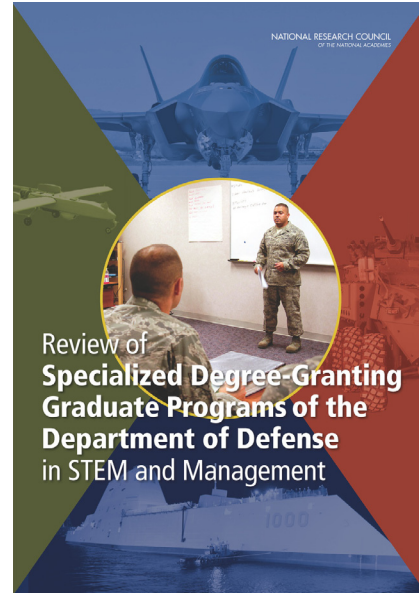


Review of Specialized Degree-Granting Graduate Programs of the Department of Defense in STEM and Management

Division on Engineering & Physical Sciences · June 2014

Due to the increasing complexity and role of technology throughout the military, the Department of Defense (DoD) has a growing need for a workforce with graduate-level science, technology, engineering, and mathematics (STEM) degrees and for greater overall STEM literacy. As such, recent National Research Council reports on STEM and the DoD have focused on the quality of the DoD STEM workforce and the importance of ensuring an adequate number of prepared STEM workers in the future. Unlike these previous reports, *Review of Specialized Degree-Granting Graduate Programs of the Department of Defense in STEM and Management* addresses the necessity of graduate STEM and management (STEM+M) education for DoD military and civilians; assesses the cost, benefits, and organizational placement of DoD institutions that grant STEM+M degrees; and evaluates alternative ways, such as civilian institutions and distance learning, to ensure adequate numbers and high-quality education outcomes for DoD personnel. The report's recommendations are designed to help DoD develop and retain a technically literate workforce through an appropriately blended portfolio of effective DoD in-house and civilian education options.



Background

In 2013, the Department of Defense requested the National Research Council to conduct a review of specialized DoD degree-granting graduate programs in STEM+M. This report is the third in a series of recent NRC reports relating to STEM and DoD's workforce; its purpose is to examine issues surrounding graduate STEM+M education for DoD military and civilian personnel. The majority of this report focuses on the graduate STEM+M education issues of the Air Force, Navy, and Marines, particularly those associated with the Air Force Institute of Technology (AFIT) and the Naval Postgraduate School (NPS)—the two major specialized STEM+M degree-granting institutions in DoD. In order to meet growing technological challenges, the Air Force, Navy, and Marines rely on a central Service office to identify, select, and fund a portion of their military officer graduate education pool, and ultimately send a significant number of their officers to AFIT and NPS. Because the Army

employs a different and decentralized graduate STEM+M education model, relying on subordinate organizations to identify and fund the graduate STEM+M education of its personnel, the report's authoring committee was unable to gather sufficient information to make meaningful recommendations for Army programs.

Need for a Greater DoD STEM+M Educated Workforce

DoD is arguably the most intensely technological and complex enterprise in existence, maintaining its edge over adversaries through continued investment in technology-enabled weapon systems. Each weapon, platform, vehicle, and person in an operating force is a node in one or more broadly distributed networks. Without STEM+M graduate education of sufficient quality and quantity, DoD's workforce will lack the understanding needed to acquire and operate these networked forces.

Currently, the DoD depends on the more than 6,700 civilian post-secondary schools to educate the majority of its civilian workforce and military members. Civilian institutions provide the opportunity to learn from world-renowned faculty, offer degrees in disciplines not available at DoD-funded institutions, particularly in law, medicine, life sciences, and social sciences, and create a diversity of perspectives and ideas that strengthen the DoD workforce and military members. The remainder of DoD civilians and military members receive their graduate STEM+M education at specialized, DoD-funded degree-granting institutions, particularly AFIT and NPS. These schools provide students unique opportunities typically unavailable at civilian institutions. Notably, students may conduct sensitive and classified research, examine militarily-relevant problems with like-minded individuals, and immerse themselves in military culture.

Due to the complexity and size of the DoD, the report does not determine how many advanced STEM+M degrees are needed or available to meet DoD needs. However, because of the rapid pace of technological change, it identified that more advanced degrees than are currently produced are needed overall. The report recognizes that due to students' wide range of educational backgrounds and needs a "one-size-fits-all" graduate education will not work. Rather, DoD STEM+M graduate education needs can be satisfied using a holistic education strategy that offers a blended portfolio of graduate education choices that includes AFIT, NPS, and civilian institutions.

Principal Findings and Recommendations

The report's principal findings and recommendations align with six major themes. Each theme is explained below. See the full report for detailed findings and recommendations. The themes, in priority order, are as follows:

1. Strengthen the STEM+M competencies of DoD's total workforce by placing greater emphasis on graduate STEM+M education.

The world's technical knowledge base and the technical complexity of modern warfare are rapidly increasing. By increasing its investments in graduate STEM+M education, even as the total workforce decreases in an increasingly constrained budget environment, the DoD can continue developing and exploiting advanced technologies as key force multipliers.

DoD leaders, regardless of background, will increasingly confront technical management issues as the already rapid pace of technology change increases. DoD leadership could therefore encourage all graduate education programs to include technical and technical management-oriented components in order to send a strong signal of STEM+M's

importance to the workforce and increase the STEM+M literacy of DoD decision makers.

2. Maintain a balanced portfolio of STEM+M graduate education sources consisting of DoD and civilian institutions.

AFIT and NPS each have important value propositions that yield significant return on DoD investments. Value-added elements include graduate programs built around defense-based curricula and supported by military-relevant graduate research, the formation of multiservice and multinational intellectual networks that aid students throughout their military careers, and infrastructure and policies that facilitate sensitive and classified research. With recognition and full support of DoD, AFIT and NPS can contribute to a balanced STEM+M portfolio. Faculty members also form a body of technical and management experts that DoD acquisition and logistics professionals use to obtain independent opinions on challenging issues.

A significant portion of DoD's STEM+M graduate education needs could be met through civilian institutions. This is particularly important for degree programs in mission critical areas, such as life and medical sciences, which are not offered at DoD education institutions in sufficient quantity to meet DoD needs.

3. Expand and adequately resource civilian workforce STEM+M graduate education initiatives.

DoD does much better strategically supporting the graduate education needs of its uniformed members than it does the needs of its civilian STEM+M workforce. This is true in terms of process, structure, opportunities, and funding. This issue could be addressed in three ways: (1) increase funding for civilian tuition assistance programs; (2) expand support for DoD's Science, Mathematics, and Research for Transformation program; and (3) aggressively use Defense Acquisition Workforce Development Funds (DAWDF) or "DAWDF-like" funds for the entire STEM+M workforce, by obtaining authorization from Congress either to expand existing DAWDF to include all STEM+M workforce professionals or to establish similar funding to educate those not covered by DAWDF.

4. Recognize and support the importance of STEM+M research at AFIT and NPS.

An active research program is essential to quality graduate education. Active, high-quality DoD research programs:

- Provide critical elements of the student's graduate education,
- Identify future education needs before requirements are specified,

- Expose students early on to emerging technologies and new scientific and engineering discoveries,
- Instill a culture of lifelong learning in the students,
- Attract and retain quality faculty for all DoD educational institutions,
- Enhance the national visibility of DoD institutions, and
- Result in cost savings and new capabilities for DoD.

Ensuring that AFIT and NPS are allowed to maintain active research programs and encouraging them to achieve international recognition in selected, DoD-relevant areas could lead to better education outcomes for students at and graduates of both institutions.

5. Enhance AFIT and NPS graduate education outcomes by increasing institutional collaboration through partnerships and effective distance learning methods.

By jointly sponsoring research and teaching activities, and by continuing to maintain and broaden their partnerships with DoD laboratories and civilian research universities, AFIT and NPS can provide a wider range of degrees and problem-solving perspectives to their students and enhance the quality and relevancy of their research.

Both AFIT and NPS understand the elements of effective, quality methods of distance learning (DL). For example, NPS has achieved a national reputation for its systems engineering programs via quality DL methods. In an era of rapidly developing DL technology and opportunities, DoD can actively leverage its proven DL approaches to connect students in residence at AFIT, NPS, and civilian institutions; broaden AFIT and NPS student bodies with more civilian DoD personnel; and expand the size of AFIT and NPS Ph.D. programs by offering a wider range of courses and research experiences.

6. Elevate AFIT's strategic priority.

Many DoD organizations recognize the strategic importance of their education institutions by having them report at the highest levels in the Services or Joint Staff. These institutions include the Service academies, Uniformed Services University of Health Sciences, and NPS. AFIT currently reports to Air University, which reports to the Air Education and Training Command (AETC), where AFIT's graduate STEM+M education and research activities do not align well with AETC's Professional Military Education and training missions. By aligning AFIT with leadership that prioritizes its education and research mission, DoD can increase AFIT's strategic value and give it the authority and autonomy it requires to

effectively interact with institutional peers, such as NPS. In accordance with the examples cited above, the best way to achieve this result is to have AFIT report directly to the Chief of Staff of the Air Force.

Additional Studies

The existence of an alternative graduate STEM+M education models between the Air Force, Navy, and Marines' centralized education approach, and the Army's decentralized one suggests the need for a subsequent study of the Army's graduate education method to determine if best practices of both centralized and decentralized education delivery models might be shared across the Services to enhance overall graduate STEM+M education outcomes.

Conclusion

Achieving success in modern conflicts is often due to military forces leveraging advanced technology. The increasing reliance on sophisticated technologies by friendly and adversarial forces to achieve force multiplier effects demands a technically competent DoD workforce capable of buying, operating, maintaining, and, in some cases, developing technologies and technology-enabled systems. DoD leaders, regardless of their background, also require a basic understanding of technical concepts as they increasingly make decisions influenced by technical factors. One of the most effective ways to prepare DoD leaders and DoD's workforce to maximize the benefits of technology-enabled capabilities is through robust STEM+M graduate education, as a properly educated DoD workforce will help ensure DoD's ability to meet future challenges.

Related Reports

This report is the third in a series of recent NRC reports relating to STEM and DoD's workforce. The two previous reports are *Assuring the U.S. Department of Defense a Strong Science, Technology, Engineering, and Mathematics (STEM) Workforce* (2012) and *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* (2010). All three reports are available for free on www.nap.edu.

Committee on Review of Specialized Degree-Granting Graduate Programs of the DoD in STEM and Management: **Jacques S. Gansler**, University of Maryland, *Chair*; **Thomas J. Burns**, Science Applications International Corporation (retired), *Vice Chair*; **Robert A. Calico, Jr.**, Independent Consultant; **Rita R. Colwell**, University of Maryland; **Earl H. Dowell**, Duke University; **John V. Farr**, U.S. Military Academy; **Brendan B. Godfrey**, University of Maryland; **Wesley L. Harris**, Massachusetts Institute of Technology; **Michael L. Heil**, Ohio Aerospace Institute; **Robert J. Hermann**, Hartford, Connecticut; **Walter F. Jones**, Office of Naval Research; **Kathryn E. Newcomer**, The George Washington University; **Leif E. Peterson**, Human Resources Concepts and Solutions; **Stephen Pollock**, University of Michigan; **Steven E. Ramberg**, National Defense University; **Charles E. Thorpe**, Clarkson University

Staff: **Carter W. Ford**, *Study Director*; **Terry J. Jagers**, *Board Director*; **Marguerite E. Schneider**, Administrative Coordinator; **Dionna C. Ali**, Research Assistant

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