



The DHS Directorate of Science and Technology: Key Issues for Congress

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Summary

The Directorate of Science and Technology is the primary organization for research and development (R&D) in the Department of Homeland Security (DHS). With an appropriated budget of \$932.6 million in FY2009, it conducts R&D in several laboratories of its own and funds R&D conducted by other government agencies, the Department of Energy national laboratories, industry, and universities. The directorate consists primarily of six divisions: Chemical and Biological; Explosives; Command, Control, and Interoperability; Borders and Maritime Security; Infrastructure and Geophysical; and Human Factors. Additional offices have responsibilities, such as laboratory facilities and university programs, that cut across the divisions. The directorate is headed by the Under Secretary for Science and Technology.

In the past, some Members of Congress and other observers have been highly critical of the directorate's performance. Although management changes have somewhat muted this criticism in recent years, fundamental issues remain. Among these are

- the allocation of R&D funding within the directorate's programs, including the balance among basic research, applied research, and development and the proportion of funds allocated to government, industry, and academia;
- how the directorate sets priorities, including its use of strategic planning documents, its system of Integrated Product Teams, and the extent to which it bases priorities on risk assessment;
- the nature and effectiveness of the directorate's relationships with other federal R&D organizations, such as the Domestic Nuclear Detection Office, other organizations inside DHS, the Department of Energy national laboratories, and other agencies;
- the definition of the directorate's mission, such as identification of its customers, the scope of its R&D role within DHS, and the extent of its non-R&D missions;
- the directorate's budgeting and financial management, including the quality of its budget documents and the persistence of unobligated balances;
- the directorate's responsiveness to Congress; and
- the establishment of metrics and goals for evaluating the directorate's output.

Congressional policymakers are widely expected to consider reauthorization legislation for DHS during the 111th Congress. Such legislation would likely include provisions that would affect the Science and Technology Directorate.

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Introduction

The Directorate of Science and Technology (S&T) is the primary organization for research and development (R&D) in the Department of Homeland Security. With a budget of \$932.6 million in FY2009, the directorate conducts R&D in several laboratories of its own and funds R&D conducted by other government agencies, the Department of Energy national laboratories, industry, and universities.

In the past, some Members of Congress have been highly critical of the directorate's performance. For example, in 2006, the House Appropriations Committee said it was "concerned about the ability of [the] S&T [Directorate] to advance the use of science and technology in battling terrorism and against other hazards related to homeland security," and the Senate Appropriations Committee called the directorate "a rudderless ship without a clear way to get back on course" and said it was "extremely disappointed with the manner in which [the] S&T [Directorate] is being managed."¹

More recently, management changes have considerably muted this criticism. For example, in 2007, the Senate Appropriations Committee stated that it was "pleased with the rapid progress S&T appears to be making toward resolving past difficulties. The new Under Secretary has restructured the directorate's programs, worked to obligate resources in a timely fashion, and instituted a capable budget office able to deliver timely, accurate, and comprehensible documents."² Nevertheless, a number of fundamental issues remain.

This report describes the evolving mission, organization, and assets of the S&T Directorate and the activities it conducts. It outlines key policy issues, including the balance of the directorate's programs, its priorities and how they are set, its relationships with other R&D organizations, its mission, its budgeting and financial management, and other concerns. The report concludes with a discussion of legislative issues for the 111th Congress. Other R&D organizations in the department (such as the Domestic Nuclear Detection Office and the R&D activities of the U.S. Coast Guard) are discussed only to the extent that they relate to the S&T Directorate.

Mission, Organization, and Assets

Mission

The Homeland Security Act of 2002 (P.L. 107-296), which established the Department of Homeland Security (DHS), created within DHS a Directorate of Science and Technology, headed by an Under Secretary for Science and Technology.³ The directorate was not given a concise

¹ H.Rept. 109-476, p. 110, and S.Rept. 109-273, p. 88.

² S.Rept. 110-84, p. 113.

³ On May 6, 2009, DHS announced the President's intent to nominate Dr. Tara O'Toole as Under Secretary for Science and Technology. "Statement by Secretary Napolitano on President Obama's Intent to Nominate Tara O'Toole as Under Secretary for Science and Technology," DHS press release, May 6, 2009, <http://www.dhs.gov/ynews/releases/> (continued...)

statutory mission. Instead, the Homeland Security Act gave the Under Secretary a wide-ranging list of responsibilities and authorities. (For the complete list, see **Appendix A**.) In 2006, Under Secretary Jay M. Cohen summarized his interpretation of the S&T Directorate's multifaceted mission as follows: "The S&T Directorate's mission is to protect the homeland by providing Federal, State, local, and Tribal officials with state-of-the-art technology and resources."⁴

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 the designation and regulation of biological select agents;⁵
- 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.

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

Another group of responsibilities and authorities are in support of other DHS organizations. 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 specify functions of the S&T Directorate itself. These include

- establishing and administering the primary R&D activities of the department;

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pr_1241698216270.shtm. Dr. O'Toole testified before the Senate Committee on Homeland Security and Governmental Affairs on June 10, 2009, http://hsgac.senate.gov/public/_files/061009Otoole.pdf.

⁴ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Emergency Preparedness, Science, and Technology, September 7, 2006.

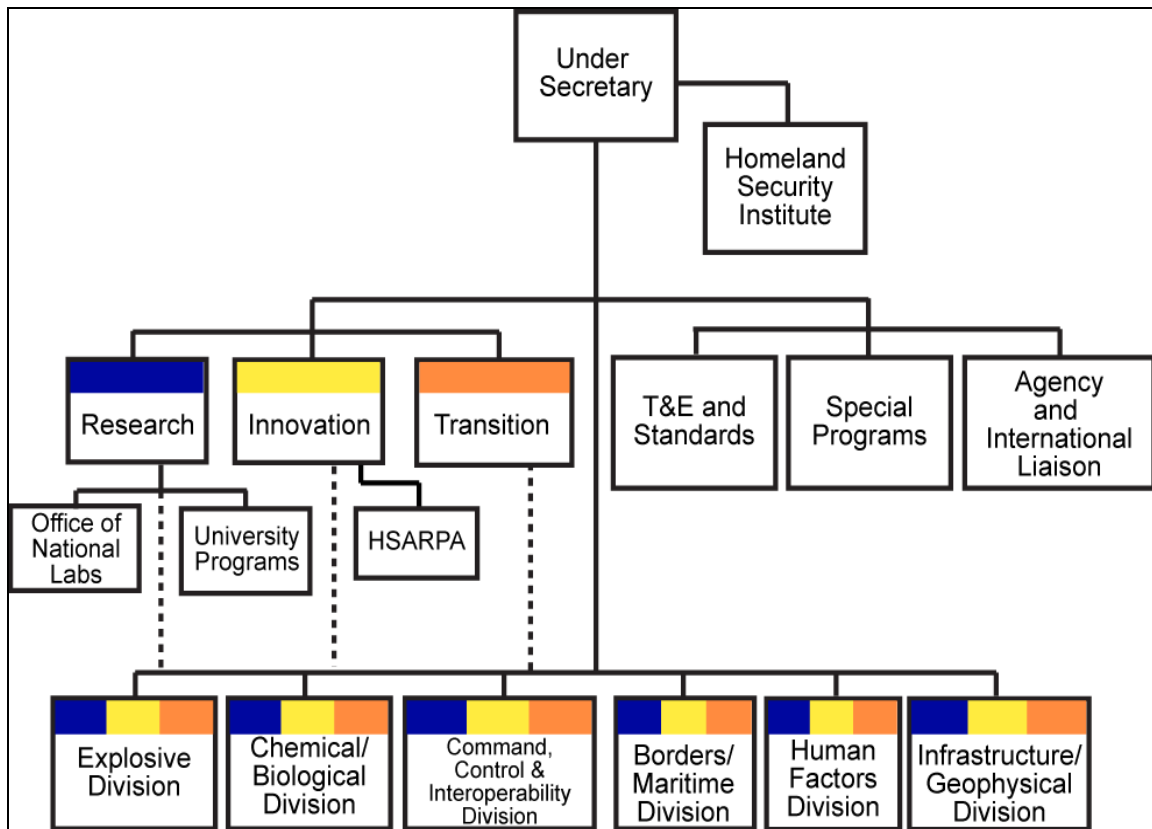
⁵ Select agents are pathogens and toxins that the Department of Health and Human Services and the Department of Agriculture have identified as posing a severe threat to public, animal, or plant health.

- 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.

Organization

Under Secretary Cohen reorganized the management structure of the S&T Directorate soon after his confirmation in August 2006. For a discussion of the previous structure of the S&T Directorate, which may be useful in understanding budgets and other documents from before the transition, see **Appendix B**.

Figure I. Organization of the S&T Directorate



Source: CRS based on DHS documents and presentations.

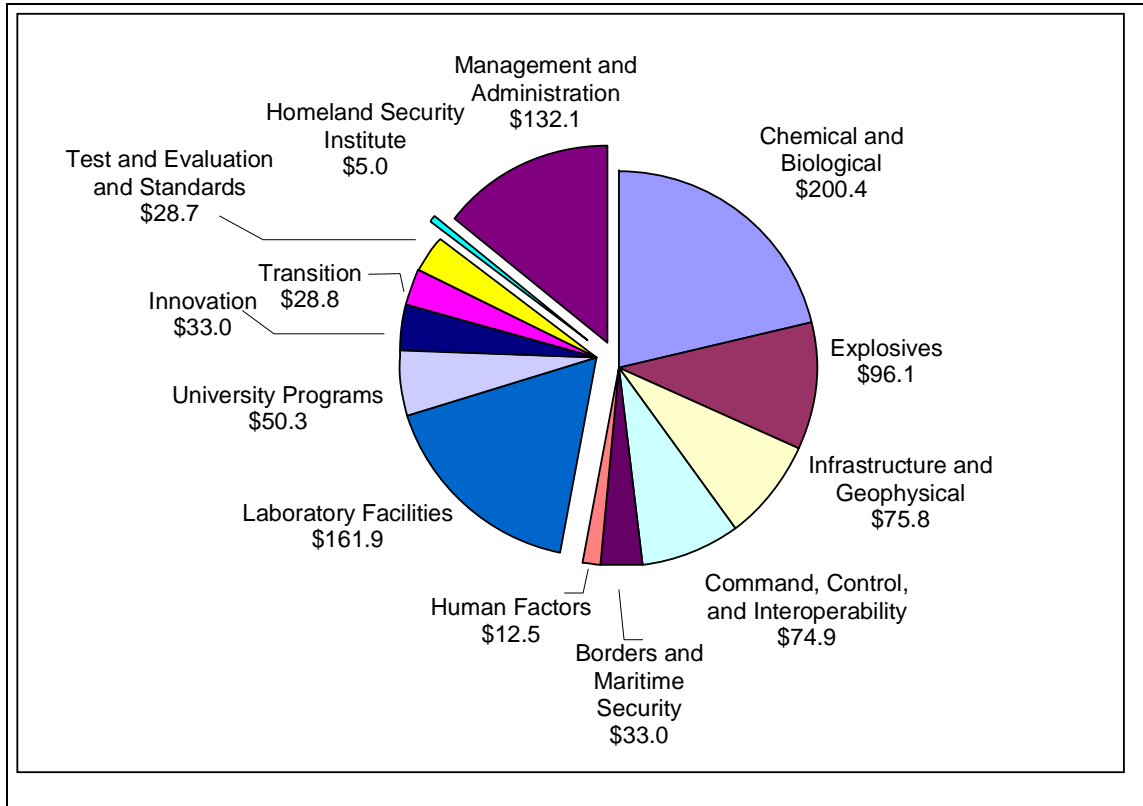
Notes: T&E = Testing and Evaluation. HSARPA = Homeland Security Advanced Research Projects Agency. The Office of National Laboratories and the Office of University Programs are parts of the Office of Research. HSARPA is part of the Office of Innovation. As indicated by the dashed lines and shading, the directors of the Offices of Research, Innovation, and Transition liaise with each of the six divisions.

The organizational structure of the S&T Directorate is shown in **Figure 1**. The directorate consists primarily of six research divisions: the Explosives; Chemical and Biological; Command, Control, and Interoperability; Borders and Maritime Security; Human Factors; and Infrastructure and Geophysical Divisions.⁶ These are the directorate's main performers and funders of R&D in their respective topical areas. The Offices of Research, Innovation, and Transition coordinate the activities of the divisions; they also conduct some activities of their own. Other functions are performed by the Offices of Test and Evaluation and Standards; Special Programs; and Agency and International Liaison. Each of these 12 divisions and offices is headed by a director who reports directly to the Under Secretary. As indicated by the dashed lines and shading in **Figure 1**, the directors of the Offices of Research, Innovation, and Transition liaise with each of the six divisions. For more information on the activities of the various components, see **Appendix D**.

The total enacted FY2009 funding for the S&T Directorate is \$932.6 million. **Figure 2** shows how Congress allocated this amount to the divisions, offices, and other activities. The Management and Administration account funds the Office of the Under Secretary as well as salaries and benefits for headquarters employees who work in the other offices and divisions. The Office of Special Programs and the Office of Agency and International Liaison receive funds indirectly through transfers from the other programs. For more information on funding, see **Appendix C**.

⁶ The FY2010 budget request proposes changing the name of the Human Factors Division to the Human Factors/Behavioral Sciences Division.

Figure 2. FY2009 Funding for the S&T Directorate



Source: CRS analysis of P.L. 110-329, Division D, and explanatory statement, *Congressional Record*, September 24, 2008.

Laboratories and Other Assets

The S&T Directorate has a variety of R&D assets that support its activities. Some are laboratories that were transferred into the Department of Homeland Security when it was created in 2002. (The transfers became effective in early 2003.) Other assets have been established more recently under the authority of the Homeland Security Act.

Environmental Measurements Laboratory

The Environmental Measurements Laboratory (EML) in New York City was formerly in the Department of Energy. It was transferred to the S&T Directorate by Sec. 303 of the Homeland Security Act. Historically, the focus of EML was detection and monitoring of low-level radiation releases. The transfer of EML to the S&T Directorate required a realignment of EML's activities to meet homeland security goals. According to some experts, this realignment process was contentious.⁷ DHS officials reportedly debated whether EML is most appropriately positioned in

⁷ EML realignment and related issues were discussed at a hearing of the House Committee on Science and Technology, Subcommittee on Investigations and Oversight, *Transitioning the Environmental Measurements Laboratory at the* (continued...)

the S&T Directorate or the Domestic Nuclear Detection Office (DNDO, discussed more below); whether EML should be closed; and whether EML should be reduced in size and the remaining capabilities relocated. In May 2007, Under Secretary Cohen testified that EML will remain in the S&T Directorate; that it will continue to operate, supporting both DNDO and other DHS organizations; and that it will remain in its current location but in smaller, “right sized” facilities.⁸ This realignment and scoping process is ongoing.

Plum Island Animal Disease Center

The Plum Island Animal Disease Center (PIADC), on Plum Island off the coast of Long Island, NY, was transferred from the Department of Agriculture to the S&T Directorate by Sec. 310 of the Homeland Security Act. The PIADC provides a federal facility where R&D can be performed on animal pathogens that might threaten livestock on a national level. Its research seeks to find quicker ways to diagnose animal diseases and to develop vaccines and other veterinary treatments for infected animals. The PIADC has been in service for over 50 years, and questions have been raised about the state of its laboratory infrastructure and the adequacy of that infrastructure to continue performing necessary R&D for DHS.⁹

In January 2009, DHS announced that a new National Bio- and Agro-Defense Facility (NBAF) will be built on the campus of Kansas State University.¹⁰ The PIADC laboratories will be decommissioned once NBAF becomes fully operational. Some policymakers have expressed concern regarding the move of foot-and-mouth disease research from an island to the mainland,¹¹ and the Government Accountability Office (GAO) has testified that more information and analysis should be performed to determine the magnitude of risks associated with moving such research from Plum Island to the mainland.¹²

Congress has enacted a series of authorities relating to the proposed creation of the NBAF, transfer of PIADC research activities, and closure of PIADC. Through the 2008 farm bill, Congress addressed concerns regarding legal authority to perform live foot-and-mouth disease virus research on the mainland. The 2008 farm bill required the Secretary of Agriculture to issue a

(...continued)

Department of Homeland Security, held May 3, 2007.

⁸ Under Secretary Jay M. Cohen, statement before the House Committee on Science and Technology, Subcommittee on Investigations and Oversight, *Transitioning the Environmental Measurements Laboratory at the Department of Homeland Security*, hearing held May 3, 2007.

⁹ Government Accountability Office, *Combating Bioterrorism: Actions Needed to Improve Security at Plum Island Animal Disease Center*, GAO-03-847, September 2003; *Plum Island Animal Disease Center: DHS and USDA Are Successfully Coordinating Current Work, but Long-Term Plans Are Being Assessed*, GAO-06-132, December 2005; and *Plum Island Animal Disease Center: DHS Has Made Significant Progress Implementing Security Recommendations, but Several Recommendations Remain Open*, GAO-08-306R, December 17, 2007.

¹⁰ “DHS Issues Record of Decision on Proposed National Bio- and Agro-Defense Facility,” DHS press release January 16, 2009, http://www.dhs.gov/xnews/releases/pr_1232132671186.shtm.

¹¹ See, for example, statements by Members during House Committee on Energy and Commerce, Subcommittee on Oversight and Investigations, *Germs, Viruses and Secrets: Government Plans to Move Exotic Disease Research to the Mainland United States*, hearing held May 22, 2008.

¹² Government Accountability Office, *High-containment Biosafety Laboratories: DHS Lacks Evidence to Conclude That Foot-and-Mouth Disease Research Can Be Done Safely on the U.S. Mainland*, GAO-08-821T, May 22, 2008.

permit to DHS allowing research on live foot-and-mouth disease virus on the mainland at any successor facility to PIADC.¹³ Congress also responded to the perceived potential risks of performing such research on the mainland. Congress required DHS to complete a risk assessment of whether foot-and-mouth disease work can be done safely on the mainland and have this risk assessment reviewed by the GAO. Until this risk assessment and review is completed, funds appropriated in the Department of Homeland Security Appropriations Act, 2009 (P.L. 110-329, Division D) may not be used for construction of the NBAF.

DHS is evaluating options for the transition and future use of the PIADC facility. Possibilities that have been suggested include turning it into a government-run laboratory for alternative energy R&D, using the site for a wind farm, and selling the property for commercial development.¹⁴ Section 540 of the Department of Homeland Security Appropriations Act, 2009 (P.L. 110-329, Division D) directs DHS to “liquidate the Plum Island Asset” and makes the proceeds available to the S&T Directorate, subject to appropriations, to offset the cost of environmental remediation at the PIADC site and construction of the NBAF; any balance still remaining after that could be used for construction of a consolidated DHS headquarters. For more information on NBAF, see CRS Report RL34160, *The National Bio- and Agro-Defense Facility: Issues for Congress*.¹⁵

Transportation Security Laboratory

The Transportation Security Laboratory (TSL) in Atlantic City, NJ, was formerly in the Transportation Security Administration (TSA) and before that in the Federal Aviation Administration. It became part of DHS along with the rest of TSA under Sec. 403 of the Homeland Security Act. It was transferred to the S&T Directorate in FY2006 as part of an effort to consolidate the department’s R&D activities. The TSL performs research, development, and testing and evaluation activities, primarily in the area of detection and mitigation of explosives and conventional weapons threats.¹⁶

National Biodefense Analysis and Countermeasures Center

The Homeland Security Act established a National Bio-Weapons Defense Analysis Center in the Department of Defense (Sec. 1708) and then transferred it, along with its funding, to the DHS S&T Directorate (Sec. 303). Subsequently renamed the National Biodefense Analysis and Countermeasures Center (NBACC), this center exists as both a program office and a laboratory facility. The facility, currently under construction in Ft. Detrick, MD, will include high-biocontainment laboratories that can perform homeland security biodefense research and bioforensics. When construction is complete, it will be operated by a contractor as a federally funded research and development center (FFRDC). For more information on NBACC, see CRS

¹³ P.L. 110-234, Sec. 7524.

¹⁴ Derrick Henry, “What’s Ahead for Plum Island?,” *New York Times*, January 25, 2009.

¹⁵ Further information from DHS on the proposed NBAF is online at http://www.dhs.gov/xres/labs/editorial_0762.shtm.

¹⁶ A more detailed discussion of TSL activities can be found in the testimony of Susan J. Hallowell, Director, Transportation Security Laboratory, Science and Technology Directorate, Department of Homeland Security, before the House Committee on Science and Technology, Subcommittee on Technology and Innovation, April 24, 2008.

Report RL32891, *The National Biodefense Analysis and Countermeasures Center: Issues for Congress*.

Homeland Security Institute and Homeland Security Studies and Analysis Institute

The Homeland Security Institute (HSI) was an FFRDC established under Sec. 312 of the Homeland Security Act and managed on the S&T Directorate's behalf by Analytic Services, Inc.¹⁷ The HSI assisted the directorate in addressing homeland security issues that require scientific, technical, and analytical expertise. Its main focus was systems analysis and evaluation. Most of its funds were received on a per-project basis from programs that request its assistance; in FY2008 and FY2009 it also received a separate appropriation of \$5.0 million. Under a sunset provision in the Homeland Security Act as originally passed, the institute would have terminated in November 2005. The Department of Homeland Security Appropriations Act, 2005 (P.L. 108-334) extended that termination date to April 25, 2009. That date was not extended further, so the statutory authority for the HSI has expired.

In March 2009, under Sec. 305 of the Homeland Security Act, which gives DHS general authority to establish FFRDCs, the S&T Directorate established the Homeland Security Studies and Analysis Institute (HSSAI). The functions of the HSSAI appear to be very similar to those of the HSI, and HSSAI is also managed by Analytic Services, Inc. The new institute will "provide mission-focused homeland security analysis and expertise focusing on program objectives, system requirements, and metrics."¹⁸ Its contract is for one year with up to four one-year extensions for total funding of up to \$269 million.

Some Members of Congress have questioned HSI's ability to provide effective, independent analysis of DHS programs, because DHS provided its funding and because its contractor might wish to compete for a continuation of its management contract after the 2009 termination date (as indeed it did, successfully).¹⁹ On the other hand, Congress established the institute specifically to provide analysis to DHS, and there has been little congressional criticism of specific Homeland Security Institute reports. It remains to be seen how these concerns will carry over to the newly established HSSAI.

¹⁷ The HSI website is online at <http://www.homelandsecurity.org>.

¹⁸ Department of Homeland Security, "DHS Science & Technology Directorate Establishes Two New Federally Funded Research & Development Centers," *Press Release*, March 5, 2009.

¹⁹ See, for example, questions by Members at House Committee on Energy and Commerce, Subcommittee on Oversight and Investigations, *Nuclear Terrorism Prevention: Status Report on the Federal Government's Assessment of New Radiation Detection Monitors*, hearing held September 18, 2007. (Hearing transcript not yet published. Archived webcast: http://energycommerce.house.gov/cmte_mtg/110-oi-hrg.091807.NuclearTerrorism.shtml.) Re-competed contracts for FFRDCs are sometimes awarded to another contractor. For example, the Science and Technology Policy Institute, which provides analytic support to the White House Office of Science and Technology Policy, was operated by the RAND Corporation until 2003 but is now operated by the Institute for Defense Analyses.

Homeland Security Systems Engineering and Development Institute

The Homeland Security Systems Engineering and Development Institute (HSSEDI) is another FFRDC, also established under Sec. 305 of the Homeland Security Act in March 2009. It will be managed on the S&T Directorate's behalf by the MITRE Corporation. The HSSEDI will provide the S&T Directorate with "advice on concept evolution, development integration, best practices in lifecycle systems engineering and management, and program-level technical and integration expertise across the homeland security enterprise."²⁰ The HSSEDI contract is for one year with up to four one-year extensions for total funding of up to \$443 million.

University Centers

The Homeland Security Act requires the Under Secretary to establish at least one university-based center for homeland security (Sec. 308).²¹ Twelve university centers of excellence have been established so far:

- the Center of Excellence for Command, Control and Interoperability, led by Rutgers University and Purdue University;²²
- the Center for Border Security and Immigration (COE-BSI), led by the University of Arizona and the University of Texas at El Paso;
- the Center for Explosives Detection, Mitigation, and Response, led by Northeastern University and the University of Rhode Island;
- the Center for Maritime, Island and Port Security, led by the University of Hawaii and Stevens Institute of Technology;²³
- the Center for Natural Disasters, Coastal Infrastructure, and Emergency Management, led by the University of North Carolina at Chapel Hill and Jackson State University;
- the National Transportation Security Center of Excellence, led by Texas Southern University in Houston, Tougaloo College, and the University of Connecticut;²⁴

²⁰ Department of Homeland Security, "DHS Science & Technology Directorate Establishes Two New Federally Funded Research & Development Centers," *Press Release*, March 5, 2009.

²¹ University centers are discussed in more detail in a CRS congressional distribution memorandum, "Department of Homeland Security Centers of Excellence Program," by John F. Sargent, October 26, 2007.

²² The two lead institutions of the Center of Excellence for Command, Control and Interoperability address different areas. Purdue University is the lead institution for visualization sciences and education. Rutgers University is the lead institution for data sciences. *74 Federal Register* 12370-12371 (March 24, 2009).

²³ The Center for Maritime, Island and Port Security is divided into two sub-centers, the Center for Island, Maritime, and Extreme Environment Security (CIMES) at the University of Hawaii and the National Center for Security and Resilient Maritime Commerce and Coastal Environments (CSR) at the Stevens Institute of Technology. DHS states that this center will satisfy the requirement in the SAFE Port Act of 2006 (P.L. 109-347) to establish a Center of Excellence for Maritime Domain Awareness. (Personal communication, DHS Office of University Programs, October 23, 2007.)

²⁴ This center was mandated by the Implementing Recommendations of the 9/11 Commission Act of 2007 (P.L. 110-53) and initially funded by the Consolidated Appropriations Act, 2008 (P.L. 110-161).

- the Center for Risk and Economic Analysis of Terrorism Events (CREATE), led by the University of Southern California;
- the National Center for Food Protection and Defense (NCFPD), led by the University of Minnesota;
- the National Center for Foreign Animal and Zoonotic Disease Defense (FAZD), led by Texas A&M University;
- the National Consortium for the Study of Terrorism and Responses to Terrorism (START), led by the University of Maryland;
- the National Center for the Study of Preparedness and Catastrophic Event Response (PACER), led by Johns Hopkins University; and
- the Center for Advancing Microbial Risk Assessment (CAMRA), led by Michigan State University (established jointly with the Environmental Protection Agency).²⁵

These centers are operated by consortia of universities. Some consortia include non-university partners. Although each consortium contains numerous members, funding and activities are typically concentrated at the lead institution and a small number of major partners. The centers are a mixture of entities established by statute and those established at the discretion of DHS.²⁶ Funding for these centers is provided through the S&T Directorate's Office of University Programs. The research activities of the centers are not managed directly by DHS, but rather by administrative staff at each center. Each center's research strategy and plan is provided to DHS for review, however, and the centers attempt to align their work with the needs of the department. As part of the reorganization begun in 2006, the S&T Directorate plans to align the topics of the centers more closely with the research divisions. Over the next several years, where multiple centers currently align with a single division, some may be closed or merged, and new ones may be established.

In addition, several university-affiliated activities are sometimes considered additional centers of excellence:

- four University Affiliate Centers (UACs), led by Rutgers University, the University of Southern California, the University of Illinois at Urbana-Champaign, and the University of Pittsburgh, that work with the Institute for Discrete Sciences at Lawrence Livermore National Laboratory;
- five Regional Visualization and Analytics Centers (RVACs), led by Penn State University, Purdue University, Stanford University, the University of North Carolina at Charlotte, and the University of Washington, that collaborate with the National Visualization and Analytics Center at Pacific Northwest National Laboratory; and

²⁵ The S&T Directorate will cease funding this center in FY2009. Department of Homeland Security, Science and Technology Directorate, *Five-Year Research and Development Plan, Fiscal Years 2008-2013*, August 2008, p. 171.

²⁶ The Center for Natural Disasters, Coastal Infrastructure, and Emergency Management and the National Transportation Security Center of Excellence were both established to meet congressional mandates.

- two centers funded by the Infrastructure and Geophysical Division (not University Programs): the Southeast Regional Research Initiative (SERRI) and the Kentucky Critical Infrastructure Protection Institute (KCI).

The UACs and RVACs support the Division of Command, Control, and Interoperability. DHS plans not to fund them after FY2008 and to transition their research activities to the new Center of Excellence for Command, Control, and Interoperability in FY2009.²⁷

The university centers of excellence and the university-affiliated activities provide the main connection between the S&T Directorate and the academic community. As such, the university centers of excellence are the primary mechanism for the S&T Directorate and the academic community to interact on R&D topics. The details of these centers have been an issue of congressional focus, with special interest given to how research at university centers of excellence relates to DHS R&D needs and S&T Directorate priorities. In 2007, Congress considered, but did not impose, limited terms for the university centers of excellence, and it has since established new university centers of excellence in specific research areas. Stakeholders resisted congressional efforts to curtail the duration of the university centers of excellence, but response to plans to realign the university centers of excellence has been more muted.²⁸

DOE National Laboratories

DHS has a special statutory relationship with the national laboratories of the Department of Energy (DOE):

Notwithstanding any other law governing the administration, mission, use, or operations of any of the Department of Energy national laboratories and sites, such laboratories and sites are authorized to accept and perform work for the Secretary, consistent with resources provided, and perform such work on an equal basis to other missions at the laboratory and not on a noninterference basis with other missions of such laboratory or site.²⁹

The S&T Directorate can use this authority to engage the DOE national laboratories to perform research for DHS as if they were being tasked by DOE. This authority reduces costs for DHS and gives its tasks equal priority with DOE tasks, unlike the tasks of other agencies that conduct R&D at the national laboratories under the status of “work for others.”³⁰ Early in its existence, the S&T Directorate identified a number of DOE national laboratories that perform R&D potentially relevant to homeland security, but it was criticized for having no strategy to use that capability.³¹

²⁷ Department of Homeland Security, Science and Technology Directorate, *Five-Year Research and Development Plan, Fiscal Years 2008-2013*, August 2008, p. 171.

²⁸ Francis Busta, Neville Clarke, Lynn R. Goldman, et al., “Cuts in Homeland Security Research,” Letter to the Editor, *Science*, Vol. 313, September 15, 2006.

²⁹ Homeland Security Act of 2002, Sec. 309(a)(2).

³⁰ “Work for others” is research or technical assistance done by a DOE laboratory or a DOE technology center for a non-DOE entity, either private or federal. Such work is fully funded by the non-DOE entity, and national laboratory eligibility to do such work is described in DOE Order 481.1B. See *Work for Others (Non-Department of Energy Funded Work)*, Department of Energy Order 481.1B, September 28, 2001. See also 48 C.F.R. 970.1707.

³¹ Comments of Charles E. McQueary, Under Secretary for Science and Technology, in the minutes of the Homeland Security Science and Technology Advisory Committee, February 26, 2004; and Government Accountability Office, (continued...)

DOE and DHS have since entered into a memorandum of agreement regarding the use of DOE assets by DHS,³² and the S&T Directorate reported in May 2007 that it had aligned its use of the DOE national laboratories with its reorganized division structure.³³ Eleven of the laboratories are included in this alignment; each division is aligned with between three and seven of them. The goal of the alignment process is to provide an enduring capability for basic research.³⁴

The relationship between the S&T Directorate and the DOE national laboratories is discussed further below (see “Relationships with Other R&D Organizations”).

Cross-Cutting Policy Issues

The directorate faces a variety of broader policy concerns in addition to the issues associated with the specific organizations and activities of the S&T Directorate discussed above. These include

- the evolution of its mission;
- its allocation of resources to basic research, applied research, and development;
- its choice of intramural or extramural performers for R&D;
- its process for prioritization and strategic planning;
- its relationships with other R&D organizations, both inside and outside DHS;
- problems with its budget documents and financial management systems;
- its responsiveness to Congress and industry; and
- metrics for evaluating its performance.

Defining the Directorate’s Mission

The Homeland Security Act did not give the S&T Directorate a concise statutory mission. Instead, it listed a variety of responsibilities and authorities for the Under Secretary. These were summarized at the beginning of this report and are reproduced in full in **Appendix A**. Different people at different times have had different conceptions of the directorate’s mission. This section discusses three aspects of that debate: whether the directorate’s “customers” are the other components of DHS, the ultimate end users, such as state and local first responders, or both; the scope of the directorate’s R&D mission relative to other DHS components (such as DNDO); and the extent to which the directorate’s role should include operational and other responsibilities as well as R&D.

(...continued)

Homeland Security: DHS Needs a Strategy to Use DOE’s Laboratories for Research on Nuclear, Biological, and Chemical Detection and Response Technologies, GAO-04-653, May 2004.

³² See *Reimbursable Work for the Department of Homeland Security*, Department of Energy Order 484.1, August 17, 2006.

³³ Department of Homeland Security, Science and Technology Directorate, *Strategic Plan*, May 2007, p. 11.

³⁴ Personal communication with DHS Office of National Laboratories, December 10, 2007.

Customers

During the tenure of former Under Secretary Charles E. McQueary (2003-2006), customers were described as being both internal (other directorates and units of the department) and external (state and local homeland security officials and first responders).³⁵ The needs of such a diverse group are broad and varied, and identifying and meeting those needs proved to be a challenge. In May 2006, the House Committee on Appropriations reported that

S&T has failed to adequately convey its role or how it supports missions of DHS component agencies.... Many DHS components express skepticism or even ignorance about the value of S&T in serving their agencies.³⁶

During the tenure of Under Secretary Cohen (2006-2008), the directorate identified its immediate customers as the DHS components, although still in a formulation that recognizes end users. In congressional testimony in September 2006, the Under Secretary referred to his

vision for and realignment of the Directorate to better meet the mission needs of our customers—the DHS Components; and the customers of our customers—the first responders and men and women that S&T enables to make the Nation safer.³⁷

He emphasized the need for the directorate to be more attuned to the needs of its DHS customers:

Our DHS customers need an organization that is easier to access in order to utilize technologies and solutions that will make their jobs better, more efficient, more cost effective, and safer. The S&T Directorate needs to be more accessible in order for the DHS components to leverage the value added of the good work the men and women of S&T are bringing to the fight.³⁸

Scope of R&D Role

The subject-matter boundaries of the directorate's R&D role within DHS have expanded and contracted since its establishment. As discussed above, it has absorbed programs from several other DHS organizations, but Congress rejected proposals that it take over certain Coast Guard activities, and the Domestic Nuclear Detection Office is now a separate organization with responsibility for radiological and nuclear countermeasures. Given that the S&T Directorate is not the only R&D operation within DHS, questions remain about what principles determine the types of R&D it should do, and when another organization should take on a particular R&D topic.

The scope of research undertaken by the S&T Directorate through its component entities also has been questioned. When DHS was established, Congress also created within the S&T Directorate

³⁵ See, for example, minutes of the Homeland Security Science and Technology Advisory Committee, February 23-24, 2005.

³⁶ H.Rept. 109-476.

³⁷ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Emergency Preparedness, Science, and Technology, September 7, 2006.

³⁸ Under Secretary Jay M. Cohen, testimony, September 7, 2006.

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.³⁹ The scope of this agency has evolved since it was created. 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 experts in the scientific community believed that, like DARPA, it would fund high-risk, high-reward R&D. Instead, the S&T Directorate used HSARPA to conduct essentially all of its extramural activities, most of which were conventional R&D with only moderate risk.

As part of his reorganization of the S&T Directorate, Under Secretary Cohen redirected the work of HSARPA. The role of HSARPA is much reduced from past years, when it was responsible for nearly all of the directorate's extramural R&D. It is now focused on activities with high risk and high reward. Through its Homeland Innovative Prototypical Solutions (HIPS) and High Impact Technology Solutions (HITS) programs, HSARPA now performs research activities more in the DARPA model.

The best way to use 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 the successes can be great. On the other hand, because most programs do not achieve their goals, many will likely need to be funded before a success is realized. The high-risk, high-reward approach is therefore likely to require a sustained and significant financial commitment if it is to be successful.

Functions Other than R&D

Although the directorate's main role is R&D, its programs include a variety of other related functions. It is currently involved in standards development, technology testing and evaluation, and technology transfer. Until 2007, it conducted several operational programs, such as BioWatch, in which it deployed and operated equipment as well as developing it. It awards scholarships and fellowships, the purpose of which has sometimes been described as "capacity building" for future R&D—a topic in which some Members of Congress have been particularly interested. The Under Secretary also has several coordinative responsibilities involving other federal agencies. While the shift of operational programs to other organizations in 2007 suggests an attempt to focus on the main R&D role, the other activities and responsibilities remain. There has been no definitive explanation of the factors that determine which non-R&D functions are appropriate for the directorate and what determines their priority relative to R&D.

Prior to the establishment of DHS, no single agency had responsibility for homeland security, and homeland security was not generally considered to be an independent field of study. While academic R&D capability and educational programs in national security and defense existed, such capacity was lacking in the area of homeland security. As part of the S&T Directorate's efforts in "capacity building," the directorate funded scholarships and fellowships in addition to establishing university research centers. Some analysts have questioned the effectiveness of this

³⁹ Section 307, P.L. 107-296, Homeland Security Act of 2002.

program, as the scholars and fellows receiving financial assistance from DHS do not necessarily enter into homeland security employment or R&D.⁴⁰

The S&T Directorate has reduced the numbers of scholars and fellows and attempted to align scholarship and fellowship activities with those of the university centers of excellence.⁴¹ This may lead to greater synergies and effectiveness between the two programs but also may limit the scale of involvement of universities, students, and scientists interested in homeland security. Whether DHS, as an R&D funding entity, should continue to attempt to develop an academic homeland security infrastructure or instead focus on using more federal assets to perform R&D activities and provide experience and expertise in homeland security may continue to be a topic of interest to policymakers.

Prioritization and Strategic Planning

A long-standing congressional criticism of the S&T Directorate is that its planning and prioritization process is opaque. This perception of opacity has led to concerns about the accountability of the planning process and the quality of the decisions it produces. Directorate priorities can be somewhat inferred from the allocation of funding within the directorate, but no planning and prioritization documents were publicly available. In June 2007, for the first time, the directorate issued a strategic plan and a five-year R&D plan. In August 2008, the five year R&D plan was updated to reflect adjustments in funding and programmatic priorities.⁴² As described in these documents, a system of Integrated Product Teams (IPTs) now helps to provide end users with more input into the prioritization process.

Planning Documents

The 2004 DHS strategic plan enunciates high-level goals for using science and technology to meet the overall mission of the department. According to this plan, DHS will

use, leverage and enhance the vast resources and expertise of the Federal Government, private sector, academic community, non-governmental organizations and other scientific bodies. We will develop new capabilities to facilitate the sharing of information and analysis; test and assess threats and vulnerabilities; counter various threats, including weapons of mass destruction and illegal drugs; and mitigate the effects of terrorist attacks. We will also focus our efforts on developing technology to detect and prevent the illicit transport of chemical, biological, radiological and nuclear materials. We will develop and deploy the capabilities,

⁴⁰ For the 2008 DHS Scholarship and Fellowship Program, the S&T Directorate included a one-year, full-time service requirement in a relevant homeland security science, technology, engineering, or mathematics field for all fellowship recipients. The work done during this service must be applicable to one of the 16 homeland security research areas (DHS, *DHS Scholarship and Fellowship Program—2008 Competition Guidelines*, online at <http://www.orau.gov/dhsed/2008pages/fellowship.html>). This requirement has continued in the 2009 program.

⁴¹ Awards in the DHS Scholarship and Fellowship program have declined from a high of 129 in 2005 to 35 in 2008. CRS analysis based on DHS data, May 4, 2009.

⁴² Department of Homeland Security, Science and Technology Directorate, *Five-Year Research and Development Plan, Fiscal Years 2008-2013*, August 2008, <http://www.dhs.gov/xlibrary/assets/SandT5yearplan.pdf>.

equipment and systems needed to anticipate, respond to and recover from attacks on the homeland.⁴³

Although the 2004 DHS strategic plan establishes this list of science and technology priorities, it provides no guidance about their relative importance.

For the first few years of its existence, the S&T Directorate lacked a publicly available long-term R&D plan. As required by a presidential directive,⁴⁴ it worked with the White House Office of Science and Technology Policy to develop an annual R&D plan for critical infrastructure protection,⁴⁵ but there is no similar requirement for other R&D topics. The directorate had an annual planning process, but the results of that process were internal to the directorate and were not publicly reviewed.⁴⁶ Some conclusions about the success of individual program elements could be drawn from the results of OMB's Program Assessment Rating Tool (PART). In the absence of an overall plan, however, it was difficult for those outside of DHS to gain a holistic, multi-year perspective.

In June 2007, the S&T Directorate released a separate strategic plan that includes a five-year R&D plan.⁴⁷ This document and its attachments briefly discuss the directorate's organizational structure, R&D goals, prioritization procedures, and workforce, but they focus more on describing the directorate's R&D topics and programs and providing milestones, budget projections, and program mission statements. Although these documents provide proposed future funding levels, they do not describe the process by which the allocation of these funds among the different homeland security research areas and projects was determined. They describe a number of specific choices, such as the topics of the six divisions, the relative emphasis placed on different threats, the selection of particular R&D projects, and the percentage target for basic research funding, but they do not clearly explain how these choices were made or how they are linked to a set of high-level strategic goals. In this sense, the S&T Directorate strategic plan is more an operational business plan than a strategic plan.⁴⁸

⁴³ Department of Homeland Security, *Securing Our Homeland—The DHS Strategic Plan*, February 2004.

⁴⁴ *Critical Infrastructure Identification, Prioritization, and Protection*, Homeland Security Presidential Directive 7 (HSPD-7), December 17, 2003.

⁴⁵ The Executive Office of the President, Office of Science and Technology Policy, and the Department of Homeland Security, Science and Technology Directorate, *The National Plan for Research and Development in Support of Critical Infrastructure Protection, 2004*, April 8, 2005. An update for 2007 was included as a classified appendix to the annual National Infrastructure Protection Plan. (Personal communication with DHS Legislative Affairs, January 16, 2008.)

⁴⁶ Internal reviews of the annual budgeting and planning process are referred to in Department of Homeland Security, *Performance and Accountability Report—Fiscal Year 2006*, November 15, 2006.

⁴⁷ Department of Homeland Security, Science and Technology Directorate, *Strategic Plan with Attachments*, May 2007. Attachment 1 to the strategic plan is the five year research and development plan (Department of Homeland Security, Science and Technology Directorate, *Five Year Research and Development Plan, Fiscal Years 2007-2011*, May 2007). Available online at

<http://hsc.house.gov/SiteDocuments/20070627105705-57451.pdf>.

⁴⁸ This criticism and others were made by Members of Congress at a hearing on the strategic plan held by the House Committee on Homeland Security, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, on June 27, 2007. See, for example, the Chairman's opening statement available online at <http://hsc.house.gov/SiteDocuments/20070627162512-45822.pdf>.

Priorities Reflected in Allocation of Funding

Independent of any explicit strategy, the S&T Directorate's funding allocations give insight into its priorities. Most notably, they reveal a strong focus on developing countermeasures to weapons of mass destruction. Countermeasures to biological agents have always constituted the largest single component in the directorate's R&D portfolio. The establishment of DNDO and its growing share of the department's R&D expenditures imply a decision to increase the priority of nuclear and radiological countermeasures. (This may affect the S&T Directorate, even though it is no longer involved in nuclear and radiological R&D, because such a decision implicitly reduces the relative priority of other R&D topics that remain in the directorate.) In part, this focus on unconventional, low-likelihood, high-consequence threats may reflect the programs transferred to the directorate at its inception, which were heavily focused on biological, chemical, and nuclear weapons.⁴⁹ The rapid increase in budget emphasis on radiological and nuclear threats starting in FY2006 appears to be a strategic choice, however. Although the White House has explained its rationale for establishing DNDO,⁵⁰ DHS has given no public explanation of its decision to increase DNDO's funding.

In the past, the directorate's focus on unconventional threats has drawn into question its ability to meet the conventional needs of other DHS component agencies. In the directorate's old budget structure, funding for support of other DHS agencies' needs was consistently less than for either biological or radiological and nuclear countermeasures. (See **Appendix C**.) The new budget structure integrates support for other DHS agencies' needs into each of the research divisions, so this issue has become difficult to track through budget trends. The IPT process includes representatives of the DHS operational agencies, however, which may help ensure that R&D efforts meet the department's conventional needs.

Integrated Product Teams

The S&T Directorate has instituted procedures to solicit input from the operational components of DHS, to work with the components in identifying technology gaps and needs, and to develop mechanisms to meet those gaps and needs. The foundation of these new procedures is a set of Integrated Product Teams (IPTs). Each IPT is focused on a different topic and brings together decision-makers from DHS operational components and the S&T Directorate as well as select end-users.⁵¹ Each IPT consists of (1) customer representatives, whose role is to identify gaps in

⁴⁹ Programs transferred to the S&T Directorate in the Homeland Security Act of 2002 included the DOE Chemical and Biological National Security program, activities of the DOE Life Sciences program related to genomic sequencing of microbial pathogens, the USDA Plum Island Animal Disease Center, the DOD National Bio-Weapons Defense Analysis Center, which were all related to biological and chemical threats, as well as part of the DOE Proliferation Detection program, the DOE Nuclear Assessment program, the DOE Environmental Measurements Laboratory, and part of the DOE Office of Science Advanced Scientific Computing Research program, which were all related to radiological and nuclear threats.

⁵⁰ Executive Office of the President, The White House, *Domestic Nuclear Detection*, National Security Presidential Directive 43 (NSPD-43) and Homeland Security Presidential Directive 14 (HSPD-14), April 15, 2005.

⁵¹ The IPT topics change depending on need. Ten IPT topics were identified in a DHS Office of the Inspector General report (Department of Homeland Security, Office of Inspector General, *The Science and Technology Directorate's Processes for Selecting and Managing Research and Development Programs*, OIG-08-85, August 2008.) Acting Under Secretary Buswell identified thirteen IPTs as being currently used.

capability; (2) providers from the S&T Directorate, whose role is to provide technical solutions; (3) acquisition officials and/or financial officers, whose role is to validate and execute future acquisition plans; and (4) end user representatives, whose role is to provide the end users' perspectives.⁵² The intent is to help the operational units make informed decisions about technology investments, based on the S&T Directorate's understanding of technology and the state of applicable technology solutions. The specific goal is to identify technology solutions that can be developed and delivered to the acquisition programs of operational units within three years.⁵³ Congress and other observers have generally taken a positive view of the IPT process compared with the directorate's previous priority-setting efforts.

One past criticism of the S&T Directorate has been that it has difficulty meeting the needs of end users. The IPT process explicitly recognizes the other DHS components as the consumers of the S&T Directorate's R&D efforts. It identifies requirements and capability gaps at the federal level. Although there can be input from the state and local level, the IPT structure does not encourage end users outside DHS, such as state and local first responders, to communicate their needs directly to the S&T Directorate. The expectation is that the DHS operational components that work with state and local agencies will understand their needs and represent their interests.

To provide a direct route for first responders to communicate with S&T, the directorate has established the TechSolutions program.⁵⁴ The goal of this program is to integrate first responder needs into the R&D pipeline and provide solutions through rapid prototyping or identification of existing technologies. It is unclear, however, how these needs are prioritized relative to each other or how TechSolutions interacts with the IPT process.

Use of External Advice

When Congress established DHS, it also created the Homeland Security Science and Technology Advisory Committee (HSSTAC), an advisory committee for the S&T Directorate. This committee met and attempted to provide the S&T Under Secretary with advice relating to priorities and effective use of the S&T Directorate assets, but its service was sporadic.⁵⁵ The original statutory authority for the HSSTAC lapsed in 2005.⁵⁶ In 2006 the committee was reauthorized and its charter extended until the end of 2008.⁵⁷ It was reformed but was not used to develop or provide a publicly available strategic overview or to review of the S&T Directorate's research investment plan. The HSSTAC has not been reauthorized since 2008.

⁵² Department of Homeland Security, Science and Technology Directorate, *Strategic Plan with Attachments*, May 2007, p. 7.

⁵³ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, February 14, 2007.

⁵⁴ An email address for first responders to communicate with the S&T Directorate through the Tech Solutions program has been created at techsolutions@dhs.gov. More information on the TechSolutions program is online at <http://www.dhs.gov/techsolutions>.

⁵⁵ For a record of the meeting minutes of the HSSTAC, see online at http://www.dhs.gov/xres/committees/gc_1163542152895.shtm.

⁵⁶ Homeland Security Act of 2002 (P.L. 107-296), Sec. 311.

⁵⁷ SAFE Port Act (P.L. 109-347), Sec. 302.

In January 2009, the HSSTAC was reconstituted as an advisory committee under the Secretary's general authority to establish advisory committees (6 U.S.C. 451). According to its charter, the HSSTAC "is established in accordance with and shall operate under the provisions of the Federal Advisory Committee Act (FACA)."⁵⁸ This version of the HSSTAC is not constrained by the terms of Sec. 311 of the Homeland Security Act, which provided specific statutory authority for the HSSTAC.

The DHS also, through the S&T Directorate, relies on the Homeland Security Institute (HSI), the agency's FFRDC, for external advice and analysis. The HSI has contributed in areas such as strategic policy and planning, investment alternatives, the identification of DOE National Laboratories' capabilities, chemical and biological warfare, critical infrastructure protection, threat scenarios, standards integration, operational analysis, and lessons learned analysis.⁵⁹ As the HSI provides its reports directly to DHS, the contents of these reports and the extent to which their recommendations are implemented are not publicly known.

Analysis of Threat Information

Like her predecessor, DHS Secretary Napolitano has stated that DHS should make decisions based on risk (in this context, the risk that different threats pose to homeland security).⁶⁰ While risk methodologies are under exploration in the S&T Directorate, the extent to which they are incorporated into decision making is unclear. For example, a presidential directive tasks DHS with completing a biennial biological risk assessment.⁶¹ Although the content of that assessment has not been made public, many observers expect that it provides sufficient analysis and detail to identify priority areas for short-, medium-, and long-term R&D investments. For example, its results are being used by the Department of Health and Human Services to help prioritize biological countermeasure procurement through Project Bioshield.⁶² On the other hand, a committee of the National Academy of Sciences expressed fundamental concerns about this assessment and recommended that it not be used for prioritization until its flaws are rectified.⁶³ Another presidential directive requires DHS to develop an integrated risk assessment for chemical, biological, radiological, and nuclear threats.⁶⁴ The connection of these two risk

⁵⁸ Department of Homeland Security, *Homeland Security Science and Technology Advisory Committee Charter*, http://www.dhs.gov/xres/committees/gc_1163543047277.shtm.

⁵⁹ Homeland Security Institute, *Homeland Security Institute Annual Report to Congress 2006/2007, 2007*.

⁶⁰ For example, in response to a questionnaire from the Senate Committee on Homeland Security and Governmental Affairs before her nomination hearing, Secretary Napolitano said that "I support the Department's efforts to use risk management as a basis for decisionmaking. ... We have to use risk analysis to set priorities and guide resource allocation." (http://hsgac.senate.gov/public/_files/011509PreHearingQs.pdf) In a speech at the Woodrow Wilson Institute on December 12, 2007, her predecessor Secretary Chertoff said that "spending decisions have to be made based on what's risk-appropriate and what is most cost-effective." (http://www.dhs.gov/xnews/speeches/sp_1197513975365.shtm).

⁶¹ Executive Office of the President, White House, *Biodefense for the 21st Century*, Homeland Security Presidential Directive 10 (HSPD-10), April 28, 2004.

⁶² See CRS Report RL33907, *Project BioShield: Appropriations, Acquisitions, and Policy Implementation Issues for Congress*, by Frank Gottron.

⁶³ National Research Council, *Department of Homeland Security Bioterrorism Risk Assessment: A Call for Change* (2008).

⁶⁴ Executive Office of the President, White House, *Medical Countermeasures against Weapons of Mass Destruction*, (continued...)

assessments to the directorate's R&D budgeting process is not apparent, however, nor is it clear whether the directorate applies or plans to apply a similar risk assessment methodology to priority-setting in other threat areas or across all its activities. It should be noted that these risk assessments may contain information relating to national or homeland security vulnerabilities and, as such, might be incorporated into the directorate's planning processes through a nonpublic mechanism.

Interagency and intra-agency coordination plays an important role in ensuring that R&D plans and strategies are informed by threat information. The techniques used and considered by terrorists adapt and evolve. Technological countermeasures may be available that provide protection against these modified techniques, but they will be ineffective if they are not deployed prior to the techniques' use. Transfer of pertinent threat information from the intelligence community to DHS, and then to the S&T Directorate, may provide an advantage in developing counterterrorism technologies and enhancing preparedness.

Balance of R&D by Type and Performer

The scope of the S&T Directorate's activities is broad. Its R&D activities address the whole range of threats to homeland security (with the exception, since 2005, of most nuclear and radiological threats, which are addressed by the Domestic Nuclear Detection Office, see "Role of the Domestic Nuclear Detection Office" below). It spans the spectrum from basic research to operational systems (though most operational functions have now been transferred to other DHS organizations). It conducts some activities directly in its own facilities and supports others indirectly through arrangements with the national laboratories, industry, universities, and other government agencies. This section discusses the balance among basic research, applied research, and development; the balance between R&D performed within the federal government (intramural) and R&D performed by industry, academia, and others (extramural); and the directorate's role in operational activities. The next section discusses how the directorate's planning and prioritization processes balance the many R&D topics that it addresses.

Basic Research, Applied Research, and Development

How the S&T Directorate allocates its resources between research and development is of interest to both policymakers and other stakeholders. The extent to which the S&T Directorate invests in basic research in particular is an issue of continuing congressional interest.⁶⁵ Investment in basic research is generally believed to address long-term needs, provide a basis for future applied research and development, and lead to advances in knowledge across disciplines. Investment in development focuses more on the near term, with results that are typically narrower in scope but

(...continued)

Homeland Security Presidential Directive 18 (HSPD-18), January 31, 2007, Sec. 14(c).

⁶⁵ See, for example, questioning of Under Secretary McQueary at hearings of the House Committee on Homeland Security, Subcommittee on Cybersecurity, Science, and Research and Development, February 25, 2004, and the House Committee on Science, February 15, 2006; and of Under Secretary Cohen at a hearing of the House Committee on Homeland Security, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, February 14, 2007.

more immediately applicable. The directorate's R&D portfolio has been criticized as being skewed too much toward development, with not enough expenditure on basic research.⁶⁶ As noted below, the directorate's stated goal is to devote 20% of its budget to basic research. According to DHS, the FY2009 budget request was the first to meet this goal.⁶⁷

In the Administration's annual budget documents, the Office of Management and Budget (OMB) provides an agency-by-agency analysis of federal R&D budget authority in four categories: basic research, applied research, development, and facilities and equipment. For this purpose, OMB defines the first three of these categories as follows:

- basic research: "systematic study directed toward a fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind."
- applied research: "systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met."
- development: "systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements."⁶⁸

The DHS portion of OMB's analysis is summarized in the upper portion of **Table 1**. Note that these figures do not distinguish between the S&T Directorate and other DHS organizations. They therefore include R&D activities in the Domestic Nuclear Detection Office, the U.S. Coast Guard, and perhaps other organizations, as well as in the S&T Directorate.⁶⁹

The National Science Foundation (NSF) also produces annual statistics on federal R&D spending. The NSF figures describe obligations and outlays, which reflect how budget authority was actually spent, and therefore they are only available after a fiscal year is complete.⁷⁰ Like OMB, NSF uses four categories: basic research, applied research, development, and R&D plant. It uses the same definitions as OMB does for basic research, applied research, and development, and its R&D plant category appears to be equivalent to OMB's facilities and equipment

⁶⁶ See, for example, James Jay Carafano, and Richard Weitz, "Rethinking Research, Development, and Acquisition for Homeland Security," *Heritage Foundation Backgrounder No. 2000*, January 22, 2007; and Rachael King, "Is Homeland Security Too Focused on Now?" *Business Week*, December 20, 2007.

⁶⁷ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Science and Technology, Subcommittee on Technology and Innovation, March 6, 2008.

⁶⁸ Office of Management and Budget, *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2008*.

⁶⁹ Because of consolidation and deconsolidation of R&D activities, the proportion of DHS R&D budget authority located within the S&T Directorate varies. Dividing the R&D appropriation for the S&T Directorate by the total DHS R&D budget authority reported by OMB yields a S&T Directorate contribution that ranges from 58% in FY2007 to 89% in FY2005.

⁷⁰ For more explanation of how budget authority, obligations, and outlays differ, see CRS Report 98-721, *Introduction to the Federal Budget Process*.

category.⁷¹ The lower portion of **Table 1** shows the NSF obligation figures for DHS as a whole and for just the S&T Directorate.

There appear to be discrepancies between these two sets of figures. See **Figure 3**. In the NSF figures for the S&T Directorate for FY2005-FY2007, basic research is 4.4% of the total each year, applied research 28.3%, development 60.1%, and R&D plant 7.2%. These proportions are identical (within rounding) in each of these three years. The OMB figures show much more variation, particularly in the balance between applied research and development. They also show very different amounts of basic research in FY2004 and FY2007. The NSF figures are obligations, whereas the OMB figures are budget authority, so some of the differences may be explained by unobligated balances carried over from year to year. (The issue of unobligated balances is discussed more below.) Some of the NSF figures are preliminary. However, CRS has been unable to determine the cause of the differences.

Table 1. DHS R&D by Character of Work
(\$ in millions)

	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	FY2009
All DHS (OMB)—Budget Authority							
Basic Research	47	68	55	85	247	248	376
Applied Research	92	247	842	662	434	382	381
Development	549	481	133	659	434	365	380
Facilities/Equipment	49	257	152	49	131	148	2,250 ^a
Total	737	1,053	1,182	1,455	1,246	1,143	3,287 ^a
All DHS (NSF)—Obligations							
Basic Research	—	166	55	80	47	—	—
Applied Research	—	247	542	525	315	—	—
Development	—	533	765	1,112	666	—	—
R&D Plant	—	117	92	132	79	—	—
Total	—	1,063	1,454	1,848	1,107	—	—
DHS S&T Directorate only (NSF)—Obligations							
Basic Research	—	85	55	80	47	—	—
Applied Research	—	199	356	516	306	—	—
Development	—	507	756	1,096	651	—	—
R&D Plant	—	116	91	131	78	—	—
Total	—	908	1,258	1,823	1,083	—	—

Sources: Office of Management and Budget, *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2009* and previous editions. (FY2003-FY2007 are actual from the budget issued two years after the year

⁷¹ For the NSF definitions, see National Science Foundation, Division of Science Resources Statistics, *Federal Funds for Research and Development: Fiscal Years 2004-06*, NSF 07-323, June 2007, pp. 339-340.

concerned. FY2008 is estimated and FY2009 is requested, both from the FY2009 budget.) National Science Foundation, Division of Science Resources Statistics, *Federal Funds for Research and Development: Fiscal Years 2005-07*, NSF 09-300, November 2008, and previous editions. (FY2006 and FY2007 are preliminary. FY2008 and FY2009 are not yet available. Comparable FY2003 data do not exist “because DHS was unable to determine adequate estimates” [*Federal Funds for Research and Development: Fiscal Years 2003-05*, NSF 06-313].)

- a. In the FY2009 budget, OMB categorized an advance appropriation of \$2.175 billion for Project BioShield as R&D Facilities/Equipment. This funding is located in the National Protection and Programs Directorate, not the Science and Technology Directorate. Additionally, questions have been raised about its categorization, as Project BioShield is a program for procuring medical countermeasures, not for building R&D facilities or purchasing R&D capital equipment. For more information, see CRS Report RS21507, *Project BioShield: Purposes and Authorities*, by Frank Gottron, and CRS Report RL34448, *Federal Research and Development Funding: FY2009*, coordinated by John F. Sargent Jr..

Comparing successive annual releases of the NSF figures for the S&T Directorate (see **Table 2**) demonstrates the extent to which the preliminary estimates may be subject to change. This raises doubts about the reliability of the data and the validity of the mechanisms used to generate them.

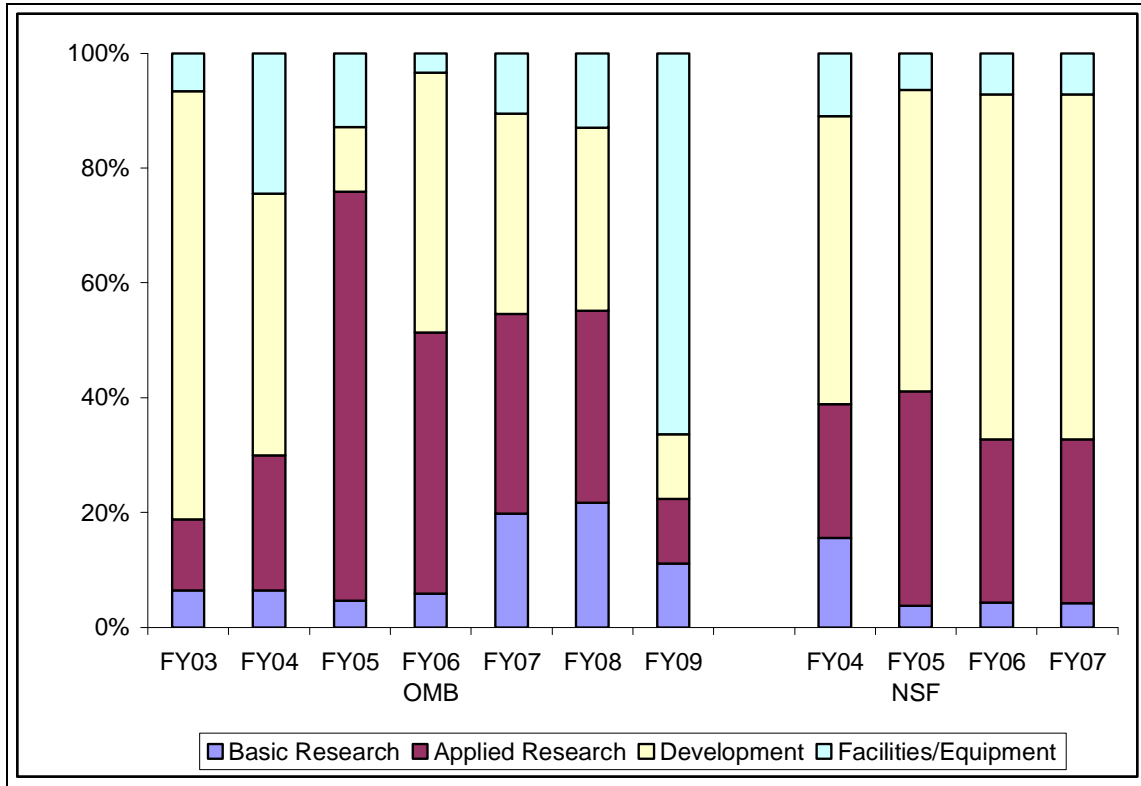
Table 2. S&T Directorate R&D Obligations by Character of Work, FY2005 and FY2006: Comparison of June 2007 and November 2008 NSF Estimates

(\$ in millions)

	FY2005 Preliminary June 2007	FY2005 Final November 2008	FY2006 Preliminary June 2007	FY2006 Preliminary November 2008
Basic Research	132	55	133	80
Applied Research	310	356	311	516
Development	789	756	792	1,096
R&D Plant	181	91	181	131
Total	1,412	1,258	1,418	1,823

Sources: National Science Foundation, Division of Science Resources Statistics, *Funds for Research and Development: Fiscal Years 2004-06*, NSF 07-323, June 2007; and *Funds for Research and Development: Fiscal Years 2005-07*, NSF 09-300, November 2008.

Figure 3. DHS R&D by Character of Work



Source: DHS R&D budget authority as categorized by OMB, FY2003-FY2009. DHS R&D obligations as categorized by NSF, FY2004-FY2007. See **Table I** for detailed data. If Project BioShield funding is removed from the OMB figures for FY2009, the percentages for that year become basic research 31%, applied research 31%, development 31%, and facilities/equipment 6%.

The S&T Directorate currently prefers to use a somewhat different set of categories, as shown in **Table 3**, although it has not provided a detailed breakdown of current or past expenditures according to these categories. The correspondence between the directorate’s categories and the ones used by OMB and NSF is only partial. The definitions of basic research appear similar. OMB’s facilities and equipment category and NSF’s R&D plant category seem to correspond to the laboratory operations and construction portion of “other spending.” The “product transition” category may be similar to development. The “innovative capabilities” category, however, seems quite different from applied research.

Table 3. Categories of R&D as Described by the S&T Directorate

Category	Description	Investment Target	Years to Delivery
Basic research	<ul style="list-style-type: none"> - Enables future paradigm changes - University fundamental research - Government lab discovery and invention 	20%	>8
Innovative capabilities	<ul style="list-style-type: none"> - High risk / high payoff - Game changer / leap ahead - Prototype, test, and deploy - HSARPA 	10%	2-5
Product transition	<ul style="list-style-type: none"> - Focused on delivering near-term products and enhancements to acquisition - Customer IPT controlled - Cost, schedule, capability metrics 	50%	0-3
Other spending	<ul style="list-style-type: none"> - Test and evaluation and standards - Laboratory operations and construction - Management and administration 	20%	0-8+

Source: Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Science and Technology, March 8, 2007. Investment targets from S&T Directorate briefing charts.

The R&D categories shown in **Table 3** fall into two time frames. Basic research is described as long-term, with products expected more than eight years in the future. Innovative capabilities and product transition are described as short-term, with results expected within five years. According to these descriptions, the S&T Directorate’s investment portfolio does not include mid-term R&D with a time horizon of five to eight years. This situation may be a barrier to bringing the results of basic research to fruition in deployable systems.

Intramural and Extramural

Just as congressional policymakers are interested in the breakdown of the S&T Directorate’s activities into basic research, applied research, and development, congressional policymakers are also interested in the balance between intramural and extramural activities.⁷² Former Under Secretary Cohen said that “we don’t do S&T, we resource and we manage S&T.”⁷³ Nevertheless, the S&T Directorate funds both extramural R&D, through contracts, grants, and other

⁷² Extramural R&D is performed under a contract, grant, or cooperative agreement by an organization outside the federal sector but with federal funds. Intramural R&D is carried out by and within a federal agency (Division of Science Resources Statistics, Directorate for Social, Behavioral, and Economic Sciences, National Science Foundation, *Federal Funds for Research and Development Fiscal Years 2000, 2001, and 2002—Detailed Statistical Tables*, Volume 50, May 2002).

⁷³ Quoted in Tom Michael, “The Search for Security,” *Innovation: America’s Journal of Technology Commercialization*, February/March 2007.

arrangements with industry, academia, and others, and intramural R&D, conducted by government employees at DHS and other federal facilities. Before the 2006 reorganization, most extramural R&D was managed by HSARPA; that is no longer true.

Categorization of the directorate's activities as extramural or intramural is complicated by its sponsorship of FFRDCs and university centers and its use of the DOE national laboratories. The FFRDCs and university centers are established and overseen by DHS but operated by outside organizations and funded by contracts and grants. The DOE national laboratories, while government-owned, are also managed and operated by contractors. The extramural or intramural status of R&D performed at these facilities is therefore potentially ambiguous.

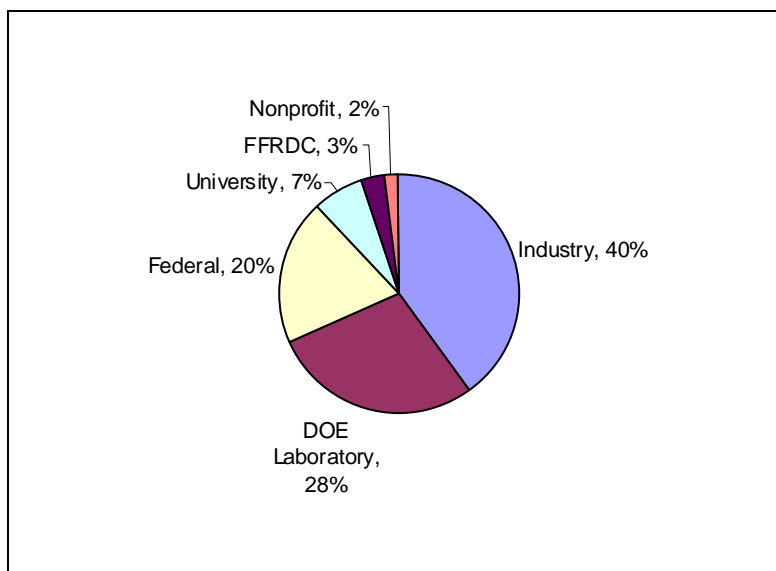
Annual budget documents typically do not provide a breakdown of funding between intramural and extramural activities; among industrial, academic, and non-profit organizations; or between public-sector and private-sector performers. This type of information is sometimes provided in hearing testimony or in briefings by directorate staff, however. An example is given in **Figure 4**.

Operational Activities

Until 2007, the S&T Directorate contained several operational programs. The department's FY2008 budget request announced plans to transfer the BioWatch, Biological Warning and Incident Characterization, and Rapidly Deployable Chemical Detection System programs from the S&T Directorate's Chemical and Biological Division to the DHS Office of Health Affairs, and the SAFECOM program from the S&T Directorate's Command, Control, and Interoperability Division to the DHS Directorate of National Protection and Programs. In March 2007, Under Secretary Cohen noted that the four programs to be transferred "pre-date the IPT process" (discussed above) and "have reached technical maturity."⁷⁴ The moves were also driven by the general reorganization of the S&T Directorate in 2006 and by the Department of Homeland Security Appropriations Act, 2007 (P.L. 109-295), which codified the position of DHS Chief Medical Officer (CMO), gave him primary responsibility for coordinating the department's biodefense activities, and led the department to create an Office of Health Affairs, headed by the CMO.

⁷⁴ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, hearing held February 14, 2007.

Figure 4. S&T Directorate Statistics on R&D Performer Types, FY2008



Source: S&T Directorate briefing charts, February 14, 2008, based on FY2008 spending plans as of that date.

Difficulty of Tracking Budget Trends

Annual budget documents, including the *Analytical Perspectives* volume of the President's budget and the S&T Directorate's own congressional budget justifications, are the most detailed published sources of information on the directorate's activities. It is difficult, however, to use these documents to track certain types of budget trends.

Information in the President's Budget

The *Analytical Perspectives* volume is a key source of department-wide data on the funding balance among basic research, applied research, and development (see **Table 1**). Budget analysts have several causes for concern, however, about the quality of these data for DHS. One issue is the consistency of how activities are categorized. Another is the scope of the activities included: sometimes the figures include expenditures that are not R&D, and sometimes they omit expenditures that are R&D.

The data include wide variations from year to year, particularly in the balance between applied research and development. For example, they indicate that the share of the department's R&D budget authority devoted to applied research went from 23% in FY2004, up to 71% in FY2005, and then back down to 45% in FY2006. Over the same period, the share devoted to development went from 46% to 11% to 45%. While such swings may reflect annual changes in the nature of the department's R&D activities, they may also indicate that in some years development activities have been recategorized as applied research, or vice versa, as the result of unexplained changes in accounting or definition.

In addition, the *Analytical Perspectives* R&D data include some DHS activities that are not R&D. For example, the FY2006 edition shows total requested DHS R&D funding of \$1.467 billion, even though the FY2006 request for the entire S&T Directorate, containing, at that time, all DHS R&D programs, was only \$1.368 billion, including salaries and expenses.⁷⁵ Similarly, the FY2009 edition includes \$2.175 billion of advance appropriation for Project BioShield, a medical countermeasure procurement program, as R&D facilities construction funding.⁷⁶ As a consequence, the apparent funding for R&D activities for FY2009 is several times greater than the requested budgets for all R&D programs combined.

Conversely, the *Analytical Perspectives* data sometimes appear to omit DHS R&D activities that should be included. For example, in the FY2006 edition, the estimate of total DHS R&D for FY2005 is \$1.185 billion. In the DHS FY2006 congressional budget justification, the total FY2005 funding for the S&T Directorate (excluding salaries and expenses) and the R&D programs of the Transportation Security Administration, Coast Guard, and Customs is \$1.244 billion. The difference of \$59 million is not accounted for by non-R&D activities in the S&T Directorate. Instead, it appears to reflect the omission of the Transportation Security Administration and Customs programs from the *Analytical Perspectives* data.

Information in DHS Budget Justifications

The directorate's congressional budget justifications are the key source of information on the budgets of individual programs (see **Appendix C**). The main difficulty in using this information to track trends from year to year is the changing organization of the directorate. In many cases, the major reorganization in 2006 makes it impossible to compare program-level budgets before and after FY2007.⁷⁷

Smaller organizational changes also present challenges for specific programs before that date. For example, when the Transportation Security Laboratory was transferred to the directorate from elsewhere in the department, its funding was first pooled with some smaller unrelated programs in a category called R&D Consolidation (FY2006) and then merged into the existing Explosives Countermeasures category (FY2007). Starting in FY2008 it became part of the Laboratory Facilities category. The budget justifications for these years do not allow the laboratory's funding to be tracked across the organizational transition. Another challenge is that the figures reported in the directorate's budget justifications have sometimes appeared inconsistent. For example, past-year data is sometimes reported as budget authority and sometimes as obligations, without clear identification.

⁷⁵ These non-R&D expenditures include, for example, the directorate's operational activities, its program of scholarships and fellowships, and under some definitions, the salaries and expenses of its management.

⁷⁶ CRS analysis of data from Office of Management and Budget, The White House, *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2009*, February 2008.

⁷⁷ While DHS provided a crosswalk between the old and new budget structure for FY2007, the information is not sufficient to recalculate prior year allotments into the new budget structure.

Financial Management

When the S&T Directorate was formed, it had to establish an entirely new financial and budgeting system, because although it incorporated some existing programs from other agencies, its mission and activities overall were largely new. In 2004, GAO reported that DHS as a whole faced a “daunting task” in bringing together the financial management systems of the agencies from which it was formed.⁷⁸ Establishing new systems from the ground up may have been an even greater challenge. Difficulties the S&T Directorate has encountered in this effort range from insufficient ethics-related management controls⁷⁹ to unclear determinations of administrative overhead costs.⁸⁰ According to the DHS annual financial report for FY2007, internal financial controls in the S&T Directorate no longer have material weaknesses (factors that might make financial reporting inaccurate), but tests of the effectiveness of those controls remain to be completed in the areas of financial system security, grants management, and payment management.⁸¹

Table 4. S&T Directorate Unobligated Balances

(\$ in millions)

	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008
Start of Year	0	0	359	381	276	401	255
End of Year	40	353	381	277	404	291	149

Source: DHS congressional budget justifications for the fiscal year two years after the one stated. For example, the figure of \$40 million at the end of FY2002 was obtained from the FY2004 congressional budget justification.

Note: Ending amounts do not always match starting amounts for the next year because of subsequent budget corrections, such as recoveries of obligated funds and rescission of prior year unobligated balances.

One aspect that has drawn the attention of congressional policymakers is the persistence of unobligated balances from prior fiscal years. The S&T Directorate has not always obligated the full amount of its annual appropriation. In the first few years after its establishment, possible reasons for this included appropriations that were consistently higher than the directorate had requested and the directorate’s inability to spend funds rapidly because of its slow progress in hiring program managers. Because funds appropriated to the S&T Directorate do not expire,⁸² a significant unobligated balance accumulated (see **Table 4**). In response, Congress rescinded \$20 million in unobligated prior-year funds in the Department of Homeland Security Appropriations

⁷⁸ Government Accountability Office, *Financial Management: Department of Homeland Security Faces Significant Financial Management Challenges*, GAO-04-774, July 2004.

⁷⁹ Government Accountability Office, *DHS Needs to Improve Ethics-Related Management Controls for the Science and Technology Directorate*, GAO-06-206, December 22, 2005.

⁸⁰ See, for example, H.Rept. 109-476.

⁸¹ Department of Homeland Security, *DHS Annual Financial Report Fiscal Year 2007*, November 15, 2007, p. 33. Similar information for previous years is in the performance and accountability reports at http://www.dhs.gov/about/budget/editorial_0430.shtm.

⁸² In many other agencies, funds that are unspent at the end of the year return to the Treasury. This is not the case for the S&T Directorate, except for its management and administration account, because its annual appropriations language includes the phrase “to remain available until expended.”

Act, 2006 (P.L. 109-90) and an additional \$125 million in the Department of Homeland Security Appropriations Act, 2007 (P.L. 109-295).

Congress places no expiration date on funds it appropriates to the S&T Directorate. Congress may intend for some unobligated balance to persist in S&T Directorate accounts. Even if that is the case, the magnitude of the existing unobligated balance may mean that it will take several fiscal years to reach the level of carryover desired by Congress.

Under Secretary Cohen has testified that the S&T Directorate is attempting to reduce its unobligated balance and intends to spend funds in the year for which they are appropriated. In February 2007, comparing the FY2007 obligation rate to the FY2006 obligation rate, he said,

I believe you'll see we've made significant progress in getting the books right, and in terms of our obligations, we have committed as of today 47 percent of our FY2007 budget. That compares with six percent at the same time last year....⁸³

By the end of FY2007, the directorate had reduced its prior-year unobligated balance to \$74 million, but it had only obligated 75% of its FY2007 appropriation.⁸⁴ As a result, an unobligated balance of \$291 million was carried forward into FY2008.⁸⁵ In testimony in April 2008, the Under Secretary noted that the S&T Directorate does not control the DHS acquisition process and referred to "challenges" with getting committed funds obligated; he suggested a need to consider "refinement" of processes in the department that may currently be "suboptimized."⁸⁶

Relationships with Other R&D Organizations

Among the statutory responsibilities of the Under Secretary for Science and Technology are coordinating and integrating the R&D activities of other DHS components with those of the S&T Directorate, entering into agreements with the Department of Energy regarding DHS use of its national laboratories, and coordinating DHS science and technology activities with other federal agencies. These relationships have raised a variety of issues.

Consolidation of R&D within DHS

When DHS was created, several components with R&D activities were transferred into the new department in their entirety, without merging their R&D activities into the S&T Directorate. The largest of these were the Transportation Security Administration (TSA), the Customs Service, and the Coast Guard. Some of these transfers were statutorily protected from subsequent reorganization. The TSA was to remain intact for two years following the enactment of the

⁸³ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Homeland Security Committee, Subcommittee on Border, Maritime and Global Counterterrorism, February 14, 2007.

⁸⁴ Personal communication with DHS Legislative Affairs, January 16, 2008.

⁸⁵ DHS congressional budget justification for FY2009. (See **Table 4**.)

⁸⁶ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Homeland Security Committee, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, April 1, 2008.

Homeland Security Act.⁸⁷ The Coast Guard is to be maintained as a distinct entity within DHS.⁸⁸ Although the Homeland Security Act charges the Under Secretary with “establishing and administering the primary research and development activities of the Department” (Sec. 302(11)), 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.⁸⁹

For the first few years of the department’s existence, a trend toward consolidation of its R&D activities tended to simplify this coordination role. The conference report (H.Rept. 108-280) accompanying the Department of Homeland Security Appropriations Act, 2004 (P.L. 108-90) gave this trend explicit direction. 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.

Consolidation was seen by its advocates as having the potential to foster collaboration, increase synergy between programs, reduce duplication, streamline processes and procedures, and improve budgeting and oversight. Critics, however, expressed doubt about the S&T Directorate’s ability to balance R&D priorities across a growing spectrum of responsibilities. One concern was whether the directorate would effectively support the department’s non-homeland security missions. (The fact that the Coast Guard has both homeland security and non-homeland security responsibilities was a key factor in Congress’s decision to keep its R&D efforts intact.)⁹⁰ Another concern was whether the directorate’s heavy emphasis on countering weapons of mass destruction would result in the neglect of other, smaller programs.

The directorate’s experiences with consolidation have been mixed. The integration of the Customs Service R&D program and several other smaller activities seems to have gone smoothly. In contrast, absorbing TSA’s R&D program was perceived as being so difficult that in 2006, the Senate Committee on Appropriations proposed transferring the Transportation Security Laboratory back to TSA:

The Committee is also aware S&T and TSA have not come to agreement on the research priorities for this portfolio. Given these issues, the Committee believes TSL would be better managed by TSA.⁹¹

This proposal was abandoned after the S&T Directorate and TSA signed a memorandum of understanding in August 2006.⁹²

⁸⁷ 6 U.S.C. 234.

⁸⁸ 6 U.S.C. 468.

⁸⁹ 6 U.S.C. 186.

⁹⁰ See, for example, Greta Wodele, “Lawmakers Aim to Keep Coast Guard R&D within Agency,” *Technology Daily*, June 23, 2004.

⁹¹ S.Rept. 109-273.

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 directive⁹³ 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, it received its funding through the S&T Directorate until FY2007.

Whether the establishment of DNDO was a singular event or the beginning of a more general trend toward deconsolidation remains to be seen. One apparent motivation for its establishment as a separate organization was Congress's displeasure with the management of the S&T Directorate. For example, the House Committee on Appropriations expressed its dissatisfaction with removing DNDO from the S&T Directorate but nevertheless approved the move because of "the liability it would face" otherwise (H.Rept. 109-476). During the tenure of former Under Secretary Cohen, Congress appeared more confident in the S&T Directorate's competence.⁹⁴ If that confidence continues, further deconsolidation may be less likely.

Role of the Domestic Nuclear Detection Office

The establishment of DNDO as a free-standing office outside the S&T Directorate (like the continued existence of a small R&D activity in the Coast Guard) raises questions about how effectively the Under Secretary for S&T will be able to carry out his responsibility of "coordinating and integrating all research, development, demonstration, testing, and evaluation activities of the Department."⁹⁵ In providing statutory authority for DNDO, the SAFE Port Act required that the Under Secretary and the director of DNDO provide joint notifications to Congress regarding nuclear and radiological detection and directed DNDO to coordinate with the Under Secretary on "basic and advanced or transformational research and development efforts relevant to the mission of both organizations."⁹⁶ It is unclear how effective this coordination has been. The rapid growth of DNDO, both in absolute terms and relative to the S&T Directorate, arguably represents a shift of R&D authority away from the Under Secretary. If S&T Directorate budgets decline or remain constant while DNDO budgets increase, the DHS R&D budget may become increasingly weighted towards DNDO efforts. Although much of DNDO's activity is operational, and operational activities have been transferred out of the S&T Directorate with little objection, DNDO also funds a substantial amount of R&D. It also conducts substantial testing and evaluation, some of which has been heavily criticized.⁹⁷ Finally, as noted above, the

(...continued)

⁹² H.Rept. 109-699.

⁹³ Executive Office of the President, The White House, *Domestic Nuclear Detection*, National Security Presidential Directive 43 (NSPD-43) and Homeland Security Presidential Directive 14 (HSPD-14), April 15, 2005.

⁹⁴ For example, in its report on the Senate's FY2008 homeland security appropriations bill (Department of Homeland Security Appropriations Act, 2008; S. 1644), the Senate Committee on Appropriations stated that "The Committee is pleased with the rapid progress S&T appears to be making toward resolving past difficulties. The new Under Secretary has restructured the directorate's programs, worked to obligate resources in a timely fashion, and instituted a capable budget office able to deliver timely, accurate, and comprehensible documents." (S.Rept. 110-84)

⁹⁵ Homeland Security Act, Sec. 302(12).

⁹⁶ Homeland Security Act, Sec. 1802(a)(6), as amended by the SAFE Port Act (P.L. 109-347), Sec. 510(a).

⁹⁷ See CRS Report RL34750, *The Advanced Spectroscopic Portal Program: Background and Issues for Congress*, by (continued...)

establishment of DNDO appears to reflect an increase in the priority DHS places on countering radiological and nuclear threats. If that priority should shift, the separation of DNDO from the S&T Directorate may make it more difficult to rebalance the department's R&D activities.

Relationship with the DOE National Laboratories

The close relationship between DHS and the DOE national laboratories has raised issues about the role of national laboratory personnel in the directorate's planning and how that may affect the directorate's decisions about awarding R&D contracts.

As well as performing R&D on behalf of the S&T Directorate, under the terms of the special statutory arrangement previously mentioned, the DOE national laboratories also frequently provide the directorate with technical experts for program planning and oversight. In some cases, these experts work for the directorate for a limited period under the Intergovernmental Personnel Act (IPA, 5 U.S.C. 3371-76) with the expectation of subsequently returning to their original laboratories. The directorate's extensive use of national laboratory employees, including IPA employees, has been an issue of congressional interest, especially with respect to the influence these employees have on the choice of contractors and the formulation of funding opportunities.⁹⁸

In addition, the national laboratories can compete for the directorate's R&D funding. Each year, the directorate issues several Broad Agency Announcements soliciting R&D proposals from outside the department. Proposals submitted in response to these announcements have largely come from industry, but because the Broad Agency Announcement process is an open, competitive solicitation, national laboratories may also participate, unless specifically excluded. Questions have been raised about whether this situation is appropriate and sound; whether the national laboratories have an undue advantage over industry (for example, because of their long history of conducting classified and sensitive R&D for the federal government); and whether the department has an explicit or implicit policy about the balance between awards to industry and awards to the national laboratories.

Soon after its establishment, the directorate tried to resolve these issues by designating some of the DOE national laboratories as intramural and others as extramural. The intramural laboratories would have had a closer relationship with the directorate but would have been ineligible for competitively awarded contracts, such as funds awarded through Broad Agency Announcements. The extramural laboratories would have been eligible for competitive awards, but not for other funding from the directorate. This plan was soon abandoned when it encountered congressional opposition.⁹⁹

(...continued)

Dana A. Shea, John D. Moteff, and Daniel Morgan.

⁹⁸ See Government Accountability Office, *DHS Needs to Improve Ethics-Related Management Controls for the Science and Technology Directorate*, GAO-06-206, December 22, 2005.

⁹⁹ For a summary of this episode, see Caitlin Harrington, "DHS Drops Contracting Plan for National Laboratories," *CQ Homeland Security*, March 4, 2004.

The Obama Administration is reportedly considering transfer of select national laboratories from DOE to the Department of Defense (DOD).¹⁰⁰ Some Members of Congress opposed this potential transfer, citing the missions of the DOE national laboratories beyond national security.¹⁰¹ Transfer of a national laboratory from DOE to DOD would also change the relationship between DHS and the national laboratory. In the absence of statutory changes, DHS would no longer have a special relationship as described in statute with the transferred laboratory. DHS activities would thus be conducted as “work for others” rather than as equivalent to that funded by the laboratory-owning agency.

Interagency Coordination

As well as requiring coordination with other DHS components, the Homeland Security Act requires the S&T Directorate to interact with a variety of other executive branch agencies. 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. He or she 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. The directorate makes extensive use of the DOE national laboratories and relies on Department of Defense facilities to house bioforensics laboratories, while the Department of Agriculture uses the directorate’s Plum Island laboratory for research not directly related to homeland security. In these and other areas, the effectiveness of interagency coordination is of continuing importance.

The national policy and strategic plan has not yet been released, and the obstacles its development has encountered illustrate the challenges of working with other agencies. Former Under Secretary Cohen testified that, as of March 2007, a draft existed that had been in preparation for about two years, but it was “perceived by the other departments and agencies as mandat[ing] what they would do for Homeland Security ... how they, through their efforts, could contribute to Homeland Security.” As a result, he said, “it had a very difficult time coming to fruition.”¹⁰² A few months later, he explained that the directorate had originally interpreted the requirement to work in consultation with other agencies as requiring the concurrence of those agencies, a process that he described as “tortuous.” He stated that he would reinterpret consultation as giving other agencies an opportunity to comment, and under that interpretation, he would “work to get this through OMB ... to the best of my ability before the end of [FY2007].”¹⁰³ In December 2007, the S&T Directorate released *Coordination of Homeland Security Science and Technology*.¹⁰⁴ According to the foreword of this document, it is a “descriptive baseline for homeland security research and

¹⁰⁰ John Fleck, “Military Control of Labs Studied; Move Would End Civilian Management,” *Albuquerque Journal*, February 4, 2009.

¹⁰¹ Heather Clark, “NM Mayor: DoD Won’t Gain Control of Labs,” *The Associated Press*, February 21, 2009.

¹⁰² Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Science and Technology, Subcommittee on Technology and Innovation, March 8, 2007.

¹⁰³ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, June 27, 2007.

¹⁰⁴ Department of Homeland Security, *Coordination of Homeland Security Science and Technology*, December 2007.

development measures across the federal government ... developed with the cooperation of [other] federal agencies” and is a “first step in developing a more prescriptive plan.”

The coordination document states that it will be updated annually to report on performance measures and progress toward homeland security goals. The first update will take place in FY2009 as part of the first Quadrennial Homeland Security Review.¹⁰⁵ Former Under Secretary Cohen testified that the document’s continued development “will play an important role in helping align strategies and missions to adapt to a fast changing world and an ever evolving enemy.”¹⁰⁶ Even though the 2007 document is not prescriptive, it may, by establishing a common framework, help agencies to identify synergies and unmet needs. If agencies indeed align their strategies, that consensus may lower barriers to achieving a more prescriptive homeland security R&D strategy.

The S&T Directorate uses a variety of mechanisms for interagency coordination. These include memoranda of understanding, participation in interagency committees and working groups, sponsorship of interagency meetings and conferences, joint management of programs, and joint strategy development.¹⁰⁷ Formal coordination takes place at a high level through several White House groups, including the Homeland Security Council, National Security Council, National Science and Technology Council (NSTC), and Office of Science and Technology Policy. The Under Secretary for Science and Technology co-chairs the NSTC Committee on Homeland and National Security. On specific R&D topics, coordination sometimes takes place through the multiagency Technical Support Working Group (TSWG), overseen by the Departments of State and Defense. The S&T Directorate and several other DHS organizations participate in TSWG. The S&T Directorate’s strategic plan notes that within the directorate, the Interagency Programs Division facilitates government-wide coordination, and the Office of National Laboratories coordinates with DOE regarding the national laboratories. The R&D plan accompanying the strategic plan does not explicitly identify areas of overlap or synergy with other federal agencies.

One prominent program for which interagency coordination has been an issue is Project BioShield. Under this program, the Secretary of Homeland Security is responsible for assessing whether a particular biological, chemical, radiological, or nuclear agent poses a “material threat” to national security. In practice, the analysis that underpins this assessment is performed by the S&T Directorate. (The Office of Health Affairs also participates.) Once the Secretary makes a material threat determination, the Department of Health and Human Services (HHS) may procure countermeasures for that agent using a 10-year block of funds that were appropriated to DHS in FY2004. Congress and other stakeholders have criticized DHS for making material threat determinations too slowly and thereby slowing the pace of countermeasure procurement by HHS.

¹⁰⁵ According to the former Secretary of Homeland Security, the Quadrennial Homeland Security Review will recommend a long-term homeland security strategy, establish national homeland security priorities, and comprehensively examine homeland security programs, assets, budget, policies, and authorities. Secretary Michael Chertoff, Department of Homeland Security, testimony before the Senate Committee on Homeland Security and Governmental Affairs, February 15, 2008.

¹⁰⁶ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, April 1, 2008.

¹⁰⁷ For some examples, see Appendix C, “S&T Directorate Interagency Interactions,” in the prepared testimony of Under Secretary Charles E. McQueary, hearing of the House Committee on Science, February 16, 2005.

Management and oversight of the program are complicated by discrepancies between DHS and HHS about the amount of funds that remain available. For more details, see CRS Report RL33907, *Project BioShield: Appropriations, Acquisitions, and Policy Implementation Issues for Congress*.

Metrics and Goals for Directorate Output

When the S&T Directorate was established, its optimal investment strategy was unclear. The range of threats and vulnerabilities was broad, and the directorate initially placed a premium on identifying technologies in an advanced stage of development, transitioning them into deployable equipment, and providing this equipment to end users. One DHS official believed, “there’s a lot of low-hanging fruit out there, capability that already exists, either commercially or in laboratory prototypes.”¹⁰⁸

As the directorate matures and its R&D results are implemented and deployed, this focus on “low-hanging fruit” may need to evolve into a more diverse strategy that also includes more fundamental research and riskier investments. Fundamental or basic research is often identified as a key source of future technologies, and research with innately higher risk, but also higher reward, may have more potential for significant breakthroughs. Some experts advocate more S&T Directorate investment in these types of research:

Failure to invest in longer-term research limits the prospects for future breakthroughs that could dramatically improve DHS’s ability to fulfill its mission. As the S&T Directorate matures, so must its S&T portfolio—which means investing in a portfolio of both near-term and long-term research. I understand that the S&T Directorate’s leadership now shares this view. I particularly welcome [the Under Secretary for Science and Technology’s] plans to fund some high-risk but potentially very high payoff projects. A serious pathology that can overtake a technology development program is to become failure intolerant, forcing it to settle on safe bets that are less ambitious than its mission requires. Admiral Cohen will need your support if he hopes to avoid this—you will have to make sure he fails often enough, and to hold him accountable if he doesn’t.¹⁰⁹

A key component of such a strategy is assessing the progress of funded research projects. Without effective assessment, it may be difficult to sustain investment in long-term research activities that appear to be progressing slowly, or conversely, it may be difficult to terminate projects that appear productive but are not leading toward an appropriate goal. Depending on the stage and purpose of the research activity, criteria for success (and thus for continued investment by the directorate) may vary. Substantial investments in planning may be needed to establish appropriate criteria and assess programs effectively.

¹⁰⁸ Comments of Penrose Albright, Assistant Under Secretary for Science and Technology, Department of Homeland Security, at the American Association for the Advancement of Science meeting “Overview of the FY 2006 Research & Development Budget,” March 10, 2005.

¹⁰⁹ Gerald L. Epstein, Center for Strategic and International Studies, testimony before the House Committee on Science and Technology, Subcommittee on Technology and Innovation, March 8, 2007.

The difficulty of establishing quantitative goals and metrics for R&D effectiveness is a well known challenge for the evaluation of R&D programs.¹¹⁰ The impact of longer-range research may not be evident for years after its completion. Even if success can be measured, success rates may vary widely between programs deemed as effective, depending on the character of the R&D undertaken. For example, the Defense Advanced Research Projects Agency (DARPA) funds high-risk, high-reward R&D. The likelihood of success for any individual DARPA activity is low, but that is expected. The success of the program overall is judged by the impact of the activities that are successful. In contrast, an R&D program engaged mainly in incremental end-stage development, where there is lower risk of failure, might be expected to have a higher project success rate but less impact for each particular result.

The Government Performance and Results Act of 1993 (GPRA, P.L. 103-62) attempted to address metrics and goals for federal agencies, creating greater efficiency, effectiveness, and accountability in federal spending, and requiring agencies to set goals and to use performance measures for management and, ultimately, for budgeting.¹¹¹ Although the outcome of GPRA has been a foundation of performance-based planning for federal agencies, evaluation of strategic planning continues to be a weakness.¹¹²

The Bush Administration also set a priority on performance measures as part of the budgetary process, establishing the program assessment rating tool (PART) as part of the performance assessment methodology used under the President's Management Agenda.¹¹³ Some of the S&T Directorate's research portfolios have undergone PART assessments, with a range of results.¹¹⁴ Some programs, such as the biological countermeasures program, were assessed as effective, while others, such as the chemical and explosive countermeasures program, were not. The PART assessment process highlights the series of factors that complicates assessment of the S&T Directorate programs. Existing programs transferred in whole or in part into the S&T Directorate may have lacked an initial homeland security focus, blunting their efficacy. New programs developed by the S&T Directorate with the necessary homeland security focus lack a history of operation and management, challenging the smooth and efficient implementation of the programs' stated goals.

Measuring outcomes from programs with long time scales, where results are not expected to be seen for several years, may pose a challenge to the PART technique. As stated by the White House Office of Management and Budget, "the Administration is aware that predicting and

¹¹⁰ See, for example, General Accounting Office, *Measuring Performance: Strengths and Limitations of Research Indicators*, GAO/RCED-97-91, March 1997, which states that "the very nature of the innovative process makes measuring the performance of science-related projects difficult. For example, a wide range of factors determine if and when a particular R&D project will result in commercial or other benefits. It can also take many years for a research project to achieve results."

¹¹¹ For more information, see CRS Report RL32671, *Federal Program Performance Review: Program Assessment and Results Act and Other Developments*, by Virginia A. McMurtry.

¹¹² Government Accountability Office, *Results-Oriented Government: GPRA Has Established a Solid Foundation for Achieving Greater Results*, GAO-04-38, March 2004.

¹¹³ For more information on the President's Management Agenda, see online at <http://www.whitehouse.gov/results/agenda/index.html>.

¹¹⁴ Detailed results from PART assessments can be found online at <http://www.whitehouse.gov/omb/expectmore/>.

assessing the outcomes of basic research in particular is never easy.”¹¹⁵ At a minimum, the PART documentation for S&T Directorate programs aims to provide clearer information about program goals and performance, R&D management, and effective practices. To the extent that this is successful, this information helps to inform outside analysts of the directorate’s plans.¹¹⁶

Some observers had hoped that the directorate’s strategic planning process would identify quantitative metrics and goals. This was not the case, however. The program work statements in the 2007 R&D plan mostly describe qualitative increases, improvements, and developments, rather than quantitative criteria.

Another, similar approach would be to use the Homeland Security Science and Technology Advisory Committee or an outside body, such as the National Academy of Sciences, to independently validate the directorate’s strategic planning documents, with goals and metrics for the short, medium, and long terms. Statute has mandated comparable requirements in other S&T fields.¹¹⁷ While the S&T Directorate uses committees of the National Academies for advice on an ad hoc basis, it has not engaged the National Academies or any other organization to perform a rigorous, end-to-end assessment of the directorate’s research activities.

Responsiveness to Stakeholders

The S&T Directorate’s responsiveness to stakeholders has been a recurring issue since the department’s creation. The S&T Directorate has continued to attempt to increase the quality and number of approaches available to stakeholders wishing to contact and do business with the department. In addition, it has attempted to improve relations with Members of Congress and congressional committees.

Industry

Companies with technologies potentially applicable to homeland security problems have sometimes had difficulty identifying appropriate contacts at the S&T Directorate. The S&T Directorate has taken several steps to improve its interactions with industry, including increasing its accessibility through the Internet, expanding stakeholder conference opportunities, and creating the position of a Chief Commercialization Officer. The directorate makes its Broad Agency Announcements (BAA) available on a website¹¹⁸ and via an e-mail mailing list, and it announces R&D solicitations targeted at small businesses on another website.¹¹⁹ All funding

¹¹⁵ Office of Management and Budget, The White House, “Guidance for Completing 2007 PARTs,” *Program Assessment Rating Tool Guidance No. 2007-02*, January 29, 2007.

¹¹⁶ For a discussion on criticisms of PART, see CRS Report RL32663, *The Bush Administration’s Program Assessment Rating Tool (PART)*, by Clinton T. Brass; and Government Accountability Office, *Performance Budgeting—PART Focuses Attention on Program Performance, but More Can Be Done to Engage Congress*, GAO-06-28, October, 2005.

¹¹⁷ See, for example, the National Defense Authorization Act for 2004 (P.L. 108-136), in which Congress required the Department of Defense to develop a space science and technology strategy that included goals and a process for achieving those goals.

¹¹⁸ <http://www.hsarpabaa.com>.

¹¹⁹ <https://www.sbir.dhs.gov/>.

opportunities are also listed on the government-wide website FedBizOpps.¹²⁰ The preferred mechanism for submission of unsolicited proposals is through the Office of Procurement Operations.¹²¹ Such submissions are sent to the Headquarters Office of Procurement Operations rather than directly to the S&T Directorate. The S&T Directorate itself maintains an email address for submissions of concepts and ideas.¹²² In May 2007, the directorate held a stakeholder conference for which Under Secretary Cohen at that time described the message as “we are open for business, and we know how to do business.”¹²³ Announcements of subsequent stakeholder conferences have listed goals such as “describ[ing] the business opportunities for private sector organizations and universities, ... demonstrating business partnership opportunities in S&T research, ... [and] explaining how to do business with the DHS S&T research enterprise.”¹²⁴ The directorate has held annual stakeholder meetings, one on each coast. These stakeholder meetings have been a mechanism to provide industry and other stakeholders with access to S&T Directorate personnel and provide fora for collaboration.

In January 2009, the directorate released a “DHS S&T Long Range Broad Agency Announcement.” This BAA was partly a response to concerns that entrepreneurs and researchers might be unable to bring their ideas to the directorate if there is no open request for proposals or BAA. The long-range BAA is open through December 31, 2009, and provides a vehicle for submission of a broad range of homeland security R&D ideas and proposals. It states, “Readers shall note that this is an announcement to declare S&T’s broad role in competitive funding of meritorious research across a spectrum of science and engineering disciplines.”¹²⁵

Former Under Secretary Cohen has also identified continued outreach efforts on the part of the directorate and the components of the directorate as efforts to encourage greater industry participation.¹²⁶ The directorate has held or partnered with other groups to hold conferences in the United States and the United Kingdom to engage stakeholders and provide attendees with access and contact. Emphasizing the importance of maintaining good contacts with industry and others, Former Under Secretary Cohen testified in 2008, “As I have often said, no one knows where good ideas may come from and for that reason I have been personally proactive in both seeking out and receiving technology briefs and opportunities from all sources. This is a culture I am working to instill throughout the DHS S&T Directorate.”¹²⁷

¹²⁰ <http://fedbizopps.gov/>.

¹²¹ For more information on how unsolicited proposals are received and handled by the Office of Procurement Operations, see online at http://www.dhs.gov/xopnbiz/opportunities/editorial_0617.shtm.

¹²² This e-mail address is S&T-Transition@dhs.gov. Personal communication with DHS Legislative Affairs, January 16, 2008.

¹²³ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, June 27, 2007.

¹²⁴ Email announcement of “Putting First Responders First,” the 2008 Homeland Security S&T Stakeholders Conference—West, held January 14-17, 2008.

¹²⁵ Department of Homeland Security, Science and Technology Directorate, “DHS S&T Long Range Broad Agency Announcement,” *BAA 09-05*, January 7, 2008.

¹²⁶ See, for example, Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Emergency Preparedness, Science, and Technology, April 1, 2008.

¹²⁷ Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before (continued...)

The S&T Directorate established a Commercialization Office headed by a Chief Commercialization Officer.¹²⁸ This office is responsible for developing and managing the S&T Directorate's outreach efforts with the private sector. Beyond these outreach efforts, the Commercialization Office also is engaged in developing detailed operational requirements documents that reflect the Departmental needs that might be met by private sector developmental activities. By combining these needs with estimates of the potential available market for a given product, the Commercialization Office attempts to induce the private sector to invest its own funds into developing solutions to departmental needs without the investment of federal R&D funds.¹²⁹

The results of these efforts have reportedly been positively received by industry. The S&T Directorate has been perceived as improving in the quality of interaction, speed of response, and provision of information to interested companies.¹³⁰

Congress

Some Members of Congress have also expressed concerns regarding difficulties in obtaining information from the S&T Directorate. Congressional policymakers have criticized the directorate, along with DHS as a whole, for not providing it with information in a timely manner. For example, the House committee report accompanying the Department of Homeland Security Appropriations Act, 2007 bill stated that "the Committee is very disappointed by S&T's poor response to Congressional requests for information, including a failure to provide congressionally directed reports. After three years, there has been no measurable improvement in this area, which is unacceptable."¹³¹

Under Secretary Cohen responded to such congressional concerns. The month after he was confirmed, he stated that

the S&T Directorate will execute appropriations as intended by Congress. We will also be fiscally accountable to our DHS Customers, the Congress and the American people.

The S&T Directorate CFO ... [will] help put in place the systems and protocols to enable S&T Directorate to be fully responsive and transparent in the development, presentation and execution of the budget.¹³²

(...continued)

the House Committee on Homeland Security, Subcommittee on Emergency Preparedness, Science, and Technology, April 1, 2008.

¹²⁸ For more information on the Commercialization Office, see online at http://www.dhs.gov/xabout/structure/gc_1234194479267.shtm and http://www.dhs.gov/xres/programs/gc_1234200779149.shtm.

¹²⁹ For more on this effort, called the SECURE (System Efficacy through Commercialization, Utilization, Relevance and Evaluation) Program, see online at http://www.dhs.gov/xres/programs/gc_1211996620526.shtm.

¹³⁰ Rob Margetta, "S&T's Cohen Has Made Enough Friends to Be a Candidate for Staying Put," *CQ Homeland Security*, December 19, 2008.

¹³¹ H.Rept. 109-476.

¹³² Under Secretary for Science and Technology Jay M. Cohen, Department of Homeland Security, testimony before the House Committee on Homeland Security, Subcommittee on Emergency Preparedness, Science, and Technology, (continued...)

While relations between the S&T Directorate and Congress have generally improved, not all in Congress have been satisfied with the S&T Directorate's performance or provision of information.¹³³ For example, Representative Dingell stated to then-Under Secretary Cohen during an oversight hearing that

DHS has not been forthcoming in providing records and information requested by the Committee [on Energy and Commerce]. In several instances, the Committee has only been provided copies of certain key records after Committee staff discovered their existence, despite the fact that we specifically requested all such records. This is simply not acceptable.¹³⁴

Expiring Authorities

Several statutory authorities related to the S&T Directorate have recently expired or will expire during 2009. Authority for the Homeland Security Science and Technology Advisory Committee expired on December 31, 2008 (6 U.S.C. 191(j)). Authority for the Homeland Security Institute expired on April 25, 2009, five years after its establishment (6 U.S.C. 192(g)). The authority for DHS to enter into "other transaction agreements" for R&D projects expires on September 30, 2009 (6 U.S.C. 391(a)).¹³⁵ Policymakers have expressed interest in the S&T Directorate's use of these entities and authorities, including holding hearings specifically on such topics.¹³⁶

Overview of Legislation in the 111th Congress

In contrast to some other federal departments and agencies, the DHS lacks budget authorization legislation. Several attempts have been made to provide such authorization, for example in the 110th and previous Congresses, but none have been passed into law. Instead, changes to particular programs have been made in the annual appropriations bills and their accompanying reports, in stand-alone bills devoted to specific topics, and in specific provisions within broader legislation. As a result, changes to the responsibilities, components, and activities of the S&T Directorate occur outside of a holistic context, with the focus of the change usually coinciding with the focus of the particular topic of the stand-alone bill. Examples of such legislation are provided below.

(...continued)

September 7, 2006.

¹³³ For example, see comments by Representative Culberson in House Appropriations Committee, Subcommittee on Homeland Security, "Developing and Transitioning Homeland Security Research Products into Use," *Hearing Transcript*, March 26, 2009.

¹³⁴ As quoted in "Committee Questions Homeland Security Plans To Move Animal Disease Research Facility To U.S. Mainland," *States News Service*, May 23, 2008.

¹³⁵ This authority was extended through fiscal year 2009 by Section 537 of Division D of P.L. 110-329.

¹³⁶ House Committee on Homeland Security, Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology, *Other Transaction Authority: Flexibility at the Expense of Accountability?* hearing held February 7, 2008.

DHS Authorization Act for FY2010

In each Congress since the creation of the Department, authorization legislation has been introduced to accompany the annual appropriations legislation. While these bills have in some Congresses passed the House, they have not passed into law. The chairmen of the House Committee on Homeland Security and the Senate Committee on Homeland Security and Governmental Affairs have each stated their intention to introduce authorization bills again in the 111th Congress.¹³⁷ It is not yet clear, however, whether these bills will be more successful than past efforts.¹³⁸

FY2010 Appropriations Legislation

The S&T Directorate is funded, along with the rest of the Department of Homeland Security, in the annual homeland security appropriations bill. For FY2009, the House and Senate versions of this bill were H.R. 6947 and S. 3181. The final appropriation was made by a consolidated bill (P.L. 110-329). For the FY2009 appropriated amounts, see **Table C-2** in **Appendix C**, and for more information, see CRS Report RL34482, *Homeland Security Department: FY2009 Appropriations*, and CRS Report RL34448, *Federal Research and Development Funding: FY2009*. **Table C-2** also shows the Administration's request for FY2010. The Administration requested a total of \$968 million for the S&T Directorate for FY2010. This was 4% more than the FY2009 appropriation of \$933 million. FY2010 homeland security appropriations legislation has not been introduced in either chamber.

H.R. 549, National Bombing Prevention Act of 2009

H.R. 549, the National Bombing Prevention Act of 2009, authorizes, among other provisions, the establishment within the S&T Directorate of an explosives research and development program and a technology transfer program for technology and equipment against explosives and improvised explosive devices. H.R. 549 was passed by the House in February 2009 and referred to the Senate Committee on Homeland Security and Governmental Affairs.

¹³⁷ Rep. Bennie G. Thompson, audio interview, "House Lawmakers Disagree Over Parts of DHS Oversight Agenda," Federal News Radio, February 5, 2009, <http://www.federalnewsradio.com/?nid=35&sid=1593715>; Sen. Joseph I. Lieberman, chairman's opening statement, confirmation hearing for Secretary of Homeland Security Janet Napolitano, Senate Committee on Homeland Security and Governmental Affairs, January 15, 2009, http://hsgac.senate.gov/public/_files/011509JILOpen.pdf.

¹³⁸ Rob Margetta, "New Quest for Authorization Bill May Again Fall Prey to Fragmentation," *CQ Homeland Security*, January 28, 2009.

Appendix A. Responsibilities and Authorities of the Under Secretary

The responsibilities and authorities of the Under Secretary for Science and Technology were established by Sec. 302 of the Homeland Security Act of 2002 (P.L. 107-296). References to radiological and nuclear threats were deleted from paragraphs (2) and (5)(A) by Sec. 501 of the SAFE Port Act (P.L. 109-347). The full text as amended (6 U.S.C. 182) is quoted here for reference:

Responsibilities and Authorities of the Under Secretary for Science and Technology.

The Secretary, acting through the Under Secretary for Science and Technology, shall have the responsibility for—

- (1) advising the Secretary regarding research and development efforts and priorities in support of the Department's missions;
- (2) developing, in consultation with other appropriate executive agencies, a national policy and strategic plan for, identifying priorities, goals, objectives and policies for, and coordinating the Federal Government's civilian efforts to identify and develop countermeasures to chemical, biological, and other emerging terrorist threats, including the development of comprehensive, research-based definable goals for such efforts and development of annual measurable objectives and specific targets to accomplish and evaluate the goals for such efforts;
- (3) supporting the Under Secretary for Information Analysis and Infrastructure Protection, by assessing and testing homeland security vulnerabilities and possible threats;
- (4) conducting basic and applied research, development, demonstration, testing, and evaluation activities that are relevant to any or all elements of the Department, through both intramural and extramural programs, except that such responsibility does not extend to human health-related research and development activities;
- (5) establishing priorities for, directing, funding, and conducting national research, development, test and evaluation, and procurement of technology and systems for—
 - (A) preventing the importation of chemical, biological, and related weapons and material; and
 - (B) detecting, preventing, protecting against, and responding to terrorist attacks;
- (6) establishing a system for transferring homeland security developments or technologies to Federal, State, local government, and private sector entities;
- (7) entering into work agreements, joint sponsorships, contracts, or any other agreements with the Department of Energy regarding the use of the national laboratories or sites and support of the science and technology base at those facilities;
- (8) collaborating with the Secretary of Agriculture and the Attorney General as provided in [7 U.S.C. 8401];

(9) collaborating with the Secretary of Health and Human Services and the Attorney General in determining any new biological agents and toxins that shall be listed as ‘select agents’ in Appendix A of [42 C.F.R. 72], pursuant to [42 U.S.C. 262a];

(10) supporting United States leadership in science and technology;

(11) establishing and administering the primary research and development activities of the Department, including the long-term research and development needs and capabilities for all elements of the Department;

(12) coordinating and integrating all research, development, demonstration, testing, and evaluation activities of the Department;

(13) coordinating with other appropriate executive agencies in developing and carrying out the science and technology agenda of the Department to reduce duplication and identify unmet needs; and

(14) developing and overseeing the administration of guidelines for merit review of research and development projects throughout the Department, and for the dissemination of research conducted or sponsored by the Department.

Appendix B. Previous Organizational Structure of the S&T Directorate

The present organizational structure of the S&T Directorate was announced by Under Secretary Cohen soon after his confirmation in August 2006. The restructuring changed both the directorate's functional organization and its operating policies. An understanding of the previous structure may be helpful when considering budgets and other documents from the period before the change.

Then, as now, the directorate had a matrix organization. Research areas known as portfolios were established in the Office of Programs, Planning, and Budget (PPB, subsequently the Office of Programs, Planning, and Requirements). The directorate's budgeting aligned with these portfolio topics. Actual management of R&D projects, however, was the responsibility of three other offices, depending on the nature of the work. Intramural R&D was managed by the Office of Research and Development (ORD), extramural R&D by the Homeland Security Advanced Research Projects Agency (HSARPA), and systems engineering and prototype transition by the Office of Systems Engineering and Development (SED). The heads of PPB, ORD, HSARPA, and SED each reported directly to the Under Secretary. Only the congressionally authorized HSARPA survives in the current structure, and its scope is greatly reduced.

This particular matrix structure had some potential advantages. The manager of each portfolio could allocate funds flexibly either within the government or outside it. Portfolio managers could facilitate information flow in their research topic between federal researchers and the private sector. Meanwhile, because ORD, HSARPA, and SED each managed parts of multiple portfolios, they could identify and act upon synergies between research areas.

On the other hand, this matrix structure created management challenges and complicated reporting and oversight. The manager of any given R&D project reported to the head of either ORD, HSARPA, or SED but was funded by a portfolio manager in PPB. Conversely, the manager of a portfolio in PPB had only indirect authority over the project managers who executed the R&D he or she was funding. Management reporting chains and lines of budget responsibility met only in the office of the Under Secretary. In addition to its inherent difficulties, this situation was unfamiliar and confusing to outside observers, including many in Congress.

Appendix C. Funding History of the S&T Directorate

For reference, **Table C-1** and **Table C-2** present historical funding data for the S&T Directorate from its inception in FY2003 through its appropriation for FY2009. This report does not attempt to track the appropriations process. For more detailed information on FY2009 funding, see CRS Report RL34482, *Homeland Security Department: FY2009 Appropriations*, and CRS Report RL34448, *Federal Research and Development Funding: FY2009*.

Table C-1 is in the directorate’s old portfolio structure, as explained in **Appendix B**. **Table C-2** is in the present division structure, as explained in the body of this report. Note that funding for FY2007 appears in both tables: FY2007 funds were appropriated in the old structure, but DHS provided a crosswalk into the new structure for comparison purposes (for FY2007 only).

Funding for DNDO is shown in **Table C-1** in order to allow historical comparisons. Even though DNDO is not part of the S&T Directorate, it evolved from the directorate’s radiological and nuclear countermeasures portfolio before FY2006, and its funding was appropriated together with the directorate’s funding in FY2006.

Table C-1. S&T Directorate Budget Authority, FY2003-FY2007
(former portfolio structure, \$ in millions)

	FY2003 Enacted	FY2004 Enacted	FY2005 Enacted	FY2006 Enacted	FY2007 Enacted ^a
Biological Countermeasures	362.6	286.5	397.7	380.0	350.2
Chemical Countermeasures	}7.0 ^b	52.0	53.0	95.0	60.0
Explosives Countermeasures		9.5	19.7	44.0	86.6
Radiological and Nuclear Countermeasures	75.0	127.0	122.6	19.1	—
Domestic Nuclear Detection Office ^c	—	—	—	318.0	481.0
Threat and Vulnerability, Testing and Assessments ^d	36.1	93.5	65.8	43.0	35.0
Standards	20.0	39.0	39.7	35.0	22.1
University and Fellowship Programs	3.0	70.0	70.0	63.0	50.0
Emerging Threats	16.8	21.0	10.8	8.0	}19.5 ^e
Rapid Prototyping	33.0	75.0	76.0	35.0	
Support to the Components / Conventional Missions	—	34.0	54.7	80.0	85.6
Counter MANPADS	—	60.0	61.0	110.0	40.0
Critical Infrastructure Protection	—	6.0	27.0	40.8	35.4
SAFETY Act	—	—	10.0	7.0	4.7
Office of Interoperability and	—	—	21.0	26.5	27.0

	FY2003 Enacted	FY2004 Enacted	FY2005 Enacted	FY2006 Enacted	FY2007 Enacted ^a
Compatibility					
Cyber Security	—	—	18.0	16.7	20.0
R&D Consolidation	—	—	—	99.9	—
Pacific Northwest National Laboratory	—	—	—	—	2.0
Management and Administration	—	44.7	68.6	81.1	135.0
Subtotal (including DNDO)	553.5	918.2	1,115.5	1,502.1	1,454.1
Subtotal (excluding DNDO)	553.5	918.2	1,115.5	1,184.1	973.1
Prior-Year Rescission	—	—	—	(20.0)	(126.2)
Supplemental (S&T)	—	—	—	—	5.0
Supplemental (DNDO)	—	—	—	—	135.0
Total (including DNDO)	553.5	918.2	1,115.5	1,482.1	1,467.9
Total (excluding DNDO)	553.5	918.2	1,115.5	1,164.1	986.9

Source: FY2005 congressional budget justification, H.Rept. 108-280, H.Rept. 108-774, H.Rept. 109-241, H.Rept. 109-699, and P.L. 110-28.

- a. Figures for FY2007 are not adjusted for transfers. See note to **Table C-2**.
- b. In FY2003, Chemical Countermeasures and Explosives Countermeasures were treated as a single Chemical and Explosives Countermeasures portfolio.
- c. DNDO is not part of the S&T Directorate but was funded through S&T in FY2006. Its funds were appropriated in a separate account starting in FY2007.
- d. This portfolio was renamed Threat Awareness starting in FY2006.
- e. In FY2007, the Emerging Threats and Rapid Prototyping portfolios were treated as a single Emergent and Prototypical Technologies portfolio.

Table C-2. S&T Directorate Budget Authority, FY2007-FY2010

(current division structure, \$ in millions)

	FY2007 Enacted^a	FY2008 Enacted	FY2009 Enacted	FY2010 Request
Chemical and Biological	229.5	208.0	200.4	206.8
Explosives	105.2	77.7	96.1	120.8
Infrastructure and Geophysical	74.8	64.5	75.8	44.7
Command, Control, and Interoperability	57.6	57.0	74.9	80.3
Borders and Maritime	33.4	25.5	33.0	40.2
Human Factors / Behavioral Sciences	6.8	14.2	12.5	15.1
Laboratory Facilities	105.6	103.8	161.9	154.5
University Programs	48.8	49.3	50.3	46.0
Innovation	38.0	33.0	33.0	44.0
Transition	24.0	25.3	28.8	45.1
Test and Evaluation and Standards	25.4	28.5	28.7	28.7
Homeland Security Institute	—	5.0	5.0	—
Management and Administration	134.0	138.6	132.1	142.2
Subtotal	883.0	830.3	932.6	968.4
Rescission of Prior-Year Funds	(126.2)	(0.2)	—	—
Emergency Supplemental Appropriation	5.0	—	—	—
Total	761.8	830.1	932.6	968.4

Source: H.Rept. 110-181; P.L. 110-161, Division E, and explanatory statement, *Congressional Record*, December 17, 2007; P.L. 110-329, Division D, and explanatory statement, *Congressional Record*, September 24, 2008; and FY2010 DHS congressional budget justification.

- a. Enacted FY2007 amounts are adjusted for the following transfers that were announced in the budget request for FY2008: \$84.1 million from Chemical and Biological to the Office of Health Affairs; \$5 million from Command, Control, and Interoperability to the Directorate of National Preparedness and Protection; and \$1 million from Management and Administration to the Office of Health Affairs.

Appendix D. Activities of the S&T Directorate

A description of the directorate's activities follows. The six divisions are discussed first, followed by the various offices, and finally activities funded by the directorate's management and administration account. This aligns with the categories now used in the directorate's congressional budget justifications and in the committee and conference reports on the annual homeland security appropriations bill.¹³⁹ (In the appropriations bill itself, all the activities except for management and administration are combined into a single account for research, development, acquisition, and operations.)

Chemical and Biological

The Chemical and Biological Division (FY2009 funding: \$200.4 million) is the largest of the six research divisions. It works to increase preparedness against agricultural, biological, and chemical threats through improved threat awareness, advanced surveillance and detection, and protective countermeasures. The agriculture component develops veterinary vaccines and other animal disease countermeasures and models the spread of animal diseases. The biological countermeasures component includes programs in systems studies and decision support tools, threat awareness, surveillance and detection R&D, surveillance and detection operations, forensics, and response and restoration, but not R&D related to human medical countermeasures, which are the responsibility of the Department of Health and Human Services. The chemical countermeasures component includes chemical threat analysis, development of forensic tools, R&D on chemical detection technologies, and development of technologies for response and recovery.

Explosives

The Explosives Division (FY2009 funding: \$96.1 million) develops technologies to detect, interdict, and lessen the impacts of nonnuclear explosives used in terrorist attacks against mass transit, civil aviation, and critical infrastructure. The bulk of its effort is devoted to explosives detection, largely through R&D programs that were transferred from the Transportation Security Administration in FY2006. It also includes R&D on protecting commercial aircraft against shoulder-fired, surface-to-air missiles (known as MANPADS, for man-portable air defense systems).

Infrastructure and Geophysical

The Infrastructure and Geophysical Division (FY2009 funding: \$75.8 million) carries out activities in two main areas: critical infrastructure protection and preparedness and response. The

¹³⁹ The Homeland Security Institute, which was a separate funding category for the first time in the Consolidated Appropriations Act, 2008 (P.L. 110-161), is not discussed in this appendix. The statutory authority for the Homeland Security Institute has expired, and DHS has replaced this institute with a different FFRDC. See the main text in the section "Laboratories and Other Assets."

infrastructure protection component includes technology development for specific infrastructure sectors and geographical regions, modeling and simulation for decision support, and preparation of the *National Plan for Research and Development in Support of Critical Infrastructure Protection*. The preparedness and response component develops technologies such as protective equipment for first responders and information-management, decision-making, and training tools for incident commanders.

Command, Control, and Interoperability

The Command, Control, and Interoperability Division (FY2009 funding: \$74.9 million) is focused on communications for emergency responders, the security and integrity of the Internet, and other information-related topics. It conducts R&D on the interoperability and compatibility of communications equipment; cyber security; knowledge management tools; reconnaissance, surveillance, and investigative technologies; and threat assessment.

Borders and Maritime Security

The Borders and Maritime Security Division (FY2009 funding: \$33.0 million) researches, develops, and transitions technologies to improve the security of U.S. borders and waterways. It has two focus areas, border protection and cargo security. The border protection component (known as Border Watch) develops tools for border security law enforcement officers and technologies for detection, identification, apprehension, and enforcement at land and maritime borders. The cargo security component develops sensor and communications technologies to improve the integrity of cargo container shipments.

Human Factors

The Human Factors Division (FY2009 funding: \$12.5 million) focuses primarily on the social and behavioral sciences. Its R&D activities include developing biometric technologies for identifying known terrorists and criminals; understanding user acceptance and application of new technologies; improving the integration of human operators and technology for transportation security screening; understanding terrorist motivation, intent, and behavior; making risk communications more effective; and better identifying public needs during emergencies.

Research (Laboratory Facilities and University Programs)

The Office of Research includes the directorate's Laboratory Facilities (FY2009 funding: \$161.9 million) and University Programs (FY2009 funding: \$50.3 million). Its director also liaises with the six research divisions as discussed above. Laboratory Facilities funds operation and construction of the S&T Directorate's own laboratories. The activities of the Laboratory Facilities program are executed by the Office of National Laboratories, one of a handful of organizational

components of the S&T Directorate that were established by statute.¹⁴⁰ University Programs manages the directorate's university centers and a program of scholarships and fellowships.

Innovation (HSARPA and SBIR)

The Office of Innovation (FY2009 funding: \$33.0 million) includes the Homeland Security Advanced Research Projects Agency (HSARPA), another component that was established by statute.¹⁴¹ HSARPA has two main programs. The Homeland Innovative Prototypical Solutions program is designed to demonstrate prototypes of high-payoff technologies in two to five years with moderate to high risk. The High Impact Technology Solutions program is designed to conduct high-risk basic research that provides proofs of concept for potential breakthroughs. HSARPA also manages the S&T Directorate's program of Small Business Innovation Research (SBIR), which is funded through a mandated set-aside of DHS R&D budget, achieved by setting aside funds from each DHS R&D program. The director of the Office of Innovation also liaises with the six research divisions as discussed above.

Transition (SAFETY Act and Technology Clearinghouse)

The Office of Transition (FY2009 funding: \$28.8 million) oversees interactions with DHS components outside the S&T Directorate to expedite technology transition. It also manages the Office of SAFETY Act Implementation, which evaluates and qualifies technologies for liability protection in accordance with the SAFETY Act,¹⁴² and the statutorily mandated Technology Clearinghouse.¹⁴³ Its director also liaises with the six research divisions as discussed above.

Test and Evaluation and Standards

The Office of Test and Evaluation and Standards (FY2009 funding: \$28.7 million) provides technical support and coordination to help emergency responders assess the safety, reliability, and effectiveness of equipment and procedures. It also aids in establishing test and evaluation methodology for the directorate and acts as the test and evaluation executive for the Department as a whole.

Special Programs

The Department of Homeland Security has original classification authority and funds some R&D projects that are classified (although Sec. 306(a) of the Homeland Security Act directs that "to the greatest extent practicable, research conducted or supported by the department shall be unclassified"). The Office of Special Programs oversees the directorate's classified projects.

¹⁴⁰ Homeland Security Act of 2002 (P.L. 107-296), Sec. 309(g).

¹⁴¹ Homeland Security Act of 2002, Sec. 307(b).

¹⁴² Homeland Security Act of 2002, Title VIII, Subtitle G.

¹⁴³ Homeland Security Act of 2002, Sec. 313.

Agency and International Liaison

The Office of Agency and International Liaison oversees the directorate's international outreach activities and interagency coordination responsibilities.

Management and Administration

Other activities of the directorate, including the Office of the Under Secretary, are funded by a separate appropriation for management and administration (FY2009 funding: \$132.1 million). This account also pays the salaries and expenses of all the directorate's federal employees.

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