



The DHS S&T Directorate: Selected Issues for Congress

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Summary

Policymakers generally believe that science and technology can and will play significant roles in improving homeland security. When Congress established the Department of Homeland Security (DHS), through the Homeland Security Act of 2002 (P.L. 107-296), it included the Directorate of Science and Technology (S&T) to ensure that the new department had access to science and technology advice and capabilities for research and development (R&D).

The S&T Directorate is the primary organization for R&D in DHS. It conducts R&D in several DHS laboratories and funds R&D conducted by other government agencies, the Department of Energy national laboratories, academia, and the private sector. Additionally, the directorate supports the development of operational requirements and oversees the operational testing and evaluation of homeland security systems for DHS. The Homeland Security Act of 2002 provided direction and broadly defined functions for the Under Secretary for Science and Technology and the S&T Directorate. Within this broad statutory framework, Administration and congressional policymakers face many challenges, including balancing funding for R&D activities, which may not result in a deployable product for many years, with other near-term homeland security needs.

Despite several restructurings and close congressional oversight, the S&T Directorate continues to face difficulties in meeting congressional expectations. The 113th Congress may consider several policy issues related to the performance of the S&T Directorate. These include

- priority-setting mechanisms for the directorate's R&D programs, such as strategic planning and targeting high-priority investments;
- the scope of the directorate's R&D activities, such as balancing incremental efforts with efforts that offer high risk, but high reward;
- efforts to consolidate or disperse R&D activity in or away from the S&T Directorate; and
- the directorate's role in the DHS acquisition process, both in identifying operational requirements and assessing operational effectiveness.

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Introduction

Both congressional and executive branch policymakers assert that science and technology play significant roles in improving homeland security. Congress established the Directorate of Science and Technology (S&T) within the Department of Homeland Security (DHS) to ensure that DHS has access to science and technology advice and capabilities for research and development (R&D). The DHS supports both short- and long-term R&D activities. However, successful R&D activities may not result in a deployable product for many years. The S&T Directorate and other DHS offices have not developed technological advances at the rate some Members of Congress expected. Since the establishment of DHS, the appropriations committees have often expressed displeasure at the rate of technology transfer, the direction of R&D efforts, and the ability of the S&T Directorate to align its resources and mission. In a time of increasing fiscal constraint, some Members have questioned whether S&T Directorate R&D activities should receive priority over other non-R&D activities.

This report provides a brief overview of the S&T Directorate's mission, organization, and budgetary structure; a discussion of selected critiques of the S&T Directorate; and an analysis of selected issues facing congressional policymakers.

Overview of the S&T Directorate

The S&T Directorate is the primary organization for R&D in DHS. Congress also authorizes and appropriates funding for R&D in the Domestic Nuclear Detection Office (DNDO) and the U.S. Coast Guard (USCG). With a total budget of \$838 million for FY2013, the S&T Directorate conducts R&D in several laboratories of its own, and funds R&D conducted by other government agencies, the Department of Energy (DOE) national laboratories, industry, and universities.¹ Additionally, the directorate supports the development of operational requirements and oversees the operational testing and evaluation of homeland security systems throughout the department.

Mission

The Homeland Security Act of 2002 (P.L. 107-296), which established DHS, created a Directorate of Science and Technology headed by an Under Secretary for Science and Technology. The Senate confirmed the current Under Secretary for Science and Technology, Tara O'Toole, in November 2009. Under Secretary O'Toole is the third Senate-confirmed Under Secretary for Science and Technology.² Reportedly, Under Secretary O'Toole will step down from this position on September 23, 2013, and be replaced on an interim basis by Deputy Under Secretary for Science and Technology Dan Gerstein.³

¹ Funding for FY2013 is pre-sequestration. According to DHS, FY2013 funding post-sequestration is \$804 million (Richard N. Williams, Director, Finance and Budget Division, Science and Technology Directorate, Department of Homeland Security, *Science and Technology FY2013 Budget*, undated).

² The previous two were Charles McQueary and Jay Cohen. There have also been several Acting Under Secretaries.

³ Jason Miller, "DHS S&T Director O'Toole Leaving," *Federal News Radio*, September 11, 2013.

The Homeland Security Act gave the Under Secretary a wide-ranging list of responsibilities and authorities. Some of the Under Secretary's responsibilities and authorities specify functions of the S&T Directorate itself. These include:

- establishing and administering the primary R&D activities of the department;
- conducting basic and applied research, development, demonstration, testing, and evaluation;
- establishing a system for transferring technologies to federal, state, and local governments and the private sector; and
- generally supporting U.S. leadership in science and technology.

Another group of responsibilities and authorities support other DHS components. These include:

- advising the Secretary on R&D efforts and priorities;
- supporting the Under Secretary for National Protection and Programs (formerly the Under Secretary for Information Analysis and Infrastructure Protection) by assessing and testing vulnerabilities and threats; and
- overseeing department-wide guidelines for merit review of R&D.

Finally, some of the Under Secretary's responsibilities and authorities are primarily coordinative. These include:

- planning and coordinating the federal civilian effort to develop countermeasures against terrorist threats;
- collaborating with the Secretary of Agriculture, the Attorney General, and the Secretary of Health and Human Services in designating and regulating biological select agents;⁴
- coordinating with other appropriate executive agencies to reduce R&D duplication and identify unmet needs; and
- coordinating and integrating the department's activities in R&D, demonstration, testing, and evaluation.

These coordinative roles involve stakeholders who do not report to the Under Secretary, so the Under Secretary's ability to perform these duties relies on the cooperation of other agencies.

Under Secretary O'Toole identifies the S&T Directorate's contributions to DHS and broader homeland security enterprise as falling into four categories:

- new capabilities and knowledge products;
- process enhancements and efficiencies;
- acquisition support; and
- understanding of homeland security risks and opportunities.

⁴ Select agents are pathogens and toxins that the Department of Health and Human Services and the Department of Agriculture have identified as posing a severe threat to public, animal, or plant health.

In addition, the S&T Directorate's current approach emphasizes R&D deliverables with high impact, the ability to rapidly transition products to use in the field, and a high return on investment.⁵

Organization

The statutory language creating DHS did not define the structure of the S&T Directorate; the Under Secretary has discretion to reorganize its structure. Each Under Secretary has had a different vision for the organization and activities of the S&T Directorate and has organized or reorganized the S&T Directorate accordingly. Under Secretary O'Toole reorganized the S&T Directorate in August 2010. The current structure organizes the S&T Directorate into four groups, each headed by a Director.⁶ The groups are:

- **Homeland Security Advanced Research Projects Agency (HSARPA)**, which contains six technical divisions that manage R&D in different topical areas and the Special Projects Office that oversees the directorate's classified R&D;
- **Support to the Homeland Security Enterprise and First Responders Group**, which is responsible for technology interoperability and compatibility, transfers technologies to first responders, and oversees the National Urban Security Technology Laboratory (formerly the Environmental Measurements Laboratory);
- **Acquisition Support and Operational Analysis Division**, which oversees the requirements generation process, interfaces with some DHS federally funded research and development centers, and provides test and evaluation policy oversight, including management of the test and evaluation activities of the Transportation Security Laboratory; and
- **Research and Development Partnerships Division**, which serves as the primary external interface for the S&T Directorate, coordinates work with the DHS University Centers of Excellence, oversees several DHS laboratories, and manages the relationship between the S&T Directorate and the Department of Energy national laboratories.

In addition to these groups, the 2010 reorganization created a Chief Scientist position reporting to the Under Secretary.

Budget Structure

In FY2012, the S&T Directorate realigned its budget structure to place most of its research and development activities into one Program, Project, and Activity (PPA) titled Research, Development, and Innovation (RD&I). The directorate aligned its other, supporting activities into three additional PPAs: Acquisition and Operations Support, Laboratory Support, and University

⁵ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

⁶ These entities are variously referred to as groups, divisions, or offices. Their heads are sometimes referred to as "Group Leads." See, for example, Tara O'Toole, Under Secretary for Science and Technology, Science and Technology Directorate, Department of Homeland Security, testimony before the House Committee on Science, Space, and Technology, Subcommittee on Technology and Innovation, March 15, 2011.

Programs.⁷ This budget structure differs substantially from the previous structure, in place since FY2007, which was aligned with R&D topic areas.⁸

The S&T Directorate provided several reasons for the realigned budgetary structure.

We believe the proposed Science and Technology Directorate (S&T) budget categories are better aligned with DHS Quadrennial Homeland Security Review (QHSR) priorities and with the actual work of S&T than are previous budget categories. The RD&I account provides better transparency of what the S&T is doing than did the previous structure by grouping projects' technical activity areas. The purpose of an individual project will now be apparent by where it is in the budget. It also makes the budget organizationally neutral. The old budget structure was tied to a particular organizational structure. The new structure is tied to enduring S&T research areas that allow the organization to evolve without affecting the budget. Further, the old structure tied to individual S&T Divisions had a tendency to lead to stove-piped projects rather than seeking multidisciplinary solutions that generally address the root cause of a problem rather than a symptom of a problem.⁹

The House and Senate Committees on Appropriations objected to this new budget structure. The House committee report accompanying the Department of Homeland Security Appropriations Act, 2012 (P.L. 112-74) described the Research, Development, and Innovation budget category as "all-encompassing ... too large and vague."¹⁰ The Senate committee report stated that the new structure "reduces transparency and accountability."¹¹ Despite these objections, the conference committee supported the S&T Directorate's new budget structure:

The new PPA for RDI will enable S&T to more quickly shift resources, if necessary, between research activities without formal reprogramming or transfer actions. In some instances, research activity may straddle several different missions and thrust areas. S&T and the Department must prioritize this consolidated research budget, which is substantially reduced from recent fiscal years, to focus on areas with the greatest promise for delivering material improvements or tangible contributions to homeland security missions in the near term. This flexibility in funding should facilitate that effort and partially offset the impact of an overall funding reduction.¹²

In the FY2013 and FY2014 budget requests, the S&T Directorate provided a more detailed description of its planned activities within the RD&I PPA than it had for FY2012. It identified spending by R&D topic, which provided greater insight into the relative funding between these subjects.

⁷ These four PPAs make up the directorate's Research, Development, Acquisition, and Operations appropriations account. The S&T Directorate also receives funding under a separate Management and Administration account.

⁸ The 11 previous PPAs were Chemical and Biological; Explosives; Infrastructure and Geophysical; Command, Control, and Interoperability; Borders and Maritime; Human Factors/Behavioral Sciences; Laboratory Facilities; University Programs; Innovation; Transition; and Test and Evaluation and Standards. In some years, partial funding for the Homeland Security Institute was also a PPA. See, for example, Science and Technology Directorate, Department of Homeland Security, *FY2011 Congressional Budget Justification*.

⁹ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, response to questions for the record in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, p. 109.

¹⁰ H.Rept. 112-91, pp. 126-127.

¹¹ S.Rept. 112-74, p. 148.

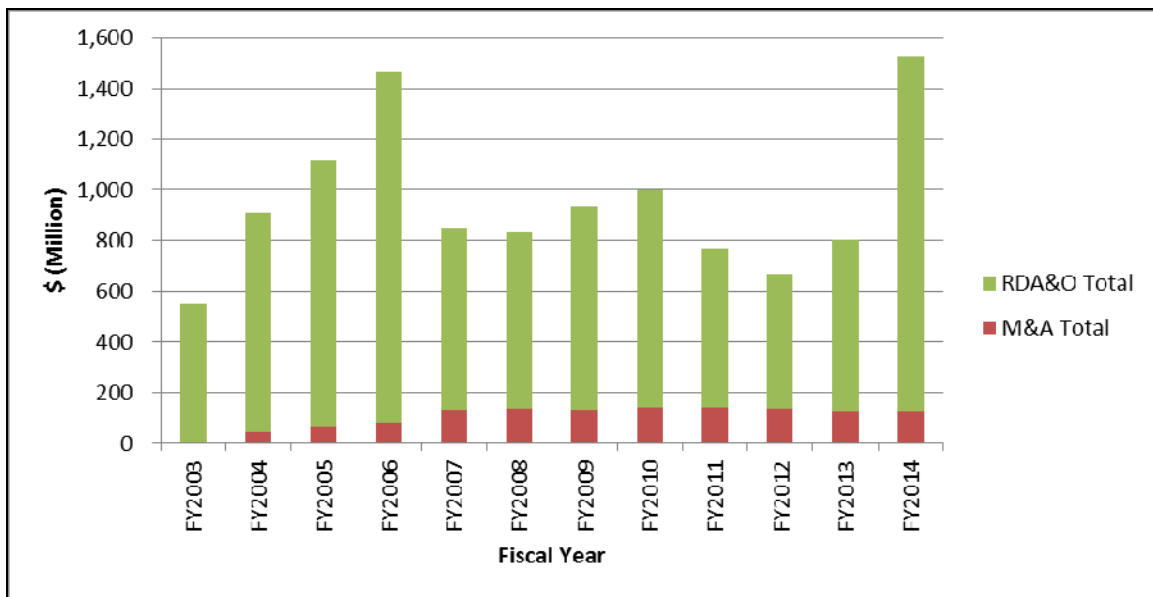
¹² H.Rept. 112-331, p. 998.

For FY2014, the House and Senate Committees on Appropriations again object to the consolidated RD&I PPA structure. Both committees would direct the S&T Directorate to divide the RD&I PPA into six PPAs: Apex, Border Security, Chem/Bio/Radiological/Nuclear/Explosives Defense, Cybersecurity, and Disaster Resilience.¹³ Neither chamber has yet voted on FY2014 appropriations legislation for DHS.

Funding

Funding for the S&T Directorate (net of rescissions) fell in FY2012 to its lowest appropriated level since Congress began appropriating funding for DHS.¹⁴ See **Figure 1** and **Table A-1** in the **Appendix**. Funding in FY2013 rebounded to a level comparable with FY2011. For additional information on DHS R&D funding in FY2013, see CRS Report R42410, *Federal Research and Development Funding: FY2013*, coordinated by John F. Sargent Jr., and CRS Report R42644, *Department of Homeland Security: FY2013 Appropriations*, coordinated by William L. Painter. The S&T Directorate requested \$1,397 million for FY2014. For additional information on DHS R&D funding in FY2014, see CRS Report R43086, *Federal Research and Development Funding: FY2014*, coordinated by John F. Sargent Jr. and CRS Report R43147, *Department of Homeland Security: FY2014 Appropriations*, coordinated by William L. Painter.

Figure 1. Appropriated Funding for the DHS S&T Directorate
(Budget authority)



Source: CRS analysis of DHS appropriations, FY2003-FY2014.

Notes: RDA&O= Research, Development, Acquisition, and Operations account; M&A= Management and Administration account. The decline in funding from FY2006 to FY2008 results from the creation of DNDO and OHA, the subsequent transfer of funds from the S&T Directorate to these new entities, and rescission of prior-year unobligated balances. FY2014 amount is the Administration request, not congressionally appropriated

¹³ H.Rept. 113-91, p. 109; and S.Rept. 113-77, p. 133.

¹⁴ The \$553.5 million in FY2003 funding transferred to the S&T Directorate from other agencies upon the creation of DHS was less than the FY2012 appropriated level.

funding. The steep increase from FY2013 to FY2014 includes \$714 million requested for construction of the National Bio- and Agro-Defense Facility.

The reductions in appropriated funding in FY2011 and FY2012 emphasized for policymakers several competing priorities within the S&T Directorate. One is establishing the appropriate balance between long-term R&D investments and near-term operational needs. As described in 2011 by the House Committee on Appropriations,

The Committee believes that S&T must more clearly demonstrate significant contributions to the homeland security mission and should prioritize the development of near-term, operational projects that promise substantive gains to our Nation's security ... The Committee believes that S&T has a meaningful role to play within DHS and affirms that this reduction will change the nature and scope of S&T's research ... S&T has not fully justified the billions of taxpayer dollars that it has spent on R&D, and the Committee believes these revised funding levels will force the Directorate to concentrate its efforts on its highest priority projects.¹⁵

Another is balancing maintenance of federal research infrastructure and investment in R&D activities performed by industry or academic stakeholders. While the construction and development of DHS infrastructure provides a location and organization to homeland security R&D activities, costs associated with construction, operations, and maintenance of such infrastructure have increased. In a declining S&T Directorate budget, these infrastructure costs competed with programmatic R&D funding. As described in 2012 by Under Secretary O'Toole,

Today, when new facilities or major infrastructure repairs are required, agency leaders and Congress often face the choice of having to use research budgets to fund infrastructure costs or pursuing promising research while delaying needed repairs and construction. Shifting research funds to infrastructure often means accepting the loss of existing, not-yet-matured research investments and facing significant opportunity costs.... Effective innovation is the core of the U.S. economy and U.S. national security; it requires investment in both facilities and research and development (R&D). The U.S. must robustly fund both of these activities in order to maintain the capability needed to respond to the diverse threats.¹⁶

The FY2013 increase in S&T Directorate funding may alleviate some tension in meeting these priorities, as the fraction of the RDA&O account dedicated to R&D activities returns to a level similar to prior years. Planned infrastructure costs associated with the construction of the National Bio and Agro-defense Facility (NBAF) and decontamination and demolition of Plum Island Animal Disease Center, however, may increase this tension in the future. The conference report accompanying the Consolidated and Further Continuing Appropriations Act, 2013 (P.L. 113-6) addressed this concern: "If additional funds are to be considered for NBAF in fiscal year 2014, or any fiscal year thereafter, such funds must be in addition to the Department's enacted budget, thereby not displacing resources for Departmental programs."

The FY2014 DHS budget request would increase funding for the S&T Directorate and several other DHS programs and components. The budget includes proposals for additional revenues that would offset the costs of some of these increases, but it could be argued that cuts elsewhere in the DHS budget result from the "displacement" of resources by the request for \$714 million for

¹⁵ H.Rept. 112-91, p. 126.

¹⁶ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the House Committee on Appropriations, Subcommittee on Homeland Security, March 21, 2012.

NBAF. The House and Senate Committees on Appropriations would both provide \$440 million for NBAF, rather than the requested amount.¹⁷

A third priority is balancing performing R&D activities and providing other types of S&T assistance to other DHS components, such as consulting on concepts of operation, developing future technology concepts, and overseeing test and evaluation. Some policymakers may believe that these latter activities are more appropriately funded through the client components rather than the S&T Directorate, while others may see opportunities for synergy and efficiency in providing a centralized source of S&T expertise.

Selected Issues

The Homeland Security Act provided direction and broadly defined functions for the S&T Directorate. However, how the Under Secretary for Science and Technology was to apply these functions and with what relative priority was left open for subsequent interpretation by the Administration and Congress. This section highlights a selection of issues: priority-setting mechanisms for the directorate's R&D programs; the scope of the directorate's R&D activities; efforts to consolidate R&D activity within the S&T Directorate; and the directorate's role in the DHS acquisition process. This list of issues is not comprehensive, but it illustrates some of the major challenges facing the S&T Directorate.

Priority Setting

In contrast to other R&D organizations in DHS, the S&T Directorate has a broad scope. For example, whereas the DNDO R&D program focuses on radiological and nuclear detection, the S&T Directorate must address all potential homeland security threats. Similarly, whereas the U.S. Coast Guard R&D program focuses on a single customer, the S&T Directorate serves a diverse customer base that includes both federal clients and nonfederal clients, such as first responders. Consequently, the S&T Directorate must prioritize and balance its R&D activities and expenditures across all potential threats and among a diverse customer base.

The S&T Directorate has identified the basis for its priority-setting:

The Science and Technology Directorate's (S&T) priorities for areas of research, development and analysis are based on DHS mission areas as articulated in the Quadrennial Homeland Security Report (QHSR), the Administration's National Security Strategy and first responder requirements. These priorities and requirements are derived from an understanding of near- and long-term threats, national needs, and operational vulnerabilities. S&T also assesses technical opportunity areas that are particularly suitable for development.¹⁸

Identifying specific priorities, based on these general principles, and then planning and executing integrated R&D activities to accomplish those priorities remain formidable tasks. Among the

¹⁷ H.Rept. 113-91 and S.Rept. 113-77.

¹⁸ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, response to questions for the record in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, p. 123.

approaches the S&T Directorate has taken toward meeting this challenge are strategic planning, a portfolio review process, and partnerships with DHS operational components to identify high-priority activities.

Strategic Planning

The Homeland Security Act authorized the Under Secretary for Science and Technology to coordinate DHS R&D and federal homeland security R&D activities. The S&T Directorate has engaged in formal strategic planning activities with varying degrees of success. This section discusses the S&T Directorate's strategic plan for itself, efforts to create joint strategic plans with other DHS entities, efforts to engage in strategic planning with other federal agencies, and efforts to develop a federal strategic plan for homeland security R&D.

Planning for the S&T Directorate

The S&T Directorate has engaged in directorate-level strategic planning since at least 2007, when it released its first strategic plan.¹⁹ The National Academy of Public Administration (NAPA) critiqued the S&T Directorate in 2009, and recommended that the S&T Directorate develop a strategic plan in accordance with federal planning guidance.²⁰ According to testimony by the chair of the NAPA panel,

In June 2007, the directorate published an internal Strategic Plan, *Science & Technology Strategy to Make the Nation Safer*. The plan describes the structure of the organization and the roles of the [Integrated Product Teams], its mechanisms for reaching out to other organizations and players, and its plans for workforce development. It does not adhere to the criteria of a strategic plan as generally applied across the federal government. Simply put, the plan can be said to detail the “what” of S&T, but it lacks the focus on the “why” that is the hallmark of successful strategic planning. The NAPA panel also found weaknesses in the process through which the plan was developed.²¹

The NAPA recommended that the S&T Directorate develop an internal strategic plan and stated that this plan should articulate “mission, goals, and strategies to provide additional focus to its work. S&T should consider broadening its mission statement to reflect its mandate more completely.” The NAPA also recommended that the S&T Directorate

follow federal guidance related to the process for developing a strategic plan and its contents. Stakeholder input is particularly important because of the significant linkages of S&T's work with other research and development entities across the federal government and the critical roles its customers fill in the homeland security arena.²²

¹⁹ Department of Homeland Security, Science and Technology Directorate, *Science & Technology Strategy to Make the Nation Safer ...*, June 2007.

²⁰ National Academy of Public Administration, *Department of Homeland Security Science and Technology Directorate: Developing Technology to Protect America*, 2009.

²¹ Cindy Williams, Chair, Panel on Department of Homeland Security Science and Technology Directorate, National Academy of Public Administration, testimony before the House Committee on Science and Technology, Subcommittee on Technology and Innovation, on October 27, 2009.

²² National Academy of Public Administration, *Department of Homeland Security Science and Technology Directorate: Developing Technology to Protect America*, p. 22.

To meet these recommendations, the S&T Directorate embarked on a new strategic planning process. In 2011, the S&T Directorate publicly released a new strategic plan to align with its new organizational structure.²³ The 2011 strategic plan states the directorate's mission and outlines five goals, each with multiple objectives. The goals are:

- Rapidly develop and deliver knowledge, analyses, and innovative solutions that advance the mission of the Department;
- Leverage technical expertise to assist DHS components' efforts to establish operational requirements, and select and acquire needed technologies;
- Strengthen the Homeland Security Enterprise and First Responders' capabilities to protect the homeland and respond to disasters;
- Conduct, catalyze, and survey scientific discoveries and inventions relevant to existing and emerging homeland security challenges; and
- Foster a culture of innovation and learning, in S&T and across DHS, that addresses challenges with scientific, analytic, and technical rigor.²⁴

The 2011 strategic plan addresses some of NAPA's criticism of its previous plan. However, it does not fully comport with best practices for agency strategic plans as identified by the Government Accountability Office.²⁵ It provides high-level direction regarding directorate priorities, including an increased emphasis on DHS component acquisition practices, but it does not identify required funding, provide metrics for monitoring progress towards meeting objectives, or identify key external challenges toward meeting the strategic goals.

Planning with Other DHS Components

The S&T Directorate has not developed a DHS-wide R&D plan. It has, however, engaged in strategic planning with willing DHS operational components. This approach has led to the development of some discrete strategic plans with individual components. The S&T Directorate intends these R&D strategies to align its future investments to DHS component priorities. According to Under Secretary O'Toole, all HSARPA R&D projects are grounded in R&D strategies developed in partnership with the users.²⁶

The S&T Directorate uses a S&T Resource Allocation Strategy (STRAS) approach to guide its engagement with partner organizations. According to the S&T Directorate, the STRAS approach

consists of a systems analysis that explicitly maps how the operational process functions and highlights potential capability gaps. Based on the analysis and an understanding of ongoing R&D efforts, a strategic plan will be jointly developed and agreed-to by the component and S&T. A formal, written agreement will codify the joint effort. Periodic updates will ensure

²³ Department of Homeland Security, Science and Technology Directorate, *DHS Science and Technology Directorate Strategic Plan 2011*, 2011.

²⁴ Department of Homeland Security, Science and Technology Directorate, *DHS Science and Technology Directorate Strategic Plan 2011*, 2011.

²⁵ For a discussion of key questions for policymakers regarding agency strategic plans, see General Accounting Office, *Agencies' Strategic Plans Under GPRA: Key Questions to Facilitate Congressional Review*, May 1997.

²⁶ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

that projects are progressing and will ultimately lead to fielding an operational capability, including, if appropriate, the transition of research products and prototype technologies into field pilots and acquisition plans.²⁷

In addition to its efforts with the DHS operational components, the S&T Directorate uses a modified version of the STRAS process to identify efforts it will undertake for the first responder community.²⁸

The S&T Directorate has developed strategic plans with only some DHS components and often focused on specific topics. For example, the S&T Directorate and the Transportation Security Administration issued a joint R&D strategy for aviation security.²⁹ The S&T Directorate has also signed strategic plans with the U.S. Secret Service and the Federal Protective Service.³⁰ Draft strategic plans exist for S&T Directorate engagement with the Office of Health Affairs, TSA (for intermodal activities), and Customs and Border Protection's Office of Border Patrol.³¹ In addition, GAO reports the S&T Directorate plans to develop R&D strategies with other components, such as U.S. Immigrations and Customs Enforcement, and FEMA.³²

The S&T Directorate intends to use these strategic plans to engage DHS components in planning the transition of R&D outputs. Component and S&T Directorate officials sign each strategic plan, and each plan links its focus areas with specific transition pathways for R&D outputs. In addition, HSARPA uses the strategic plans to map its efforts to the priorities and focus areas in the plans. This process clarifies how existing efforts align strategically and where new efforts or capabilities would meet identified strategic priorities. The S&T Directorate has also engaged in outreach activities, such as webinars and industry days, to improve information sharing with R&D performers and other stakeholders regarding R&D needs as identified through the joint S&T Directorate/operational component process.

Planning with Other Federal Agencies

The S&T Directorate is also engaging with other federal agencies in order to assess strategic partnerships that might align S&T Directorate capabilities with other agency needs and activities. In some cases, such strategic planning may serve to align activities across the R&D portfolio, such as in the joint R&D plan between the S&T Directorate and the General Services Administration.³³ In other cases, the S&T Directorate has engaged in strategic planning in response to specific threats, such as on chemical and biological threats with the USDA Animal

²⁷ Department of Homeland Security, Science and Technology Directorate, *DHS Science and Technology Directorate Strategic Plan 2011*, 2011, p. 6.

²⁸ Tara O'Toole, Under Secretary for Science and Technology, U.S. Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Cybersecurity, Infrastructure Protection, and Security Technologies, November 16, 2011.

²⁹ Department of Homeland Security, *Aviation Security Technology Research and Development Strategy*, March 2011.

³⁰ The latter is a joint strategic plan with the General Services Administration (Department of Homeland Security, Science and Technology Directorate and Federal Protective Service, and General Services Administration, *Research and Development Strategic Plan*, May 31, 2013).

³¹ Department of Homeland Security, Science and Technology Directorate, Homeland Security Advanced Research Projects Agency (HSARPA), *R&D Strategies*, June 10, 2013.

³² Government Accountability Office, *Department of Homeland Security: Oversight and Coordination of Research and Development Should Be Strengthened*, GAO-12-837, September 2012. p. 20.

³³ This is a joint strategic plan with the Federal Protective Service.

and Plant Health Inspection Service (APHIS), Federal Bureau of Investigation, and Environmental Protection Administration.³⁴

Such multiagency strategic plans may help DHS to obtain situational awareness of other agencies' activities. In addition, they may serve as the interim steps toward the development of a broader, integrated federal homeland security R&D strategy.

Planning for Federal Homeland Security R&D

The Homeland Security Act requires the S&T Directorate to interact with a variety of other executive branch agencies as well as requiring coordination with other DHS components. The Under Secretary is required by Sec. 302 of the Homeland Security Act to develop, in consultation with other agencies, a national policy and strategic plan for federal civilian efforts to identify and develop countermeasures against terrorism; to coordinate those efforts; and to identify priorities, goals, objectives, and policies for them. The Under Secretary has specific responsibility to collaborate with the Secretary of Agriculture, the Attorney General, and the Secretary of Health and Human Services in the designation and regulation of biological select agents.

No Under Secretary has released such a national policy and strategic plan. Topical federal R&D strategies for homeland security activities instead seem mostly to issue from the National Science and Technology Council (NSTC), a White House entity that coordinates federal R&D activities.³⁵ One of the NSTC's five standing committees is the Committee on Homeland and National Security, which is co-chaired by the DHS Under Secretary for Science and Technology.³⁶ Some policymakers may view issuance of topical federal R&D strategies from this committee as meeting the mandate of the Homeland Security Act. Others may expect the Under Secretary to issue a free standing document under her own authority.

Portfolio-Based Review

The S&T Directorate has adopted a portfolio review process to characterize the effectiveness of its R&D investments. This process includes written submissions on each project, an oral presentation by each project manager, and analysis of the project's likely impact and feasibility as judged against specific metrics determined by the directorate. A review panel of S&T officials,

³⁴ Department of Homeland Security, Science and Technology Directorate, Homeland Security Advanced Research Projects Agency (HSARPA), *Chemical and Biological Defense Research and Development Strategic Plan: Annex Supporting United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services*, June 5, 2013; Department of Homeland Security, Science and Technology Directorate, Homeland Security Advanced Research Projects Agency (HSARPA), *Chemical and Biological Defense Research and Development Strategic Plan: Annex Supporting Federal Bureau of Investigation*, May 22, 2013; Department of Homeland Security, Science and Technology Directorate, Homeland Security Advanced Research Projects Agency (HSARPA), *Chemical and Biological Defense Research and Development Strategic Plan: Annex Supporting Environmental Protection Agency*, April 9, 2013

³⁵ For example, the NSTC has released several federal homeland security strategies or roadmaps. See Executive Office of the President, National Science and Technology Council, *National Biosurveillance Science and Technology Roadmap*, June 2013; Executive Office of the President, National Science and Technology Council, *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program*, December 2011; and Executive Office of the President, National Science and Technology Council, *A National Strategy for CBRNE Standards*, May 2011.

³⁶ <http://www.whitehouse.gov/administration/eop/ostp/nstc/committees/chns>.

representatives of other DHS components, and technical experts evaluates and rates each project at least annually. The S&T Directorate reports that this portfolio review has identified places in the portfolio where program managers could combine activities to create synergies and cost savings, reprioritize funding, and speed projects to completion.³⁷

In 2011, the S&T Directorate predicted that this portfolio review process would:

provide a transparent and “shareable” view of all R&D within S&T; enable more strategic, longer-term budget decisions; ensure efficient delivery to the component or end user; and nurture effective communication throughout the process.³⁸

Although the S&T Directorate believes that the portfolio review improves strategic long-term planning, it could also have adverse effects. Annual portfolio reviews could result in an emphasis on short-term results that may be at odds with the long-term results emphasized in the multi-year timeline of overall strategic planning activities. The S&T Directorate may be able to reduce this risk by closely overseeing the metrics used and the direction given to experts participating in the portfolio review.

Congressional policymakers have generally supported the portfolio review process. The Senate report accompanying FY2013 appropriations described the process as “effective” and stated “This type of review would be of great value to coordinate research and development work and related efforts across the Department.”³⁹ The FY2013 explanatory statement directed DHS to adopt and expand the S&T Directorate’s portfolio review process across DHS. Some DHS components have subsequently implemented a portfolio review process. For example, the U.S. Coast Guard has reviewed its R&D portfolio and provided lessons learned back to the S&T Directorate. In addition, U.S. Immigration and Customs Enforcement is considering employing a similar portfolio review process.⁴⁰

High-Priority Investment

A significant change in the S&T Directorate’s R&D strategy was the creation in 2011 of what DHS calls Apex projects. Apex projects aim to solve urgent problems identified by the head of a DHS operational component. As a consequence, the S&T Directorate designates Apex projects as high-priority investments. The Under Secretary for Science and Technology and the head of the operational component sign the Apex charter, which delineates roles, responsibilities, and expectations. A commitment by senior component leadership is a key factor in the S&T Directorate agreeing to engage in a particular Apex project.

The S&T Directorate employs a non-traditional R&D approach to providing solutions to these problems. Rather than developing a technological solution and transferring it to the operational

³⁷ Tara O’Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, p. 11.

³⁸ Tara O’Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, pp. 15-16.

³⁹ S.Rept. 112-169, p. 15.

⁴⁰ Tara O’Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

component to implement, the S&T Directorate itself integrates the results of Apex projects into the operations of DHS components. Each Apex project has a multidisciplinary team from the S&T Directorate that partners with a similar team from the operational component.⁴¹ In order to do this, the S&T Directorate becomes more closely involved than usual in developing detailed concepts of operation and overcoming operational challenges associated with the technology's implementation.⁴² In other words, the S&T Directorate aims to provide a complete solution to the problem, rather than simply a piece of technology.

Congressional policymakers have generally supported the directorate's establishment of the Apex project. They cite its focus on expediting technological solutions and its collaborative nature as positive developments.⁴³

Because the Apex approach extends the S&T Directorate engagement up to and possibly through the process of procurement, these projects may have a more integrated planning process, including ongoing engagement between S&T Directorate and operational component representatives. S&T Directorate participants may find that the Apex project's higher degree of integration with DHS operational components makes it easier to adapt technology development to emerging operational needs. Similarly, Apex project planning activities may be more holistic, with operational considerations built into project planning at an earlier stage relative to non-Apex projects.

The Apex project approach may prove advantageous when compared with traditional R&D investment because of the involvement of senior operational component officials in setting priorities. In the past, the S&T Directorate has experienced significant challenges in successfully transitioning R&D results into operational environments. Reasons underlying these challenges include a failure of R&D projects to reflect leadership priorities, lack of further investment, ambiguous operational requirements, insufficient user demand, failure to devise an appropriate and timely commercialization strategy or acquisition process, and lack of integration into concepts of operation. The structure of Apex projects may ameliorate some of these challenges through increased commitment by senior DHS policymakers and explicit integration of the technology solution into the operational environment.

On the other hand, uncertainties attending the budgets and schedules for Apex projects may increase their risk of failure or underperformance. The S&T Directorate expects funding for an Apex project to be larger than it has typically invested in previous individual projects since Apex project investments extend through deployment. Such increased investment may lead to a correspondingly higher success rate, or it may make each failure more costly. The need to support multiple simultaneous Apex projects may strain S&T Directorate funding unless Congress provides additional funds expressly for these projects. If Congress instead supports Apex projects but does not provide additional funding for them, the S&T Directorate may be required to shift funding away from other priorities to meet the Apex project's need. Since the Apex projects are a new effort, the S&T Directorate additionally has little data to estimate their future rate of successes or required durations. Thus, it is unclear how quickly Apex projects will address high-

⁴¹ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

⁴² Personal communication between S&T Directorate staff and CRS, January 10, 2011.

⁴³ S.Rept. 113-77, p. 133.

priority, near-term problems and whether the use of Apex projects to solve urgent short-timeframe problems will come at the expense of solutions to long-term, fundamental problems.

The S&T Directorate had two Apex projects in FY2013, has capacity for a total of three or four simultaneous Apex projects, and anticipates starting new Apex projects with additional DHS components.⁴⁴ One Apex project with the U.S. Secret Service was successfully completed. The other Apex-like project with Customs and Border Protection was terminated by mutual agreement.⁴⁵ Based on its experiences with the early Apex projects, the S&T Directorate has identified several lessons learned for application to future projects. These include

- acquiring commitment from the highest levels of leadership in both the S&T Directorate and the DHS component;
- managing a flexible project team so that scope and product expectations are maintained;
- developing and documenting agreement about project goals, objectives, design and scope;
- establishing project operating procedures that encourage participation and build mutual trust;
- creating cross-organizational, multi-disciplinary teams;
- identifying core problems underlying more complicated issues; and
- leveraging all available resources to ensure that technology is quickly developed, piloted, and deployed.⁴⁶

For FY2014, the S&T Directorate requested funds for two new Apex projects, one with Immigrations and Customs Enforcement and one with CBP.⁴⁷ The effectiveness of the approach may become easier to assess if additional Apex projects are implemented.

Policy Options

If congressional policymakers are unsatisfied with the S&T Directorate's planning processes, they have many options to address perceived challenges. They might support ongoing efforts within the S&T Directorate by providing additional authorities to the Under Secretary regarding Apex projects or similar integrated R&D/procurement efforts. They might require increased rigor in strategic planning or establish an independent oversight and direction function for DHS R&D. They might give the Under Secretary greater discretion to redirect funding from underperforming projects to other priorities.

⁴⁴ Government Accountability Office, *Department of Homeland Security: Oversight and Coordination of Research and Development Should Be Strengthened*, GAO-12-837, September 2012. p. 19.

⁴⁵ Personal communication between S&T Directorate staff and CRS, June 13, 2013.

⁴⁶ Department of Homeland Security, Science and Technology Directorate, *Apex STORE Project Summary*, December 31, 2012.

⁴⁷ Department of Homeland Security, *FY2014 Congressional Justification-Science and Technology Research, Development, Acquisitions, and Operations*, pp. 15-16.

Support Integrated Projects

Congressional policymakers might choose to place greater support behind integrated projects, such as the Apex projects or other projects that integrate S&T Directorate activities with the operational components. The participation of an operational component in the R&D process may increase the likelihood that research results will successfully transition into the field. Similarly, a close partnership between the operational component and the S&T Directorate may increase the likelihood that S&T Directorate work addresses the high-priority needs of the component. To date, the S&T Directorate has partnered on an opportunistic basis, identifying willing operational components through personal relationships. Policymakers may wish to evaluate whether Apex project investment leads to successful outcomes from both the S&T Directorate and operational component perspectives. To the extent that the S&T Directorate completes these integrated projects successfully, both current and future partners may increase their demand for joint or integrated R&D activities. Policymakers may wish to monitor the extent to which such integrated projects become limited to specific operational components due to resource constraints or other challenges. Similarly, policymakers may wish to weigh the balance between S&T investments for partnering components and support for other homeland security clients, such as first responders. Because successful partnerships may increase interest in future projects, operational components that have an early positive experience could become the primary consumers of these more intensive R&D projects. This might result in an uneven distribution of R&D support for DHS operational components.

Increase Rigor of Strategic Planning

Congressional policymakers have historically valued strategic planning for homeland security R&D and might require a more rigorous strategic planning process for R&D in the S&T Directorate or DHS-wide. The S&T Directorate participates in multiple planning activities and reviews through DHS-wide activities, such as the Quadrennial Homeland Security Review, the development of departmental strategic plans, and the generation of future year homeland security programs (FYHSP). That said, the S&T Directorate has not publically released a detailed multiyear R&D plan. Some experts may question whether the S&T Directorate's current strategic planning process provides stakeholders with sufficient clarity about the directorate's long-term plans. Congress might mandate an ongoing, formalized planning process over a specific time period, such as five or ten years, to allow interested Members of Congress increased oversight of these investments. Such a formal process might increase agency predictability, potentially allowing the private sector greater access to and notice of S&T Directorate funding opportunities. It might also increase transparency with respect to the S&T Directorate's priorities and its progress toward meeting them. However, such a mandate might also have drawbacks. Rigid long-term planning might limit flexibility and responsiveness within the S&T Directorate's activities due to adherence to the long-term plan and its interdependencies. For example, the S&T Directorate might less readily react to the results of its portfolio review process or shift funds between projects if it had already developed a formal multiyear plan for those projects. A process for amending the strategic plan based on portfolio review findings or other similar analysis might ameliorate the tension between predictability and rigidity. The act of planning might itself provide insights to the holistic needs and capabilities of the agency and its partners, a benefit beyond producing the plan itself.

Establish a Planning Advisory Board

Congress might establish an advisory board to assist the Under Secretary in identifying research priorities, developing strategic directions, and making R&D investments. One possibility might be for the S&T Directorate to use the Homeland Security Science and Technology Advisory Committee (HSSTAC) for this purpose by implementing a formal HSSTAC review process of strategic priorities and direction. This might require a fundamental revision of how the S&T Directorate currently interacts with the HSSTAC, which has met sporadically.⁴⁸ Alternatively, the S&T Directorate could rely on an external advisory panel for such guidance, such as the National Academies, as some other agencies do in some fields of science, such as astronomy and astrophysics.⁴⁹ Such an advisory board would allow the Under Secretary to receive wide-ranging input into the prioritization process. Other federal agencies have relied on internal or external advisory boards to provide strategic planning for specific or general areas of agency interest. For example, the Department of Energy (DOE) Office of Science has established advisory boards for each of its major programs areas, and several of these boards have provided strategic plans for the DOE Office of Science.⁵⁰ A more directive approach might follow that of the National Science Board, which jointly with the National Science Foundation Director pursues the goals and functions of the National Science Foundation. The Under Secretary might find such input cumbersome to incorporate into S&T Directorate planning process and challenging when trying to meet the specific technology needs of other DHS components, as well as mandates or direction from the DHS Secretary.

Support Greater Flexibility

The above alternatives might tend to reduce the discretion of the Under Secretary. Congressional policymakers might choose instead to increase that discretion by providing the S&T Directorate with the ability to transfer funding more easily between programs, either through explicit transfer authority or by providing S&T Directorate programmatic funding within a single PPA. As noted above, the S&T Directorate has moved towards establishing its R&D funding as a single PPA in order to achieve more flexibility in allocating funding to research programs, but Congress has not generally supported this move. Funding transfers might result from regular portfolio reviews, S&T Directorate leadership decisions, or other changes in priorities. Congress might link increased flexibility to increased accountability for research success. One potential side effect of increased flexibility may be a shift towards short-term investments, as they may be more likely to meet demonstrable milestones and yield deployable results. Such a shift might adversely affect long-term needs.

⁴⁸ For more information on the HSSTAC, see <http://www.dhs.gov/st-hsstac>.

⁴⁹ The National Research Council of the National Academies releases a survey of astronomy and astrophysics outlining priorities for the coming decade in order to inform National Aeronautics and Space Administration (NASA) strategic planning. For one example of how this information is used in NASA planning, see Astrophysics Division, Science Mission Directorate, National Aeronautics and Space Administration, *Astrophysics Implementation Plan*, December 2012.

⁵⁰ For example, see Particle Physics Project Prioritization Panel, High Energy Physics Advisory Panel, *U.S. Particle Physics: Scientific Opportunities A Strategic Plan for the Next Ten Years*, May 29, 2008.

Scope of S&T Directorate R&D

Other organizations besides the S&T Directorate also conduct R&D with homeland security applications. According to the American Association for the Advancement of Science (AAAS), at least eight other agencies invest in homeland security R&D.⁵¹ Of those agencies, DHS's investment is the third largest, following the Department of Defense and the Department of Health and Human Services' National Institute of Health. Moreover, as described by Under Secretary O'Toole, the S&T Directorate "has responsibilities in some areas—notably biosecurity and civilian cybersecurity—which, to meet critical overarching national needs, extend beyond certain requirements of its DHS component customers or the first responder community."⁵² Policymakers may therefore question what principles determine the scope and type of R&D the S&T Directorate should do, how the S&T Directorate should coordinate its scope of effort with other federal agencies, and when another organization inside DHS or elsewhere should be responsible for a particular R&D topic.

Role of the Homeland Security Advanced Research Projects Agency

When Congress established DHS, it created within the S&T Directorate the Homeland Security Advanced Research Projects Agency (HSARPA), which was to administer a newly established Acceleration Fund for Research and Development of Homeland Security Technologies.⁵³ The scope of HSARPA has evolved since Congress created it. Initially, it was unclear how the S&T Directorate would implement HSARPA. Given the similarity of its name to the Defense Advanced Research Projects Agency (DARPA), some policymakers and experts in the scientific community believed that, like DARPA, it would fund high-risk, high-reward R&D. Instead, the S&T Directorate initially used HSARPA to conduct essentially all of its extramural activities, most of which were conventional R&D with only moderate risk.

The second confirmed Under Secretary for Science and Technology, Jay Cohen, restructured HSARPA, removing its conventional R&D funding and responsibilities and establishing it as a small, high-risk, high-reward program. Through its Homeland Innovative Prototypical Solutions (HIPS) and High Impact Technology Solutions (HITS) programs, HSARPA performed some research activities in the DARPA model. Because of its size, however, this version of HSARPA could not take on projects of the scope and significance addressed by DARPA.⁵⁴

Under Secretary O'Toole reorganized HSARPA, and it now again encompasses the vast majority of the R&D activities in the S&T Directorate. The HSARPA performs mostly conventional R&D with only moderate risk. The directorate's portfolio review process may further reduce the incidence of high-risk, high-reward activities, as the program's likelihood of success is a discriminating factor in the review process.

The HSARPA has become more focused on transitioning technology to the field. One consequence of the combination of this focus, a tightened budgetary environment, and the use of

⁵¹ Intersociety Working Group, American Association for the Advancement of Science, *AAAS Report XXXVI: Research and Development FY 2013*, Table I-6, p. 52.

⁵² Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

⁵³ Homeland Security Act of 2002 (P.L. 107-296), Section 307.

⁵⁴ In FY2007, HSARPA received \$38 million; DARPA received \$3.115 billion.

the portfolio review process is a consolidation and reduction in the number of projects and programs. The S&T Directorate has terminated underperforming projects and combined projects with similar aims in order to maximize the likelihood of successful technology development. Such consolidation might increase funding devoted to a particular problem over a critical threshold, leading to the discovery of a technological solutions. Alternatively, it might overly focus HSARPA activities on a limited range of threats. A challenge for the S&T Directorate is maintaining a number of programs and projects sufficient to cover the range of homeland security threats while also providing each program and project with sufficient resources to achieve meaningful progress or success.

Technology Foraging

The S&T Directorate may not always know of technologies or products available in the private sector that could meet DHS's general needs or specific requirements. Under Secretary O'Toole identified this challenge in testimony:

It is really difficult to know who is doing what in the R&D community. This is a global community. It is churning out new products all the time, and it is difficult to keep up with. What we want to do is become best in class at surveying this dynamic and expanding world, identifying potential partners, discovering technologies in late-stage development which we might adopt or adapt for new purposes, new environmental conditions, or new scales.⁵⁵

To identify technologies developed in the private sector, the S&T Directorate is investing in "technology foraging." This effort uses scientific periodicals, the internet, and other sources to seek out technologies already in existence that may be readily adaptable to meet homeland security needs. The S&T Directorate completed a Technology Foraging Pilot at the end of April 2012 with the goal to increase technology foraging efforts and obtain additional insights into improving the process.⁵⁶ Based on the results of this pilot, the S&T Directorate established a Technology Foraging Office managed by the Research and Development Partnerships Office. According to Under Secretary O'Toole, technology foraging has "already had a large impact on [the S&T Directorate's] ability to deliver a high return on investment."⁵⁷

The S&T Directorate plans to institutionalize technology foraging best practices to ensure low-cost and timely identification of technologies.⁵⁸ The S&T Directorate requires program managers to include technology foraging activities in their plans to develop new technologies. According to the S&T Directorate, program managers can request technology foraging activities to support mission needs, and this technology foraging activity can be conducted at three different levels of depth and duration. The S&T Directorate has completed at least twenty-eight formal projects,

⁵⁵ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, p. 13.

⁵⁶ Personal communication between S&T Directorate staff and CRS, June 8, 2012.

⁵⁷ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

⁵⁸ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, p. 16.

including those done during the pilot.⁵⁹ Several prototypes have been developed building on technologies and research identified through the technology foraging process.⁶⁰

Fielding of Results

A further challenge facing the S&T Directorate is the extent to which it should assume a responsibility for aiding in the fielding of equipment and developing concepts of operations (CONOPS) for operational components. Historically, the S&T Directorate brought R&D activities to a specific level of development, often that of a working prototype, but it would then transition this technology to an operational end-user for final development and adaptation to field environments.⁶¹

The challenge of fielding R&D results may be particularly notable when the end-user is not a DHS component but instead the private sector. As noted by Under Secretary O’Toole, the S&T Directorate

has also found it difficult to “transition” successful R&D results to use by private sector entities, such as those responsible for the bulk of the nation’s critical infrastructure sectors. In the current economic environment, the private sector’s embrace of added security or resiliency is dependent upon approval by corporate boards focused on thin profit margins.⁶²

The S&T Directorate has broadened its approaches to encouraging technology transfer to the field. Through its strategic planning process, it attempts to identify areas where the DHS component plans to invest its own future resources. By linking S&T Directorate R&D programs to these priorities, it expects that component will be more likely to adopt successful R&D outputs as part of their planned future investments. In certain circumstances, a DHS component may jointly fund R&D activities with the S&T Directorate, which may also increase the odds for adoption of the R&D output.

Apex projects, which extend the role of the S&T Directorate through fielding and development of CONOPS, further alter the previous approach to transitioning technology. Under the Apex project model, the S&T Directorate has additional responsibilities and bears additional costs, but it may also be more technically capable than the operational component in adapting the R&D output to succeed in the field.

The S&T Directorate may find it challenging to broadly employ the technology transition and Apex models simultaneously as they likely require program managers with different skills. Additionally, it is not apparent what the balance of work is between developing the technology to the prototype stage and bringing the prototype into the field. It may be that the resources of the S&T Directorate will be further strained if it takes on the responsibility for fielding the technology in conjunction with the operational component. Previous R&D expenditures by the

⁵⁹ Personal communication between S&T Directorate staff and CRS, June 12, 2013.

⁶⁰ Science and Technology Directorate, Department of Homeland Security, “Smart Scavenging—Technology Foraging at DHS,” *S&T Snapshots*, July 19, 2013, <https://www.dhs.gov/st-snapshot-tech-foraging>.

⁶¹ During the tenure of Under Secretary Cohen, operational components and the S&T Directorate would enter into non-binding technology transfer agreements (TTAs) that described the technology requirements to be met prior to transfer from the S&T Directorate to the operational component.

⁶² Tara O’Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

S&T Directorate stopped at the prototype stage. Extending development through deployment may increase the cost of individual R&D programs.

Impacts of Uncertain Funding

The S&T Directorate has received uncertain funding for several years due to a combination of fiscal constraint and funding through continuing resolution. Such funding uncertainty has several impacts on an R&D entity. These impacts include loss of productivity due to termination or suspension of ongoing R&D and loss of R&D tempo due to delays in starting new projects.

The S&T Directorate experienced funding reductions in FY2011 and FY2012 that placed additional constraints on R&D activities. The S&T Directorate used the previously discussed portfolio review process to prioritize funding toward programs deemed with highest impact, reducing the number of R&D projects. In addition, the S&T Directorate prioritized its R&D investments at that time to four priority areas: biological defense, unclassified cyber security, explosives detection in the aviation environment, and first responder technologies.⁶³

In addition to constricting the type of R&D program funded, the uncertain funding environment led the S&T Directorate to cancel multiyear programs before the end of the project timeline.⁶⁴ Such termination interrupts the flow of R&D, and R&D programs are terminated before their outcomes occur. Therefore programs that might have yielded a positive result following several additional years of investment were likely terminated or paused. With the increased FY2013 funding, the S&T Directorate expanded its research investment beyond these priority areas. The S&T Directorate restarted some research programs paused in prior fiscal years.

During the periods when Congress funded the S&T Directorate through continuing resolutions, the S&T Directorate was not able to start new programs. While further appropriations for the S&T Directorate then allowed new program starts, these new programs would begin later in the fiscal year than previously planned. Such delays likely lead to agency challenges in meeting previously established R&D milestones and goals. Also, due to the comparatively long time frame involved in soliciting R&D proposals, rating them, and issuing final contracts, delaying the start of new programs may contribute to increases in agency unobligated balances.⁶⁵

Policy Options

Congressional policymakers may opt to provide direction regarding the approaches and types of R&D in which the S&T Directorate engages. Interested congressional policymakers might direct the S&T Directorate to place a particular focus on how it engages the R&D community. For example, they might direct it to focus on high-risk, high-reward efforts; direct it to narrow the focus of its efforts to specific topics; provide it with the funding necessary to engage in activities

⁶³ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2013*, Committee Print, Part 4, p. 303.

⁶⁴ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

⁶⁵ Since FY2010, Congress has appropriated funding with a three-year expiration for the S&T Directorate's R&D activities, not including laboratory facility operation and construction.

across the homeland security R&D spectrum; or direct it to invest in specific stages of the R&D enterprise, such as technology development rather than basic research.

Focus on High-Risk, High-Reward Approach

How the S&T Directorate implements HSARPA may continue to be a topic of congressional interest. Policy makers might direct the S&T Directorate to adopt a higher proportion of DARPA-like R&D. Advocates of the DARPA model point out that while its risks are high, and only a small fraction of funded programs achieve their goals, the benefits from successes can be substantial. On the other hand, because most programs do not achieve their goals, many funded programs will fail to produce the desired results. The high-risk, high-reward approach therefore likely requires a sustained and increased financial commitment if it is to produce a significant number of successful results. In the current fiscal environment, congressional policymakers may find it difficult to provide such a sustained and increased financial commitment.

Focus on Fewer Threats

Historically, the S&T Directorate has spread its resources over a large number of projects to address the panoply of homeland security threats. The S&T Directorate appears to have reconsidered this approach, first with the development of Apex projects and second with its prioritization of particular research areas during its time of fiscal constraint. Additionally, the use of the portfolio review process has reduced the number of projects. These changes appear to be intended to focus resources on fewer projects that address identified and designated urgent needs. The tradeoff is that a more focused program may not be able to address all threats simultaneously or equally.

Congress may choose to consider the breadth of S&T Directorate R&D activities. Congressional policymakers have historically identified specific areas of R&D interest for the S&T Directorate, but they have also tended to support R&D activities across the threat spectrum. Congress could provide more explicit direction to the S&T Directorate regarding which threats should have primary focus. Alternatively, Congress could direct the S&T Directorate to adopt an approach that encompasses efforts against as many threats as possible.

Increase Funding to Match Scope

The S&T Directorate has generally attempted to fund R&D against many potential threats. In FY2013, when the directorate budget increased, it did not, for example, retain a smaller portfolio of targeted threats. Congressional policymakers might choose to increase the funding of the S&T Directorate in order to allow it to invest in more R&D programs and align its portfolio to its R&D scope. Such an approach might allow the S&T Directorate to invest in both high-risk, high-reward R&D and incremental R&D against all homeland security threats. Also, increasing S&T Directorate funding might allow the S&T Directorate to support more, larger individual efforts, like Apex projects, while simultaneously supporting smaller projects as well. Such an increase may be untenable in the current fiscal climate, may not be supported generally in Congress due to concerns about past S&T Directorate performance, or may be seen as less important than other congressional priorities. For example, an increase in S&T Directorate funding might be seen as reducing the resources available to other homeland security priorities with their own resource needs and supporters.

Limit R&D Type

Alternatively, congressional policymakers might choose to direct the S&T Directorate to focus on specific types of R&D, for example, mandating that it focus on a specific portion of the R&D continuum. To some extent the S&T Directorate has adopted such an approach with its focus on near-term development in contrast to basic research. Not all federal entities maintain a balanced portfolio across the R&D enterprise. For example, the National Science Foundation and the National Institutes of Health focus more on basic research than on developmental activities. Conversely, the Defense Threat Reduction Agency performed no basic research in its early years. Congress has generally supported a greater focus by the S&T Directorate on short-term development and transitioning technologies to DHS operational components and first responders. It might choose to make such support more explicit.

Alternatively, Congress could direct the S&T Directorate to become more research-oriented by requiring it to focus more on long-term basic research. Such a long-term focus might enable the S&T Directorate to develop fundamental knowledge across a wide range of relevant disciplines by sustaining or developing communities of scientists and technologists interested in researching homeland security issues.⁶⁶ Over-emphasis on either short- or long-term results may have important tradeoffs. Some experts have cautioned the S&T Directorate against under-investment in basic research.⁶⁷ Excessive focus on short-term projects may lead to a dearth of research results to build upon in future years. Excessive focus on long-term results may result in failures to supply technological solutions that meet the needs of operational components. While leveraging the complementary capabilities of other agencies, such as the Department of Defense, may mitigate such tradeoffs, it may also incur costs. Solutions developed by other agencies may not align with DHS needs. The S&T Directorate may need to adapt the other agency's efforts to the homeland security mission space.

Consolidate or Disperse R&D Activities

When DHS was created, Congress transferred several components with R&D activities into the new department in their entirety. Congress did not merge all R&D activities into the S&T Directorate; some components retained their R&D activities. The largest of these were the Transportation Security Administration (TSA), the Customs Service, and the Coast Guard. Although the Homeland Security Act charges the Under Secretary with establishing and administering the primary research and development activities of the Department, it also states that

nothing in this title shall be construed to preclude any Under Secretary of the Department from carrying out research, development, demonstration, or deployment activities, as long as such activities are coordinated through the Under Secretary for Science and Technology.⁶⁸

The conference report (H.Rept. 108-280) accompanying the Department of Homeland Security Appropriations Act, 2004 (P.L. 108-90) stated Congress's general preference for DHS to

⁶⁶ James Jay Carafano, and Richard Weitz, "Rethinking Research, Development, and Acquisition for Homeland Security," *Heritage Foundation Backgrounder No. 2000*, January 22, 2007.

⁶⁷ Jessica Zuckerman, "The 2013 Homeland Security Budget: Misplaced Priorities," *Heritage Foundation Backgrounder 2664*, March 23, 2012.

⁶⁸ 6 U.S.C. 186.

consolidate its R&D into the S&T Directorate. The R&D activities of the former Customs Service were transferred to the S&T Directorate in FY2005. The R&D activities of TSA, including its Transportation Security Laboratory, followed in FY2006. In both years, however, Congress disapproved the department's proposals to transfer the Coast Guard's R&D program. The Coast Guard program continues to operate an independent program of R&D, testing, and evaluation.

The establishment of the Domestic Nuclear Detection Office (DNDO) in 2005 was the first dispersal of R&D activities away from the S&T Directorate. Created by presidential directive and subsequently given statutory authority by Title V of the SAFE Port Act (P.L. 109-347), DNDO took over the S&T Directorate's radiological and nuclear countermeasures portfolio. Although it became a separate organization under the direct authority of the Secretary in FY2006, DNDO received its funding through the S&T Directorate until FY2007.

Proposed DNDO R&D Transfer to the S&T Directorate

In both the FY2011 and FY2012 budgets, the Obama Administration proposed transferring the DNDO Transformational R&D program from DNDO to the S&T Directorate. The FY2011 congressional budget justification for the S&T Directorate's proposed new Radiological and Nuclear Division provided the following explanation:

Bringing all of the fundamental research in DHS together in one component allows for economies of scale that range from the administrative to the scientific research aspects of the program. The benefits of collaborative research across the S&T Directorate are immediately apparent when considering the basic physics behind rad/nuc detection. There are many similarities in the technologies used to identify chemical, explosive, and rad/nuc threat materials among other commonalities. Bringing these research programs together creates a more cross-disciplinary environment for the basic research and transition components of all the programs. It also creates a synergy between all sensor-developing activities, which eventually will all need to operate in the same environment if not the same device.

Under Secretary O'Toole also described the consolidation efforts in terms of centralizing research expertise:

The proposal to move the Transformational and Applied Research (TAR) program back under the Science and Technology Directorate (S&T) reduces duplicative efforts in program management and support. The move also consolidates Chemical, Biological, and Radiological, Nuclear and Explosive (CBRNE) research under S&T, which serves as the research and development (R&D) expertise for homeland security. Unifying CBRNE research within S&T will create a better environment for R&D coordination in support of the DHS mission.⁶⁹

These themes of synergy, efficiency, and fostering a multidisciplinary approach echo previous consolidation proposals for DHS R&D.

Congress rejected the proposed consolidation of DNDO Transformational R&D in both FY2011 and FY2012. The Senate generally supported such transfer of R&D responsibilities, while the House did not. For example, in FY2012, the House Appropriations Committee stated:

⁶⁹ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, response to questions for the record in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, p. 111.

While the Committee recognizes that S&T is the lead agency for homeland security research, and that it has established a network of diverse research communities, it is not yet clear that the transformational and basic research related to nuclear detection is better removed from the agency with primary responsibility for nuclear detection policies and investments. In fact, the Committee is concerned that DNDO may find significantly reduced support for its research mission, given the shift in S&T to quicker payoff investments. Therefore, the Committee is not persuaded that the proposed realignment is optimal and finds the Department's justification for the shift to have been insufficient. At the same time, the Department expects S&T to work closely with DNDO and bring to bear its unique research and development expertise and resources on the specific challenges of radiation and nuclear detection.⁷⁰

For FY2013, Congress directed DHS to consider potential consolidation and reorganization of DNDO's activities, including its R&D activities. The conference report accompanying the Consolidated and Further Continuing Appropriations Act, 2013 (P.L. 113-6) directed DHS to

undertake an in-depth review of its organization, operations, and communications in carrying out its WMD programs, to include an evaluation of potential improvements in performance and possible savings in costs that might be gained by consolidation of current organizations and missions, including the option of merging functions of the Domestic Nuclear Detection Office (DNDO) and the Office of Health Affairs (OHA).

Such an analysis might again recommend transferring DNDO Transformational R&D activities back to the S&T Directorate. For FY2014, both the House and Senate Committees on Appropriations would direct the S&T Directorate to establish a chemical, biological, radiological, nuclear, and explosives defense PPA, but both committees would also continue to fund radiological and nuclear R&D predominantly through DNDO.⁷¹

Coordination of R&D Activities in Other DHS Components

As mentioned above, although the S&T Directorate is the primary R&D entity within DHS, the Homeland Security Act of 2002 allows other DHS components to perform R&D activities so long as they are coordinated through the Under Secretary for Science and Technology. The extent of these activities has historically been unclear, partly due to differences in the reporting of R&D activities between budget documents, National Science Foundation surveys, and other sources.⁷² In 2012 a Government Accountability Office (GAO) audit of R&D in DHS identified R&D and R&D-related activities occurring in 12 other DHS components, only two of which, DNDO and the U.S. Coast Guard, receive explicit appropriations for R&D from Congress or report R&D activities to the Office of Management of Budget.⁷³ For FY2011, GAO concluded that the S&T

⁷⁰ H.Rept. 112-91, p. 129.

⁷¹ H.Rept. 113-91, and S.Rept. 113-77.

⁷² For a historical discussion of such conflicting information, see CRS Report RL34356, *The DHS Directorate of Science and Technology: Key Issues for Congress*, by Dana A. Shea and Daniel Morgan.

⁷³ Many different definitions of research and development exist. This report considers all activities funded through the DHS S&T Directorate's Research, Development, Acquisitions, and Operations appropriations account as research and development. This definition aligns with that used by the Office of Management and Budget and the President's budget.

Directorate was the entity obligating the largest amount of R&D and R&D-related funding, but that this funding was only 31% of total DHS R&D and R&D-related obligations.⁷⁴

The GAO also detailed weaknesses in the coordination and oversight of DHS R&D activities. While identifying some existing coordinating mechanisms, the GAO found them lacking:

S&T has taken some steps to coordinate R&D efforts across DHS, but the department's R&D efforts are fragmented and overlapping, which increases the risk of unnecessary duplication. R&D at DHS is inherently fragmented because S&T, the Coast Guard, and DNDO were each given R&D responsibilities in law, and other DHS components may pursue and conduct their own R&D efforts as long as those activities are coordinated through S&T. S&T uses various mechanisms to coordinate its R&D efforts including component liaisons, component R&D agreements, joint R&D strategies, and integrated R&D product teams composed of S&T and component officials. ... DHS has not developed a policy defining who is responsible for coordinating R&D and what processes should be used to coordinate it, and does not have mechanisms to track all R&D activities at DHS that could help prevent overlap, fragmentation, or unnecessary duplication.⁷⁵

The GAO recommended that the Secretary of Homeland Security develop and implement policies and guidance for defining and overseeing R&D at the department. The S&T Directorate has researched potential department-wide definitions and suggested one to DHS leadership.⁷⁶ The DHS is currently drafting policies to define R&D activities on a DHS-wide basis.

Congressional policymakers are addressing this issue in the 113th Congress in the appropriations process. The House FY2014 DHS appropriations bill would direct DHS to submit a report on reforms to its R&D programs, including a formal process for setting R&D priorities, a formal process for DHS-wide involvement in R&D decision-making and review, metrics for R&D program status and return on investment, and the implementation of GAO's recommendations. The Senate FY2014 DHS appropriations bill includes no provision on this topic, but report language directs DHS to implement policies and guidance for defining and overseeing R&D, in accordance with the GAO recommendations.

Policy Options

Congressional policymakers have many options regarding the structure of the department's research and development activities. Congress could opt to allow departmental officials, within ongoing congressional oversight, to make their own determinations about consolidation or dispersal of R&D activities. Congress could mandate or support consolidation of R&D into the S&T Directorate. Alternatively, Congress might disperse the R&D capabilities centered in the S&T Directorate back to operational components.

⁷⁴ Government Accountability Office, *Department of Homeland Security: Oversight and Coordination of Research and Development Should Be Strengthened*, GAO-12-837, September 2012. p. 37.

⁷⁵ Government Accountability Office, *Department of Homeland Security: Oversight and Coordination of Research and Development Should Be Strengthened*, GAO-12-837, September 2012.

⁷⁶ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

Consolidate R&D

Congressional policymakers might choose to strengthen the role of the S&T Directorate by limiting or removing the ability of other DHS components to perform independent R&D activities. One approach might be to strengthen the coordinating role of the S&T Directorate. This might slow the conduct of R&D activities due to the need to involve the S&T Directorate. Additionally, absent a clear definition of R&D activities, what programs to consolidate would be discretionary; for example, certain technology acquisition programs might be interpreted as subject to such coordination while others were not. An alternative approach might be to prohibit other components from performing R&D activities. Following such a prohibition, R&D requirements might all flow directly through the S&T Directorate, potentially providing the S&T Directorate with more insight regarding component needs. Such a prohibition might adversely affect operational performance improvements of existing technologies, however, unless a clear delineation was established between R&D activities and technology acquisition.

Advocates see consolidation as having the potential to foster collaboration, increase synergy between programs, reduce duplication, streamline processes and procedures, and improve budgeting and oversight. Critics, however, express doubt about the S&T Directorate's ability to balance R&D priorities across a growing spectrum of responsibilities. Other concerns include whether the directorate would effectively support the department's non-homeland security missions and whether the directorate's heavy emphasis on countering weapons of mass destruction would result in the neglect of other, smaller programs.

Disperse R&D

A competing approach would be to transfer some or all R&D responsibilities to operational components. For example, the U.S. Coast Guard retains its R&D activities while also engaging with the S&T Directorate. Component needs might be more easily identified and met with the R&D responsibilities within the operational component. With such an approach, the S&T Directorate might become responsible for R&D activities supporting only those components unable to meet their own R&D needs or for R&D activities affecting multiple components.

If the operational component retained its R&D capabilities, it might be more easily able to target R&D efforts against its own high priorities. On the other hand, such dispersion might bear significant organizational costs, as duplicative organizational structures would be required for each R&D capability in each operational component, and it might impede identification of synergies between the various operational components. With the S&T Directorate providing the majority of DHS R&D activities, the directorate may be able to identify R&D results that are applicable to the needs of multiple operational components.

An additional drawback to the further dispersal of R&D responsibilities is that the S&T Directorate might be less able to coordinate DHS-wide R&D activities. Its smaller R&D investment might make it less the center of DHS R&D activities and potentially reduce its status. Similarly, if the S&T Directorate lacked insight into the component's R&D needs, the S&T Directorate might be less able to serve in an advisory role to other components or provide meaningful assistance in technology acquisitions.

Formalize Relationships

A third option might be for policymakers to support greater, formal interactions between operational component and S&T Directorate leadership. Current coordination and establishment of joint projects relies upon personal relationships rather than formal oversight. The success of such partnerships will likely depend on additional factors, such as effective coordination between components, agreement on goals and requirements, and sufficient resources to meet expectations. Congressional policymakers might support establishment of an R&D oversight council within DHS, or some other DHS-wide entity that would provide a vehicle for a leadership focus on R&D within DHS. Some policymakers might view the S&T Directorate portfolio review process, where representatives of multiple DHS components review S&T Directorate R&D investments, as a model for such a DHS-wide entity.

Acquisition Roles

As noted above, the Under Secretary for Science and Technology has statutory responsibilities beyond the oversight of homeland security R&D. Notably, the Under Secretary for Science and Technology has a statutory responsibility to oversee departmental operational test and evaluation activities. In addition to this responsibility, the S&T Directorate has begun to increase its presence in the early stages of acquisition within DHS operational components. This increased presence in the acquisition process raises policy questions regarding the optimal balance between engaging in acquisition support and managing R&D for DHS customers.

Operational Component Technology Acquisition

DHS has encountered several challenges in developing, procuring, and deploying homeland security technologies in the field. For example, Congress has identified the deployment of explosives trace-detection portal machines by TSA; the deployment of the technological portion of the Secure Border Initiative by U.S. Customs and Border Protection; the development of next generation BioWatch detectors (Gen-3) for the Office of Health Affairs (OHA); and the research, development, and procurement of the Advanced Spectroscopic Portal (ASP) and the Cargo Advanced Automated Radiography System (CAARS) by DNDO as technology investments that have not yielded the expected returns. Such failures have raised questions about the coordination of R&D activities with technology procurement activities and whether DHS technical expertise is sufficiently informing DHS procurement decisions.

In general, separating technology development from product development and acquisition is a best practice that can help reduce costs and deliver a product on time.⁷⁷ In a separated approach, the acquiring component generates operational requirements and the R&D component attempts to develop technologies that will meet them. For example, OHA determines its requirements and communicates them to the S&T Directorate through written requirements documents and other less formal processes. This approach may reduce the possible competition between funding acquisition and operation of current products and development of next-generation products. However, in this approach, the development of next-generation biological detectors competes for

⁷⁷ United States Government Accountability Office, *Combating Nuclear Smuggling: Inadequate Communication and Oversight Hampered DHS Efforts to Develop an Advanced Radiography System to Detect Nuclear Materials*, GAO-10-1041T, September 15, 2010.

priority and resources against all the other products under development by the S&T Directorate. Additionally, enforcing a strict division between developers and acquirers of technology may lead to lost opportunities for synergy through joint funding of R&D activities.

Other operational components appear to be performing activities that some may identify as development activities arguably better suited for the S&T Directorate. These agencies generally consider these efforts to be acquisitions rather than R&D.⁷⁸ Under Secretary O'Toole has identified the early inclusion of S&T Directorate views in operational component technology acquisitions as key to future acquisition success.

Acquisition Support

The GAO has found that cost-benefit and alternatives analyses help reduce the risk of cost overruns, missed deadlines, and performance shortfalls. It has also found that DHS has not consistently included these analyses in its acquisition decision making. According to GAO, DHS is attempting to improve its mechanisms in this area:

DHS reported that it plans to establish a new model for managing department-wide investments across their life cycles. Under this plan, S&T would be involved in each phase of the investment life cycle and participate in new councils and boards DHS is planning to create to help ensure that test and evaluation methods are appropriately considered as part of DHS's overall research and development investment strategies. S&T will help ensure that new technologies are properly scoped, developed, and tested before being implemented.⁷⁹

As part of the reorganization launched by Under Secretary O'Toole in 2010, the S&T Directorate established an Acquisition Support and Operations Analysis (ASOA) Division. This group aims to provide a full range of coordinated operations analysis, systems engineering, test and evaluation, and standards development support to the DHS operational components:

S&T's Acquisition Support and Operational Analysis Division helps DHS Components analyze and translate mission needs into testable requirements so that DHS procures technologies that work as expected and are delivered on time and on budget. Through its systems analysis and standards development capabilities, S&T enriches the DHS investment lifecycle with process improvement for customized analysis for trade-off decisions, operational requirements development, alternatives assessment, and portfolio analysis. Through its analytic efforts, S&T is providing a more holistic approach to the Department's needs, the requirements for meeting them, and understanding the impact various alternative solutions may have. Operational analytics also enable S&T to establish trust and build credibility with partners by facilitating collaboration and communication across the Homeland Security Enterprise. S&T's input facilitates decision making that ensures future technology investments will effectively integrate and transition into Component operations.⁸⁰

⁷⁸ For an overview of DHS spending on R&D activities outside of the S&T Directorate, see Government Accountability Office, *Department of Homeland Security: Oversight and Coordination of Research and Development Should Be Strengthened*, GAO-12-837, September 2012.

⁷⁹ Government Accountability Office, *DHS Could Strengthen Acquisitions and Development of New Technologies*, GAO-11-829T, July 15, 2011.

⁸⁰ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, response to questions for the record in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2013*, Committee Print, Part 4, p. 320.

According to Under Secretary O’Toole, the S&T Directorate expects such engagement will lead to improvements in the ability of the S&T Directorate to identify and develop products for the operational components:

We are working with the DHS Under Secretary of Management and the components to leverage S&T’s technical skills—again, we are the core group of science and engineering expertise in DHS—to improve the front end of the acquisition process by helping the components to formulate clear requirements stemming from their mission needs. This will enable us to much more readily develop technologies that will serve their actual needs.⁸¹

Some portion of the S&T Directorate’s participation in the acquisition process arises from existing contacts between component and S&T Directorate staff, such as those engendered by Apex projects. In addition, the integrated investment life cycle management (IILCM) process under development by the Under Secretary for Management may formalize an increased role for the S&T Directorate earlier in the acquisition process.⁸²

The increased participation of the S&T Directorate in the activities of the operational component raises questions about the directorate’s role and scope. Historically, the S&T Directorate has acted separately from the operational components, attempting to garner requirements from them and develop technologies to meet those requirements. This approach sometimes created challenges in transferring technologies from the final development stage in the S&T Directorate to an acquisition program in the operational component; a lack of clarity regarding the relative importance of competing operational component priorities; and a failure of technology acquisitions in specific operational environments. According to Under Secretary O’Toole,

we think we can leverage S&T’s technical expertise much more effectively if we worked as advisors on the front end when the components are deciding how to translate their mission needs into requirements for new technology and save DHS a lot of money, a lot of grief, and be very successful in getting the components what they need, whoever develops the technology, whether it is S&T or the commercial sector or whomever. So this is not an expensive proposition, because we are basically acting as coaches in the acquisition office.⁸³

The closer integration of S&T Directorate expertise into acquisition activities may improve acquisition quality and provide a resource for operational components. The perception of operational components may play a key role. Some operational component officials have expressed support for early stage activities by the S&T Directorate and the closer coordination of S&T Directorate R&D with component acquisition activities.⁸⁴ In general though, GAO has

⁸¹ Tara O’Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, p. 12.

⁸² Tara O’Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

⁸³ Tara O’Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, p. 31.

⁸⁴ For example, see comments by John Sanders, Assistant Administrator for the Office of Security Capabilities and Chief Technology Officer, Transportation Security Administration, in Homeland Security Research Project Agency (HSARPA), Science and Technology Directorate, and Office of Security Capabilities (OSC), Transportation Security Administration, Department of Homeland Security, “Industry Webcast for Aviation Security,” *Webinar*, June 26, 2013.

found mixed opinions among DHS operational component staff regarding S&T Directorate coordination.⁸⁵

According to DHS, the S&T Directorate has limited capabilities and staffing in this area and must be selective regarding the extent of acquisition support it can provide.⁸⁶ Under Secretary O'Toole testified that she expects the S&T Directorate's activities in this area to increase and that the S&T Directorate has requested additional funding for these activities in FY2014.⁸⁷ If the S&T Directorate increases its role in acquisition support, but maintains a constant workforce size, this acquisition support may compete with R&D program oversight and development responsibilities. On the other hand, if the S&T Directorate integrates its program managers more closely into the activities of the DHS operational components, the R&D it does manage may become more successful at meeting those components' needs.

Testing and Evaluation Role

The S&T Directorate oversees operational testing and evaluation of major acquisition programs:

S&T's Test & Evaluation and Standards Division (TSD) develops and implements robust Department-wide T&E policies and procedures. As the designated independent oversight authority for operational testing within DHS, TSD approves Test and Evaluation Master Plans, which describe the necessary tasks that must be conducted in order to determine system technical performance and operational effectiveness. This critical role ensures that technologies acquired by DHS actually do the job they are intended to do. S&T TSD provides ongoing support for approximately 84 DHS major acquisition programs and projects, ensuring each program complies with DHS Test and Evaluation Policy.⁸⁸

The Government Accountability Office (GAO) has found that the S&T Directorate has met some but not all of its T&E oversight responsibilities.⁸⁹ The GAO found that additional steps were needed to ensure that all requirements were met and identified specific challenges the S&T Directorate experienced.

[S&T] and DHS component officials stated that they face challenges in overseeing T&E across DHS components which fell into 4 categories: (1) ensuring that a program's operational requirements—the key performance requirements that must be met for a program to achieve its intended goals—can be effectively tested; (2) working with DHS component program staff who have limited T&E expertise and experience; (3) using existing T&E directives and guidance to oversee complex information technology acquisitions; and (4)

⁸⁵ David C. Maurer, Director, Homeland Security and Justice Issues, Government Accountability Office, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

⁸⁶ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

⁸⁷ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, July 17, 2013.

⁸⁸ Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony in House Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, p. 16.

⁸⁹ U.S. Government Accountability Office, *DHS Science and Technology: Additional Steps Needed to Ensure Test and Evaluation Requirements Are Met*, GAO-11-596, June 15, 2011.

ensuring that components allow sufficient time for T&E while remaining within program cost and schedule estimates.⁹⁰

The GAO recommended that the S&T Directorate more robustly document its approvals of operational test agents, reviews of component acquisition documents, and the extent to which acquisition documents meet the requirements of departmental test and evaluation directives. In response to the GAO recommendations, the S&T Directorate issued additional policies detailing test and evaluation oversight procedures with discrete criteria to track operational test agents and acquisition documents.

Policy Options

Congressional policymakers might refine the S&T Directorate's role in acquisition by codifying existing activities or expanding the S&T Directorate's role in supporting acquisition by other DHS components

Codify Test and Evaluation Responsibilities

Congressional policymakers might codify the operational test and evaluation oversight activities developed by DHS and the S&T Directorate. The DHS has established management directives to guide agency components engaged in acquisition-related activities. One such directive requires the Under Secretary for Science and Technology to establish T&E policies and processes through the Director, Test and Evaluation Standards Division (TSD), and the Director, Operational Test and Evaluation (OT&E). Providing statutory authority for these roles might help to maintain the independence of testing and evaluation, but it also might inhibit DHS's ability to restructure or reform T&E oversight.

Congress could expand the test and evaluation funding or staff within the S&T Directorate in order to strengthen S&T Directorate oversight of test and evaluation. Such additional funding or staff might enable the S&T Directorate to oversee more acquisition activities, reduce time pressure, and increase effectiveness. In the current fiscal environment, however, additional resources may need to be taken from some other priority; policymakers may have to weigh the relative value of shifting such funding.

Congress might expand the role of the S&T Directorate in testing and evaluation oversight. Such an expanded role might be informal or formal in nature. For example, Congress might require the S&T Directorate to provide operational components with the ability to consult with test and evaluation experts in the S&T Directorate, but not require the operational components to rely on such consultation. In contrast, Congress might formalize the current or an expanded role for the S&T Directorate in the DHS acquisition and test and evaluation process. This formalized role might slow technology acquisition due to the need to involve the S&T Directorate in more component activities, since not all components use the acquisition support services of the S&T Directorate. Additionally, such a codification of agency process might reduce the ability of DHS to alter its own processes in order to quickly or flexibly address an emerging challenge. However,

⁹⁰ U.S. Government Accountability Office, *DHS Science and Technology: Additional Steps Needed to Ensure Test and Evaluation Requirements Are Met*, GAO-11-596, June 15, 2011.

it also might increase the quality of technology acquisitions, reducing the potential for purchasing suboptimal technologies.

Alternatively, congressional policymakers might reduce the responsibilities of the S&T Directorate with respect to test and evaluation. Within DHS, the Under Secretary for Management generally oversees major acquisition. Oversight of operational test and evaluation activities might be transferred to the Under Secretary for Management. Conversely, the component acquiring the technology is responsible for testing and evaluating the technology. They currently contract for operational test and evaluation, and oversight of these activities and their results might be combined with more general program management.

Expand Integration of R&D and Acquisition

One way to strengthen the relationship between R&D and procurement might be greater integration through operational components co-funding S&T Directorate activities, so that the entity that performs R&D also procures its results. In theory, this approach could allow for a seamless flow of information between those setting the requirements and those developing the technologies. This integration might allow requirements to be more easily amended to take into account new information discovered during the development process. Some policymakers may view the increased role of the S&T Directorate in providing acquisition support and operational analysis as a first step in developing a more integrated R&D and acquisition process.

However, according to GAO, a managerial best practice involves separating acquisition and R&D responsibilities in order to reduce the possibility that prior involvement in the R&D process might influence procurement decisions. In 2010, the Government Accountability Office testified in the context of DNDO's CAARS program that

separating technology development from product development and acquisition is a best practice that can help reduce costs and deliver a product on time and within budget because separation of the technology development phase from production in particular helps to ensure that (1) a sound business case is made for the product, (2) product design is stable, and (3) production processes are mature and the design is reliable.⁹¹

An integrated R&D and acquisition process may lead agencies to continue unsuccessful procurement efforts longer than is cost effective due to a history of investment in the underlying R&D and an institutional attachment to the success of that investment. Similarly, having procurement, R&D, and possibly operations within the same component might create budgetary competition between these functions. For example, officials might reduce funding for the development of next-generation detectors in order to acquire additional current-generation detectors or to operate or support detectors already deployed. Such budgetary tradeoffs might occur via a higher decision-making authority or be viewed differently if different parts of DHS performed next-generation R&D, acquired current technology, or operated and supported fielded equipment.

⁹¹ Government Accountability Office, *Combating Nuclear Smuggling: Inadequate Communication and Oversight Hampered DHS Efforts to Develop an Advanced Radiography System to Detect Nuclear Materials*, GAO-10-1041T, p. 10. See also Government Accountability Office, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-07-406SP, March 30, 2007; and General Accounting Office, *Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes*, GAO/NSIAD-99-162, July 30, 1999.

Legislation in the 113th Congress

In the past, Congress has generally addressed these and other issues primarily through appropriations bills and reports, oversight hearings, and authorization of particular programs within the S&T Directorate. In prior Congresses, Members have introduced comprehensive authorization legislation for DHS as well as specifically for the S&T Directorate, but none of these bills were enacted. In the 113th Congress, Members may introduce additional legislation to further refine oversight of the S&T Directorate.

Appropriation Legislation

P.L. 113-6

The 113th Congress enacted P.L. 113-6, the Consolidated and Further Continuing Appropriations Act, 2013, which provided FY2013 funding for DHS and other agencies. For more information about FY2013 S&T Directorate funding, see CRS Report R42644, *Department of Homeland Security: FY2013 Appropriations*, coordinated by William L. Painter.

H.R. 2217

H.R. 2217, the Department of Homeland Security Appropriations Act, 2014, would provide FY2014 funding for DHS. H.R. 2217 has passed the House and has been reported by the Committee on Appropriations in the Senate. For more information about FY2014 S&T Directorate funding, see CRS Report R43147, *Department of Homeland Security: FY2014 Appropriations*, coordinated by William L. Painter.

Authorization Legislation

H.R. 2952

H.R. 2952, the Critical Infrastructure Research and Development Advancement Act of 2013, would require the Secretary of Homeland Security, through the Under Secretary for Science and Technology, to submit to Congress a strategic plan for federal physical security and cybersecurity technology research and development efforts for protecting critical infrastructure. The DHS would submit updates every two years. The Under Secretary for Science and Technology would coordinate with the Under Secretary for the National Protection and Programs Directorate and consult with other stakeholders when developing this strategy. The act would also require the Secretary of Homeland Security, through the Under Secretary for Science and Technology, to submit to Congress a study on DHS use of public-private R&D consortiums for accelerating technology development for critical infrastructure protection. The DHS would submit updates every two years. In addition, the act would direct the Secretary of Homeland Security, through the Under Secretary for Science and Technology, to establish a technology clearinghouse for rapidly sharing proven technology solutions for protecting critical infrastructure. The GAO would be directed to evaluate the effectiveness of this clearinghouse within two years of its establishment.

H.R. 2872

H.R. 2872, the Border Enforcement, Security, and Technology Act of 2013, would, among other provisions, direct the Secretary of Homeland Security to develop a comprehensive plan for the technology for the security of the U.S. international borders. As part of this plan, the Secretary would be required to describe how the U.S. Customs and Border Protection Commissioner and the Commandant U.S. Coast Guard Commandant are working, or are expected to work, with the Under Secretary for Science and Technology to identify and test new technology.

H.R. 2719

H.R. 2719, the Transportation Security Acquisition Reform Act, would, among other provisions, direct the Administrator of the Transportation Security Administration (TSA) to develop a strategic multiyear technology acquisition plan in consultation with the Under Secretary for Management, the Chief Information Officer, and the Under Secretary for Science and Technology. In addition, the act would require TSA to establish and document a set of formal baseline requirements prior to implementing a security-related technology acquisition. The act would direct these baseline requirements to include the estimated costs (including lifecycle costs), schedule, and performance milestones for the planned duration of the acquisition; and identify the acquisition risks and a plan for mitigating these risks. The act would direct the TSA Administrator to consult with the Under Secretary for Science and Technology to ensure that achieving these performance milestones is technologically feasible and to develop a plan for testing and evaluating the acquired technologies against the performance requirements.

H.R. 2691/S. 1303

H.R. 2691/S. 1303 would repeal existing provisions in P.L. 110-329, Consolidated Security, Disaster Assistance, and Continuing Appropriations Act, 2009, and P.L. 112-74, Consolidated Appropriations Act, 2012, that require the Administrator of the General Services Administration to sell through public sale all property and assets supporting the Plum Island Animal Disease Center following a determination by the Secretary of Homeland Security to locate the National Bio- and Agro-defense Facility at a site other than Plum Island, New York.

S. 744

S. 744, the Border Security, Economic Opportunity, and Immigration Modernization Act, as passed by the Senate, would, among other provisions, require the Department of Defense's Assistant Secretary of Defense for Research and Engineering to collaborate with the Under Secretary for Science and Technology to identify equipment and technology used by the Department of Defense that could be used by U.S. Customs and Border Protection to improve the security of the southern border by detecting border tunnels; detecting the use of ultralight aircraft; enhancing wide aerial surveillance; and otherwise improving the enforcement of such border.

Appendix. Appropriations for the S&T Directorate

Table A-1. Appropriations for the DHS S&T Directorate by Fiscal Year
(budget authority in \$ millions)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
RDA&O	553.5	868.3	1,046.9	1,386.8	718.1	691.7	800.5	856.3	626.1	533.0	677.3	1,397.5
M&A	0.0	44.4	68.6	80.3	133.8	138.4	132.1	143.2	140.5	135.0	126.5	129.6
Total	553.5	912.8	1,115.5	1,467.1	851.9	830.1	932.6	999.5	766.6	668.0	803.9	1,527.1

Source: CRS analysis of DHS appropriations, FY2003-FY2014.

Notes: RDA&O = Research, development, acquisition and operations; M&A = Management and administration. Appropriations reduced by rescissions and sequestration in certain fiscal years. FY2014 amount is the Administration request. Totals may differ from the sum of their components due to rounding.

Table A-1 shows budget authority for the S&T Directorate, reduced by applicable rescissions and sequestration. It does not reflect transfers of appropriated funds not included in appropriations reports or funds appropriated to other DHS components subsequently that were provided to the S&T Directorate to support component research needs. Note also that the S&T Directorate may not have obligated the entire amounts in the year of their appropriation. As a result, data on obligations or outlays would differ from the amounts in the table.

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