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 homeland security 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 prioritizing S&T Directorate R&D activities rather than other departmental needs.

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).[1] 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. 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]

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:

[1] Many different definitions of research and development exist. For the purposes of this report, we consider 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.

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

- 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;[3]
- 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.

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.[4] The groups are:

[3] 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.

[4] 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.

- **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 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 Programs.[5] This budget structure differs substantially from the previous structure, in place since FY2007, which was aligned with R&D topic areas.[6]

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

[5] 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.

[6] 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.*

> 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.[7]

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."[8] The Senate committee report stated that the new structure "reduces transparency and accountability."[9] 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.[10]

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 research and development topic, which provided greater insight into the relative funding between these subjects.

Funding

Funding for the S&T Directorate (net of rescissions) increased each year from FY2007 to FY2010, but fell in FY2012 to its lowest appropriated level since Congress began appropriating funding for DHS.[11] Funding in FY2013 rebounded to a level comparable with FY2011. See **Figure 1**. 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.

[7] 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.

[8] H.Rept. 112-91, pp. 126-127.

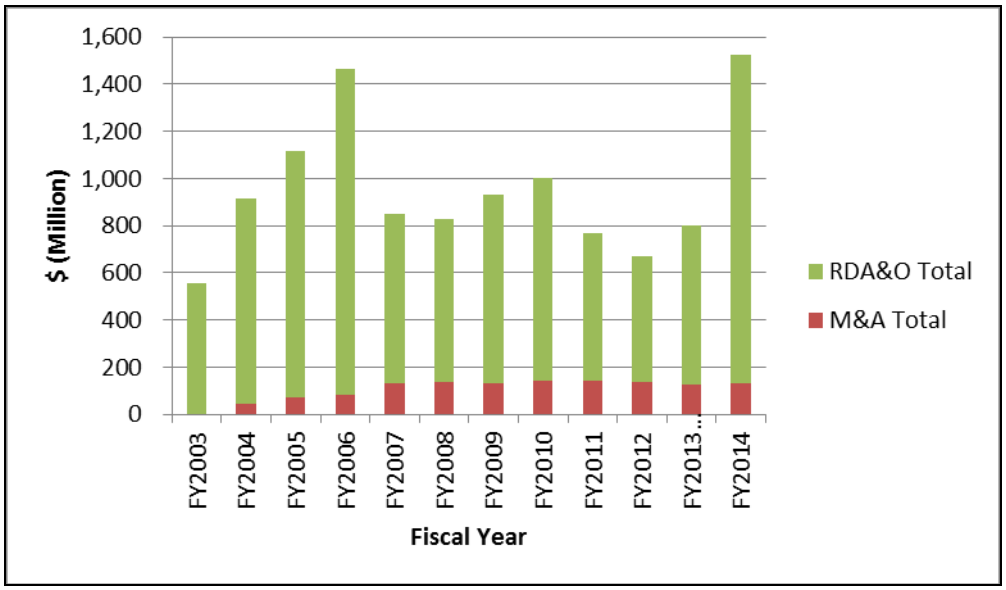
[9] S.Rept. 112-74, p. 148.

[10] H.Rept. 112-331, p. 998.

[11] 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.

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 appropriations reflect DHS request, not congressionally appropriated 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 sources of tension present within the S&T Directorate. One is 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.[12]

Another source of tension is the balance between maintaining a federal research infrastructure and investing 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,

[12] H.Rept. 112-91, p. 126.

> 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.[13]

The FY2013 increase in S&T Directorate funding may alleviate some of this tension, as the fraction of the RDA&O account dedicated to R&D activities returns to a level similar to prior years. Additional planned infrastructure expenses, specifically costs associated with the potential construction of the National Bio and Agro-defense Facility (NBAF) and decontamination and demolition of Plum Island Animal Disease Center, may increase this tension in future fiscal years. The conference report accompanying the Consolidated and Further Continuing Appropriations Act, 2013, (P.L. 113-6) specifically addresses this tension and identifies that "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 requests $714 million for NBAF. The FY2014 DHS budget increases gross discretionary funding for the S&T Directorate and other programs and components of DHS. The budget includes proposals for additional revenues that would appear to offset the costs of some of these increases, but it could be argued that cuts elsewhere in the DHS budget are the result of such "displacement" of resources by the NBAF increase.

A third source of tension is the balance between performing R&D activities for DHS components and providing other types of S&T assistance, such as consulting on concepts of operation, developing future technology concepts, and overseeing test and evaluation. Some policymakers may believe that the these latter activities are more appropriately funded through other DHS components rather than through 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.

[13] 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.

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 both all potential threats and 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.[14]

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 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 S&T Directorate has engaged in directorate-level strategic planning since at least 2007, when it released its first strategic plan.[15] 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.[16] 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

[14] 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.

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

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

> hallmark of successful strategic planning. The NAPA panel also found weaknesses in the process through which the plan was developed.[17]

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.[18]

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.[19] 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.[20]

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.[21] 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.

[17] 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.

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

[19] Department of Homeland Security, Science and Technology Directorate, *DHS Science and Technology Directorate Strategic Plan 2011*, 2011.

[20] Department of Homeland Security, Science and Technology Directorate, *DHS Science and Technology Directorate Strategic Plan 2011*, 2011.

[21] 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.

In addition to the 2011 strategic plan, the S&T Directorate asserts that it is developing an S&T Resource Allocation Strategy (STRAS) approach to 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 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.[22]

The S&T Directorate uses a modified version of the STRAS process to identify efforts it will undertake for the first responder community.[23]

The S&T Directorate has developed some topic-specific strategic plans with other DHS components. For example, the S&T Directorate and the Transportation Security Administration issued a joint R&D strategy for aviation security.[24] In addition, GAO reports the S&T Directorate plans to develop R&D strategies with other components, such as the U.S. Secret Service, Customs and Border Protection (CBP), Immigrations and Customs Enforcement, and FEMA.[25]

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, representatives of other DHS components, and technical experts evaluates and rates each project. The S&T Directorate reports that it has performed this portfolio review at least twice, identifying places in the portfolio where program managers could combine activities to create synergies and cost savings, reprioritize funding, and speed projects to completion.[26]

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.[27]

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

[23] 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.

[24] Department of Homeland Security, *Aviation Security Technology Research and Development Strategy*, March 2011.

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

[26] 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.

[27] Tara O'Toole, Under Secretary for Science and Technology, Department of Homeland Security, testimony in House (continued...)

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.

High-Priority Investment

Another significant recent change in the S&T Directorate's R&D strategy is the creation 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 S&T Directorate uses a new approach to providing solutions to these problems. Rather than developing a technological solution and transferring it to the operational component to implement, the S&T Directorate itself expects to integrate the results of Apex projects into the operations of DHS components. In order to do this, the S&T Directorate will be more closely involved in developing detailed concepts of operation and overcoming operational challenges associated with the technology's implementation.[28] In other words, the S&T Directorate aims to provide a complete solution to the problem, rather than simply a piece of technology.

Because the Apex project approach extends the R&D 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 lack of further investment, ambiguous operational requirements, insufficient user demand, 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. 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

(...continued)

Committee on Appropriations, Subcommittee on Homeland Security, *Department of Homeland Security Appropriations for 2012*, Committee Print, Part 4, pp. 15-16.

[28] Personal communication between S&T Directorate staff and CRS, January 10, 2011.

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 needs. In addition, the schedule for completion of an individual Apex project is unknown. Thus, it is unclear how quickly Apex projects will address high-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 (one with the U.S. Secret Service, and another Apex-like project with Customs and Border Protection) in FY2013, has capacity for a total of three or four simultaneous Apex projects, and anticipates starting new Apex projects with additional DHS components.[29] For FY2014, the S&T Directorate requested funds for two new Apex projects, one with Immigrations and Customs Enforcement and one with CBP.[30] The effectiveness of the approach may become easier to assess if additional Apex projects are implemented.

Policy Options

Congressional policymakers have many options to address perceived challenges with the S&T Directorate's planning processes. 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 reduce the discretion of the Under Secretary by requiring increased rigor in strategic planning or by establishing an independent oversight and direction function for DHS R&D. They might increase the discretion of the Under Secretary by supporting an ability to redirect funding from underperforming projects to other priorities.

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 support of an operational component may increase the likelihood that their 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 addressed the high-priority needs of the component. Balancing such integrated projects with support for other homeland security clients, such as first responders, may be a challenge. Successful partnerships may increase interest in future integrated projects. Operational components that have a positive experience with integrated projects may become 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 might require a more rigorous strategic planning process for the S&T Directorate investments, or for departmental investment. Congress might mandate an on-

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

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

going, 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. 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 trajectory for those projects. The tension between the possible benefits and drawbacks of mandating rigorous multi-year strategic planning might be ameliorated by allowing course corrections to incorporate the findings of the portfolio reviews. Long-term planning activities may provide benefits in addition to producing a plan. Regardless of whether an agency rigorously adheres to a five-year plan, the act of planning itself may provide insights to the holistic needs and capabilities of the agency and its partners.

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) in such a manner, implementing a formal review process of strategic priorities and direction under its auspices. This might require a fundamental revision of how the S&T Directorate currently interacts with the HSSTAC, which has met sporadically.[31] 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.[32] 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. Alternatively, the S&T Directorate could rely on an external advisory panel for such guidance, such as the National Academies, as is done in some fields, such as astronomy and astrophysics.[33] Such an advisory board would allow the Under Secretary to receive wide-ranging input into the prioritization process. 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.

[31] For more information on the HSSTAC, see http://www.dhs.gov/st-hsstac.

[32] 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.

[33] 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.

Support Greater Flexibility

Congressional policymakers might choose instead to provide the S&T Directorate with the ability to more easily transfer funding between programs, either expressly or by providing S&T Directorate programmatic funding within a single PPA. Such funding changes might occur through the results of regular portfolio reviews, through S&T Directorate leadership decisions, or through other changes in priorities. Congress might accompany such increased flexibility with an increased accountability for research success. One potential side effect of increased flexibility may be a shift towards short-term investments, as they are more likely to meet demonstrable milestones and yield deployable results. Such a shift might adversely affect long-term needs.

Scope of S&T Directorate R&D

Other organizations besides the S&T Directorate conduct R&D with homeland security applications. Policymakers may therefore question what principles determine the types of R&D the S&T Directorate should do, and when another organization inside DHS or elsewhere should take on 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.[34] 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.[35]

Following the most recent reorganization of the S&T Directorate and its budgetary structure, HSARPA now again encompasses the vast majority of the R&D activities of the S&T Directorate and seems likely to perform 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, because likelihood of success is a discriminating factor in the review process.

A further consequence of the portfolio review process is a consolidation and reduction in the number of projects and programs. Such consolidation has both risks and potential benefits. it

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

[35] In FY2007, HSARPA received $38 million; DARPA received $3.115 billion.

might increase funding devoted to a particular problem over a critical threshold, leading to the discovery of a technological solutions. Alternatively, it might focus S&T Directorate resources 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 meet needs or requirements identified by the S&T Directorate or other DHS components. 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.[36]

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. 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.[37] The S&T Directorate plans to institutionalize technology foraging best practices to ensure low-cost and timely identification of technologies.[38]

Fielding of Results

A further challenge facing the S&T Directorate is the extent to which it should assume the 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. The S&T Directorate would then transition this technology to an operational end-user for final development and adaptation to field environments.[39] This model is under reconsideration with the development of the Apex projects, which extend the role of the S&T Directorate through fielding and development of CONOPS. The S&T Directorate may find it challenging to employ both models simultaneously as they likely require program managers with different skills. Additionally, it is

[36] 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.

[37] Personal communication between S&T Directorate staff and CRS, June 8, 2012.

[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, p. 16.

[39] 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.

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.

Impacts Due to Fluctuating Funding

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 has prioritized its R&D investments to four priority areas: biological defense, unclassified cyber security, explosives detection in the aviation environment, and first responder technologies.[40] It remains unclear the extent to which the S&T Directorate will expand its research investment beyond these priority areas. The increased funding in FY2013 may allow the S&T Directorate to restart some paused research programs. Indeed, even among those restarted projects, the effect of fluctuating funding on the success of those projects is yet unknown.

Policy Options

Congressional policymakers may opt to provide direction regarding the direction 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 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

The best way for the S&T Directorate to implement HSARPA may continue to be a topic of congressional interest. 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

[40] 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.

reconsidered this approach, first with the development of Apex projects and second with its prioritization of certain research areas over others in its constrained fiscal environment. Additionally, the use of the portfolio review process has reduced the number of projects. These approaches 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 which approach it would prefer. 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

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 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 supporters.

Limit R&D Type

Congressional policymakers might choose to limit the types of R&D performed by the S&T Directorate, mandating that it focus on a specific portion of the R&D continuum. 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 could decide that the S&T Directorate should be more operational in nature and require it to focus on short-term development. Alternatively, Congress could direct the S&T Directorate to become more research-oriented by requiring it to focus more on long-term basic research. Over-emphasis on either short- or long-term results may have important tradeoffs. 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. Leveraging the complementary capabilities of other agencies, such as the Department of Defense, may mitigate such tradeoffs. However, such leveraging may also come at some cost, as activities at other agencies may not align exactly with DHS needs. The S&T Directorate would still 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.[41]

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

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

[41] 6 U.S.C. 186.

> 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.[42]

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:

> 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.[43]

For FY2013, Congress has 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) directs 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.

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.[44] In 2012 a Government Accountability Office (GAO) audit of R&D in DHS identified R&D

[42] 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.

[43] H.Rept. 112-91, p. 129.

[44] 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.

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. For FY2011, GAO concluded that the S&T Directorate was the entity obligating the largest amount of R&D funding, but that this funding was only 31% of total DHS R&D obligations.[45]

The GAO also detailed weaknesses in the current 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.[46]

The GAO recommended that the Secretary of Homeland Security develop and implement policies and guidance for defining and overseeing R&D at the department.

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.

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, technology acquisition programs may or may not be subject to such coordination. An alternative approach might be to prohibit other components from performing R&D activities. Following such a prohibition, such R&D

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

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

requirements might flow more directly through the S&T Directorate, potentially providing greater insight to the S&T Directorate regarding component needs.

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

Congressional policymakers might choose to transfer R&D responsibilities to operational components. 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.

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. In contrast, such dispersion might bear significant organizational costs, as duplicative organizational structures would be required for each R&D capability in each operational component, and lose the opportunity for the identification of synergies between the various operational components. With the S&T Directorate providing the majority of R&D activities, it may be better able to identify when an R&D result applies to the needs of multiple operational components.

Additionally, if congressional policymakers dispersed R&D responsibilities from the S&T Directorate, it might be less able to coordinate DHS-wide R&D activities, given its smaller R&D investments. Similarly, the S&T Directorate might be less able to serve in an advisory role to other components or provide meaningful assistance in acquisition if the S&T Directorate lacked insight into the component's R&D needs.

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.

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.[47]

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) Group. 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.[48]

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.[49]

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 created a series of potential difficulties, including challenges in transferring technologies from the final development stage in the S&T Directorate to an acquisition program in the operational component; lack of clarity regarding the relative importance of competing operational component priorities; and failure of

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

[48] 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.

[49] 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.

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.[50]

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 activity 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.[51]

The Government Accountability Office (GAO) has found that the S&T Directorate has met some but not all of its T&E oversight responsibilities.[52] 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)

[50] 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.

[51] 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.

[52] 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.[53]

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.

Operational Component Technology Acquisition

The 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.[54] Thus, 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 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 more well-suited for the S&T Directorate to pursue. These agencies consider these efforts as acquisition activities rather than R&D activities.[55] 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.

[53] Ibid.

[54] 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.

[55] 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.

Policy Options

Congressional policymakers might refine the S&T Directorate's role in acquisition by codifying existing activities, expanding the S&T Directorate's role in supporting acquisition by other DHS components, or by addressing the distinction between R&D and acquisition activities.

Address Test and Evaluation Responsibilities

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 increase the ability of the S&T Directorate to oversee a greater number of acquisition activities, reduce time pressure, and increase effectiveness. Any increase in such funding may, in the current fiscal environment, need to come 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 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, 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. Oversight of operational test and evaluation activities might be transferred to the Under Secretary for Management as part of general oversight of the acquisition process or placed within the operational components themselves. The operational components currently contract for operational test and evaluation, and oversight of these activities and their results might be combined with more general program management.

Integrate R&D and Acquisition

Greater integration, so that the entity that performs R&D also procures its results, might be one way to strengthen the relationship between R&D and procurement. 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.

However, 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.[56]

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 agency might create budgetary competition between these functions. For example, officials might reduce funding for the development of new detectors in order to acquire additional current technology detectors or to operate or support fielded detectors. Such budgetary tradeoffs might occur at 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.

Concluding Remarks

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

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[56] 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.