

A man in a light-colored military uniform is standing on the left, gesturing with his right hand towards an audience. The audience, consisting of many men in various military uniforms, is seated in rows, filling the background. The scene appears to be a formal presentation or lecture.

CSIS

CENTER FOR STRATEGIC &
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Science, Technology, and U.S. National Security Strategy

The Role of the War Colleges

*How should S&T drive
national security strategy,
and how should national
security strategy drive S&T?*

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| Foreword

The United States emerged victorious from the Cold War with a military reliant on leveraging its technological advancements against a numerically superior foe. Now, in the most chaotic global environment since, America must craft a new grand strategy to meet and overcome the current range of threats arrayed against us.

This cannot be done without the same technological superiority upon which our previous strategy hinged. Critical to this superiority is training and educating our future uniformed and civilian leaders to see the link that exists between strategy and science. Each should continuously feed into the other, fueling both innovative solutions and adaptive strategy.

I am concerned, as was the late David Abshire who originally proposed this study, that the synergy between strategy and science and technology should be embedded into the curricula of the war colleges, especially from the point of view of how those advances can enable better and faster strategic thinking and indeed impact the results and recommendations to the president in terms of our defense policies and strategies.

The following report offers initial steps toward this realization and also suggests future avenues of approach to adapt the war colleges to the demands of an ever-changing security picture.

John J. Hamre
President, CEO, and Pritzker Chair
CSIS

| Acknowledgments

The Center for Strategic and International Studies (CSIS) is grateful for the generous support of the Richard Lounsbery Foundation, which made this study possible. CSIS also recognizes the role of the late David Abshire who as chairman of the board of the Lounsbery Foundation originally proposed this study, the formal name of which was “Improve the Way War Colleges Teach the Impacts of Emerging Sciences & Technologies (S&T) on Strategic Thinking.”

Raymond F. DuBois, resident senior adviser at CSIS, managed this project and coauthored the final report with Dr. James Keagle. The authors wish to thank the CSIS publications staff and in particular to thank Vice Admiral Paul Gaffney (USN Ret.) and Collin Dudeck, research assistant to Mr. DuBois, for their many contributions to the report.

The authors appreciate the insights of outside experts who attended two closed-door, off-the-record CSIS roundtable discussions (see Appendices A and B). In addition, other former government officials and academic experts contributed their perspectives to the proposed initiatives contained in the final report (see Appendix C), for which we are most grateful.

While the contributions of all those mentioned above have enhanced the final product, all findings, opinions, and omissions remain those of the authors.

| Executive Summary

Rapid scientific and technological (S&T) advancements have placed a strain on our nation's warfighters and strategic thinkers in recent years. Developments can take place in a matter of months that undermine and make obsolete established strategy and leave us racing to address new threats and opportunities. The education of our armed forces' future leaders needs to keep pace with this ever-changing strategic and technological reality. The service or joint, senior and intermediate professional military education (PME) institutions would be enhanced by developing instruction methods that better prepare our future military minds to understand the strategic impacts of emerging sciences and advanced technologies—an understanding we term “strategic innovation.”¹ As emphasized in the 2015 National Military Strategy, such enhancements would allow strategists to better understand that the “diffusion of technology is challenging competitive advantages long held by the United States,” and that a grasp of strategic innovation is a critical skill for those who will lead on the battlefield of the future and prepare for it.²

The Center for Strategic and International Studies has undertaken a project to improve the way the service or joint, senior and intermediate PME institutions teach strategic thinking as it specifically applies to emerging innovative technologies to their students. Throughout this report, the term “war colleges” will serve as shorthand for the more accurate label “service or joint, senior and intermediate PME institutions.” This in no way reflects a sole focus on the senior PME institutions, as all levels of PME institutions will need to incorporate strategic innovation into their curricula.

This initial study has identified eight options, which could be used alone or in combination, to improve the exposure of war college students to strategically innovative thinking.

Involving New Resource Arrangements

1. Using existing complementary organizations or research centers within the war colleges as an S&T resource;
2. Encouraging regional partnerships between war colleges and the service laboratories/technology centers (e.g., Naval Research Laboratory and Army Research Laboratory) and defense and service research offices (e.g., Defense Advanced Research Projects Agency and Office of Naval Research), leading-edge technology companies, University Affiliated Research Centers (UARCs),

¹ The term “strategic innovation” can encompass “scientific competency,” technological advancement, futuristic modeling, cultural impacts and the operating concepts of an opponent. Also see p. 4.

² Joint Chiefs of Staff, *The National Military Strategy of the United States of America 2015: The United States Military's Contribution to National Security* (Washington, DC: U.S. Department of Defense, June 2015), 1, http://www.jcs.mil/Portals/36/Documents/Publications/2015_National_Military_Strategy.pdf.

federally funded research and development centers (FFRDCs), and research universities;

3. Creating a “chief innovator” position within a war college president’s office to manage strategically innovative learning (perhaps with joint posting to a teaching component within the war college;

Involving Methods of Instruction

4. Developing a series of lectures inserted throughout the academic year for all students from nationally recognized technology leaders;
5. Offering strategic S&T electives to students;
6. Offering hands-on, student-faculty S&T projects;
7. Including strategic innovation during war-gaming exercises; and
8. Creating a self-selected, post-graduate program for worthy war college graduates that focuses specifically on strategic thinking for innovation.

These options were presented, discussed, and largely endorsed with two separate groups of experts over the course of the study. The first of these discussions was a small, diverse working group made up of individuals with close association to the teaching methodologies in the war colleges and who focused on refining the team’s initial options (see Appendix A). The second discussion was a group of experts made up mostly of individuals who were “users” of strategic thinkers at the highest levels of the Department of Defense (DoD) and who offered comments or criticisms on this initial study and the subject at large (see Appendix B). Our findings and feedback from both groups were then incorporated into this final report of the initial study.



| Science, Technology, and U.S. National Security Strategy

The Role of the War Colleges

Introduction

Our nation faces a looming crisis—a dearth of intellectual capacity to understand or even anticipate the strategically relevant security implications of the ongoing science and technology (S&T) revolution. Therefore, we must improve our structures and processes to recruit and then develop tomorrow’s leaders of the joint force and the national security team. We then need to apply those insights to the art and science of preparing for and fighting war, and maintaining and enforcing the peace.

While we began this study focusing on increasing the depth and breadth of S&T offerings at the senior professional military education institutions (the professional military education’s war colleges) and their links to policy and strategy, we quickly came to realize that the problem and its challenges were more comprehensive. We need to look at an integrated package of education and human resource policies and approaches across a set of disciplines perhaps more appropriately focused on “strategic innovation.” Moreover, we need to develop at all levels of military education an ever unanimous “scientific competency,” with an array of integrated and reinforcing studies throughout the life of a student, which complement and build on each other.

The specific national requirement is to recruit, develop, and retain a cadre as part of the national security team who can think strategically about potentially “game-changing” disruptive technologies, and to employ that force as part of national strategy and policy. These game-changing technologies are truly transformational, exponential force multipliers that would change the very way we think about war and peace (hypervelocity weapons, like the railgun, laser weapons, and cognitive computing are possible illustrative examples). All will need some knowledge of this potential—and a much smaller subset need to know this world intimately. There is another important aspect of this educational effort: teaching future leaders to be able to focus on what S&T developments would best support the national security strategy. It is a two-way street: decisionmakers need to be able to recognize emerging technologies that can alter strategies while at the same time advance technologies that enable strategies.

If, as some defense analysts have said, our military technology is inferior to other major powers in such areas as air and missile defense, long-range conventional strike,

electronic warfare, cyber and indirect fires on land,¹ then it behooves us to invest in the brain power to make smart, timely, decisions in S&T.

Are we losing our advantage in military technology because of diminished resources or because we make uninformed decisions about what technologies to invest in, or both?

Secretary of Defense Chuck Hagel posited in 2014 that “Our military could arrive in a future combat theater facing an arsenal of advanced, disruptive technologies that thwart our technological advantages, limit our freedom of maneuver, and put American lives at risk.”² Through his Defense Innovation Initiative, he sought to deny that possibility—and to advance or at a minimum sustain our technological superiority. This is doubly difficult in a world in which the U.S. government may have lost its advantages to the private sector or foreign sources.

Known to some as the “third offset,” this initiative must include an aggressive effort to identify early and then mature within the national security team those who can think strategically, understand the intersections between and among technologies and policies, anticipate changes over the horizon, develop associated operating concepts for the future capabilities, and build and control the narrative that explains and garners support for this emerging reality.

Without such a national commitment to invest in our future by overhauling our education and human resource systems, we will inevitably face the prospect of a nation unprepared for the next set of conflicts. Even worse, this new kind/way of war may be “won” so quickly that we will not have the luxury of a mobilization phase. We must take steps *now* to address these shortfalls. What follows is an initial examination of our current systems and a series of recommendations for consideration. We acknowledge that this effort is incomplete but addresses the central challenges to overcome. With this report we hope to create a sense of urgency and launch a national debate that will ultimately chart a way ahead and marshal appropriate resources.

Background and Study Genesis

CSIS was interested in improving the strategically innovative thinking abilities of the graduates of the various DoD war colleges. Given this interest, CSIS proposed an initial study on improving the strategic thinking of the war colleges’ graduates by addressing two components of strategy:

1. An understanding of emerging S&T possibilities; and

¹ Daniel Gouré, “U.S. Rearmament Must Begin Now,” Lexington Institute, October 7, 2015, <http://lexingtoninstitute.org/u-s-rearmament-must-begin-now/>.

² Secretary of Defense Chuck Hagel, “Defense Innovation Days’ Opening Keynote” (speech delivered to the Southeastern New England Defense Industry Alliance, Newport, RI, September 3, 2014), <http://www.defense.gov/News/Speeches/Speech-View/Article/605602>.

2. A grasp of S&T investment strategies and S&T expertise within the U.S. defense enterprise.

Discussion

The project team has spent time refining the scope of the study. The team began by defining the terms “war college” and “strategic thinking for innovation.”

- **“War College.”** Within the DoD military officer professional education continuum, there are a number of accredited graduate programs. The war colleges offer master’s-level degrees, which focus on the services, joint, and national security policy, and strategy and planning. Each service has a war college(s) that offers in-residence and distance-learning degree programs for intermediate and senior-rank officers (as well as some defense and federal civilian counterparts). This study focuses on the following war colleges.
 - National Defense University
 - The National War College
 - Eisenhower School
 - Joint Forces Staff College
 - U.S. Army War College
 - U.S. Army Command and General Staff College
 - Naval War College
 - College of Naval Warfare
 - College of Naval Command and Staff
 - Air University
 - Air War College
 - Air Command and Staff College
 - Marine Corps University
 - Marine Corps War College
 - Marine Corps Command and Staff College

This study addresses only the classic service and joint war colleges described above and does not include focused graduate programs in disciplines such as intelligence, special operations, information technology, and acquisition.

It is important to note that there are other institutions within the Joint Professional Military Education (JPME) program such as the Naval Postgraduate School (NPS) and the Air Force Institute of Technology (AFIT)—although JPME credit is not always granted at these institutions. JPME is required of most officers as they advance their careers and is embedded in the war colleges and distance learning programs. The chairman of the Joint Chiefs of Staff (CJCS) directs JPME through the director of Joint Force Development (J-7). JPME prescribes a significant part of the curriculum of each war college. When considering the strategic innovation content of a war college program, one must consider the CJCS directive covering JPME and its role in changing curricula.

The project team discussed the possibility of taking a broader look at how to improve overall strategic thinking education, but this study's time constraints and resources allow only a first step: a look at the war colleges. In addition, we recognize that to truly incorporate strategic thinking into the thought process of our leaders, there needs to be a system of reiterative learning throughout their professional lives, and that such a system must start at the career entry level.

- **“Strategic Thinking for Innovation.”** “Strategic Thinking for Innovation” is understanding, analyzing, and ultimately applying, synthesizing, and evaluating promising technological innovations and associated changes to culture and operating concepts in the crafting of national strategy. This would ideally identify future strategic effect such innovations may produce. It replicates this process for other actors in the dynamic and interactive world of international relations. At the same time it is also identifying and then advancing technologies that enable a strategy.

This idea is strongly linked to the third offset, and is centered on teaching strategists to be aware and adaptable to what exactly will make up this next strategic offset.

For the generalists we are educating, some basic scientific competency and subject-matter expertise is needed to understand what will soon be possible, and to imagine how such advances can be operationalized and incorporated into a strategy.

A deep understanding of this world, while quite valuable, will not be the goal of creating strategic innovators. Rather, it will give them the necessary foundational knowledge and then show them what resources are available in the national security enterprise from which to seek guidance or information.

This will not just include the broad array of scientific and technological disciplines in DoD's ~\$12B annual S&T budget. Private-sector knowledge and

experience, whether funded by DoD or their own corporate funds, is another key part of developing these thinkers. Engaging our own leading-edge technology companies in this endeavor will add another dimension to the education of these future strategic thinkers. S&T organizations can also be called upon for immediate solutions to technology challenges and its record in that regard is admirable.

Strategic innovation looks beyond the current needs of DoD to ensure future global technological military superiority. For the purposes of this study, it is S&T's forward look and its potential impact on strategic thinking that is most important.

Activities to Date

To date, the study team's efforts have focused on three principal areas:

1. Understanding the war colleges' structure and culture and the constraints and opportunities within CJCS officer professional military education and JPME directives;
2. Developing a strawman discussion paper with options for increasing exposure of war colleges' students to strategy-relevant S&T issues; and
3. Holding two expert panel discussions about whether, and the proper place, to improve strategic innovation exposure within the war colleges' academic timeframe.

We have avoided stipulating detailed curricula changes at this point because such changes are in themselves complicated and time consuming. However, we have offered guiding principles for S&T incorporation into curricula and some examples of better coordination. The options presented in this study can, alone or in some combination, be implemented without substantial cost or JPME process approval; nor do they conflict with any law that governs PME/JPME.

In addition to our formally convened discussion groups, the study team has engaged with more than a dozen individuals, inside and outside of DoD, with recognized graduate education, strategy/policy, S&T, and war college experience (see Appendix C). In order to ensure that all relevant perspectives were represented in our meetings, the study team relied on two primary mechanisms for convening experts. First, a small, diverse working group came together to help refine the team's baseline options. Shortly thereafter, a separate group of former senior DoD officials convened to debate and advise the team on the topic and its options. Both discussion groups reflected joint and national strategy/policy expertise, defense and contractor S&T experience, knowledge of the war college community, non-DoD academic credentials, and included both military officer and civilian representation.

Preliminary Findings

General

Consider just a few rather recent technological advances and the strategic changes, challenges, and/or opportunities they presented: the IED, a digitized battlefield, counter-pandemic military operations (e.g., Ebola), antisatellite technologies, and unmanned combat vehicles of all types. These topics may be covered in war college classes now that they are battlefield realities, but it is unlikely they were addressed in any systematic, strategic way as they were emerging.

A first-order question is, “How deep and how broad must the delivery of strategic innovation education be?” Students of strategic thinking do not need to be trained mid-career as physicists, biologists, or chemists, but they do need to understand that science presents new tools that can affect and enhance strategic thinking. The team’s initial thoughts are that student exposure should include the following.

- Students should be asked first the following strategic question: does strategy drive the direction of S&T or vice versa (or both)?
- Lessons learned: recent and historical scientific breakthroughs that affected strategy.
- How and why the DoD (its services and agencies) invests in forward-looking S&T—noting, for example, that DoD precedes (World War II origins) almost all other agencies in formally investing in basic research in America’s universities.
- Understanding the DoD S&T enterprise (intramural and extramural investment and performance) and where to go to get S&T advice and hear about the forward march of S&T as a senior national security leader. How to actually reach out and contact an expert.
- What are the DoD priorities for S&T research with high potential impact on military capability and economic competitiveness. To what extent are these S&T research priorities driven by the needs of our national-security strategy?

Curriculum Change

At any college, changing the curriculum is difficult, time consuming, and inspires numerous debates over authority, job security, and resource allocation. This is where some of the greatest cultural resistance to change is likely to occur. This punctuates the inflexibility within a curriculum often leading to zero-sum situations where an existing course must be dropped to add a new one. In addition, other contemporary demands must be kept in mind (e.g., ethics and sexual harassment training at DoD). War college leadership daily manages such changes. In the defense war college system there are overarching CJCS directives, joint processes, Title 10 requirements, and

accreditation requirements to be accommodated, as well. Suffice it to say, substantive curriculum changes are difficult for the war colleges.

There is one set of key defense players who do not usually insert themselves in the war college curriculum or general program requirements process in a systematic way: the secretary of defense and service secretaries. The joint chiefs and service chief staffs, while involved and interested in S&T, do not “own” S&T as the civilian leadership does. The team believes the secretary of defense should make a policy statement about the importance of exposing war college students to emerging technology issues that can affect service, joint, and national-security policy.

Options to Improve the Exposure of War College Students to Strategically Innovative Thinking

At a more tactical level, the study team sees several options to expose or introduce war college students to emerging S&T matters. They may be used as standalone ideas or used in combination.

- **Complementary organizations.** Within the overall war college system as well as within each military department, there are research centers or institutes and other “future thinking” organizations that conduct think-tank-like activities for the services, Office of the Secretary of Defense (OSD), or other federal agencies. To the extent that such organizations employ technical talent, they should be a resource for the war college courses, students and faculty, lecturers, and advisers to students and faculty. Existing examples of these centers include the NDU Center for the Study of Weapons of Mass Destruction, the Center for Technology and National Security Policy, the Naval War College Strategic Research Program, and the CNO Fellows program. The study team recommends an inventory of such complementary organizations.
- **Required introductory (and continuing) lectures.** At the beginning and then distributed throughout each academic year, nationally recognized technology leaders should present an educational lecture to the full student complement at each war college and close their lecture by introducing the opportunities for involving students in strategic S&T projects or electives that will become available in the ensuing academic year. Luminaries who have delivered such themed lectures include Secretary William Perry, Secretary Harold Brown, Hon. Norman Augustine, Speaker Newt Gingrich, and Congressman Rush Holt, among others. Following the lecture a “breakout” session would be scheduled, where a number of the lecturer’s subordinates would engage in a seminar discussion with groups of students. The study team recognizes that not all college students start the academic year in the fall; this issue would need to be managed by each institution.
- **Individual elective courses and/or concentrations.** Within the established curriculum timeframe, there are typically some opportunities for a few elective

courses (several such electives exist today, some with substantial attendance and others with light attendance). There should be some strategic innovation elective courses offered in the selection pool, preferably by faculty embedded in the teaching components and not from the research side of the colleges. A first step could follow the example of the transformation chairs seeded at the PME schools and funded by OSD. These electives would need to be incentivized by demonstrating the value of students educated in this subject. The study team recommends an inventory of current courses that appear to be S&T-centric.

- **Research studies and projects in lieu of electives.** A step beyond the elective course is the opportunity for a student-faculty, hands-on strategic S&T project. The project may be small and simply cover the time of an elective course, or it may involve a semester or trimester. An example is individual and group projects carried out by a few students as part of the Naval War College's Advanced Research Program within the Gravely/Halsey/Mahan Forum. Topics, while strategic in nature, could center on an emerging S&T issue, for example, nano-satellites.

A variation of this approach could be comparable to the industry studies program at the Eisenhower School. This semester-long program is the principal focus of study at Eisenhower from January through May of each year and offers the opportunity for much deeper research. It could be offered in parallel with the core course of study for a select subset of the student population.

- **Geographically convenient regional partnerships with service laboratories/technology centers (e.g., NRL and ARL) and defense and service research offices (e.g., DARPA and ONR), leading-edge technology companies, University Affiliated Research Centers (UARCs), federally funded research and development centers (FFRDCs), and research universities.** When adding any new program to an organization, the question of personnel resources arises. Some war colleges may have, as part of the workforce, a stable of S&T-experienced personnel dedicated to S&T matters; others may not. Nearly every war college, however, has in its geographical vicinity a substantial and respected defense (or other federal agency) technology center or laboratory. The war college and the laboratory could create formal arrangements wherein senior laboratory scientists would be routine war college advisers, faculty/student tutors, adjunct faculty, occasional lecturers, or strategic research project advisers. Potential partnerships include the following:

- National Defense University—Naval Research Laboratory
- Naval War College—Naval Undersea Warfare Center
- Marine Corps University—Marine Corps Warfighting Laboratory
- Air University—Redstone Arsenal

- Army War College—Army Research Lab or the University Affiliated Research Center (UARC) at Penn State (Applied Physics Lab—Penn State)
- Army Command and General Staff College—Training and Doctrine Command (TRADOC) Analysis Center
- Joint Force Staff College—NASA Langley Research Center

In addition, partnerships with leading-edge, private technology companies and research universities would give students the opportunity to see through a different lens what needs to be incorporated into their strategically innovative thinking process.

- **War college leadership innovation adviser.** Just as senior service and joint commanders have the “commander’s science adviser” or chief scientist (e.g., EUCOM Science Adviser, CENTCOM Science and Technology Adviser), each war college could also create a staff advisory position in the war college president’s office of chief innovator, who could manage the strategic innovation teaching and learning opportunities. Sources of such talent might be from within the war college’s faculty, people detailed from defense labs, Intergovernmental Personnel Act (IPA) appointees, contractors from the defense industry, or academia. If the combatant commanders, strategic thinkers all, have science advisers, why wouldn’t the schools that teach strategic thinking have innovation advisers?
- **Inclusion in war gaming.** War gaming is an important feature in war college educational offerings. The colleges should ensure that game planning for student games includes both emerging sciences and technologies. The addition of a “soulless” force red team using strategic innovation to ruthless effect would also highlight some of the ways this new thought process could be used by future opponents. A variation of this option is to establish technology innovation cells for each game or as a permanent feature of a college’s war-gaming center.
- **Self-selected, strategic innovation postgraduate program.** A follow-on period after graduation from a war college that focuses on strategic innovation would give some worthy students the chance to gain a deeper understanding of its importance and utility. A variation of this could be a period of intense study highlighting developments within the private sector, similar to a Capstone/Pinnacle exercise.

The Way Ahead: Challenges and Opportunities

First and foremost, the secretary and the new chairman should speak out briefly, but loudly, on the need to consider technology innovation within the DoD strategic education enterprise.

Next, a national blue-ribbon commission is needed to galvanize and inspire the national debate on the need for more strategic thinking regarding technological innovation for national security. This must include senior political appointees of the president's team, Congress, and the new CJCS.

We must expand R&D investments and shift their focus toward disruptive technologies. This will directly confront cultural resistance generally and within the R&D world, as Clayton Christensen highlights in his book, *The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business*.

We must develop concentrated academic programs for a smaller subset of our PME population and grow the interaction with the private sector, where most of the innovation is occurring.

We must realize that this is indeed a national problem for our entire educational system from primary school through postgraduate studies that can inspire and empower our greatest national resource—our brain—to think strategically about the challenges and opportunities presented to us by the pace of technological innovation, and ultimately become the driver of change rather than merely a passenger.

Finally, war college leaders can take initiatives on their own, quickly and inexpensively, without the burden of heavy bureaucratic approvals. This study offers eight options to get started.

| Afterword

In World War II, the national command authorities recognized a need to harness American science and technology talent, from within government, from academe, and from industry. Great institutions resulted—the Manhattan Project and its progenies, the Department of Energy national labs, and the Office of Naval Research, pre-dating the creation of the National Science Foundation, and leading the way for the creation of Army and Air Force research offices and ARPA/DARPA. Our forbearers understood that science could affect strategy, even create new strategies, and, conversely, strategy could elicit solutions from science.

Every military thinker should understand this connection. It is as critical today as it was in World War II. Some figure it out through the college of hard knocks: career experiences. That is chancy. The department has an opportunity, through its rather unique-in-government career-long professional military education (PME) enterprise, to expose students to the strategy-science linkage. This study looks at a very rich segment of the PME continuum and provides a few options, from which the leaders of the war colleges can choose on their own.

It would be even better if the top civilian leadership and the service chiefs would ask the colleges to generate learning options that address the question: does strategy drive science, or vice versa, or both?

*Vice Adm. Paul Gaffney (USN Ret.)
Former President, National Defense
University
President Emeritus, Monmouth University*

| Appendix A. First CSIS Roundtable

Participants

Dr. Hans Binnendijk, Senior Fellow, Center for Transatlantic Relations, Johns Hopkins School for Advanced International Studies; former Vice President for Research and Applied Learning, National Defense University

Dr. Greg Foster, Professor of Political Science, Eisenhower School, National Defense University

Lt. Gen. Dave Huntoon (USA Ret.), former Commandant, Army War College; and Superintendent, U.S. Military Academy

Dr. Bruce Jette, President and CEO, Synovision Solutions LLC; former Director of Army Rapid Equipping Force

Dr. James Keagle, University Professor and former Provost, Eisenhower School, National Defense University; and former Deputy Director, Center for Technology & National Security Policy, National Defense University

Dr. Steven Ramberg, Distinguished Research Fellow, Center for Technology and National Security Policy, National Defense University (on assignment from the Applied Research Laboratory, Penn State University)

Dr. Cynthia Watson, Professor of Security, National War College; and former Dean of Academic Affairs, National War College

| Appendix B. Second CSIS Roundtable Participants

Adm. Frank “Skip” Bowman (USN Ret.), *Independent Nonexecutive Director, British Petroleum; and former Director, Naval Nuclear Propulsion*

Gen. James “Hoss” Cartwright (USMC Ret.), *Harold Brown Chair in Defense Policy, CSIS; former Vice Chairman, Joint Chiefs of Staff; and former Strategic Command Commander*

Hon. Rudy deLeon, *Senior Fellow, Center for American Progress; and former Deputy Secretary of Defense, former Under Secretary of Defense for Personnel and Readiness, and former Under Secretary of the Air Force*

Gen. Ron Fogleman (USAF Ret.), *Chairman, Orbital ATK Board of Directors; and former Chief of Staff, U.S. Air Force, and former Transportation Command Commander*

Vice Adm. Paul Gaffney (USN Ret.), *former President, Monmouth University; and former President, National Defense University*

Gen. Richard Myers (USAF Ret.), *Colin Powell Chair for National Security Leadership, Character, and Ethics, National Defense University; Member Board of Directors, United Technologies Corporation; and former Chairman, Joint Chiefs of Staff*

Dr. Harlan Ullman (USN Ret.), *Chairman, Killowen Group, and Senior Adviser, Atlantic Council*

Dr. Linton Wells (USN Ret.), *Founder, TIDES Project; and former Director, Center for Technology and National Security Policy (CTNSP), National Defense University*

Second CSIS Roundtable Observers—CSIS Visiting Military Fellows

Capt. Michael Cribbs, USCG

Lt. Col. Peter Farnum, USMC

Col. John O’Grady, USA

Lt. Cdr. Dennis Jensen, USN

Lt. Col. Tracy Onufer, USAF

| Appendix C. Individuals Who Provided Input, But Did Not Participate in CSIS Roundtables

Gen. Daniel Allyn (USA), *Vice Chief of Staff of the Army*

Hon. Norman R. Augustine, *former President and CEO, Lockheed Martin; and former Under Secretary of the Army*

Lt. Gen. Robert Brown (USA), *Commanding General, U.S. Army Combined Arms Center*

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