup>

A higher level of STEM+M education within the officer corps provides three benefits:

1. it increases the technical knowledge required of Army officers in scientific, engineering, and management fields;
2. it enhances the development of problem-solving and critical thinking skills, such as human judgment, to address ill-defined, ambiguous, and complex, multilayered challenges; and
3. it fosters integrating new ideas, technologies, and social interactions into the greater context of officer professional development.<sup>5</sup>

Military officers, especially commanders and senior leaders, must be comfortable navigating this third pillar, as they often sit at the apex of driving innovative technological systems and connecting ideas, employing technology, and updating doctrine for present and future conflicts. These benefits demonstrate the value of STEM+M education within the officer corps and the value to the Army of having highly educated officers who are adept thinkers and problem solvers.

Technological advances have increased the number of professional specialties and subspecialties (such as hypersonics, drone and anti-drone technologies, cyber, AI, and systems integration) required to understand and apply new bodies of knowledge. The military must ensure its officers possess the requisite levels of STEM+M education to keep pace with the expanded scope and specialization and fully leverage its capabilities. The military needs an officer corps with a STEM+M education commensurate with the technical requirements of their work to meet the demands of an evolving security environment.

We will first examine some factors the Army considers when funding STEM+M education. Then, we will provide a brief history of STEM education in the Army and current statistics about STEM education in the officer corps to give readers the appropriate historical context and demonstrate that the Army is behind in STEM+M education. Third, we will discuss new and emerging STEM+M graduate education options the Army should use to help close the STEM education gap in the officer corps. Finally, we will conclude with recommendations for changes in personnel policy and educational opportunities that can help the Army close this gap.

## **Framing the Army's Officer Education Investment Decision**

To understand the factors that impact the level of STEM+M education within today's officer corps, we will first provide a simple framework for the trade-offs the Army faces when choosing how much to invest in officer education. Some of these factors are unique to the Army, given its personnel policies and constraints. Others are universal, such as the expense of paying for employee education or the difficulty of investing in future needs when facing more pressing, near-term requirements. All, however, play a role in the Army's past and future decisions regarding the education of its officer corps within the STEM+M fields.

When an organization cannot hire the skills or access the education it requires, it faces a human-capital investment decision. Like buying new equipment or constructing a larger building, the decision to build the requisite human capital comes at an opportunity cost. Unlike the other services, the Army does not have a centralized, enterprise-level office for managing its officers' graduate education needs. Instead, the Army model is decentralized, relying on an individual organization (for example, the Corps of Engineers or the United States Military Academy), to define graduate education needs and select and fund employees to meet these needs. While this decentralization has advantages (such as allowing individual

branches more control over their educational investment), it often leads to an underinvestment in the overall STEM+M education the Army needs since the individual branch bears the full cost of losing officers when they pursue additional education that may have long-term benefits for the Army.<sup>6</sup>

The opportunity cost of creating its technology-enabled officers has been two-fold for the Army, in money and the allocation of manpower. Sending officers to graduate school requires that the Army pay for two- or three-year advanced degrees. While costs vary between programs and schools, the Army must allocate funding to this investment. Always in competition with the other programs, the DoD budget and requirements for everything from equipment modernization to personnel readiness are based on stagnant education requirements (the positions coded within the Army that require an advanced education have been nearly unchanged for 30 years) and advanced education funding has been insufficient to allow a substantial increase in STEM+M education within the Army to meet war-fighting requirements.

The time required to make this investment is more critical for the Army than money. Due to the Army's previously immutable up-or-out promotion system capping the amount of time officers can serve at any grade, any time officers spend outside of operational assignments is time lost in filling operational assignments—the core of the Army mission. To invest in officers' advanced education requires the Army to remove officers from the operational force and place them in a schooling status for two to three years.

This process has two effects. First, it removes officers from the available pool to fill required operational assignments. In times of excess officers, schooling costs little in terms of manpower. In times of an officer shortage, however, removing officers from the operational force to attend school poses a long-term (strategic) investment and a significant readiness cost. The second effect is the constraint on meeting critical career milestones for officer promotion. Until recently, the Army managed officers on a rigid time line built around its promotion system. From the officers' perspective, advanced academic education meant a reduced opportunity to serve in career-enhancing operational assignments.<sup>7</sup>

The Army's opportunity cost of investing in the advanced education of its officer corps has constrained its ability to grow its human capital. Under this limitation, the Army has made the strategic choice to allocate this human-capital development to the areas it needs today and to forgo developing human capital in areas that are more strategic in their potential return to the Army. The result is an Army able to meet its current manning requirements but lacking an officer corps that can identify, understand, and

integrate emerging technology and science into future readiness, doctrine, and war-fighting capabilities.<sup>8</sup>

Civilian graduate education for Army officers is of first-order importance for the Army to adapt to emerging threats, modernize continually, and incorporate new science and engineering advancements in a country that leads the world in technology. This education imparts analytical skills and critical thinking that complement and enhance what is learned in traditional military training. More importantly, this investment in STEM+M education connects officers with civilian professors and graduate students, helping create an Army more integrated with STEM+M expertise, advances, and uses. These elements generate a learning organization and an officer corps that is more comfortable, creative, agile, and adept in a technologically advanced environment.<sup>9</sup>

## A History of Army STEM+M Education

The trade-offs and investments required to change the level of officer education are not new to the Army—neither are the debates about how much and what kind of education officers should possess. Since its inception, the Army has routinely questioned, researched, and enacted policies to adjust its officer corps' educational requirements to keep pace with, and sometimes catch up to, technological advances and changes to its operational requirements.

### The Early Years

Army civilian graduate education began in 1775 when “medical officers” began attending civilian schools to study as military physicians for the Continental Army. In 1802, the United States Military Academy was established to fulfill the nation's engineering needs. Later, a review of Civil War operations pushed the Army to expand its civilian education to include medicine and technical fields like ballistics, metallurgy, and engineering sciences. Between the Civil War and World War I, the Army invested in civilian schooling in engineering and other technical fields to help its officer corps keep pace with technological advances.<sup>10</sup>

In 1916 and 1920, the National Defense Act authorized up to 2 percent of the Regular Officer Corps to undertake studies at technical, professional, or other educational institutions, though the actual number of officers sent to civilian schools was limited. They also mandated that this education meet officially recognized, specific Army requirements. The graduate training was intended to fill specific needs, not enhance officers' academic credentials.

These policy restrictions and congressional cost-cutting measures reduced the number of officers entering graduate education from 1920 until World War II, when the Army recognized the need for “greater depth and breadth” of officer education.<sup>11</sup>

### Post–World War II

The Army’s Advanced Civil Schooling (ACS) Program has operated since 1946, in large part due to the Gerow Board recommendations. Since then, Army leadership has directed separate boards to determine officer corps’ educational needs. From the Gerow Board of 1945 to the Officer Personnel Management System XXI Board of 1996, the Army has studied and implemented recommendations involving officer education informed by manpower constraints as often as by recognizing the benefits of a more educated officer corps.<sup>12</sup>

In 1949, the Department of the Army Board on Educational System for Officers (known as the “Eddy Board,” after Lieutenant General Manton S. Eddy, the board’s president) recommended that, “within reasonable limitations,” select officers be provided the opportunity to acquire graduate degrees via full-time study. This suggestion was part of a larger recommended plan that the Army maintain a sufficiently flexible military educational pattern for its commissioned personnel to ensure a smooth transition from peacetime to full mobilization.<sup>13</sup>

The 1958 report of the Department of the Army Officer Education and Training Review Board (known as the “Williams Board”) supported raising the limit of Regular Army officers attending civilian schools to no more than 8 percent. The board reaffirmed that civil schooling was intended to enhance an officer’s value to the service. It also stated that the purpose required broadening—to include the intellectual development of potential liberal arts and social science leaders capable of coping with “the political, economic, scientific and social problems”—to coordinate the Army’s exploitation of advanced knowledge in the physical and social sciences and prepare officer specialists in various geographic, ethnic, and cultural areas of the world.<sup>14</sup>

In January 1958, there were 567 officers (approximately 0.6 percent of total Army officers) enrolled in civilian colleges and universities under the ACS program. This number would continue to grow following the 1966 Haines Board that saw more than 900 officers (approximately 1 percent of total Army officers) pursuing full-time graduate education per year, producing an officer corps in which more than 28 percent possessed a master’s degree or higher.<sup>15</sup>

The 1970s Army had an even greater need for officers with graduate degrees, and officers had a corresponding desire to obtain those degrees. The 1971 Norris Review cited the “educational explosion” evidenced by the significant increase in graduate enrollment in US schools. Major General Frank W. Norris provided some forward-looking advice to the Chief of Staff of the Army on the importance of a robust graduate education program, citing “highly education-conscious” junior officers and the need for the Army not to fall “behind the educational power curve of the nation at large.” During the Vietnam era, the Army’s commitment to graduate school deepened, with the number of validated slots growing fivefold. A fundamental shift in thinking occurred so that officers no longer perceived graduate school as only for specialists who chose school over a chance for promotion to the Army’s top ranks; highly competitive officers began pursuing master’s and doctoral degrees to strengthen their professional résumés.<sup>16</sup>

Still, the Vietnam War left many senior Army leaders with the perception that the Army had unsatisfactory officer training and that education was not producing officers with “the desired level of military competency.” There was a call for a renewed emphasis on military proficiency and tactical competence for the all-volunteer Army. The Government Accounting Office report of 1970 and 1978 Review of Education and Training for Officers report pointed to a “broad and permissive” graduate education policy and reemphasized the importance of producing officers with mastery of the knowledge and skills “unique to the military profession.” Consequently, civilian graduate education in the officer corps took a sharp downturn with the renewed emphasis on military skills, the rising costs of fully funded graduate education, and decreasing defense budgets. Officer graduate civilian education opportunities decreased again during the Army drawdown in the 1990s.<sup>17</sup>

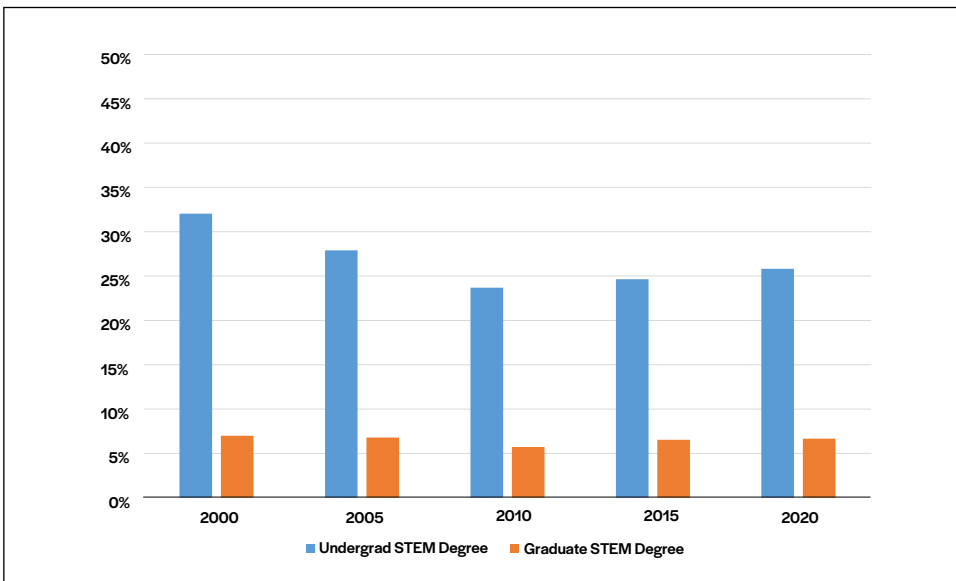
### Post-September 11 Attacks and Beyond

A US Army War College strategy research project paper from 2000 proclaimed, “The challenges faced by the Army of the 21st century will be vastly different from those faced over the last two hundred years.” Few appreciated how prophetic these words would become as Army officers wrestled with military operations requiring new and diverse educational requirements and thinking. The conflicts in Iraq, Afghanistan, and now in Ukraine further underscore the importance of exploiting and defending against emerging systems and technology on the battlefield. To deliver a modern adaptive Army, STEM+M education is needed to guide systems development and integrate organizational innovation. Since 2000, the Army has made several formal attempts to address its understood shortfall in STEM+M officer education. In 2006, the Army established the Career



Satisfaction Program and Graduate School option as a retention incentive for officers that would increase advanced education within the officer corps; the Graduate School program was discontinued in 2013 after producing hundreds of advanced degrees. Ultimately, these two programs and similar efforts suffered the same challenges: funding, manning, and officer career time lines.<sup>18</sup>

The lack of a strategic, forward-looking, concerted effort to increase officer advanced education, coupled with the immediacy for manning the wars in Iraq and Afghanistan, has allowed the Army's STEM+M graduate education level to remain essentially unchanged despite the increasing need for STEM+M knowledge within everyday tasks (civilian and military) and repeated reports of a lack of STEM+M education across labor sectors and our military. Figure 1 (below) shows the percentage of officers within the Army who hold a STEM+M degree, which has declined since 2000. This chart contrasts sharply with what is occurring in US colleges and the labor market, where STEM+M graduate education has doubled over the last decade and where the number of jobs requiring a STEM+M background has grown by more than 30 percent.<sup>19</sup>



**Figure 1. Officer corps STEM+M over time**  
(Source: Defense Manpower Data Center)

The consequences of this backslide are significant. Figure 2 (below) shows the percentage of officers, by rank, who possessed a STEM+M-related degree in 2020. Fewer than 14 percent of field grade officers and fewer than 16 percent of senior grade officers possess graduate-level STEM+M education.

At these levels, 55 percent of Army battalions and nearly 15 percent of brigades are unlikely to have any staff officers possessing advanced STEM+M degrees. This shortage will become more important as the use of disruptive technologies increases during military operations where critical decisions are under accelerated time lines.

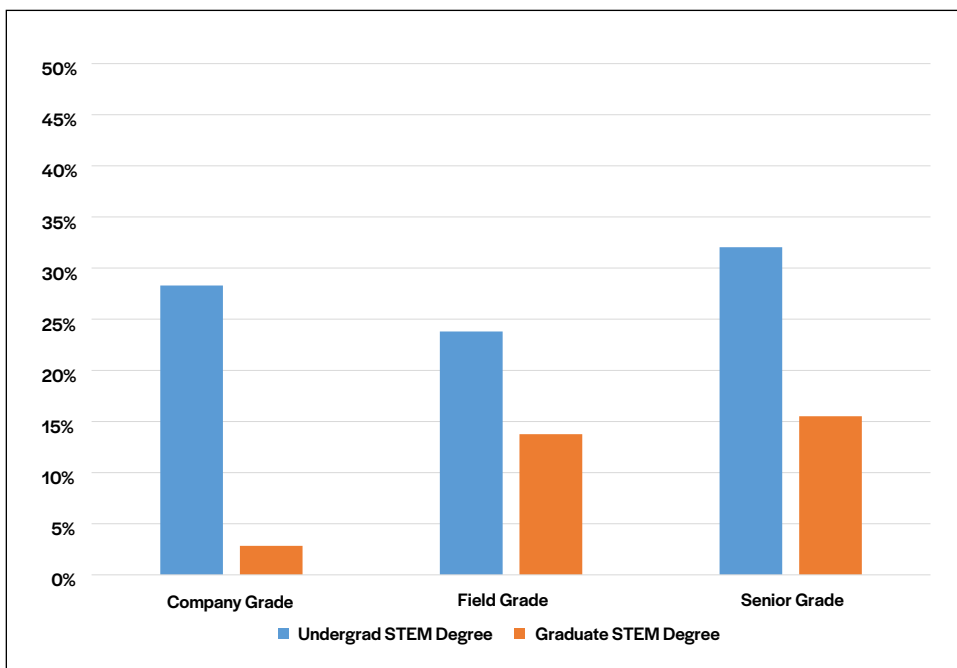


Figure 2. STEM+M degrees distribution across grades, 2020  
(Source: Defense Manpower Data Center)

## The Emergence of New STEM+M Graduate Education Options

Over the past two decades, the Army has faced unprecedented technological change, yet advanced civil schooling—specifically, STEM+M education within the officer corps—has decreased. Now is the time for new thinking and better planning to ensure Army leaders and their staffs have adequate levels of resident STEM+M education to draw upon.

The traditional money, manning, and career time line constraints on the Army's progress in educating its officer corps have been relaxed by recent changes in Army policy and STEM+M education. Changes in Army personnel policies and the delivery of talent management initiatives allow officers more flexibility in their career time lines. Likewise, the change in STEM+M education, traditionally only accessible through full-time graduate programs at brick-and-

mortar schools, is now less costly, more flexible, and more tailorable than ever at many schools. The Army has yet to leverage these new opportunities fully in ways that could reverse the current trend in education and provide the Army with the requisite amount of STEM+M education demanded by modern warfare and national defense policy.

Talent management and *The Army People Strategy* have unshackled the Army from many long-standing, rigid personnel practices. While breaking with tradition takes time, officers today can opt out of promotion boards and participate in service breaks (through the Career Intermission Program, or CIP), allowing them to pursue broadening assignments and educational opportunities that were previously unavailable due to career time line concerns. Officers and the branches that support them can pursue graduate education and create bold new alliances with educators, researchers, and Army and DoD laboratories leading innovation and disruptive technologies while remaining (or becoming more) competitive for future promotion boards. Leveraging these and similar policies and their potential for collaboration and partnerships will ensure that the Army has the thinking needed in its officer ranks to bring new technologies, skills, and ideas to the battlefield and national security strategy.<sup>20</sup>

In addition to the Army's recent policy changes to reduce the tradeoffs between education and career time lines for officers, the STEM+M educational environment has changed significantly, becoming less costly, more flexible, more accessible, and more tailored than ever. The COVID-19 pandemic profoundly affected higher-learning institutions, requiring them to invest substantially in distance-teaching capabilities and to develop new, more flexible curriculum models. Asynchronous classroom lectures, robust online platforms and learning management systems, and a shift in student demand have enabled greater responsiveness to student needs and help deliver education where and when students need it at a fraction of a traditional program's cost. For example, the University of Illinois offers its full MBA program online for a total tuition of \$22,000, and Georgia Institute of Technology has pioneered a master's degree in computer science for a total tuition of \$7,000.

Well-regarded public and not-for-profit universities offer hundreds of graduate certificate and credentialing programs and provide officers flexibility and tailoring. Certificate programs provide individuals or organizations with a competitive advantage, benefiting officers who wish to upgrade their skills, make a career-field shift, or better position themselves for a promotion. These programs can educate officers in specialty areas such as hypersonics, cyber, engineering science, AI, and many others. Since there is no degree track, students can enroll directly in their preferred program, many of which are online, thus allowing students to learn where and when they choose. Students

can complete these programs in weeks or months while fully employed, allowing on-the-job innovative education exactly when needed. Adapting Army policy and culture to leverage these new educational opportunities can increase STEM+M education without the financial or workforce costs of the traditional two-year, full-time master's degree model. In addition to the Army's current ACS program, giving major commands additional funding for officer education would allow senior commanders to tailor their officers' advanced education to fulfill their technological warfighting needs.<sup>21</sup>

There are other benefits associated with the officer corps increasing its education through more modern education delivery modes. Universities have developed innovative programs and pedagogy to enhance educational opportunities in science and technology, making research and collaborative work more virtual, connected, decentralized, and multidisciplinary. Comfortability and learning to work in this world are as important as the education received.

As an example of these practices, the Purdue Military Research Institute practices the pedagogy of "purposeful design and inquiry" as a component of integrative STEM+M education. The integrative STEM+M education methodology is grounded in constructivism and decades of cognitive science findings. At Purdue University, groups of officers from various military branches collaborate in a "Joint" environment to increase diversity of thought and address strategically important operational problems. These research teams allow for diverse connections across unrelated fields, a hallmark of innovation. Purdue deliberately developed this educational strategy as an innovation initiative to position the university as a strategic national asset.<sup>22</sup>

## Recommendations

The changing nature of twenty-first-century work and warfare demands a more technologically adept workforce and increased STEM+M education. To its credit, the Army is not immune from this trend and has recognized these needs. Past internal Army policy constraints and limited educational options offered by US universities have hindered the Army's ability to address its STEM+M gap. Opportunities are now available to increase the number of officers with STEM+M degrees in a more meaningful way. Money and manpower have traditionally constrained the Army, and changes in education and

Army manpower policy have reduced both. Given this fact, we recommend that the Army consider the following four actions (which we will discuss below).

- Increase the use of low- or no-cost civilian schooling options.
- Update current Army education requirements and decentralize graduate certificate program education.
- Incentivize officers to complete self-structured, developmental technical certificate programs to account for emerging technology and strategic needs.
- Support promotion board deferral and sabbatical programs that create career flexibility and can enable graduate education.

### **Low- or No-Cost Civilian Schooling**

The current global environment and technology's role in US national security have encouraged partnerships between academic, government, and private organizations to boost STEM+M education. Graduate programs at the Massachusetts Institute of Technology's Lincoln Laboratory and Carnegie Mellon University's AI Professional Scholars program are two examples of partnerships that provide military officers access to top-tier STEM+M education while they study and work on defense-related topics with university scholars. Traditional US graduate programs routinely provide substantially reduced tuition to officers funded by the Army as a service to the country and to intersperse their graduate student population with mature, motivated practitioners. The Air Force Institute of Technology and the Naval Postgraduate School also provide excellent curricula at a fraction of the cost of equivalent degrees from civilian institutions. Nonetheless, the number of no-cost or reduced-cost educational opportunities exceeds the number of officers the Army is willing to send. For example, the Purdue Military Research Institute allows more than 100 active-duty military officers to attend their graduate program at no cost, yet the Army has never exhausted its allotment.

### **Update Army Education Requirements and Decentralize Graduate Certificate Program Education**

The Personnel Management Authorization Document (PMAD) codes the number and type of officer education requirements governing Army advanced

education funding and slots. While this document's requirements allow branches and major commands to manage graduate education programs toward its authorizations, it often prevents education outside its bounds. Major command and career fields should manage and fund broader STEM+M education opportunities to help fill the gap. Army ACS funds are currently focused on traditional graduate degree programs for validated Army requirements.

Still, today's STEM+M requirements necessitate a more decentralized program to complement the ACS program, which can respond more quickly to senior commanders' needs and take advantage of the modern education landscape. The Army can provide soldiers with non-degree-granting civilian education and training opportunities. For example, Signal officers can attend certificate programs that will keep them current on the latest cybersecurity advances or better themselves for their work requirements. Increasing unit education, funding for training, and broadening the ability to pay for civilian graduate certificate programs and other certificates would allow senior commanders to access the STEM+M-educated officers they need when they need them.

Encouraging the use of these decentralized funds would allow two things. First, it would create and imbed in commands the educational flexibility needed as missions and world events change, such as the Russia-Ukraine War and its dependence on hypersonics and drone, anti-drone technologies. Instead of waiting years to propose, validate, fund, and assign an increase in officers familiar with hypersonics, commanders can close this STEM+M knowledge gap as soon as they identify it. Second, it would help the Army understand the true demand for the type of education its officer corps needs. Instead of attempting to predict the number of hypersonic graduate education slots it might need in the future, the Army could use the signal generated by commands currently sending officers for certificates to guide their changes to the Personnel Management Authorization Document, ACS funding, and officer education.

### **Incentivize Self-Structured, Developmental Technical Certificates**

Officers will pursue more educational opportunities if the costs decrease or benefits increase. The rise in educational opportunities requiring less than two years to complete, a decrease in residence requirements, and decreased costs for attendance work toward increasing STEM+M education in the Army's officer corps. The Army, however, must also incentivize officers to pursue this education by demonstrating its benefits to the individual and the enterprise. The Air Force recently included and highlighted

officer education and degrees as part of its promotion board to encourage the value of STEM+M in its ranks. Although the Army already includes degree-granting education in its promotion board, it does not include certificate and professional courses. Its Assignment Interactive Model 2.0 (also known as AIM 2), where commanders can select officers for their unit, does let officers list their certificates and degrees, allowing commanders to select them based on their educational background and expertise. Finally, the Army's Voluntary Transfer Incentive Program (or VTIP) can incentivize STEM+M by encouraging officers looking to transfer to those functional areas to pursue and complete certificates that will make them more valuable to the functional area as part of the VTIP application.<sup>23</sup>

### **Support Promotion Board Deferral and Sabbatical Programs**

Despite legal and policy changes, Army culture has resisted encouraging officers to defer their promotion board or take advantage of the Career Intermission Program. Much of this resistance is likely because these programs did not exist for most mentors who are advising young officers and because of fear of the unknown consequences for those officers' careers. Nevertheless, uninformed fears should not be imposed on officers for whom these programs may fit personal and professional goals. Instead, commanders and mentors should encourage officers to consider the opportunity we did not enjoy: the ability to pursue advanced education and job expertise without jeopardizing an Army career. Today's officers can do both, and the Army would benefit from more officers deferring their promotion board to pursue education, gaining the human capital officers receive without sacrificing manning years in the pursuit of education.

### **Conclusion**

The Army no longer enjoys a clear technological advantage over its competitors—a fact that has been acknowledged in *National Defense Strategy* language as far back as 2017. Absent a clear hardware advantage, the US military must ensure its human-capital advantage remains intact—starting with its officer corps. Like past wars, future wars will be won by officers who are adept at integrating emerging technologies and comfortable with technology that allows for rapid adaptation and application in support of military strategy. The benefits of a graduate-level education lie in intellectual growth, cognitive development, and learning practical, relevant, and transferable skills that officers can leverage throughout their careers. Complementing these efforts,

the Army should modernize its human capital (our people)—one of the remaining differentiators between our Army and those of our adversaries.

Constraints on the Army to grow its own STEM+M-educated officer corps have been loosened and present an opportunity for the Army to increase its science, technology, and management expertise significantly. In response to the COVID-19 lockdowns, US educational institutions and programs deliver high-quality, on-demand, asynchronous STEM+M education that increases access, is cost efficient, increases flexibility for learners, and provides rich learning experiences and careerlong learning opportunities. Civilian and military colleges and universities now offer low-cost alternatives to graduate school—four- or five-course certificate programs in technical fields, such as hypersonics, cyber, and energetics. Also, no-cost fellowships (at institutions like Purdue, military support programs, and others) have eliminated the cost of STEM+M education for certain individuals and the military. Army talent management has created flexibility in the officer promotion time line, reducing the trade-off between schooling and operational assignments. Unlike any time since World War II, conditions exist today for the Army to increase STEM+M education significantly, and with it, preparedness to fight and win on a future battlefield.

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