A Report of a Panel of the

NATIONAL ACADEMY OF PUBLIC ADMINISTRATION

For the U. S. Congress and the U. S. Department of Homeland Security

Department of Homeland Security Science and Technology Directorate:

Developing Technology to Protect America

2009

National Academy of Public Administration®

THE NATIONAL ACADEMY

The National Academy of Public Administration is a non-profit, independent organization of top public management and organizational leaders who tackle the nation's most critical and complex public management challenges. With a network of more than 650 distinguished Fellows and an experienced professional staff, the National Academy is uniquely qualified and trusted across government to provide objective advice and practical solutions based on systematic research and expert analysis. Established in 1967 and chartered by Congress in 1984, the National Academy continues to make a positive impact by helping federal, state and local governments respond effectively to current circumstances and changing conditions. Learn more about the National Academy and its work at www.NAPAwash.org

A Report by a Panel of the

NATIONAL ACADEMY OF PUBLIC ADMINISTRATION

For the U.S. Congress and the Department of Homeland Security

June 2009

Department of Homeland Security Science and Technology Directorate:

Developing Technology to Protect America

Panel

Cindy L. Williams, *Chair**
Barry Bozeman*
Louise K. Comfort*
David F. Garrison*
Sally T. Hillsman*
Caroline Purdy

* *Academy Fellow*

Officers of the Academy

J. Christopher Mihm, *Chair of the Board*
Michael C. Rogers, *Vice Chair*
Jennifer L. Dorn, *President and Chief Executive Officer*
Diane M. Disney, *Secretary*
John J. Callahan, *Treasurer*

Project Staff

Lena E. Trudeau, *Vice President*
Rick Cinquegrana, *Program Area Director*
Laurie Ekstrand, *Project Director*
Ruth Ann Heck, *Senior Advisor*
Zlatko B. Kovach, *Former Senior Advisor*
Maria Rapuano, *Senior Advisor*
Jonathan Tucker, *Senior Research Analyst*
Caroline Epley, *Research Associate*
Anna V. Tkachenko, *Former Research Associate*
Martha S. Ditmeyer, *Senior Administrative Specialist*

The views expressed in this report are those of the Panel. They do not necessarily reflect the views of the Academy as an institution.

National Academy of Public Administration
900 7th Street, N.W.
Suite 600
Washington, DC 20001-3888
www.napawash.org

First published June 2009

ISBN 1-57744-180-X

Academy Project Number: 2129

* *Academy Fellow*

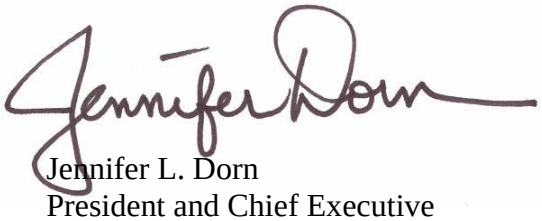
FOREWORD

Homeland security may well be the signature national issue for the United States during the first decade of the 21st century. The tragic events of 9/11 and the dramatic consequences of hurricane Katrina focused attention on the need to prevent harm and ensure effective responses when harm does occur. The Science and Technology Directorate (S&T) of the Department of Homeland Security plays a crucial role in the effort to keep America safe by leading the development of technologies and tools that federal, state, and local first responders and others need to prevent and respond to human and natural disasters. S&T's mandate also requires the Directorate to coordinate across the many federal agencies involved in homeland security-related research to ensure they are directing their efforts to achieve the best possible outcomes.

Recognizing the significance of S&T's mission to the safety of the nation, Congress asked the National Academy to conduct a comprehensive review of S&T's structure, processes, and the execution of its cross-government leadership role. The independent Study Panel has recommended changes that would substantially improve both the efficiency and effectiveness of S&T. These include developing and implementing an internal S&T strategic plan and performance measures that would help maintain a focus on results. Other recommendations call for developing processes and procedures to increase transparency and communication within S&T, across government, and with the first responders. The Panel also recommends that S&T take additional steps to fulfill its leadership role and develop a homeland security-related research plan for the entire federal government.

As part of this Study, the National Academy also was asked to assess whether a shift in priorities to homeland security-related research may have displaced funds for other important research areas or resulted in unnecessary duplication of effort. In seeking to answer this complex question, the Study Panel sought input from scientists and administrators in a range of federal agencies engaged in homeland security-related research, scientists from outside government, science policy experts, and members of the first responder community. We did not find evidence that increases in homeland security-related research funding have resulted in reduced funding for other important research areas or in unnecessary duplication of effort.

The Academy thanks the members of the Panel for their excellent work, and to the project team for their research and other contributions. We also thank the management and staff of S&T, and the many individuals from other federal agencies and non-government experts who generously contributed their time, expertise and perspectives to this important effort. Their assistance has helped produce a report with findings and recommendations that will make a real difference in S&T's future management of the nation's homeland security-related research program.



Jennifer L. Dorn
President and Chief Executive

The Page Left Intentionally Blank.

TABLE OF CONTENTS

APPENDICES

FIGURES AND TABLES

EXECUTIVE SUMMARY

The Department of Homeland Security (DHS), Science and Technology Directorate (S&T) is charged with planning, organizing, and guiding the homeland security-related scientific, engineering, and technological resources of the nation and leveraging these resources into technical tools to protect the homeland. With a Fiscal Year 2009 budget of $800 million, S&T ranks third behind the Departments of Health and Human Services and Defense in spending for homeland security-related research. In addition to coordinating work with its federal partners, S&T interacts with state, local and international counterparts to ensure that homeland security research dollars are spent as effectively as possible.

In response to a congressional mandate and in consultation with S&T, the National Academy of Public Administration formed an expert Panel and initiated a review of S&T's effectiveness and efficiency in addressing homeland security needs. This review included a particular focus on identifying any unnecessary duplication of effort, and any opportunity cost arising from an emphasis on homeland security-related research. Under the direction of the Panel, the study team reviewed a wide variety of documents related to S&T and homeland security-related research in general. The team also conducted interviews with over 200 individuals, including S&T officials and staff, officials from other DHS component agencies, and from other federal agencies engaged in homeland security-related research. Experts outside of government in science policy, homeland security-related research, and other scientific fields were also interviewed.

RESULTS IN BRIEF

S&T has made strides towards becoming a mature and productive research and development organization, particularly during the last three years. But, its ability to fulfill its mission and become a world class research and development organization is limited by the lack of a cohesive strategy, the insularity that defines its culture, and the lack of mechanisms necessary to assess its performance in a systematic way. Moreover, S&T has yet to play its mandated leadership role in developing a homeland security-related research strategic plan for all national efforts.

S&T's lack of a strategic plan has contributed to a fragmented and unwieldy structure, one that has grown on an ad hoc basis rather than being grounded in carefully planned organizational mission and goals. S&T's efforts to reach out to state and local first responders and incorporate their needs into the research agenda is a case in point. S&T is now devoting an increased level of effort in this area. However, its overall approach lacks the vision and cohesiveness that would allow it to identify and engage these customers—who sit at the core of the nation's first response to threats of all kinds—in a systematic and sustainable way.

S&T's fragmented structure, with overlapping roles and responsibilities, has also led to internal communication breakdowns that can affect performance. Improved internal communication would result in more consistent performance across organizational units, as best practices could

be more readily shared and adopted, and would also enhance transparency in both processes and decisions.

In recent years, S&T has apportioned a major role to DHS component agencies in setting the research agenda and has made commendable progress in coordinating and collaborating with other research organizations both nationally and globally. Yet, S&T has failed to engage the broader scientific research community in assessing its work as is the practice with many other federal research agencies. Scientific peer review is critical to ensuring quality in design and execution of research. Additionally, competition for funding is a major factor in expanding the pool of researchers interested in working in certain areas and, consequently, expanding the capacity to conduct that research. Greater transparency to the broader research community is needed. Solicitation and peer review of competing proposals, outside expert reviews of portfolios of work, and transparency of structure are not the norm at S&T.

S&T, while relatively young in terms of federal government research and development organizations, is rapidly approaching the time when specific results will be expected from its efforts to deliver technologies and other products that will enhance homeland security. Thus, the need for reliable and valid measures of progress and the tracking of results is vital. This harkens back to the first point about strategic planning. A strategic plan, developed with input from all relevant parties, is the foundation for development of sound benchmarks of progress. Tracking of progress towards goals, peer review, and feedback from those who are the intended recipients of S&T's products are all important elements in assessing the performance of S&T as it moves toward maturity.

S&T faces a significant challenge in marshaling the resources of multiple federal agencies to work together to develop a homeland security-related strategic plan for all agencies. Yet, the importance of this role should not be underestimated. The very process of working across agencies to develop and align the federal homeland security research enterprise around a forward-focused plan is critical to ensuring that future efforts support a common vision and goals, and that the metrics by which to measure national progress, and make changes as needed, are in place.

While there is always a cost to change, the long-term benefits of adjustments to reduce insularity and fragmentation, and increase communication, transparency, and strategic focus far outweigh near-term costs. S&T's relative newness as an organization, and the advent of a new Administration, afford an opportunity to institute the changes that will help maximize its potential.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Organization and Communication at S&T: S&T has been a DHS Directorate for six years and underwent a substantial reorientation and reorganization three years ago. Its organization is highly complex with six technical divisions that work in conjunction with three Portfolio Offices—Research, Innovation, and Transition (i.e., basic research to implementation)—to maintain a flow of new technologies and other products to DHS component agencies and first responders. This cross-functional arrangement demands continuous communication for optimal

performance. At S&T, there have been breakdowns in communications across the management team and staff. **The Panel recommends that S&T management engage staff in a process of identifying communications problems and implementing solutions. Web-based technology would be a valuable tool to initiate this process.** (See pages 9 through 15 for a more detailed discussion.)

The fact that there are 20 direct reports to the Under Secretary and a proliferation of offices and sub-units, exacerbates the communications problems, and can lead to bottlenecks and confusion. Overlapping responsibilities, such as those held by the multiple offices that interact with the first responder community, cause inefficiencies. **The Panel recommends reconsideration of S&T's structure to ensure a more reasonable number of direct reports, and a more cohesive structure for managing first responder interaction.** (See pages 12 through 15 for a more detailed discussion.)

Customer Focus of Transition Research: Research in S&T's Transition Portfolio is intended to provide technologies to DHS components and first responders within three years. There is widespread agreement within DHS that S&T has made substantial improvement during recent years in focusing research on DHS component needs. Although there is room for improvement, S&T's adoption of the Integrated Product Team (IPT) approach to obtain and prioritize component input to the research agenda has generally been praised. The goal is for about half of the research budget to be allocated on the basis of IPT input. **The Panel recommends a number of refinements to the IPT process, including more standard structures and procedures to help ensure its institutionalization, reconsideration of the appropriate customer base, mechanisms that will ensure that the highest DHS priorities will be served, and greater transparency in decision-making.** (See pages 23 through 37 for a more detailed discussion.)

While first responders are also recognized as important customers of S&T technology development, mechanisms to include them in the priority setting process have been generally ineffective. While S&T has programs to reach out to first responders, large parts of that community are unfamiliar with S&T, and very few are active participants in S&T priority setting. S&T is embarking on several new strategies to engage first responders. **The Panel recommends refinements in the structures already in place and inclusion of first responders in existing IPTs, where appropriate. Adding the proposed new first responder IPT seems unlikely to be effective.** (See pages 39 through 55 for a more detailed discussion.)

Basic Research Portfolio: About 20 percent of S&T's research budget funds basic research. Less customer-driven than work in the Transition Portfolio, basic research is expected to take five to eight years and provide the breakthroughs that will feed future transition projects. The allocation of basic research funds—in total and across divisions—seems to rest on historical allocations and may not be relevant today. Further, many basic research projects are not competitively awarded, with potentially negative effects on the efficiency and quality of the research. **The Panel recommends that S&T take steps to rationalize decision making about the allocation of basic research funding, and that funds be awarded on a competitive basis based on scientific peer review except when this is clearly not feasible.** (See pages 57 through 68 for a more detailed discussion.)

S&T's Leadership Role across Government: S&T's statutory mandate charges it with a leadership role in guiding federal homeland security-related research efforts. S&T has control over less than one third of the federal homeland security-related research budget, and has no authority over the other actors in this field. This places S&T in a weak position to exert the leadership needed to carry out its mandate to develop a national homeland security-related research Strategic Plan. Indeed, little or no progress has been made in this area during the last six years. However, officials at other federal agencies report that S&T is doing a good job exchanging information and working with them across a range of research subject areas. S&T officials are active participants in many task forces and inter-agency committees, and coordinate with other agencies on numerous projects. This is a significant step towards developing the relationships that are needed for S&T to successfully work with agencies across government to develop the kind of strategic plan that would provide the vision, direction and goals for homeland security-related research for the nation. The process of developing this national strategic plan will ensure that future research efforts across all agencies are optimally linked, and that metrics to measure progress as a nation in homeland security-related research can be developed and tracked. **The Panel recommends that S&T work with the White House Office of Science and Technology Policy and the array of federal agencies engaged in homeland security-related research to develop a comprehensive national strategic plan for such research.** (See pages 17 through 22 for a more detailed discussion.)

Strategic Planning: S&T's Strategic Plan was issued in June of 2007. However, this plan does not provide the vision and strategy needed to guide the Directorate. While the Plan is a useful document in describing the "what" of S&T's programs, it fails to describe the "why." The process of developing a strategic plan should focus an organization on clear goals and reflect how the views and needs of stakeholders have been incorporated. The goals articulated in such a strategic plan become the foundation for developing metrics to assess progress in reaching goals. **The Panel recommends that S&T follow the guidance provided by the Office of Management and Budget and the Government Accountability Office to formulate a strategic plan that will effectively guide its work toward specified goals.** (See pages 17 through 22 for a more detailed discussion.)

Performance Measurement: S&T utilizes milestones to measure progress, but these may not be providing meaningful indicators of progress. While milestones in S&T's 2007 Five Year Plan are clearer and more measurable than they have been in the past, there appears to be little or no consequence for missing milestones. **The Panel recommends that S&T systematically collect and analyze information about milestones met and missed, adopt appropriate consequences, and provide clear guidance for setting valid initial and subsequent milestones.** (See pages 83 through 99 for a more detailed discussion.)

Performance measurement, in general, has received little focus in S&T. Unlike other federal research organizations, S&T has not widely used peer review to assess program performance. Given the inherent difficulties of evaluating the quality and value of research, especially basic research, it is vital that outside peer review be used to ensure that ongoing work meets the highest standards. **The Panel recommends that S&T use independent external scientific peer review at the division, or appropriate program, level to review basic, innovation, and**

transition research efforts across a program area to ensure balance and quality. Other methods used by research organizations across government, such as tracking conference presentations, citations, and products transitioned, should also be adopted. (See pages 83 through 99 for a more detailed discussion.)

Unnecessary Duplication: Interviews with S&T officials and those of other agencies engaged in homeland security-related research did not surface any instances of unnecessary duplication of effort in this research area. Officials noted that there are cases in which research projects appear to be similar, but in fact differ because one is focusing on technologies for a combat environment and another is focusing on a civilian environment in which civil liberties are of greater concern. Further, outside experts consulted in the course of this study did not cite examples of unnecessary duplication of effort and indicated that some duplication is purposeful in scientific research, as multiple solutions to a problem can lead to an opportunity to pick the best solution rather than the only solution. Because of limited funds, officials at S&T and other federal agencies said they work hard to leverage each other's research in order to get the most return for the research dollar and try to avoid unnecessary duplication. However, it is important to note that this study identified serious weaknesses in the strategic planning process, both as it occurs within S&T, and in S&T's mandate to lead the development of a homeland security-related strategic plan for all federal agencies. Currently, there is no effective and systematic mechanism in place to evaluate the relative merits of competing priorities across S&T, or across the federal homeland security research enterprise. It would seem likely, therefore, that the risk of unnecessary duplication of effort is currently higher than it would be if robust and effective strategic planning processes were in place. (See pages 69 through 81 for a more detailed discussion).

Opportunity Costs: Congress has expressed concern that recent increases in homeland security-related research may have resulted in reduced funding for other significant research endeavors. No evidence has been found in the course of this review to indicate that this has occurred. During the past five years, three of the ten federal agencies with the largest research budgets, have reduced or held constant overall research budgets while spending on homeland security research increased. The reasons for the specific changes are unclear. However, a broad range of science policy experts and researchers said they did not believe that there had been a displacement of other research because of increases in homeland security-related research. Researchers in criminal justice were an exception, noting that a shift to terrorism-related research has resulted in less funding for more traditional areas of criminal justice behavioral and technology research. Experts also cautioned that in any event a wide variety of policy decisions can affect funding across research areas and cited numerous other likely reasons for fluctuations, including shifts in Administration priorities and changes in the federal budget. Whether homeland security-related research will crowd out other significant research in the future is unpredictable. That said, the fact that no evidence of opportunity cost was found in this study does not constitute a conclusive determination that opportunity costs do not exist. The methodology employed in examining this question was limited by the scope of the study and the availability of data. This question also involves elements of policy judgment. (See pages 101 through 106 for a more detailed discussion.)

This Page Left Intentionally Blank.

LIST OF RECOMMENDATIONS

All of the Panel's recommendations in this report are listed below. The first number in each recommendation corresponds to the chapter in which the recommendation appears and where the context and further explanation can be found. The second number identifies the order in which the recommendations appear in the chapters.

CHAPTER III: S&T ORGANIZATIONAL STRUCTURE

3-1. Take steps to improve communication within the Directorate.
Staff concerns about insufficient communication across organizational lines, and lack of knowledge by some staff of documents relevant to their work, indicates a need for improved internal communications.

3-2. Consider the benefits and costs of streamlining the organizational structure to reduce the number of direct reports to the Under Secretary to a more reasonable number.
The number of direct reports heightens the likelihood of bottlenecks and delays. The benefits of change, however, should be weighed against the inevitable costs of change in an organization that has experienced considerable change in recent years.

3-3. Adopt a more cohesive structure for gathering first responder input.
The fragmented structure for gathering and considering input from first responders may reduce coordination within S&T and increase frustration on the part of first responders.

CHAPTER IV: MISSION AND STRATEGIC PLAN

4-1. Develop an S&T Strategic Plan.
A Strategic Plan, prepared in accordance with federal planning guidance, would provide the articulation of mission, goals, and strategies that would provide additional focus for its work.

4-2. Develop a homeland security-related research strategic plan.
Work with the White House and other federal agencies to develop a strategic plan that focuses federal efforts, helps ensure coordination and collaboration, and avoids unnecessary duplication of effort.

CHAPTER V: TRANSITION PORTFOLIO

5-1. Define customers clearly.
Defining customers for S&T and each IPT will provide the basis for identifying effective mechanisms for customer participation, thereby ensuring that S&T can more effectively meet their specific needs.

5-2. Increase outputs and accelerate transition.
Customers are dissatisfied with S&T's output to date, which is in part due to the large number of legacy projects in its portfolio. In addition, many projects lack transition plans and customers do not always understand how they will acquire the technologies being developed.

5-3. Establish and meet realistic targets.
S&T advertises that transition projects will be completed within three years. However, the majority of the projects have been ongoing for at least five years. There do not appear to be disincentives for continuing projects that are unlikely to meet objectives and S&T staff complained that incentives for completing projects on time and within budget are lacking.

5-4. Institutionalize the IPTs and impose standard structures and procedures.
Customers and S&T staff alike are concerned that the IPTs are insufficiently institutionalized to withstand inevitable changes in leadership. The lack of standard structures and procedures, which makes it necessary for each IPT to develop its own processes and procedures through trial and error, also frustrates both Customers and S&T staff.

5-5. Restructure the IPT process.
Developing capability gaps in each IPT, in isolation from other IPTs, increases the likelihood that Department of Homeland Security-wide priorities are not being met. In addition, IPT budgets are not flexible enough to meet changing Department priorities and take advantage of promising opportunities.

5-6. Establish a formal process for collecting feedback from IPT members.
There is no systematic method for collecting feedback from IPT customers regarding how the IPT process could be improved, how well projects have been transitioned, how well technologies have been integrated into operations after transition, and how technologies are performing in the field.

5-7. Improve transparency.
Processes, procedures, and decisions are not well-documented, explained, or disseminated. Information on projects is not shared sufficiently within S&T or with customers, increasing the potential for unnecessary duplication, missed opportunities to leverage related research, slipping milestones, and continuing projects that should be terminated.

5-8. Compete projects and use peer review to select research performers.
Competing projects and peer review of grant awards is standard practice at other federal research agencies and will help ensure the highest possible quality of research.

CHAPTER VI: MEETING THE NEEDS OF FIRST RESPONDERS

6-1. Identify IPT customers and develop appropriate mechanisms for customer participation.

Strengthening first responder participation in each of the existing IPTs will improve their functioning and negate the need for a new first responder IPT.

6-2. Prioritize, tailor, and increase outreach.

S&T's interactions with first responders appear to be disproportionately geared to first responders in areas where less critical infrastructure and fewer people are at risk, such as small or mid-size cities in less populous states. Further, these first responders are less likely to have the time, training, and technical expertise to understand capability gaps and future requirements. At the same time, awareness of S&T in the first responder community is low.

6-3. Leverage existing organizations and outreach mechanisms.

S&T has not taken full advantage of national associations and existing federal agency advisory groups to reach out to first responders through, for example, websites and publications. In addition to reaching their own members, national associations can disseminate information quickly and efficiently to state and local associations, greatly broadening S&T's outreach capabilities with little additional effort.

6-4. Give greater priority to testing and evaluation and to standards.

First responders identified testing and evaluation as well as standards for existing equipment as needs that are more urgent than new technologies.

6-5. Make it easier for first responders to participate.

First responders want to participate, but it is a burden on individuals and their agencies to travel to multi-day meetings.

6-6. Continue and strengthen the First Responder Technology Council.

S&T lacks an internal mechanism for systematically collating and weighing first responder input from various interactions and coordinating responses. The First Responder Technology Council could serve this purpose because its members represent all the S&T functional areas with responsibility for interacting with first responders.

CHAPTER VII: BASIC RESEARCH AND INNOVATION

7-1. Develop and implement clear and transparent processes and criteria for identifying basic research and innovation needs, prioritizing projects, and selecting performers.

There is no clear basis for concluding that the current allocation for basic research is appropriate, S&T-wide, among the divisions, or within individual divisions. S&T also has only general criteria for selecting basic and innovation research projects and no clear process by which to prioritize basic research across divisions or within divisions.

7-2. Ensure S&T builds on current efforts to integrate research across the National Laboratories, Centers of Excellence, and others.

Continued and expanded efforts to involve outside experts effectively in setting agendas, such as the efforts of the Office of University Programs and meetings among the aligned divisions and National Laboratories, could improve the quality of the basic research program. More integrated research should ensure better knowledge transfer and greater efficiency of effort and allow external expert views to be considered in decisions about the overall program of research, including the adequacy of the allocation of resources to basic and innovation research efforts.

7-3. Make competitive processes that include external scientific peer review the norm for basic research and all other awards as appropriate.

Scientific peer review is critical to ensuring quality research and development, especially for basic research, because assessing likely impact is difficult over the short term. Merit selection through external scientific peer review of proposals is not now the norm in S&T for selecting performers and, in most cases, decisions about the content, quality, and selection of proposals to fund are made by small groups or individuals. Adding outside input from experts in the many fields pertinent to homeland security research will increase S&T's confidence, and that of its clients and appropriators, that the extent and nature of its basic research is thoroughly vetted and that the research being conducted is of the highest standards of excellence.

CHAPTER VIII: LEVERAGING INVESTMENTS AND AVOIDING UNNECESSARY DUPLICATION THROUGH COORDINATION AND COLLABORATION

8-1. Provide a single, unified explanation of the allocation of responsibilities in S&T for interagency coordination at S&T in a readily available public document.

S&T should clearly define component roles and responsibilities for interagency coordination and communicate this information internally and externally. One approach would be to publicly release a single unified explanation in a revised version of the Science and Technology Organization Regulation Manual (STORM).

8-2. Clarify the allocation of responsibility within S&T for interagency coordination about the development and transfer of technologies related to first responder needs.

The Interagency and First Responder Programs Division and the Office of Transition should work together to define their respective roles and responsibilities for interagency coordination relating to first responder technology needs. The resulting definition should be included in the unified statement of responsibilities in a revised STORM.

8-3. Improve the internal communication about coordination planning and work to ensure responsibility for interagency coordination reflects the strategic plan when it is developed.

CHAPTER IX: PERFORMANCE MEASUREMENT

9-1. Ensure that milestones are valid measures of progress, represent reasonable but stretch goals, and are tied to appropriate consequences when they are not met. S&T has made progress in developing clear and measurable milestones, but there is no mechanism to ensure milestones are set at the most appropriate levels. Additionally, milestones are not used as effectively as they could be because there are few or no consequences to missing a milestone. S&T could track information on met and unmet milestones to inform changes that could better ensure the milestones are valid and used to maximum effect.

9-2. Conduct process evaluations of selected critical functions to maximize S&T's efficiency and effectiveness. Now that the new structure has matured, such evaluations can be an important tool to improve S&T's ability to accomplish its mission. As processes and procedures continue to evolve, such evaluations should also continue. The assessment of IPT customers using logic models, recommended elsewhere in this report, should provide an important basis for analysis of the IPT process. But many other financial and operational processes should be reviewed.

9-3. Use independent external, scientific peer review to ensure S&T's research is well managed, appropriately balanced among the three portfolios, and of high quality. This review would be most useful initially at the division or, when divisions conduct multiple programs focused on significantly different subjects, at the program level. This review should include, as appropriate, both scientists and practitioners. The insular nature of S&T's work is of great concern; it does not offer the scientific credibility that other federal research agencies gain through peer review, and that policymakers, customers and appropriators expect.

9-4. Use quantitative indicators of quality—as an adjunct to peer review—to help assess the overall quality of S&T's research.
Output indicators, such as, the number of peer reviewed journal articles that report on S&T research and the number of scientific awards given to S&T researchers, are widely recognized in the research field and can be fairly easily documented. A metric for all programs that speaks directly to technologies available for transfer could provide important information and powerful incentives for producing timely and useful outputs. Such metrics stop short, however, of assessing the usefulness of the technologies. An assessment of customer satisfaction could help.

This Page Left Intentionally Blank.

CHAPTER I: STUDY MANDATE, METHODOLOGY, AND CONTENT OF THIS REPORT

The Department of Homeland Security (DHS), Science and Technology Directorate (S&T) is charged with planning, organizing, and guiding the homeland security-related scientific, engineering, and technological resources of the nation and in the development of technological tools to protect the homeland. With a 2009 budget of approximately $800 million, the Directorate not only leads the research efforts of other DHS components, but also interacts with federal, state, and local governments, and with private sector and international counterparts, to ensure that homeland security research dollars are spent effectively.

THE MANDATE AND FOCUS FOR THE REVIEW

The DHS Appropriations Act for Fiscal Year (FY) 2008, as part of the Consolidated Appropriations Act of FY 2008 (P.L. 110-161), was signed into law on December 26, 2007. The report of the House Appropriations Committee (H.R.110-181) accompanying the House version of the Act (H.R. 2638) directed DHS to contract with the National Academy of Public Administration (Academy) to review "*the coordination of the government-wide homeland security research portfolio and the opportunity costs in other research areas as homeland security activities absorb a larger share of limited resources….*" The report further stated that this independent review was "*necessary to determine whether Federal resources are being adequately and efficiently used in DHS and other Federal agencies to address homeland security needs, as well as to identify opportunity costs that may result from the increasing prominence of homeland security priorities in Federal research priorities outside the Department.*"

As a result of direction from Congress, and in consultation with S&T management, the primary areas of this Academy review are:

- An assessment of DHS S&T's research mission and the overall approach used to carry out that mission;
- The approach used by S&T to interact, collaborate, and coordinate with other government and non-government entities in such research;
- The extent and nature of efforts by S&T and other entities to avoid unnecessary duplication of homeland security research;
- The methods used to develop priorities and to develop and apply criteria for determining which homeland security-related research to support;
- The approaches used by S&T to identify and interact with research customers, determine and validate their homeland security research needs, evaluate program areas and proposed projects against those needs, and measure the extent to which those needs are being met;

- Trends in the type and amount (i.e. dollars and numbers of projects and program areas) of homeland security research being supported and conducted government-wide over the past several years; and
- The extent to which there are opportunity costs associated with the scope and nature of homeland security-related research that is being supported.

The Academy initiated this review on June 15, 2008. An interim report was delivered to S&T in December 2008.

STUDY METHODOLOGY

To ensure that the study team acquired a complete picture of the issues and potential sources of information, a "design matrix" was developed for each topic area. The design matrix broke each topic into a set of questions to be addressed to be responsive to the mandate. For each question, likely sources of information, types of analysis, likely findings, and possible limitations to findings were identified. This guided the literature and document review, the development of lists of interviewees and the interview protocols, as well as the organization and analysis of the information collected.

Guided by the design matrix, an extensive review was undertaken of a wide variety of written documents concerning S&T and homeland security-related research in general. Materials reviewed included pertinent legislation, official DHS and S&T documents, such as the Strategic Plan for both the Department and S&T, S&T descriptions of operations, and a DHS Inspector General review of S&T; reviews of S&T by other organizations such as the Congressional Research Service (CRS), the Government Accountability Office (GAO), and others; Congressional hearing transcripts; and media coverage of S&T from its inception to the present. Relevant documents related to other entities engaged in homeland security-related research both nationally and globally were also reviewed.

Over 200 semi-structured interviews were conducted during the course of this study. Initially, numerous semi-structured interviews were conducted with S&T officials, starting at the highest organizational levels in order to develop a broad overview of the Directorate's mission and operations. The initial interviews were followed by an expanded range of interviews at S&T, to include Division Deputies, program managers, and others. While almost all of the interviews were with individuals, several group interviews were convened with personnel who are in similar positions but work within different S&T divisions. As needed, during the course of the study, follow-up interviews were held with some of the S&T officials.

Outside S&T, many DHS staff who interact with S&T in the course of identifying gaps in capabilities and requirements to prioritize much of S&T's focus were interviewed. The goal was to assess the efficiency and effectiveness of these interactions, and the overall satisfaction level with S&T interactions with other agencies within DHS. Additionally, representatives of the Domestic Nuclear Detection Office and the U.S. Coast Guard who are also engaged in research within DHS, but outside of S&T were interviewed to assess the extent to which these groups coordinate with S&T.

Another set of interviews was conducted with officials at many other federal agencies who also engage in homeland security-related or other research that might be related in some way to S&T's portfolio. Many of these interviewees are members of inter-agency committees or task forces that include S&T representation. Others either coordinate or collaborate with S&T on specific programs of research. Others' contact with S&T was more limited. All interviews included a discussion of the level and quality of interactions between their agency and S&T and a specific set of questions designed to identify unnecessary duplication of effort. For interviews with agency officials whose portfolios seem to afford a high potential for duplication of effort, questions focused on specific S&T programs to probe more deeply into the issue of unnecessary duplication.

Two sets of interviews were held with experts outside the federal government. These interviews involved scientists and science policy experts across academia and science policy-related organizations. The initial set of interviews focused on perceptions of S&T's role, its execution of that role, and how it fits within the community of homeland security-related research organizations. The second set of interviews focused on opportunity costs, specifically, the extent to which the focus on homeland security-related research had reduced funding for other important research areas. Various means were used to identify appropriate individuals to respond to these issues. First, officials at non-DHS federal agencies were asked about diversion of funding and to identify others within their agency who might have a relevant perspective on this issue. Second, the Academy Panel provided contact information for knowledgeable individuals within the science community to address this issue. Additionally, Academy Fellows who are engaged in science and public policy issues were selected to both address this question and to suggest others who may have insights on this issue.

To gather a broader perspective on several issues within S&T itself, a web-based discussion using Web 2.0 technology with all S&T headquarters staff was recommended. The topics chosen were internal S&T communications and potential refinements to the Integrated Product Team (IPT) process—the process used to work with other agencies within DHS to set priorities for S&T programs.[1] The technology would have allowed interaction of participants with each other and with the study team to offer comments and suggestions, and to react to the ideas of others. Participants would not identify themselves. Unfortunately, although S&T management was supportive of this idea, the Chief Information Officer for S&T identified procedural issues that could not be resolved within the time frame of this study.

To augment this substantial effort to gather information from individuals, a wide range of documents were collected and analyzed. In addition to documents noted above that provided the foundation for the initial literature review, documentation concerning homeland security-related research budgets, not only for DHS, but also for other federal entities engaged in homeland security-related research was collected. S&T staffing data and an extensive array of S&T internal documents were also collected and reviewed.

The Academy Panel met with the study team during the early stage of the review to provide direction to the team on overall study design and data collection strategies. The Panel met again

[1] The IPT process will be discussed in detail in Chapter V of this report.

to provide guidance for the analysis of issues to be included in the Interim Report, which was issued to S&T in December 2008. During its third meeting in March 2009, the Panel provided guidance to the study team concerning key findings, recommendations, and the final report outline. At a fourth meeting in April 2009, the Panel provided direction to the study team and approved the contents of the draft final report. Finally, the Panel approved the final report following a DHS S&T comment period.

CONTENTS OF THIS REPORT

Nine additional chapters, as well as eleven appendices follow this initial introductory chapter. Recommendations to S&T are included in each chapter, as appropriate.

- Chapter II provides historical information about S&T from its beginning in 2003 until 2006 when there was a major reorganization.
- Chapter III outlines S&T's organizational structures and processes.
- Chapter IV discusses S&T's mission and Strategic Plan.
- Chapters V and VI provide information about S&T's interaction with customers, with the former focused on DHS agencies as customers and the latter on the first responder community.
- Chapter VII describes S&T's Research and Innovation Portfolios.
- Chapter VIII discusses steps to avoid wasteful duplication of effort and, more generally, S&T coordination and collaboration with other federal agencies.
- Chapter IX focuses on performance measurement at S&T and similar federal agencies' performance measurement strategies.
- Chapter X discusses opportunity cost issues.

The appendices, in addition to providing information about the Academy Panel and staff, and a list of individuals interviewed for the study, provide additional information concerning S&T to augment the report chapters.

CHAPTER II: S&T EARLY HISTORY

The Homeland Security Act of 2002 (P.L. 107-296), ("the Act") established the Department of Homeland Security (DHS) and created the Directorate for Science and Technology (S&T) within the Department. The Act pulled together 22 different agencies and more than 170,000 employees into one department attempting to unify activities related to homeland security.

S&T represents a microcosm of the Department itself and was intended to unite disparate homeland security-related science and technology functions within a single organization to increase cohesion, coordination, and effectiveness. S&T, headed by an Under Secretary (U/S) for Science and Technology, incorporated portions of programs from the Department of Energy, Department of Defense, and the Department of Agriculture, as well as some research programs within DHS legacy agencies. It is charged with developing technologies that will counter threats as diverse as global disease, natural disasters, suicide bombers, chemical and biological weapons, and improvised explosive devices. Aircraft, ports of entry, nuclear power plants, bridges, the water supply, livestock, urban transit, and the internet are among the vast and diverse array of entities and infrastructure that must be protected.

The Directorate's specific focus is on developing technologies that can assist both DHS and the state and local first responder[2] community to prevent adverse events and respond when they cannot be avoided. The Department of Health and Human Services (DHHS) and the Department of Defense (DOD) have larger annual homeland security research budgets than DHS and have either Presidential Directives or legislative authorization that give them specific responsibilities in the homeland security-related research arena. Other federal departments, such as the Environmental Protection Agency (EPA) and the Department of Justice (DOJ), also conduct homeland security-related research. Among S&T's statutory roles is coordination of these research efforts across the federal government.

S&T START UP

When S&T began operating in March 2003, it recruited and hired scientists, engineers, and other experts from a variety of sources, including academia, federal laboratories, and other federal agencies. Many were acquired using the authority provided by the Intergovernmental Personnel Act (IPA) to gain expertise quickly, although IPAs return to their "home" institutions after a specified period of time.

During S&T's first full fiscal year of operations, its budget was set at $918 million and the number of employee positions was at 140. As with any new organization, S&T's first tasks included developing a coherent mission and the basic policies and procedures to function. Some

[2] First responders are federal, state, local, and tribal emergency professionals who prevent, defend against, and mitigate consequences of terrorist attacks and natural disasters. First responders include the disciplines of emergency management, emergency medical services, fire, hazardous material, law enforcement, bomb squads, tactical operations/special weapons assault teams, and search and rescue.

business processes were adopted from the Defense Advanced Research Projects Agency (DARPA) at the DOD. However, much more was required.[3]

In April 2003, Charles E. McQueary was sworn in as the first S&T Under Secretary. In a statement to the both the House and Senate Appropriations Subcommittees on Homeland Security just after his swearing in, U/S McQueary said that he expected S&T to be operational by October 1, 2003. By January 2004, S&T's staff totaled 212. However, half of the staff were either on assignment from other federal agencies, IPAs, or contractors. Thus, long-term staff stability was an issue.

S&T was organized initially into research and development portfolios that were intended to span its product line. Four portfolios addressed specific threats:

—Biological Countermeasures;
—Chemical Countermeasures;
—High Explosive Countermeasures; and
—Radiological and Nuclear Countermeasures.

Four additional portfolios cross-cut all of these threats:

—Threat and Vulnerability, Testing and Assessment;
—Standards;
—Emerging Threats; and
—Rapid Prototyping.

Additional portfolios supported DHS operational units (such as Border and Transportation Security, Coast Guard, and Secret Service), the University and Fellows Program, and Counter-Man Portable Air Defense Systems, which addresses technologies to protect commercial aircraft from ground-launched missile attacks. Of the portfolios, by far the largest in terms of funding during S&T's early years was Biological Countermeasures ($363 million in FY 03 and $285 million in FY 04). Radiological and Nuclear Countermeasures ($75 million in FY 03 and $126 million in FY 04) was a distant second. All other programs were funded at substantially smaller levels.

EARLY ACCOMPLISHMENTS AND CRITICISM

In Congressional testimony in February and March 2004, U/S McQueary touted the progress made across all of the portfolios, stating that the operational components of DHS were his customers and that substantial efforts had been made to reach out to other federal agencies that engaged in related research. He also indicated that S&T's priorities came from many sources, including multiple national strategy documents, Presidential Directives, the 2003 Report on Combating Terrorism prepared by the Office of Management and Budget, current threat assessments, and input from DHS components.

[3] For a discussion of S&T's first year of operation, including its organizational structure, budget, and procedures, see "Survey of Science and Technology Directorate," March 2004, Department of Homeland Security, Office of the Inspector General, OIG-04-24.

Despite these claims, criticisms of S&T during these initial years were widespread. In June 2006, the Senate Appropriations Committee expressed its displeasure with S&T, calling the Directorate a "rudderless ship without a clear way to get back on course." Others—both customers within DHS as well as first responders—were critical of its lack of customer focus and the pursuit of research solely for research's sake rather than for the development of specific homeland security-related technologies. Lack of transparency in setting priorities, limited success in partnering with other federal agencies engaged in related research, low staff morale, inability to obligate resources in a timely manner, and basic accounting problems rounded out the litany of complaints.

In the Spring of 2005, concerns about the ability of S&T to operate effectively resulted in the formation of the Domestic Nuclear Detection Office (DNDO) within DHS to assume activities handled by S&T's Radiological and Nuclear Countermeasures portfolio. At about the same time as this shift in responsibilities took place, U/S McQueary announced his resignation. Two individuals served as Acting Undersecretary between the resignation of U/S McQueary and the appointment of a new U/S in August 2006. The new U/S, Admiral (Retired) Jay Cohen, ushered in a number of organizational and process changes, discussed in Chapter III.

This Page Left Intentionally Blank.

CHAPTER III: S&T ORGANIZATIONAL STRUCTURE

S&T is a relatively small federal organization with a highly complex structure that relies heavily on close coordination and interaction among many individual internal entities, that is, it is a "matrixed organization."[4] Its current structure was put in place in late 2006 by then Under Secretary Jay Cohen, who patterned it after the Office of Naval Research (ONR) which he had previously headed.

S&T'S BASIC STRUCTURE

The S&T Directorate consists of six technical divisions that are responsible for proposing priorities, and funding, and implementing projects. These divisions are:

—Chemical and Biological;
—Explosives;
—Command, Control and Interoperability;
—Border and Maritime Security;
—Infrastructure and Geophysical; and
—Human Factors/Behavioral Sciences.

Three Portfolio Offices coordinate the work of the technical divisions to ensure an appropriate balance and coordination between basic and applied S&T research projects:

—Office of Transition;
—Office of Research; and
—Office of Innovation.

The first two of these offices have staff "leads" embedded within each of the technical divisions. These leads report to the division directors, although they also have responsibilities in relation to the Portfolio Offices. Neither the Transition nor Research Office has resources to fund projects directly. In contrast, the Office of Innovation does not have leads within the divisions, but has its own funds to initiate projects. Innovation Office projects are overseen by program managers within the divisions.[5]

[4] Matrixed organizations assign groups of employees specific tasks and give them multiple reporting relationships. The intent is to transcend boundaries among organizational components and functions, and integrate activities. For additional information concerning matrixed organizations see Bartlett, C. and Ghosal, S. (1998) "Managing across Borders." Boston, Harvard Business School Press; Galbraith, Jay R., Diane Downey and Amy Kates (2002) "Designing Dynamic Organizations: A Hands-On Guide for Leaders at All Levels." New York: AMACOM, and Galbraith, Jay R. (2005) "Designing the Customer-Centric Organization: A Guide to Strategy, Structure, and Process." San Francisco: Jossey-Bass, A. Wiley Imprint.

[5] Additional information concerning the roles and responsibilities of the Office of Transition is discussed in Chapter V, and of the Offices of Research and Innovation in Chapter VII.

Specialized program functions are handled by five additional S&T components:

—Test and Evaluation and Standards Division;
—Special Programs Division;
—Interagency and First Responder Programs Division;
—International Cooperative Programs Office; and
—Operations Analysis Division.

Management support offices include Business Operations and Services, General Counsel, Communications, and the Office of the Chief Financial Officer.

Table 3-1 provides a brief description of the program offices discussed above. FY 2008 funding amounts for the technical divisions are also shown.

Table 3-1: S&T Divisions

Topical Divisions for Research, Development, Testing and Evaluation Programs[6]

Technical Division	Program Area Responsibility	FY 2008 Budget in Millions
Chemical and Biological	Chemical and Biological Countermeasure R&D; Threat Characterization; Operations; Agro-Defense; Biological Surveillance; and Response and Recovery	$208
Explosives	Aviation Security; Mass Transit Security: Counter MANPADS	78
Infrastructure and Geophysical	Critical Infrastructure Protection; Regional, State, and Local Preparedness and Response; and Geophysical	65
Command, Control and Interoperability	Information Management; Information Sharing; Situational Awareness; Interoperability and Compatibility; and Cyber Security	57
Border and Maritime Security	Land Borders; Maritime; and Cargo Security	25
Human Factors/Behavioral Sciences	Social-Behavioral Terrorist Intent; Human Response to Incidents; and Biometrics	14

[6] Technical Division and Division/Offices program area responsibilities are from the Department of Homeland Security, Science and Technology Strategic Plan, May 2007. Budget data are from analyses issued by the American Association for the Advancement of Science. Additional S&T budget information is included in Appendix A of this report.

Research Coordination Portfolios

Portfolio	Responsibility
Office of Research	University Programs, National Labs, Program Executive Office for Counter-IED
Office of Innovation	Basic and Applied Research to Promote Revolutionary Changes in Technology
Office of Transition	Expedite Technology Transition and Transfer to Customers

Divisions/Offices for Other Critical Missions

Division/Office	Responsibility
Test and Evaluation and Standards Division	Independent Objective Testing of Technology Developments by the Six Divisions and across DHS. Oversees Standards Development for DHS.
Office of Special Programs	Coordinates Classified Projects Executed by the Six Divisions
Operations Analysis Division	Supports Risk Analysis and Manages the Homeland Security Institute Studies and Analysis Effort
Interagency and First Responder Programs Division	Facilitates Government-Wide Science and Technology Coordination, and Coordinates Exchange of Information with State, Local, Tribal, Academic and the Private Sector
International Cooperative Programs Office	Provides Outreach to U.S. Allies

STRUCTURAL COMPLEXITY AND COMMUNICATIONS ISSUES

While interviewees generally agreed that the matrixed structure can promote unity of effort, and is more operationally effective than what it replaced, concerns were raised both by S&T managers and DHS component staff about communications across division/portfolio/office lines. In order for S&T's matrix management organization to work effectively, technical division staff must communicate and cooperate with staff from Transition, Research, and Innovation Offices, and these three offices must communicate with each other.

Several managers reported that more direct communication between individual portfolio directors and the six division directors would be useful to promote better operations. Although both portfolio directors and division directors attend weekly leadership meetings to share information, concerns remain about the effectiveness of one-on-one communication. In some cases, portfolio directors and division directors have not been in agreement on policies and procedures, causing confusion among program managers as to how to proceed. As a result, some technical division staff have established their own mechanisms to share information and to establish some uniformity in practice across the divisions. Program managers said that more communication and interaction across division lines would enhance learning from one another.

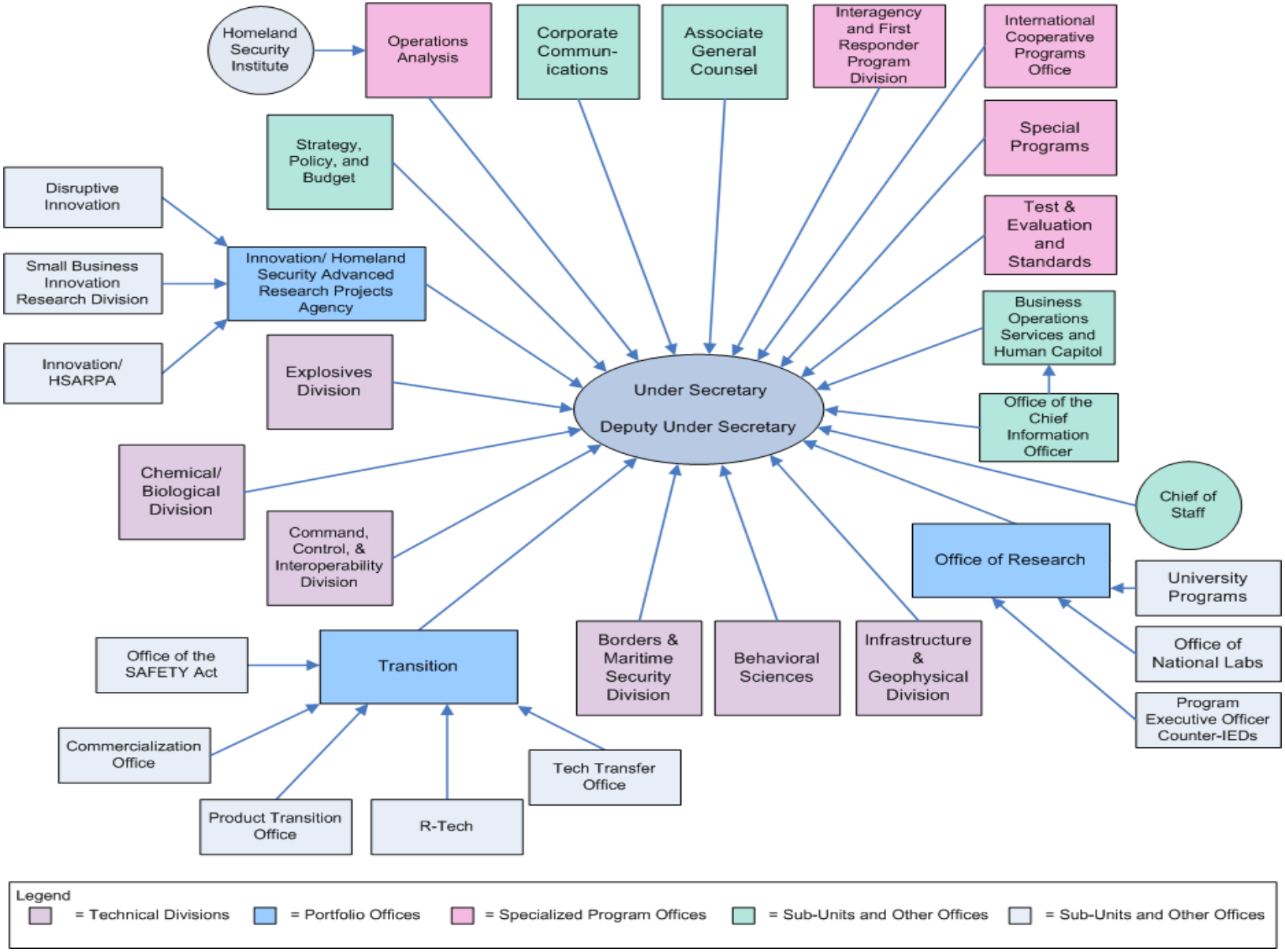
Some managers did not know about policy guidance or other written materials prepared by other S&T units that were relevant to their responsibilities. For example, several managers with responsibilities for coordination with other federal agencies were not familiar with the Homeland Security and Technology Coordination Plan prepared by S&T that discusses homeland security-related research projects across federal agencies.

Interviewees also noted that the effectiveness of matrixed structures is very dependent on personalities, and that some S&T officials are better at working in this environment than others. One portfolio office manager noted that without a budget he has had to build his influence over time by developing personal relationships with technical division staff. When someone new assumes this, or a similar role, he or she also will have to develop those personal relationships within the organization. When the individuals in this type of a structure make communications a high priority, it works well. However, the complexity of the structure and its dependence on personal interaction can result in dysfunction.

MATRIXED STRUCTURE RESULTS IN MANY DIRECT REPORTS AND NUMEROUS SMALL OFFICES

Figure 3-1, is a graphic presentation of offices and reporting lines within S&T. As shown, there are 20 direct reports to the U/S and deputy U/S. S&T officials note that access to the U/S and deputy U/S is important in a matrixed organization. However, this large number of direct reports could result in both decision-making bottlenecks and delays as the direct reports vie with each other for access to the decision makers, and decision makers juggle multiple responsibilities simultaneously. S&T Division and Office directors did not raise concerns about access to the U/S or deputy U/S as a result of the current structure. S&T officials note that direct access to top management is an important feature of a matrixed structure. While this is true, the number of direct reports should be at a manageable level. As new leadership is put in place, this structure could be unwieldy and slow to respond as a new Under Secretary is working with directors with whom he or she has not worked before.

Figure 3-1: Organizational Chart Conveying Lines of Authority



Source: National Academy of Public Administration

Figure 3-1 also identifies sub-units of the Offices of Transition, Research, and Innovation Portfolios. A number of these eleven sub-units are extremely small. For example, the Commercialization Office within Transition consists of the Chief Commercialization Officer and one administrative staff person, and the Technology Transfer Office is just one individual. The S&T Organizational Regulation Manual (STORM) lists 20 major units within the Directorate, and 22 sub-units. Given the size of the organization—about 750 personnel in headquarters—the structure is fragmented.[7] Indeed, some S&T staff at different levels within the organization said that they did not know what many of these smaller offices do. In some cases, they were unaware that offices within S&T existed and had no idea of their function.

OVERLAPPING RESPONSIBILITIES IN RELATION TO FIRST RESPONDERS

The Interagency Coordination and First Responder Program Division, and the R-Tech unit within the Office of Transition, both have major responsibilities for interaction and responsiveness to first responder needs. In addition, some technical divisions work with first responders to identify and prioritize their needs. Representatives of the first responder community also participate in the Homeland Security Science and Technology Advisory Committee (HSSTAC) which is under the direction of the Operations Analysis Division.

This means that multiple separate units within S&T interact in various ways with first responders. In addition, S&T is planning to create a first responder Integrated Product Team (IPT) that would involve first responders in identifying capability gaps and requirements across all areas of S&T work.[8]

Thus, from an organizational standpoint, a substantial level of interaction and coordination is required to ensure that sufficient attention is paid to the needs of first responders, and that it is done efficiently, in this matrixed structure.

CONCLUSIONS

The basic S&T organizational structure has been in place for about three years. Because it is comprised of overlapping and interdependent units, the need for high levels of communication is paramount. However, communication problems were evident, both in relation to oral communication, and the dissemination of documents. Communications issues may be exacerbated by the large number of direct reports to the U/S and the proliferation of small offices. Issues related to overlapping responsibilities are exemplified by the number of different entities within S&T that interact with the first responder community.

[7] About 250 additional staff members are located in S&T-operated labs. See Appendix B for more detailed information about S&T's current workforce.

[8] The effectiveness of S&T interaction with the first responder community is discussed in detail in Chapter VI of this report.

RECOMMENDATIONS

3-1. Take steps to improve communication within the Directorate.

Staff concerns about insufficient communication across organizational lines, and incomplete knowledge of documents relevant to their work, indicate a need for more focus on improving internal communications. A matrixed organizational structure requires an organizational structure that encourages sharing of information, self-initiation, and identification and correction of errors. S&T could first identify areas for improvement and collect ideas for change by engaging staff in a web-based dialogue using Web 2.0 technology. This tool could be used, as well, to gather and discuss staff ideas about sharing knowledge in general and best practices in particular.

3-2. Consider the benefits and costs of streamlining the organizational structure to reduce the number of direct reports to the Under Secretary to a more reasonable number.

While not identified as a problem in S&T at this time, generally the current number of direct reports to the Under Secretary would be considered too many. Each direct report adds to the time and attention a manager has to spend in ensuring coordination of activities and a clear focus on goals. While minimizing layers of management is also a valuable goal, so too is ensuring that a management structure does not result in bottlenecks and delays. The value of reorganization for the long run should be weighted against the inevitable costs of change in an organization that has experienced considerable change during the last three years.

3-3. Adopt a more cohesive structure for gathering first responder input.

The fragmented structure for gathering and considering input from first responders may result in lack of coordination within S&T, and frustration on the part of first responders as they try to determine how best to affect S&T's research agenda. This topic is discussed further in Chapter VI.

This Page Left Intentionally Blank.

CHAPTER IV: MISSION AND STRATEGIC PLAN

MISSION STATEMENT

According to the May 2007 Strategic Plan for the Science and Technology Directorate, the organization's mission is:

> To improve homeland security by providing to our customers, the operating components of DHS and state, local, tribal and territorial emergency responders and officials, state-of-the-art technology that helps them accomplish their missions.

Although this mission statement is consistent with Title III of Public Law 107-296, that established the S&T Directorate within DHS, it understates the range of responsibilities that are assigned to the organization in the legislation. In addition to the mandate to provide customers with state-of-the-art technology to help them accomplish their mission, S&T is charged with numerous other responsibilities. These include: advising the Secretary of DHS concerning technology issues; developing a national policy and strategic plan for the federal government's civilian efforts to develop countermeasures to threats, including developing definable goals for these efforts and measurable objectives to assess goal achievement; and assessing and testing homeland security vulnerabilities and possible threats. Other specific responsibilities cited in the legislation include coordinating and collaborating with numerous other federal agencies on endeavors to accomplish national homeland-security-related objectives. According to an S&T official, the mission statement did not specifically address S&T's other responsibilities because S&T officials felt that they were subsumed under the goal of ensuring effective provision of state-of-the-art technology to DHS components and first responders.

STRATEGIC PLAN

The S&T Strategic Plan was submitted on June 13, 2007 to the Chairmen and Ranking Members of both the House Committee on Homeland Security and the Senate and House Appropriations Subcommittees on Homeland Security. The 15-page Strategic Plan provides an overview of the organizational structure of S&T and processes for gathering capability-gap information from DHS component agencies and first responders. It also discusses how S&T will interact with other research entities, such as university-based Centers of Excellence and the National Laboratories,[9] to achieve mission goals. Finally, it describes S&T's plan for creating a work environment that will ensure a "culture of organizational excellence that promotes a common identity, innovation, mutual respect, accountability and teamwork to achieve efficiencies, effectiveness and operational synergies."

[9] Technically, the National Laboratories include those managed by the Department of Energy and the National Aeronautics and Space Administration labs. However, in the context of this report, National Laboratories refers to DOE Laboratories.

The 138-page Five Year Research and Development (R&D) Plan that accompanied the Strategic Plan enumerates the projects that each S&T division has undertaken or plans to undertake and the milestones to be achieved through FY 2011. The second attachment to the Five Year R&D Plan is a set of Power Point slides describing the Homeland Innovative Prototypical Solutions (HIPS) and High Impact Technology Solutions (HITS) program initiatives. Other Power Point slides provide representative examples of Capstone IPT high priority technology areas, arranged by S&T division.

Congressional Reaction to the Strategic Plan

The Strategic Plan was not well received by the House Committee on Homeland Security. The Chairman's opening statement at a Committee hearing on June 27, 2007 acknowledged progress at S&T, but expressed two major concerns about the Strategic Plan.[10] The first was that the plan was not a federal strategic plan but solely a plan for S&T.[11] Further the U/S for Science and Technology had been directed to develop a national plan for homeland security-related research in the 2002 legislation that created DHS, and S&T, so such a plan was five years overdue.

The Chairman's second concern was that the Strategic Plan fell short of what would be required for a strategic plan for S&T itself, i.e., the plan focused on "what" but lacked "why." It described structure, roles, and responsibilities, but not the vision or strategy that led to them. He further stated that the plan lacked metrics to measure progress towards goals and did not explain how priorities are set, either across divisions within S&T, or at the IPT level. Finally, he faulted the plan for not including a roadmap of how basic research transitions to technology development.

S&T's Strategic Plan Compared to Federal Guidelines

Both OMB and GAO have produced guidance for the development and content of strategic plans.[12] The Government Performance and Results Act of 1993 mandated that every major federal agency develop a mission statement, set goals, measure performance, and report accomplishments. The practice of requiring strategic plans for components within agencies was a natural out-growth of this requirement since component strategic plans are the key to ensuring the achievement of agency-wide objectives.

In its *Executive Guide,* GAO cites the following practices as critical to successful strategic planning:

- Stakeholder involvement, including Congress and the Administration, state and local governments, third-party providers, interest groups, agency employees, fee-paying customers, and the public;

[10] House Committee on Homeland Security, A Roadmap for Security? Examining the Science and Technology Directorate's Strategic Plan, June 27, 2007.
[11] Although referred to at the hearing as the national strategic plan, in fact, the plan is intended to focus on mission, goals, objectives, and strategies for federal entities in pursuing homeland security-related research.
[12] See OMB Circular No. A-11, Part 2 and GAO, Executive Guide: Effectively Implementing the Government Performance and Results Act, GAO/GGD-96-119, June 1996.

- Assessment of the internal and external environment continuously and systematically to anticipate future challenges and make future adjustments so that potential problems do not become crises; and
- Alignment of activities, core processes, and resources to support mission-related outcomes.

Stakeholders were not specifically involved in drafting the S&T Strategic Plan. According to an S&T official involved in developing the Plan said that stakeholders from DHS components and others did have input into the S&T restructuring in the fall of 2006. An offsite meeting had been held with S&T officials and representatives from other DHS component agencies to discuss S&T's new organizational structure and new methods of interacting with them. Component agencies had also been involved in early Capstone IPT processes and were familiar with this new approach to working with S&T. However, a systematic environmental scan to inform the Strategic Plan was not conducted.

An S&T official said that the U/S, then recently appointed, had many contacts in the federal science and technology community and that the community was familiar with how he would manage S&T and gave their tacit endorsement. Other means of obtaining input from these stakeholders, or from other stakeholders outside of DHS, were not specifically pursued. The new alignment of activities and processes was specifically intended to support mission-related outcomes.

- A comprehensive mission statement;
- Long-term goals for all major functions and operations;
- Approaches and strategies to achieve the goals and objectives and obtain the various resources needed;
- A relationship between long-term goals/objectives and annual performance goals;
- An identification of key factors, external to the agency and beyond its control, that could significantly affect achievement of the strategic goals; and
- A description of how program evaluations have been used to establish or revise strategic goals, and a schedule of future program evaluations.

The text box to the left lists the six required components of a strategic plan as presented in GAO's Executive Guide.

Table 4-1 compares the requirements from the GAO Executive Guide with S&T's June 2007 Five Year Strategic Plan.

Table 4-1. Content of the S&T Strategic Plan

GAO Guide Required Component	Content of S&T Plan
Mission Statement	Although the plan includes a mission statement, it is not comprehensive, because portions of S&T's mandated roles are not included.
Long-Term Goals and Objectives	Long-term goals and objectives are not specifically stated.
Approaches to Achieve Goals and Objectives	Approaches to organizing, staffing, and conducting S&T's work are discussed in some detail but activities cannot be linked to goals, because the long-term goals are not articulated.
Relationship between Long-Term Goals and Objectives and Annual Performance Goals	The absence of clearly articulated long-term goals and the lack of performance measures makes it impossible to draw these linkages.
Key External Factors that Could Affect Goal Achievement	The plan does not discuss key external factors that could affect goal achievement.
Use of Program Evaluations to Establish or Revise Strategic Goals; Future Evaluation Plans	The plan indicates that the Director of Research is evaluating approaches to measure performance: customer satisfaction surveys to gather feedback from DHS components are to be used as part of a measure of outcome-based performance; peer-reviewed papers, patents, conferences and workshops attended, and prizes awarded are potential measures. Because S&T is a new organization, prior program evaluations that apply do not exist. Evaluations of similar government organizations that may be relevant are not mentioned.

As the table indicates, a central issue with S&T's Strategic Plan is the lack of articulated long-term goals for major functions and operations. While the mission statement provides a very broad goal statement, it lacks the specificity to provide the structure for a coherent plan and the foundation for strategies, annual performance goals, and metrics to assess progress. The milestones listed in the Five Year Plan that was attached to the Strategic Plan were cited by an S&T official as the metrics by which S&T would assess progress.

An S&T official indicated that the primary objective of the strategic plan was to explain how the pieces of the newly structured S&T fit and were to work together. He stated that the content of the document was more helpful to S&T, DHS components, and to Congress than a document that conformed to strategic planning guidelines. Further, a main reason why OMB and GAO guidelines were not adhered to in developing the plan was because they did not believe that DHS had adequately developed "operational capability goals" that would be needed for S&T to be in a position to develop the type of strategic plan intended by the guidelines. The official explained that more specific information about goals and DHS component agencies' requirements was needed before S&T could align its goals with them.

In effect, although the Strategic Plan is a helpful document in explaining how S&T is organized and how it will function to provide customers with state-of-the-art technology, it does not adhere to the criteria of a strategic plan as generally applied across the federal government. Nonetheless, S&T has no current plans to revise the Strategic Plan to bring it into line with OMB and GAO guidelines for strategic plans. An S&T official said that the continued lack of operational capability goals for DHS, as well as the change in Administration, are reasons not to initiate a new strategic planning effort at this time.

Other R&D Agencies Have Strategic Plans That Adhere to Many Federal Guidelines

A number of federal R&D agencies have Strategic Plans that offer examples of good practice in adhering to federal strategic planning guidelines. Of four plans reviewed—NSF, DARPA, ONR, and DOE's Office of Science—all demonstrate some best practices in planning.[13]

The DOE Office of Science plan is particularly strong. In developing the plan, the Office of Science cast a wide net across the research community to ensure that a broad array of ideas and concerns were integrated into the plan. This outreach included gathering expert advice from Advisory Committees and discussions with a variety of outside experts. An appendix to the plan lists 170 individuals who participated in a workshop devoted to plan development. The Office of Science also reviewed key testimonies, forecasts, and other studies to ensure a broad perspective. The Strategic Plans for ONR, NFS, and DARPA also specifically discuss gathering input from outside the agency.

The DOE Office of Science plan states the mission and vision of the organization and articulates seven goals. The strategy for the achievement of each goal is presented, as well as indicators of success and a strategic timeline. While using somewhat different language, the NSF, DARPA, and ONR plans describe mission, goals, and strategy. Although differing in level of detail, all four of the plans discuss strategies for measuring performance. The NSF plan offers a good example of acknowledging the external factors that could result in the need to adjust the plan. Although these plans vary in strength, collectively they show that sound strategic planning for federal R&D organizations can be achieved.

Homeland Security-Related Research Strategic Plan Still Needed

The 2007 S&T Strategic Plan is not the homeland security-related research planning document that is mandated by the Homeland Security Act of 2002. An S&T official said that they consider a 2007 S&T document that describes coordination activities with other federal agencies as the first step in producing such a comprehensive strategic plan.[14] He also indicated that the Quadrennial Homeland Security Review (QHSR), due to be delivered in December of 2009, would be an additional step.

[13]"National Science Foundation Strategic Plan, FY 2003 – 2008," National Science Foundation, September 2003. "Bridging the Gap, Powered by Ideas," Defense Advanced Research Projects Agency, February 2007. "Naval S&T Strategic Plan, Defining the Strategic Direction for Tomorrow," Office of Naval Operations, January 2007. "Office of Science Strategic Plan," Department of Energy, Office of Science, February 2004.
[14] DHS, S&T, Coordination of Homeland Security Science and Technology, December 2007.

S&T is a relatively small actor within the federal homeland security research community, and has no specific authority to direct or influence the research agendas of other agencies. Thus, S&T would have to seek and rely on White House support to obtain the active participation from federal agencies that would be required to produce a comprehensive research strategy. Alternatively, action could be taken to obtain additional statutory authority from Congress or transfer responsibility for development of the homeland security-related research strategic plan, that includes consideration of state and local needs, to the White House Office of Science and Technology Policy (OSTP).

CONCLUSIONS

S&T has made little progress both in relation to developing a functional strategic plan for S&T itself, and in developing a homeland security-related research strategic plan to guide federal efforts across departments. Both of these documents are essential to ensuring optimal focus on mission, goals and objectives. Both federal strategic planning guidance, and examples of plans from other federal science agencies, are available to direct S&T's efforts to develop a strategic plan. For S&T to pursue a strategic plan for all federal homeland security-related research, the assistance of the White House seems essential.

RECOMMENDATIONS

4-1. Develop an S&T strategic plan.

S&T should develop a Strategic Plan that articulates mission, goals, and strategies to provide additional focus to its work. S&T should consider broadening its mission statement to reflect its mandate more completely. DHS's 2008 - 2013 Strategic Plan offers the department-level perspective that can guide S&T's planning efforts. Other federal R&D agencies' strategic plans can be helpful in framing the planning effort. S&T should follow federal guidance related to the process for developing a strategic plan and its contents. Stakeholder input is particularly important because of the significant linkages of S&T's work with other research and development entities across the federal government and the critical roles its customers fill in the homeland security arena.

4-2. Develop a homeland security-related research strategic plan.

S&T should work with OSTP and the array of federal departments engaged in homeland security-related research to develop a comprehensive strategic research plan. This plan would focus federal efforts, help to ensure coordination and collaboration, and avoid unnecessary duplication of effort. It could also allow for the development of metrics that could track progress. Such a plan should consider the needs of state agencies and local first responders through appropriate consultation to meet the nation's homeland security-related research needs.

CHAPTER V: TRANSITION PORTFOLIO

S&T's transition portfolio is designed to develop and deliver technologies to customers within three years. Almost half (approximately $361 million) of S&T's total FY 2009 budget is devoted to the transition portfolio, reflecting the priority S&T has placed over the last two years on meeting customer needs.

Transition portfolio priorities are set by customers working with S&T staff through the Integrated Product Team (IPT) process. The process includes meetings of Capstone IPTs, which bring together DHS component agency and S&T staff to identify and prioritize capability gaps.[15] DHS component agencies are expected to represent their own needs, as well as the needs of their external customers (e.g., first responders, state and local governments, other federal agencies, the private sector). Based on the prioritized capability gaps identified by the Capstone IPTs, S&T technical divisions initiate projects to provide solutions to customers.

There is a transition manager in each technical division who is responsible for overseeing the IPT process and the transition portfolio in that division. Transition managers report to technical division heads (in some cases transition managers are also technical division deputy directors), but also work closely with the Director of Transition.

Transition projects are carried out primarily by industry. Others are done by the National Laboratories, other federal labs, federally funded R&D centers, or universities. All projects are supposed to include a transition plan for either transferring the technology to the appropriate DHS component agency or commercializing the technology.[16]

IDENTIFYING AND PRIORITIZING CUSTOMER NEEDS

S&T Customers

The Homeland Security Act of 2002 does not specifically define S&T's customers, but it does give S&T the responsibility to transfer technologies to other federal agencies, state and local governments, and the private sector. Originally, U/S Cohen determined that the transition portfolio would meet the needs of DHS customers, with the understanding that these customers would in turn represent the needs of their own customers—state, local, and tribal governments; first responders; other federal agencies; and the private sector. However, over time the transition portfolio has increasingly considered the "customers of its customers" to be S&T's direct customers.

[15] Capability gaps are the difference between current capabilities and the capabilities needed to meet objectives.

[16] It is unclear how many S&T projects have been transitioned. According to March 26, 2009 testimony by Acting U/S Bradley I. Buswell to the U.S. House of Representatives Committee on Appropriations, Subcommittee on Homeland Security, approximately 15-20 products were transitioned to DHS customers or deployed in the field (by first responders or the private sector) between March 2008 and March 2009.

At a March 2007 hearing the House Committee on Science and Technology Subcommittee on Technology and Innovation expressed concern about how well S&T's priorities met the needs of DHS component agencies, other federal agencies, and state and local governments. In particular, the Subcommittee noted complaints from state and local governments and first responders that S&T was not responsive to their requests and recommendations. The Subcommittee viewed the establishment of the IPTs as an important step toward ensuring customer needs were met, but indicated that more was needed, including establishing a formal mechanism for responding to end users. The Subcommittee did not specify what this mechanism should be.

At the hearing, U/S Cohen defined S&T customers as the 22 DHS component agencies[17] and their customers (first responders) and said, "The first responders and the communities are not at the bottom in my book. They are at the top, and I exist to fulfill and serve their requirements." Cohen further explained that S&T had instituted a number of changes to improve interactions with customers, including:

- Establishing the IPTs, "the centerpiece" of S&T's transition portfolio; and
- Issuing a new document, the S&T Organization Requirements Manual (STORM), which is designed to communicate to customers what the organization does, how it functions, and its capabilities.

The STORM includes position descriptions for the heads of each of the divisions and primary offices of S&T. Although this document is intended to help customers understand and navigate S&T, as of April 2009 it had not posted been on S&T's website.

Establishing the IPTs has successfully shifted S&T's focus to meeting the needs of DHS component agencies. However, non-DHS customers are included to varying degrees or not at all, depending on the particular IPT. Non-federal first responders are explicitly excluded from IPT membership and are rarely invited to meetings.[18] Instead, S&T relies on the component agencies to represent the needs of first responders, a role the DHS Office of Inspector General concluded is impossible.[19] In recognition of the inadequacy of relying on DHS component agencies to provide first responder input, some technical divisions interact directly with first responder communities to identify needs and insert these needs into the IPT process.

Other government agencies and the private sector have been included in the IPT process on an ad hoc basis. The National Guard Bureau and U.S. Northern Command both have designated liaisons responsible for attending all IPT meetings and representing their agencies' perspectives. In addition, the private sector has been included in the Incident Management IPT.

---

[17] Although all 22 DHS component agencies are S&T customers, S&T's focus is on meeting the needs of the seven "operational" component agencies.

[18] CRS, The DHS Directorate of Science and Technology: Key Issues for Congress, RL34356, February 1, 2008, p. 16.

[19] DHS, OIG, *The Science and Technology Directorate's Processes for Selecting and Managing Research and Development Programs*, OIG-08-85, August 2008, p. 24. S&T's attempts to identify and meet the needs of first responders are discussed in detail in Chapter VI.

While S&T's approach to interacting with non-DHS customers has been evolving, there has been no systematic analysis of whose needs S&T should be serving or who the customers are for each IPT. Further, there are no standard mechanisms for including non-DHS customers in the IPT process.

Integrated Product Team Process and Structure

In late 2006, S&T established the IPT process to serve DHS components by giving them the opportunity to identify and prioritize their capability gaps. Customers chair the IPTs; are the decision-makers; and are integrated into every stage of the process, including product research and development, transition, and acquisition. Technologies produced through the IPT process are called "Enabling Homeland Capabilities" and ostensibly can be transitioned within three years. As a function of the federal budget cycle, it takes two years to initiate projects that have been identified by the IPTs. Thus, the 2006 IPT round identified projects for inclusion in S&T's FY 2009 budget.

In conjunction with the initiation of the IPTs, S&T and the component agencies reviewed 167 ongoing S&T programs, some of which may have included multiple projects. The goal was to determine which projects should be transferred into the new organizational structure, which should be modified to better meet customer needs, and which should be terminated. Approximately 15 projects were terminated, primarily because they lacked a customer but there also may have been other reasons, such as poor performance. Four projects were modified to better meet customer needs. The remaining projects were transferred to the IPTs, with most undergoing at least modest refinements in response to customer input.

One of the criteria for the initial project assessment was the existence of a customer for the project. S&T recognized that even potentially great technologies will not be integrated into operations unless customer parameters are considered, including how the technology will be used and maintained, as well as its cost.[20]

The Capstone IPTs are a mechanism for interaction between and among decision-makers from the DHS component agencies and S&T (nonvoting). Each IPT has one or two customer leads from the DHS components with the largest stake in the IPT. Other component agencies with an interest in the IPT are members and have a vote, but the lead customers have the final say. Any component agency can send representatives to IPT meetings, even if it is not a member.

There are 12 Capstone IPTs, each with its own budget.[21] Table 5-1 lists the IPTs and the S&T division and customer leads for each. While many of the IPTs are interdependent (e.g., Information Sharing, Interoperability, and Incident Management), they operate in virtual isolation of each other and have different customer leads.

[20] DHS, OIG, The Science and Technology Directorate's Processes, pp. 14-15.
[21] Appendix B provides information concerning the IPTs' FY 2009 budgets.

Table 5-1: IPTs, S&T Leads, and Customer Leads

Capstone IPT	S&T Division Lead	Customer Lead(s)
Border Security	Borders and Maritime Security	Customs and Border Protection; Immigration and Customs Enforcement
Cargo Security	Borders and Maritime Security	Customs and Border Protection
Maritime Security	Borders and Maritime Security	U.S. Coast Guard
Chemical/Biological Defense	Chemical and Biological	Office of Infrastructure Protection; Office of Health Affairs
Cyber Security	Command, Control, and Interoperability	Office of Cyber Security and Communications
Information Sharing/Management	Command, Control, and Interoperability	Office of Intelligence and Analysis
Interoperability	Command, Control, and Interoperability	Federal Emergency Management Agency; Office of Emergency Communications
Counter-IED	Explosives	Office for Bombing Prevention; U.S. Secret Service
Transportation	Explosives	Transportation Security Administration
People Screening	Human Factors/ Behavioral Sciences	Citizen and Immigration Services; Screening Coordination and Operations
Infrastructure Protection	Infrastructure and Geophysical	Office of Infrastructure Protection
Incident Management	Infrastructure and Geophysical	Federal Emergency Management Agency

Capstone IPTs meet two to four times a year. Acquisition staff from the component agencies usually attend to help ensure the Enabling Homeland Capabilities that are developed will be used.

The component agencies submit capability gaps to the Capstone IPT. Each Capstone typically collects dozens of capability gaps from its members. Capability gaps are supposed to describe the outcome or effect needed, be actionable, and not presuppose solutions. For example, the Border Security Capstone IPT could identify tunnel detection as a capability gap and the Chemical and Biological Defense IPT could identify forensic analysis as a capability gap. S&T is involved in the identification and prioritization of gaps to varying degrees, depending on the IPT.

S&T's role in the IPT process, in addition to providing advice and administrative support, is to determine whether technologies already exist to address gaps or if another entity is already working on their development. The capability gaps that remain after this process is complete are evaluated against each other and prioritized by the Capstone IPT.

Once the capability gaps are prioritized, S&T develops a Research and Development plan, including cost estimates, to address gaps. The IPTs review the projects in S&T's plans and decide which should go forward, based on how well they address gaps, available funds, and estimated costs.[22]

Under the Capstone IPTs, there are 45 Sub-IPTs that oversee the implementation of one or more projects within a program. For example, First Responder Equipment is a Sub-IPT of the Incident Management Capstone IPT and Cargo Conveyance Security is a Sub-IPT of the Cargo Security Capstone IPT. Members of the Sub-IPTs are designated by the Capstone and are primarily program managers and subject matter experts (SMEs) from S&T and the component agencies. Customer representatives at the Sub-IPT level provide S&T with the operational information it needs to execute programs.

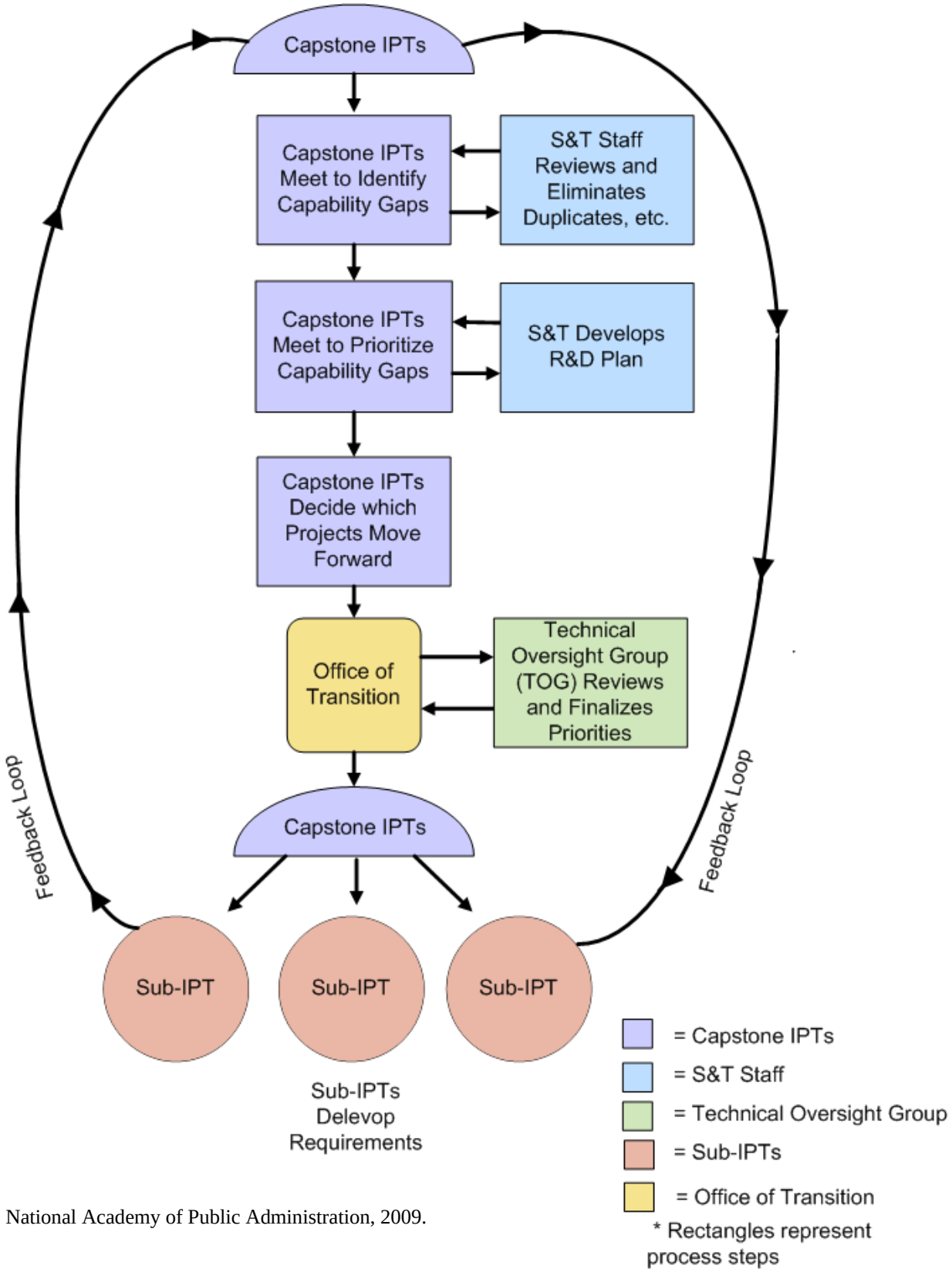
Sub-IPTs are responsible for refining project plans, specifications, and schedules. The Sub-IPTs also monitor progress once projects have been launched. Program managers involved in the Sub-IPTs report back to the Capstone on project progress on a regular basis and the Capstones provide feedback to the Sub-IPTs and S&T on whether projects experiencing delays or other problems should be continued.

Sub-IPTs hold meetings, but officials said that in some cases there is much more communication among members via email and telephone than in face-to-face meetings. Sub-IPT meetings involve more competition among component agencies than at the Capstone level because this is where specific requirements are set and product trade-offs are made.

There is great variation in structure and process among the IPTs because there was little guidance provided on how to operate them when the IPTs were initiated. Therefore, members of each IPT devised their own structure and processes through trial and error. There are also variations resulting from differences in customers and mandates. Figure 5-1 represents a generic version of the IPT process. Appendix C includes two examples of IPT processes that show the complexity of the process and the differences across IPTs.

[22] DHS, OIG, The Science and Technology Directorate's Processes, p. 22.

Figure 5-1: Generic IPT Process



Source: National Academy of Public Administration, 2009.

S&T is beginning to achieve some consistency in structure and processes in the IPTs. The transition managers from the six technical divisions have developed some standardized practices, including a Technology Transition Agreement template, a Capability Gap Prioritization process, and a Capability Gap Statement template, and have begun introducing them into the IPT process. The transition managers also have drafted a Capability Gap Acceptance Process flow chart and plan to continue developing standardized processes and procedures.

DHS components have taken different approaches to working with S&T in the IPT process. For example, the Office of Infrastructure Protection has established an office with a staff of seven and the primary role of partnering with S&T. The Transportation Security Administration has a staff person who works full-time participating in and managing participation across the 12 Capstone IPTs and 45 Sub-IPTs. Most other component agency staff assigned to the IPTs have other duties and their participation is less focused. In one extreme case, a component had three changes in its IPT representation in less than one year. Component agencies with staff dedicated to working with S&T in the IPT process reported greater knowledge of and influence over S&T's activities, and a higher level of satisfaction with S&T.

Technology Oversight Group

A summary of the results of the IPT process is communicated to the Technical Oversight Group (TOG), which is made up of the DHS Deputy Secretary (chair) and the U/Ss of National Protection and Programs, Management, and S&T (who is nonvoting). The DHS Chief Financial Officer also attends. The objectives of the TOG are to oversee the transition portfolio, ensure investments are balanced across IPTs, and provide coordination at the Department level. The TOG makes sure that projects align with DHS priorities.

The summary submitted to the TOG is a memorandum jointly signed by the customer lead and the relevant technical division head. The memorandum is sent to the S&T U/S via the Director of Transition and includes information on the priorities identified by the IPT and specific projects that the division will undertake. The TOG memo usually includes information on capability gaps identified as priorities but not funded, and sometimes includes suggestions on how to shift funding to pay for these priorities. The projects S&T will undertake are not finalized until they are reviewed by the TOG, which can make changes. The finalized list of projects goes to the Sub-IPTs.

Although all customers are invited to TOG meetings, some customers indicated frustration that the invitations are often issued at the last minute, which prevents them from attending. In addition, the TOG meeting minutes lack detail and context and, until recently, were not routinely disseminated to customers. Therefore, customers often learn of decisions made by the TOG from conversations with Office of Transition or technical division staff, and the basis for decision-making by the TOG is not well understood by customers.

A new TOG Working Group (TOGWG) has been created to conduct specific analyses requested by the TOG and provide advice to the TOG. The TOGWG was originally made up of GS-15 level representatives from each of the seven operational component agencies. The TOGWG

recently conducted a Strategic Balance Assessment to make recommendations that will be factored into the next IPT round. At the Assessment meeting, S&T Division Heads provided a briefing on IPT projects and TOGWG members were asked to prioritize and rank projects across IPTs based on their individual assessment of operational impact. In other words, all TOGWG members rated all projects, regardless of their relevance to the member.

This experience was unsatisfactory according to interviewees from the component agencies and S&T. While the TOG made the decision to institutionalize the TOGWG, the plan is to expand participation to include representatives from DHS directorates and component agencies beyond the seven operational components. It is unclear what types of analyses the TOGWG would perform, but it would not conduct additional strategic assessments of the transition portfolio. Plans call for future Strategic Balance Assessments to be conducted by academics and other outside organizations, and results are intended to be provided to the TOG to help it make decisions about investment balances. It is important to ensure that whoever conducts assessments of the transition portfolio in the future is provided with some basic information and arguments regarding the tradeoffs under consideration in advance of the meeting.

Technology Transition Agreements

Once requirements are final, S&T attempts to enter into a Technology Transition Agreement (TTA) with the customer. The TTA is a good-faith, non-binding written agreement confirming that the project S&T is embarking on meets customer needs. A primary purpose of the TTAs is to ensure that customers are serious about the projects that S&T is planning to initiate or continue. TTAs can be modified upon mutual agreement, and can be terminated by any party at any time. There are different levels of TTAs, beginning with a "basic" version that includes a description of the product, key technical and cost parameters, and the signatures of the customer and S&T. As project plans progress and customers and S&T agree on specifications and other details, a "final" TTA is developed and signed.

The final TTA builds on the basic TTA and also describes the capability gap that the S&T deliverable will meet; the deliverable; the technical requirements/parameters; and the project plan, including schedule, funding, and transition approach (e.g., acquisition, commercialization, etc.). The customer, depending on circumstances, agrees to either integrate the technology into its acquisition program by a certain date, or to advocate the use of the product by end users by a certain time. Once a TTA is developed, a program manager takes over. However, S&T has been experiencing difficulties in getting TTAs signed and the majority of transition projects have been assigned to program managers and initiated without a signed TTA in place.

Findings

Strengths of the IPT Process

The IPT structure has successfully improved S&T's relationship with its customers. With only one or two exceptions, interviews with DHS customers revealed views of the IPT process ranging from guarded optimism to staunch enthusiasm. Even those who are still less than fully satisfied admit that the IPTs are a significant improvement over how S&T did business in the

past. Several aspects of the IPT process that have improved customer satisfaction include the following:

The IPT process is customer-driven. Stakeholders lead the IPT process, helping to ensure that S&T understands and is responsive to customer needs and increasing the likelihood that the technologies produced by S&T will be integrated into customer operations. Most customers believe that S&T is making a good-faith effort to identify and meet customer needs. Customers characterize S&T staff as accessible and responsive to customer concerns. In addition, customers report a better understanding of what S&T can do for them, helping to build a constituency of support for S&T's work.

The process can be flexible and responsive. There is a two-year lag between the IPT requirements process and the initiation of projects. Nonetheless, customers are confident that the IPT structure is flexible enough to accommodate any changes needed to respond to new threats or other circumstances.

The IPTs are becoming more "user-friendly." Customers appreciate the standardization that the transition managers are imposing on the IPT structure and process and want more of it. For example, one customer said that the capability gap template helps make submissions more specific and actionable. Another customer expressed a hope that standardized processes will reduce the amount of time customers spend on the IPTs.

The IPTs encourage information-exchange among the component agencies. One ancillary benefit of the IPTs has been their facilitation of stronger communication and coordination among DHS agencies. Component agencies now have a better understanding of other components' concerns, perspectives, and activities.

Weaknesses of the IPT Process

While the benefits of the IPTs are substantial, the process also has drawbacks.

The IPTs are not adequately institutionalized. Customers say that the IPTs are insufficiently institutionalized to withstand changes in leadership. This is a concern because they believe the IPT process increases the likelihood they will get technologies they need, and because they do not want the time and effort they have invested in the IPTs to be wasted. One indication that the IPTs may be vulnerable is the postponement of the January 2009 TOG meeting until the appointment of a new U/S.

The IPT process is customer-driven. There are benefits to having customers lead the process, but also drawbacks. Operational component representatives may not be aware of opportunities inherent in innovation, gaps in knowledge, or opportunities that cut across divisions. Customers also may have unrealistic expectations of what can be delivered and how quickly, because they do not fully understand the current state of the technology.

Roles and responsibilities of participants are undefined. The lack of clear definitions of roles has caused confusion among customers and frustration among S&T staff. Sometimes customers

want to dictate the solution instead of working with S&T to clarify parameters and letting S&T identify appropriate solutions. At the same time, S&T is often overly involved in the capability gap prioritization process. In extreme cases, customers view S&T as the facilitators, coordinators, and overseers of the IPT process and are merely reactive to S&T presentations.

Technology Transition Agreements are ineffective. Ideally, all projects would have a signed TTA to demonstrate customer support for the project before project initiation or continuation. Despite softening of TTA language to make it clear that they are "good faith" agreements that articulate intentions, not obligations, component agencies are reluctant to sign them. Only 49 out of 114 FY 2009 transition projects[23] have signed TTAs. Five of the 12 IPTs do not have TTAs signed for any of their projects. S&T has been pressured by DHS leadership to have TTAs signed. S&T officials report that the TOG is responsible for ensuring that customers sign TTAs. The Deputy Secretary receives reports on the status of TTAs and routinely addresses TTA status with customers. However, customers do not appear to perceive that there is pressure from DHS leadership for them to sign TTAs—customers instead view the pressure as coming from S&T and routinely avoid signing the TTAs. In addition, since the IPT budgets are fixed and will be spent whether or not the customers sign TTAs, there is no incentive for customers to sign them.

Customers do not fully understand the TOG and TOGWG processes. The TOG is not sufficiently transparent. Customers do not understand the TOG's mission or criteria for decision-making. Furthermore, TOG meeting minutes simply note that decisions were made, but not the rationale for the decisions. Customers are also confused about the purpose and results of the TOGWG Strategic Balance Assessment, primarily because they do not believe participants had the expertise necessary to evaluate and balance S&T's transition portfolio.

There is no standard mechanism for collecting input from non-DHS customers. There is a wide variety of customers for the different IPTs, including state and local governments, other federal agencies, the private sector (which owns and operates much of the country's critical infrastructure), the Homeland Security Council, and first responders. IPT membership is generally restricted to DHS component agencies, although some IPTs have made exceptions and added representatives of other federal agencies or first responders. There is no standard mechanism for getting input from non-DHS customers and balancing their different needs. The extent to which these customers are invited to IPT meetings or their input is sought through other mechanisms is dependent on the particular IPT chair and S&T leads.

Processes and procedures are not adequately standardized. The establishment of the IPTs has created a structure and process for regular involvement of DHS customers in setting S&T's transition research agenda, but the structure is not founded on a stable platform of policies and procedures. This causes confusion among customers and S&T staff, and means that each IPT has to develop its own processes and procedures through trial and error. Ideally, a standardized process that includes a formal analysis of current and target capabilities[24] would be used to identify capability gaps. There is no evidence that the IPTs have conducted such analyses and

[23] This total number of FY 2009 transition projects was provided by S&T on March 25, 2009. However, supporting documents that detail project funding by Capstone indicate that a total of 151 transition projects are funded in FY 2009.

[24] Target capabilities are the operational capabilities necessary to achieve mission-critical objectives.

there is no standard procedure for prioritizing gaps. In at least some of the IPTs, members negotiated among themselves so that everyone got some of their needs met, resulting in decisions that were not necessarily optimal.

Customers lack incentive for investing the time and effort necessary to make the IPTs maximally effective. Most DHS component agencies did not have S&T budgets before their merger and relied on the purchase of off-the-shelf technologies. Because S&T has successfully transferred few technologies to customers over the last five years, there is little incentive for DHS customers to invest the staff time necessary to participate effectively in the time-consuming IPT process.

TRANSITION PORTFOLIO ISSUES

S&T's focus on transforming the transition portfolio over the last two years has resulted in significant improvements in how projects are identified, prioritized, and selected. The customer-driven process now in place will help ensure that the technologies S&T develops will be utilized by customers. The composition of the portfolio is also gradually being transformed, as legacy projects are replaced with projects resulting from the IPT process. In FY 2008 24 percent of the 83 projects in the transition portfolio were new. In FY 2009, the percentage of new projects in the portfolio had risen to 56 percent (out of a total of 114).[25]

However, the changes that have been implemented are fairly new and it remains to be seen how successful they will be over time. In addition, as discussed above, the processes and procedures that have been established are immature and lack institutionalization and standardization. A number of issues remain to be addressed for the transition portfolio to succeed.

The IPT process may not be addressing DHS-wide priorities. A major flaw of S&T's IPT structure is that there is no mechanism to compare priorities and reallocate funds across IPTs to ensure that the most important projects are funded. Thus, there is a risk that the project at the bottom of the funded list in one IPT may be less important overall than a project at the top of the unfunded list in another IPT. While some target capabilities are defined in Homeland Security Presidential Directives or DHS documents, there is no DHS-wide consensus on target capabilities—each customer submits capability gaps based on its own understanding of target capabilities.[26] Further, while one of the objectives of the TOG is to address the strategic balance between Capstone IPTs, the TOG meeting minutes do not indicate that this issue is addressed by the TOG. In any case, the budgets of the IPTs are relatively fixed and to date the TOG has not reallocated funds among the IPTs.

Outputs. Some customers complained that they have not received a single product from S&T in five years and want to know how S&T has been spending its money. Other customers could

[25] These FY 2009 numbers were provided by S&T on March 25, 2009. However, the supporting documents, which list funded projects for each IPT, indicate that there were 96 new starts out of a total of 151 projects in the transition portfolio in FY 2009.
[26] Homeland Security Institute, *Comprehensive Integrated Product Team Gap Analysis*, May 31, 2007, p. 19.

name only one or two technologies they have received from S&T in the last five years. Transition projects are supposed to be completed within three years.[27]

Legacy projects. There are still many projects in the transition portfolio that were initiated before the IPTs were established in 2006. While the number of these legacy projects has dropped significantly, and will continue to drop as the IPTs mature, there are problems with some of those remaining in the portfolio. A systematic review of these projects to assess their viability has not been conducted and there appears to be a reluctance to terminate them. In addition, there are indications that S&T is still shopping for customers for some of the remaining legacy projects.

Transition plans. Many projects lack clear transition plans. This is troubling because transferring technologies to customers is the purpose of the transition portfolio. This situation may improve with the increased use of the TTAs and the establishment of the Commercialization Office.

Transparency. The benefits of transparent processes are that they provide everyone, including customers, with the opportunity to understand the rationale for decisions made and help overcome perceptions of bias. S&T may be making rational, unbiased decisions, but, without documentation, this is impossible to verify. There is also a lack of transparency within S&T. There is no mechanism for tracking and cross-referencing projects. The only information S&T leadership now has on ongoing projects is presented in the semi-annual reviews, which S&T is planning to scale back to once per year. S&T officials believe these reviews are useful in connecting with customers and providing transparency. However, these are limited in time and do not allow for detailed presentation of data or substantive discussion. Also, IPTs with larger portfolios do not present all projects. The reviews are held over several days, which makes it difficult to compare projects across IPTs. A new project data collection and analysis data base currently being pilot tested, the Project Execution System, is intended to allow for cross-referencing of projects to avoid wasteful duplication and identify opportunities for leveraging. The intention is to make the database available to S&T leadership and DHS IPT customers, which would greatly improve transparency.[28]

Communication and management. The challenges of a matrixed organization, discussed in Chapter III, have also caused problems in the transition portfolio. S&T staff report communication breakdowns between the Office of Transition, transition managers, and division heads. Communication between the customers and the TOG, which occurs primarily through the Office of Transition, is also reported to be flawed. These communication issues, combined with the complex organizational structure of S&T, have resulted in inadequate overarching management of the IPTs. For example, there does not appear to be a formal mechanism for information-sharing and coordination among the IPTs. Cross-fertilization between the IPTs would help avoid unnecessary duplication, create synergies, and contribute the ability of the IPTs

[27] It is unclear how many S&T projects have been transitioned. According to March 26, 2009 testimony by Acting U/S Bradley I. Buswell to the U.S. House of Representatives Committee on Appropriations, Subcommittee on Homeland Security, approximately 15-20 technologies were transitioned to DHS customers or deployed in the field.
[28] See Chapter IX for more information on the Project Execution System.

to deliver necessary technologies. Also, as discussed above, the structure and processes of the IPTs are inadequately standardized.

Competition and Peer Review. It is unclear to what extent transition projects are competed. However, in interviews where this issue was raised, the response was typically that the division staff knows who the best performers are for projects. Furthermore, project proposals are not peer-reviewed.

Evaluation. There is no mechanism for obtaining feedback from customers to measure outcome-based performance. Despite the reference in S&T's strategic plan to satisfaction surveys designed to gather feedback from DHS component agencies for this purpose, no surveys have been conducted.

CONCLUSIONS

S&T's definition of its customers and the relative emphasis placed on meeting needs of different customers has changed over time and remains unclear. Similarly, S&T has not gone through a formal process to identify customers external to DHS for each of the IPTs.

The number of legacy projects in the transition portfolio has been decreasing. However, there has been no systematic assessment of legacy projects to determine which should be terminated. DHS customers are not satisfied with S&T output to date, in part because legacy projects do not necessarily meet their needs, and the projects identified through the IPTs that should are just beginning to be implemented. Also, the goal of completing transition projects within three years creates false expectations on the part of customers and sets S&T up for failure or the impression of failure.

The IPTs are inadequately institutionalized and processes and procedures are not adequately standardized or transparent. The IPTs are treated as distinct entities when there is substantial overlap. Coordination among the IPTs to identify potential duplication and opportunities for leveraging is lacking. Since the IPTs operate in isolation of each other, there is no comparison of requirements across IPTs to ensure that capability gaps of highest priority to DHS as a whole are being addressed.

A related issue is that IPT budget allocations do not necessarily reflect DHS-wide priorities or allow for taking advantage of the most promising opportunities. There are no formal processes in place for collecting feedback from IPT customers on how to improve the process or how effectively technologies have transitioned.

RECOMMENDATIONS

5-1. Define customers clearly.

Logic models should be used by S&T to identify its customers, as well as customers for each IPT—including other agencies and first responders. Logic model results can provide the basis for developing a process for incorporating input from customers other than DHS component agencies in the IPTs. (Logic models are discussed in Appendix D.)

5-2. Increase outputs and accelerate transition.

S&T should arrange for an external review of legacy projects and terminate those that are performing weakly or offer little hope of transition, thus making room for new projects. Incentives, such as tying successful transition within a certain timeframe to personnel evaluations, should be developed for terminating projects that are unlikely to be successful and for completing projects on time and within budget. The distinction between long-term programs and projects with specific outputs and delivery dates should be improved, and transition plans should be developed at the beginning of projects.

5-3. Establish and meet realistic targets.

S&T should change the definition of transition to encompass technologies that can be developed and transferred "within three to five years" rather than the current "three years." Based on S&T's experience and the experience of other federal agencies engaged in science and technology, this is a more realistic timeframe for developing and deploying technologies. Using the definition "within three years" gives customers false expectations and sets S&T up for failure. However, this longer time frame should not be used as an excuse to lengthen projects. The goal for the portfolio should be a 20 percent turnover in projects, at a minimum, each year.

5-4. Institutionalize the IPTs and impose standard structures and procedures.

S&T should work with stakeholders to develop an IPT charter that delineates roles and responsibilities of participants, and establishes common terminology and standard operating procedures. There should be a DHS management directive sanctioning the IPTs, requiring customer signatures on TTAs before projects can begin, and directing DHS customers to devote at least one full time employee to the IPT process.

5-5. Restructure the IPT process.

The IPT process should be restructured to ensure that the highest-priority DHS-wide needs are being met. A mechanism should be developed for establishing DHS-wide target capabilities based on department priorities and threat assessments. This could be achieved through the TOG if membership is expanded to include the heads of the operational components. The divisions and the IPTs should identify capability gaps based on an analysis of current and target capabilities and develop proposed projects for filling gaps. These projects should be compared against each other and the target capabilities to determine which projects fall above and below a single S&T funding cut line. In addition to ensuring the best projects for meeting DHS needs are being funded, this process would also facilitate reallocating funds in response to changing threats and department priorities, as well as to the most promising projects. S&T should educate

customers on the importance and purpose of the TTAs (e.g., they are not binding agreements). The TOG should be responsible for ensuring that reluctant customers sign TTAs and determining whether ongoing projects without signed TTAs should be continued. Also, communication and coordination among IPTs should be improved.

5-6. Establish a formal process for collecting feedback from IPT members.

S&T should institute a formal process for collecting feedback from customers regarding areas for further improvement to the IPT structure and process. IPT customers should rate the progress of ongoing projects on an annual basis and assess how successfully technologies resulting from completed projects have been transitioned at the end of projects. Assessments should be provided to S&T in a standard format.

5-7. Improve transparency.

The STORM should be posted on DHS's website. Processes, procedures, outputs, and performer selection, should be documented. Make the IPT decision-making process transparent. TOG meeting minutes should include a rationale for each decision made and be disseminated to customers. A project tracking system should be made accessible to customers and upper management. The semi-annual reviews should be eliminated. Standard written reports on each project should be disseminated to S&T leadership and customers on a semi-annual basis.

5-8. Compete projects and use peer review to select research performers.

Competing projects and peer review of grant awards is standard practice at other federal research agencies and should be the norm at S&T, not the exception. Not only will this ensure the highest possible quality of the research, but it will help build a community of research performers interested in and able to do the work.

This Page Left Intentionally Blank.

CHAPTER VI: MEETING THE NEEDS OF FIRST RESPONDERS

Over time, S&T has come to recognize first responders as an important external customer. First responders are federal, state, local, and tribal emergency professionals who prevent, defend against, and mitigate consequences of terrorist attacks and natural disasters. First responders include the disciplines of emergency management, emergency medical services, fire, hazardous material, law enforcement, bomb squads, tactical operations/special weapons assault teams, and search and rescue.

S&T conducts outreach to first responders through S&T-sponsored stakeholder conferences, participation in national association conferences, an electronic newsletter, websites, focus and user working groups, and one-on-one outreach to state and local first responders. The goals of outreach are to raise awareness of S&T's activities in support of first responders, collect input from first responders on capability gaps and S&T activities, and field-test technologies.

As discussed in Chapter V, IPT members represent the needs of first responders to varying degrees. The extent to which IPTs address first responder needs depends on a variety of factors, including: the extent to which first responder input is relevant to the particular IPT; the DHS customer leads' willingness and ability to interact with first responders and consider their input when setting priorities; and the initiative of the S&T division lead in pursuing first responder input.

In addition to meeting first responder needs through the IPTs, S&T's First Responder Technologies Program (R-Tech) has a budget of $4.5 million to develop technologies in response to first responder capability gap submissions. S&T also has created a new Commercialization Office that is intended to influence industry in developing and marketing first responder technologies.

Resources to meet first responder needs are limited; therefore, S&T relies as much as possible on identifying or developing technologies that have dual uses. For example, if an IPT identifies a need that is potentially useful to first responders, S&T will attempt to ensure that the specifications allow for use by both federal customers and state and local first responders. In addition, Section 1401 of the 2003 Defense Authorization Act provides S&T with a mechanism to adapt relevant DOD technologies to meet the needs of first responders. An interagency group consisting of DOD, S&T, and the Department of Justice meets quarterly to discuss first responder capability gaps and identify DOD technologies that could potentially meet those gaps. The goal is to identify technologies that can be transferred as-is or with minor modifications.

First responders who have participated in S&T focus groups or user working groups, or have been contacted by S&T to provide input in other ways indicate satisfaction that S&T is sincerely interested in their input and is making an effort to incorporate their suggestions. However, it is a burden for first responders to participate in lengthy meetings or events that involve travel, and smaller first responder organizations incur overtime expenses when employees have to work extra hours to cover the shifts of those who are out of town to participate in S&T meetings.

More efficient and effective methods are needed to facilitate S&T's communication with first responders.

Despite S&T outreach efforts, many first responders are not aware of S&T or how S&T could support first responders. Even in large cities, first responders report having no contact with S&T.[29] In addition, emergency medical services first responders and emergency managers have even less contact with S&T than other first responder disciplines.[30]

Many first responders may not understand S&T's relevance to their work. S&T is developing technologies that would be useful to first responders in both natural and terrorist events, but S&T's mission statement and other written documents may leave the impression that the primary focus is on terrorism events. To be successful in reaching out to first responders, S&T's language should match its activities.

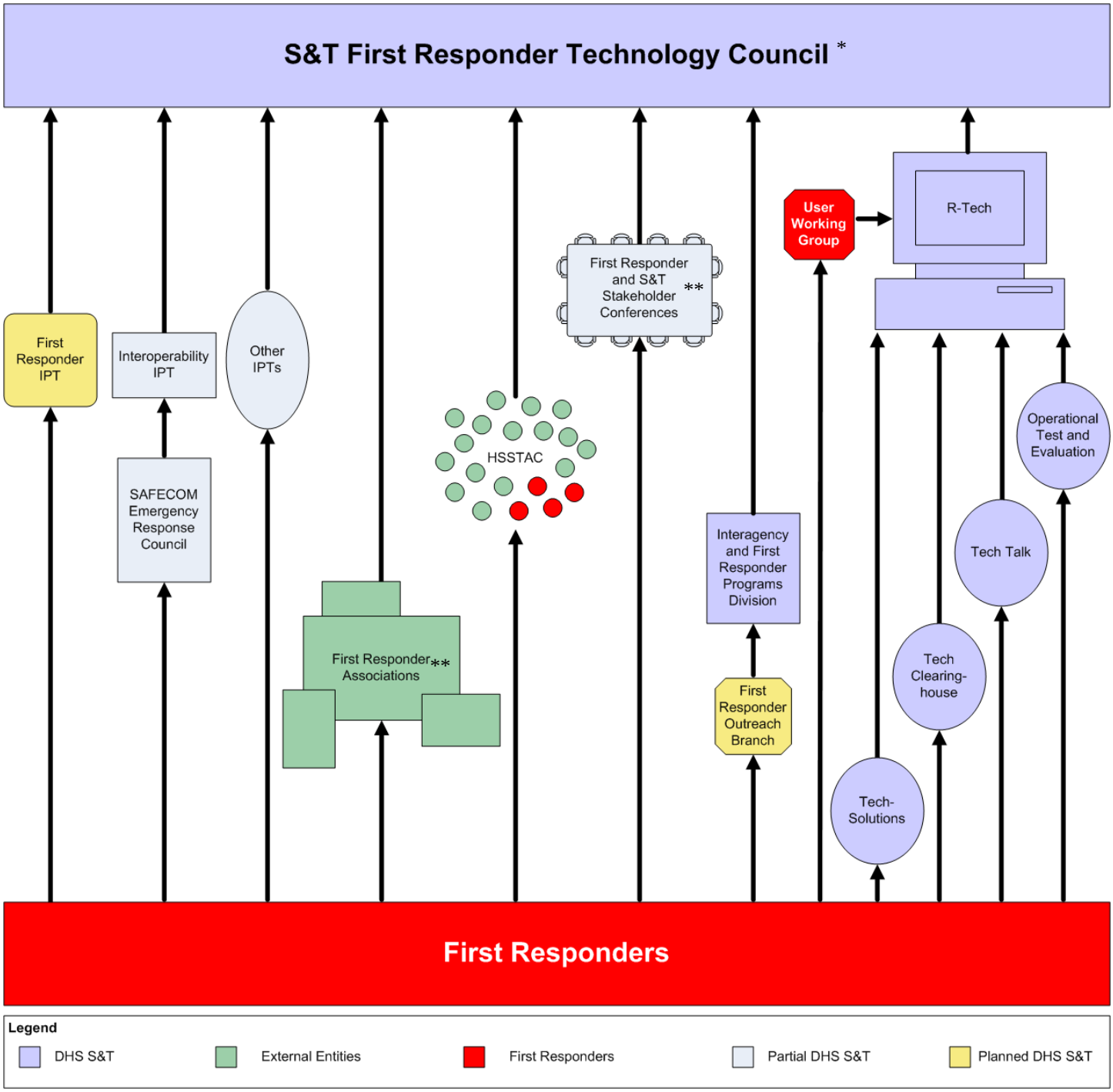
Further, many first responders do not understand the concepts of current capability gaps or future requirements that should drive technology investments, due to lack of time and training. The vast majority of first responder agencies are small and staffed by part-time volunteers—80 percent of law enforcement agencies have 25 or fewer officers and 85 percent of fire departments are volunteer. Members of small organizations and part-time volunteers are typically too busy dealing with day-to-day emergencies and learning how to use and maintain the equipment they already have to consider future requirements.[31]

S&T collects input from first responders through a variety of avenues. This is appropriate, given that first responders are a large, diverse, and geographically dispersed group. However, this approach requires that S&T develop a process for integrating, weighing, and prioritizing input from the many different representatives of the first responder community. Such a process is not in place. This fragmented approach to interacting with first responders illustrates a lack of cohesive strategy in first responder outreach.

Figure 6-1 illustrates the channels for first responder input to S&T. The roles of the First Responder Technology Council and other key entities depicted in the figure are discussed further in this chapter.

[29] Interviews with first responders; Homeland Security Science and Technology Council, *IEDs: Coming to America*, February 29, 2008, p. 13.
[30] Interviews with first responders and S&T staff.
[31] Interviews with first responders; *IEDs: Coming to America*, supra, n.1.

Figure 6-1: First Responder Channels to S&T



* The new First Responder Technology Council provides an internal S&T forum for information-sharing on first responder needs and coordination of responses to identified needs, such as research, development, and delivery of technologies.
** Multiple S&T programs do or are intended to get input from First Responder Associations and S&T Stakeholder Conferences such as R-Tech, the Interagency and First Responder Programs Division, and the planned First Responder IPT.

Source: National Academy of Public Administration, 2009.

FIRST RESPONDER TECHNOLOGIES PROGRAM (R-TECH)

S&T's R-Tech program has evolved from the Technology Clearinghouse program, which was established by the Homeland Security Act to promote technological innovation by serving as an interface with other federal agencies, state and local governments, and the private sector. Specific activities the Clearinghouse was directed to undertake include: disseminating information on relevant technologies; issuing announcements for "unique and innovative" technologies; establishing a process to screen and evaluate submitted proposals; providing guidance and technical assistance in the use of technologies; and providing information on how to submit proposals.

R-Tech's Programs

Tech Clearinghouse is a website that provides information on all federal programs and resources relevant to first responders.

TechSolutions funds projects to meet first responder technology needs.

Tech Talk is a pilot program that gives first responders the ability to communicate with each other via a secure website.

Field Assessment of Technologies is a new program that rates products for first responders and conducts field tests of equipment in partnership with first responders.

S&T has transformed and expanded the original idea of the Clearinghouse into R-Tech, which resides in the Office of Transition. R-Tech consists of four programs designed to meet the needs of federal, state, local, and tribal first responders: Tech Clearinghouse; TechSolutions; Tech Talk; and Field Assessment of Technologies. Two of these programs—Tech Talk and Operational Test and Evaluation—are very new and still in the pilot stage.

In addition to these four programs, R-Tech launched a monthly newsletter geared to first responders in April 2008. The newsletter is emailed to subscribers, distributed through the Inter Agency Board for Equipment Standardization and Interoperability (IAB)[32] and Responder Knowledge Base[33] websites, and handed out in hard copy to meeting and conference participants. Most first responders interviewed were not yet aware of the newsletter.

As described below, R-Tech relies heavily on the internet to communicate with first responders. First responders interviewed say that the first responder community has adequate access to the necessary technologies and is very internet-savvy. Therefore, S&T's reliance on the internet is not a barrier to first responder participation. In fact, first responders who currently interact with S&T want S&T to utilize video conferencing and the internet more and minimize in-person meetings that require travel.

R-Tech depends on a User Working Group made up of first responders to provide input to the program. The group meets four times per year and provides feedback on things like accessibility

[32] The IAB consists of first responders from a variety of emergency management fields and federal agency staff. The purpose of the IAB is to provide advice to the federal government on first responder standards and technology needs.

[33] Responder Knowledge Base provides information on first responder equipment to help state and local agencies make informed purchasing decisions.

and ease of use. For example, the group provided input during the development phase of the Tech Clearinghouse website. There are currently 56 members, including S&T staff. First responders from urban high-risk locations are under-represented and first responders from small cities in less populous states are over-represented.[34]

R-Tech also forms focus groups, as needed. For example, when a group of first responders identified a communications technology need, R-Tech organized a two-day focus group composed of Subject Matter Experts to validate the need.

R-Tech's Programs

Tech Clearinghouse

The Tech Clearinghouse website (www.firstresponder.gov) was launched in January 2008 after several years of development.[35] The website contains information on all federal resources (Centers for Disease Control and Prevention, Federal Emergency Management Agency (FEMA), Department of Justice, etc.) available to first responders. These include product performance test and evaluation results, which help first responders make informed decisions about equipment acquisitions. The website also includes information on grants, events, training, and so forth. First responders also may provide feedback to R-Tech via this website.

First responders indicate lack of awareness of the Tech Clearinghouse website, although it has existed for almost one-and-a-half years, and most of those who have visited the site reported they did not find it particularly useful. The few first responders who were positive about the site admitted that they have visited it only once or twice. It appears that the information is too static and first responders do not have the time to visit websites very frequently.[36]

TechSolutions

The S&T TechSolutions program initiates and funds projects to meet the technology needs of first responders. The goal of TechSolutions is to provide technologies to first responders that meet most of their operational requirements in 12 to 15 months and with a research investment of less than $1 million—although these criteria are described by R-Tech staff as guidelines. TechSolutions intends to meet these requirements by relying on rapid prototyping or the identification of existing technologies that meet stated needs. However, many projects exceed the timeline due to unforeseen delays and their budgets may exceed $1 million.

R-Tech funds TechSolutions projects and co-manages them with the S&T technical divisions. Technical divisions and the Office of Innovation have co-funded TechSolutions projects with dual uses. If the technology is not advanced enough to meet a submitted capability gap,

[34] There is strong representation from New York City, but the only California city represented is San Diego and there is no Washington, DC metropolitan area representation. The majority of members are from smaller cities in less populous states like South Carolina, Idaho, Kentucky, and Nebraska.
[35] Some interviewees voiced concern about the length of time (at least four years) and the amount of money spent developing this website.
[36] Interviews with first responders.

TechSolutions will attempt to have it incorporated into the basic research portfolio or the IPT process.

TechSolutions provides a mechanism for first responders to submit capability gaps directly to S&T. Until recently, this was done via an email address posted on the DHS website. A brief paragraph on the TechSolutions page of the website invited first responders to submit capability gaps and provided brief instructions: i.e., submissions should describe capability gaps that affect multiple first responder departments or sectors or ideas that would help first responders do their job more quickly, safely, and efficiently. No additional information to help first responders formulate a submission was provided.

To date, the number of submissions to TechSolutions from first responders has been disappointing. As of December 2008, TechSolutions had received 330 submissions, the vast majority of which were information requests. This is at least partially due to lack of awareness about the program among first responders and the fact that the system for submissions was difficult to use.

The submission process recently became more user-friendly. In February 2009, the TechSolutions website was launched through the Tech Clearinghouse website. First responders can log in and submit a capability gap using an online form. However, there is no definition of what a capability gap is, or list of frequently asked questions, or examples of submissions, and the form is still very general. Most first responders in the field do not have a good understanding of what a capability gap is. They are not experts in technology or trained to think in terms of future capabilities and requirements. It is therefore unlikely that the new TechSolutions website will result in a significant increase in capability gap submissions from first responders. Also, while these new functions are available through the Tech Clearinghouse website, they cannot be accessed from the TechSolutions page on DHS's website, where the only submission option is the old email link.

Proposals received through TechSolutions are intended to be initiated within 45 days. Subject Matter Experts (SMEs), who are first responders from throughout the country, evaluate the merit and need of the proposals. SMEs are provided with a Due Diligence Form to assess capability gap submissions based on a number of criteria, including whether a solution already exists, the submission has merit, and the solutions would be broadly applicable. SMEs are asked to rate the impact of the technology on a scale of "None" to "Very High" and to provide additional comments. Submissions that are deemed worthy of pursuit are then reviewed by S&T technical division staff, DHS component agencies, National Laboratory staff, or relevant industry personnel to identify potential solutions and develop requirements and a cost estimate. The DHS OIG concluded that the TechSolutions review process is repeatable, mostly documented, and based on clear criteria.[37]

TechSolutions intends to partner with first responders from the beginning to the end of the process. First responders who submit capability gaps through TechSolutions receive a copy of the review process and timeline. In response to feedback, R-Tech also has developed an automated system, accessible through the TechSolutions website, which first responders can use

[37] 2008 OIG Report, The Science and Technology Directorate's Processes, p. 25.

to track the progress of their submissions. When appropriate, submitters will be given the opportunity to test the product.

TechSolutions has initiated 13 projects. Three are considered complete, although two of these have not yet been transitioned. The FireGround Compass, a product that enables firefighters to maintain their reference point and re-establish their orientation within buildings, has transitioned and is now commercially available. Only two of the 13 projects originated from website submissions, although all were identified by first responders. Other sources of customer needs include the International Association of Firefighters, Border Patrol, U.S. Coast Guard, the IAB, and IPTs.

TechSolutions addresses product cost by surveying first responders to determine appropriate prices and making specification trade-offs to meet those price points. Affordability is a concern to first responders, but they do not view it as a barrier because federal grants are typically available. First responders are more interested in having access to the tools they need (whatever the cost) and ensuring that the equipment they spend money on can be integrated into existing systems, is interoperable, and will perform as advertised.

Another barrier identified by first responders is that there is a small subset of first responders with the technical expertise and national perspective necessary to identify capability gaps.[38] Even if first responders identify a gap, they may have to go through the chain-of-command in their organization because they would be submitting gaps as a representative of their organization, not as a private individual, and this may impede ideas from getting to S&T.

Field Assessment of Technologies

The Homeland Security Act of 2002 gives S&T the responsibility to assess the performance of all technologies for first responders, including those developed by the commercial market. This responsibility was recently shifted from FEMA to the S&T Testing & Evaluation and Standards Division, which received $5 million in the FY 2009 budget for testing and evaluation of commercially available first responder equipment. Results are posted on the Responder Knowledge Base website, which is linked to the Tech Clearinghouse website, and there are plans to further disseminate results through the R-Tech newsletter and articles in professional journals. R-Tech works closely with the Testing & Evaluation and Standards Division to provide input on testing and evaluation activities relevant to first responders.

R-Tech, with input from the Testing & Evaluation and Standards Division, also has launched a pilot Field Assessment of Technologies Program that is intended to partner with first responder agencies to field test TechSolutions products. This effort is intended to give first responders the opportunity to evaluate product performance themselves, and allow S&T to quantify the costs and benefits of a particular technology against current capabilities. If there is an existing standard related to the product being tested, the Field Assessment of Technologies Program is required to rate the product against that standard.

[38] Interviews with first responders and federal agency staff.

There have been two pilot projects. The FireGround Compass was tested by three Kentucky firefighters. QuietPro, a military technology intended to improve communications in noisy environments, has also been tested to determine the technology's potential applicability to the fire service. Results have been shared in press releases and published articles. R-Tech is working to add an area to the Tech Clearinghouse website where R-Tech plans to post Field Assessment of Technologies program results in the future.

First responders interviewed believe testing and evaluation and the development of standards are important niches for S&T to fill. First responders do not view technology as an inhibitor, and, while developing new technologies is important, integrating existing technologies is viewed by them as a higher priority. Almost every first responder indicated that interoperability and standards for existing technologies are their most urgent needs. First responders want more standards and a more efficient and faster process for developing standards. Many first responders believe that this should be the primary focus of S&T activities to meet first responder needs.

Tech Talk

Tech Talk is a pilot program that gives first responders the ability to share information and collaborate with each other on specific topics through a secure interactive website. Each topic is referred to as a "community of practice." The four ongoing Tech Talk communities of practice are: Center for Terrorism and Disaster Preparedness; EMS Curriculum Development Committee; Requirements and Standards; and Emergency Response Planning. Approximately 100 people are participating in each pilot community of practice. Users can post to the main discussion or create smaller controlled spaces with more limited access. For example, states within a particular geographic region may want to have their own discussion on a particular topic. Tech Talk also provides an opportunity for state and local agencies to interact with DHS SMEs.

Although the pilots have been deemed successful, Tech Talk has not been expanded because R-Tech is changing platforms to provide features pilot participants have indicated they would like the program to have. R-Tech has identified the platform, which is being modified.

First responders interviewed were not aware of Tech Talk. However, when Tech Talk was described to them, almost all were very enthusiastic and said that first responders in their discipline would use and benefit from it.

R-Tech's New Outreach Plan Builds on Lessons Learned

Recognizing the need to improve outreach, R-Tech has developed a new outreach plan that builds on lessons learned to date. Many tactics R-Tech is planning to pursue were suggested by first responders interviewed as efficient and effective mechanisms for improving S&T's outreach to first responders. Elements of the plan include:

- Increasing engagement with first responder associations and their relevant committees, such as the Technology Council of the International Association of Fire Chiefs;

- Co-authoring articles with high profile first responders and placing them in trade publications;
- Developing handouts tailored to different audiences for distribution at training institutes utilized by first responders; and
- Increasing emphasis on state and regional events because R-Tech has learned that it is difficult to have meaningful interactions with first responders at large national association conferences, especially since many first responders never attend such meetings.

INTERAGENCY AND FIRST RESPONDER PROGRAMS DIVISION (IAD)

The Interagency and First Responder Programs Division Director reports directly to the U/S. IAD was originally set up to coordinate with other federal agencies and state, local, and tribal governments. The responsibility to interact directly with first responders was added to IAD's mission within the last year. The rationale for the mission expansion is that interacting with emergency management staff in a state necessarily involves firefighters, policemen, etc.

The structure and processes for IAD's first responder outreach are still evolving. IAD views its role as providing information to first responders on S&T's activities and to help them navigate S&T's processes. IAD does not view its role as collecting capability gaps or other input from first responders (this is the responsibility of TechSolutions). However, IAD staff document interactions with first responders and what they learn in trip reports, and this information is transmitted to the relevant technical division. In addition, each IAD staff person is responsible for coordinating with specific technical divisions.

IAD divides its state and local work among five staff members, who each cover two of FEMA's ten geographical regions. This approach is designed to strengthen S&T's relationship with FEMA, a customer, while giving IAD the ability to leverage FEMA's relationships with state and local agencies.

In addition to the five staff described above, IAD is adding new hires to focus on first responder outreach. The Director of First Responder Coordination (currently a vacant position) is responsible for IAD's first responder outreach efforts. IAD recently hired a retired police officer to conduct outreach to first responders on the West Coast and an individual with National Guard experience to conduct outreach on the East Coast. There are plans to hire two additional first responder liaisons and establish a first responder outreach branch within IAD. It is unclear how this outreach branch will interact and coordinate with R-Tech and the IPTs, especially since these other activities are under the purview of the Office of Transition, while IAD is not.

IAD is considering reaching first responders through DHS Urban Areas Security Initiatives (UASIs),[39] which is a logical approach for several reasons. UASIs have been designated by DHS as being high risk areas based on a combination of data. UASI designation requires different disciplines and jurisdictions to work together. UASI members also have an understanding of

[39] The UASI program focuses on enhancing regional preparedness in the 62 major metropolitan areas designated as highest risk by DHS.

capability gaps because this is part of the investment justification they must submit to DHS. Some first responders agreed this is a useful way to prioritize outreach, but cautioned against focusing exclusively on UASIs because they vary in organization and level of coordination, can be very political, and tend to be dominated by one agency.

INTEGRATED PRODUCT TEAMS (IPTs) AND FIRST RESPONDER NEEDS

Although the needs of the first responder community are supposed to be represented by DHS component agencies in the IPTs, all IPTs are encouraged to interact directly with first responders to get their input on capability gaps, and they do to varying degrees. However, there are no rules or established processes for integrating input from first responders in the IPT process, or validating requirements generated by the IPTs. In fact, non-federal first responders are technically excluded from IPT membership. Therefore, the level of participation and the weight given to first responder input is a function of individual IPT leaders.

For some IPTs, such as Interoperability or Infrastructure Protection, first responders play a critical role and there are formal mechanisms for getting first responder input. The other IPTs get input from first responders in different ways and to varying degrees. For example, one of the customer leads for the Counter-IED IPT is the Office for Bombing Prevention, which works closely with bomb squads and represents their needs on the IPT. In addition, members of the National Bomb Squad Commanders Advisory Board attend Capstone IPT meetings, submit capability gaps, and attend relevant Sub-IPT meetings. The other customer lead of the IPT, the U.S. Secret Service, also has an incentive to ensure first responder needs are met because the Secret Service relies on local bomb squads when a bomb is discovered at an event. S&T staff, customer leads, and bomb squad representatives all agreed that first responder requirements are being inserted effectively into the Counter-IED Capstone IPT.

The Interoperability IPT Considers Direct Input from First Responders

The S&T lead for the Interoperability IPT is the Command, Control and Interoperability Division (CID), and the customer leads are the Federal Emergency Management Agency and the Office of Emergency Communications. CID describes the Interoperability IPT as practitioner-driven.

CID staff report that it is critically important to ensure that federal solutions meet local needs, especially in the case of interoperability. They also explain that the prescribed IPT process is not the best structure to identify and prioritize capability gaps, because only one set of customers is represented. CID has solved the problem by relying on the SAFECOM[40] Emergency Response Council to identify capability gaps. The Council is made up of more than 100 representatives of national and international first responder organizations (e.g., International Association of Chiefs of Police, International Association of Fire Chiefs, and National Association of Emergency Medical Services), and federal, state, local, and tribal government organizations (e.g., the National Governors Association and the U.S. Conference of Mayors). The Council meets twice per year. CID convenes two additional meetings per year, as well as monthly conference calls,

[40] SAFECOM is a DHS communications program run jointly by Office for Emergency Communications and S&T that provides support on interoperability issues to federal, state, local, and tribal emergency response agencies.

with the Council's Executive Committee. In addition, CID has convened stakeholder conferences on interoperability, where the majority of the participants are first responders. CID staff present information collected from the first responders to the Capstone IPT.

In addition to the Council, CID utilizes the IAB and other practitioner organizations to populate working groups that "operate in a manner functionally equivalent to Project IPTs."[41] These working groups help define requirements and participate in test and evaluation and typically consist of 50-60 first responders from around the country with specific types of expertise.

CID's direct interaction with first responders to collect capability gaps initially generated some conflict with the DHS component customers of the IPT, primarily because it caused confusion about roles and authorities. The component agencies have been mandated to represent first responder needs. As one noted, the first responder community is such a large and diverse group that perceptions of needs will vary depending on the segment of the community being consulted. Over time, however, the component agency customers have come to appreciate first responder input and believe there is general agreement among DHS and first responder customers of this IPT on the capability gaps they want S&T to address.

Infrastructure Protection IPT's Systematic Collection of First Responder Capability Gaps

The Office of Infrastructure Protection is the customer lead of the Interoperability IPT and is responsible for representing the needs of critical infrastructure sectors. The Office of Infrastructure Protection has worked with the Infrastructure and Geophysical Division, the S&T lead, to develop a formal mechanism for collecting and prioritizing capability gaps from all critical infrastructure sectors, including emergency services. S&T is involved in this process from the beginning in order to help the sectors understand what a "good" capability gap is and which specific criteria are used by the Office of Infrastructure Protection and S&T to prioritize gaps. The process used by the Infrastructure Protection IPT is described in more detail in Appendix C.

The Emergency Services Sector has been designated as a critical infrastructure sector by DHS. As do the other critical infrastructure sectors, the Emergency Services Sector has a "sector coordinating council" that interacts with DHS on a variety of issues, including identifying technological capability gaps. The coordinating council includes members of national associations representing nine functions: law enforcement; bomb and explosive ordinance demolition; special weapons and tactics and tactical operations; firefighters; emergency medical services; search and rescue; urban search and rescue; emergency management; and hazardous materials response.

PROPOSED FIRST RESPONDER IPT

S&T recognizes that outreach to first responders is an immense task and that it must do a better job getting input on capability gaps. In response to criticism from Congress and complaints from first responders, S&T is making plans to establish a new first responder IPT. The S&T lead will

[41] Interoperability Capstone IPT Status Review Power Point, January 14, 2009.

be the Interagency and First Responder Programs Division. Other members of the Capstone will be FEMA Grants (because most first responder departments use these grants to purchase equipment), R-Tech, the Commercialization Office, Testing & Evaluation and Standards, and relevant DHS component agencies.

First responders will not be members of the Capstone IPT, but there will be a working group of 31 first responders under the Capstone IPT that will submit requirements to the IPT. The composition of the working group will be two-thirds practitioners and one-third representatives of first responder associations. Working group members will represent all relevant disciplines at the state, local, and tribal levels, as well as DHS staff.

DHS component agencies will represent the first responders on the Capstone. For example, emergency medical technicians will be represented by the Office of Health Affairs and firefighters will be represented by FEMA. The Capstone member representing a particular discipline will be responsible for presenting capability gaps relevant to that discipline to the Capstone.

The first responder IPT will not have its own budget.[42] S&T will query other IPTs, other federal agencies, and the international community to determine whether ongoing projects could be leveraged to meet a capability gap. If the gap cannot be filled with existing projects, the First Responder IPT will work with the Commercialization Office to determine if the market is large enough for the requirement to be met by industry. If not, R-Tech may initiate a project to fill the gap.

While details are sparse, the vision provided by S&T presents a number of potential problems.

- There do not appear to be plans for a formal mechanism whereby the First Responder IPT will be able to feed capability gaps into existing IPTs and obtain feedback. It is also unclear how the IPTs already collecting capability gaps directly from first responders will weigh these against capability gaps from the First Responder IPT.
- The first responder community is so diverse that reaching consensus about priority capability gaps across the different disciplines to be involved in the IPT is likely to be difficult.
- It is unclear how this IPT will be integrated with other first responder activities already carried out by S&T. For example, there has been no mention of including first responders already working with R-Tech or HSSTAC members in the First Responder IPT.
- The S&T lead for the First Responder IPT will be the Interagency and First Responder Division Director. This may be problematic because the requirements are likely to be met by R-Tech, the Commercialization Office, or other IPTs, which all fall within the purview of the Transition Portfolio. IAD is not part of the Transition Portfolio.

[42] The FY 2010 President's Budget Request includes $12 million for S&T to develop and design technologies to address capability gaps identified by federal, state, local, and tribal first responders in the first responder IPT.

HOMELAND SECURITY SCIENCE AND TECHNOLOGY ADVISORY COMMITTEE (HSSTAC)

The HSSTAC is another way that S&T receives input from the first responder community. The HSSTAC is an advisory committee and includes first responders as members. The first responders on the HSSTAC are relied upon by other HSSTAC members to provide first responder viewpoints and identify other first responders to brief the HSSTAC. In addition, the HSSTAC has made field visits as a group to meet with first responders and get a better understanding of the conditions under which they work.

The HSSTAC's size and composition is congressionally mandated. It is supposed to have 20 members[43] that represent first responders; citizen groups; and luminaries in related fields, such as research and engineering. The members serve three-year terms. The HSSTAC, which is coordinated by the Operations Analysis Division, provides advice to S&T, including identifying potential research projects. The HSSTAC was deactivated in late 2006 because of a lapse in Congressional authorization, but is now active again. Congressional authorization lapsed again at the end of 2008, but the HSSTAC continues to function as a discretionary advisory committee.

Three HSSTAC members come from the first responder community: a fire chief; a sheriff; and an emergency medical technician. As long as these members have a national perspective and broad backgrounds, this representation may be adequate. S&T staff and HSSTAC members also indicated that it might be useful to add a fourth first responder to the HSSTAC to represent bomb squads.

In preparation for a February 2008 report on IEDs, the HSSTAC interviewed first responders in the United States and abroad. The HSSTAC found that, in general, information about S&T and its current and planned programs was not disseminated effectively and first responders had limited awareness of S&T and how it could support first responders. The HSSTAC has made a number of recommendations to S&T regarding improving first responder outreach that deserve consideration, including:

- Involving first responders in planning for training exercises;
- Developing on-line training for first responders, who cannot always attend in-person training;
- Incorporating first responders in the entire research and development process to improve chances that technologies developed will be useful;
- Creating or funding a single testing and evaluation organization to meet the needs of first responders;
- Investigating existing solutions to the technology gaps most often identified by first responders in the United States and elsewhere, including individual explosive detection at a distance and reliable communications in and out of buildings, tunnels, and other structures; and

[43] Currently there are 19 members of the HSSTAC.

- Developing metrics to evaluate the usefulness of first responder participation in S&T programs.[44]

FIRST RESPONDER TECHNOLOGY COUNCIL

The First Responder Technology Council is intended to provide a forum for internal S&T information-sharing on first responder needs and coordinate responses, including projects, research, development, and delivery of technologies. The Council is very new. It initially met in March 2009, and as of the end of May 2009 has met one additional time. The plan is for the Council to meet monthly and be chaired by the Director of First Responder Coordination (currently vacant) in the Interagency and First Responder Programs Division. The membership of the Council reflects the different offices and divisions within S&T that interact with, or execute programs to, meet the needs of first responders, including: the six S&T technical division heads; the Director of R-Tech; the Commercialization Officer; the Director for Operations and Analysis; the Director or Deputy Director of Test & Evaluation; and representatives of Corporate Communications and the Office of National Labs. The Council may form committees or working groups that could meet more frequently than monthly.

The First Responder Technology Council is too new to evaluate its effectiveness. However, its charter suggests that the Council can provide the systematic mechanism for collecting and integrating input from first responders the Academy recommended it its interim report. Creating linkages between the S&T divisions interacting with first responders will help S&T prioritize its work in relation to first responders and coordinate responses to first responder needs.

CONCLUSIONS

S&T has multiple avenues available to interact with first responders, yet S&T's effectiveness in making its presence known and engaging with first responders has been limited. As discussed in Chapter IV, the lack of a strategic plan has resulted in a fragmented approach to interacting with first responders. The lack of a comprehensive S&T mission statement that encompasses an all hazards approach also could be impeding constructive interaction with first responders who generally respond to natural disasters. Even though S&T is addressing all hazards, and R-Tech recently revised its mission statement to include all hazards, this approach is not adequately reflected in S&T's mission statement or other written documents.

First responders who have become involved in various committees, focus groups, or advisory panels indicate that their interactions with S&T have been productive. However, participation in these groups is not representative of the nation's first responder population, demonstrating a lack of strategy for first responder outreach.

Few first responders are using S&T's web-based communications. Their lack of knowledge about S&T's websites and the absence of user-friendly means to input capability gaps seem to be

[44] HSSTAC, IEDs: Coming to America, pp. 34-36.

hampering interaction. Just two IPT projects have been generated from first responder input through TechSolutions.

S&T has recently added new first responder activities and is planning to initiate a first responder IPT. Coordinating these activities internally will be challenging, especially because various activities are located within different S&T divisions. Although the new First Responder Technology Council is intended to foster sharing of information and ideas and coordinate decision making within S&T, whether it can be effective given competing demands remains to be seen.

It is particularly unclear how the planned first responder IPT will enhance first responder input to the capability gap process given that it will be led by internal DHS management, has no resources of its own, and will have to compete for resources with other entities that have their own priorities. It would be far more reasonable and effective to incorporate relevant first responders into the already existing IPTs so they can work in conjunction with DHS component agencies in setting priorities for S&T. S&T officials believe that first responders could not meaningfully participate in the existing IPTs because the related expense and the fact that IPTs convene and deliberate at times suitable to the IPT customer. However, these issues would appear to apply to the first responder IPT as well.

Increasing the complexity within S&T as a means of meeting first responder needs is not the right path. Strengthening existing methods of outreach and following the lead of the IPTs that already collect substantial first responder input would be far more efficient and effective.

RECOMMENDATIONS

Instead of creating new mechanisms, such as the First Responder IPT and the IAD First Responder Outreach Branch, to get first responder input, existing mechanisms should be strengthened. As recommended below, this should include: improving outreach; facilitating first responder input through the IPTs and R-Tech; and ensuring the First Responder Technology Council functions as intended. IAD should continue to report back to the First Responder Technology Council on information gathered through state and local outreach, but should not establish a separate first responder outreach branch.

6-1. Identify IPT customers and develop appropriate mechanisms for customer participation.

Logic models (discussed in more detail in Appendix D) should be used to identify first responder customers for each IPT and the most effective means for their participation. Existing models for first responder participation, such as the Interoperability, Counter-IED, or Infrastructure Protection IPTs should be evaluated for this purpose, and a policy for first responder participation in IPTs should be developed. Metrics should be developed to measure the efficacy of first responder participation.

6-2. Prioritize, tailor, and increase outreach.

Outreach should be prioritized to target first responders in areas with the higher levels of threat and vulnerability for manmade or natural disasters. Interaction with first

responders in areas with less critical infrastructure and lower populations should be sought to the extent possible, but the balance should shift further toward higher risk regions. At the same time, more should be done to ensure that all relevant disciplines are consulted, including emergency medical technicians and emergency managers. Recognizing that different segments of the first responder community have different skills and expertise to offer, outreach should be tailored accordingly. First responders in the field can be useful in vetting proposed technologies, providing input on specifications, and participating in testing and evaluation. First responder officials in large cities, at the state level, or in national organizations, are more likely to think in terms of capability gaps on a national level and have the technical expertise to identify and prioritize gaps and requirements. This does not mean that S&T should exclude rural participants, since there are some differences in capability gaps between the urban and rural areas. On-line training on how to identify and describe capability gaps should be provided and the R-Tech outreach plan should be fully implemented and augmented.

6-3. Leverage existing organizations and outreach mechanisms.

S&T should increase its utilization of existing organizations and mechanisms for outreach to first responders, including national associations, such as the International Association of Fire Fighters, the International Association of Emergency Managers, and the International Association of Chiefs of Police. National associations can easily and quickly disseminate information to state associations, which collectively have larger memberships than the national associations. Examples of other existing organizations and mechanism include the Emergency Services Sector Coordinating Council and the National Institute of Justice's National Law Enforcement and Corrections Technology Center Regional Advisory Group. Most of these groups have websites, publications, committees, and meetings that S&T should take advantage of in a targeted way.

6-4. Give greater priority to testing and evaluation and standards.

More emphasis should be placed on testing and evaluation and standards development. Most first responders believe the technologies they need already exist but are challenged by interoperability issues and lack of evaluation of existing technologies to determine whether they will perform as promised.

6-5. Make it easier for first responders to participate.

Increase the use of video conferencing, Web 2.0, and other technologies to reduce the burden on first responders and their organizations of participating in S&T activities, and to allow for greater input from more first responders. Additional information, such as frequently asked questions, definitions, and sample capability gap submission forms, should be provided to make it easier for first responders to submit capability gaps. Finally, the DHS website should link to www.firstresponders.gov and the TechSolutions website.

6-6. Continue and strengthen the First Responder Technology Council.

The First Responder Technology Council should be structured to provide a systematic and organized way to weigh, prioritize, and integrate input from different representatives of the first responder community, as well as to coordinate responses. The Council can

provide this function and also help S&T develop coordinated outreach plans, based on lessons learned. Working groups should be formed to devise processes for how the Council will perform these functions. The First Responder Technology Council should retain its current members and continue to plan to meet at least once per month.

This Page Left Intentionally Blank.

CHAPTER VII: BASIC RESEARCH AND INNOVATION

Basic research constitutes an important portion of S&T's overall work and is critical to its ability to carry out its mission over the long run. S&T's Strategic Plan emphasizes the importance of balancing investments among basic research, transition, and innovation to produce a continuous pipeline of technology to customers. Basic research, as defined by S&T, is long-term—S&T generally expects projects to last five to eight years, or more—and is intended to produce information that is needed for the eventual success of future "transition" research and development aimed at meeting customer needs.[45] S&T also dedicates a relatively small amount of funding to an Innovation Portfolio of projects expected to be high risk, but potentially "game changing."

BASIC RESEARCH PORTFOLIO

Basic research constitutes about 23 percent, $173 million, of S&T's budget. Almost three quarters of that funding is programmed and overseen by the six technical divisions. Most of the remainder is under the Office of Research, which has direct responsibility for managing the DHS Centers of Excellence—through the Office of University Programs—and coordinating DHS work by the National Laboratories—through the Office of National Laboratories. Over half of S&T's basic research is conducted by universities (primarily the Centers of Excellence) or the National Laboratories.

Setting the Research Agenda

There are no clear criteria or processes for identifying requirements and prioritizing basic research across or within S&T divisions. Further, many of the representatives of the DHS component agency customers indicated that they did not know what basic research was ongoing or planned, and some feared S&T was not funding enough basic research. The DHS Inspector General raised similar concerns about basic research project selection, reporting that the lack of a process or criteria for project selection allows the perception of conflict of interest and does not guarantee the most appropriate research is being done.[46]

The technical divisions are responsible for all aspects of their basic research, including prioritizing needs, selecting programs and projects to fund, selecting performers, and managing the projects.[47] A research lead in each technical division has responsibility for overseeing the division's basic research work, while individual programs and projects are managed day-to-day by program managers. The division research leads are part of the technical division, report to the division director, and serve as liaisons between the divisions and the Office of Research.

[45] As described in Appendix B, the S&T definition of research appears to correspond with the definitions used by the Office of Management and Budget and the National Science Foundation.
[46] DHS, OIG, the Science and Technology Directorate's Processes, pp. 1 and 13.
[47] Ibid p. 20.

As presented by S&T officials in the FY 2009 Budget Brief, basic research should accomplish one or more of the following:

- Address unique homeland security responsibilities (e.g., psychology of terrorism);
- Address areas identified in IPTs that do not have transition or innovation solutions;
- Support S&T partnership with other government agencies, industry, and other countries;
- Fulfill mandates from DHS or Congress; or
- Take advantage of a technology discovery or surprise.

However, it is not clear how or when these very general criteria are applied or how priorities are set across or within divisions when selecting basic research projects to pursue.

Allocation of Funding for Basic Research

The general level of S&T funding for basic research has increased somewhat in recent years to a level of about 23 percent of the total research and development budget in 2009. This exceeds the goal of 20 percent established by U/S Cohen. That goal was set based on his judgment and was seen as a level of funding DHS components would accept for work not directly related to meeting current capability gaps. There is significant variation among the divisions with regard to the portion of total funding devoted to basic research. The proportion ranges from 2.2 percent in the Borders and Maritime Division, to 38 percent for the Human Factors Division.[48] In addition, 100 percent of the work in the Counter-IED Program Executive Office, which oversees and funds projects from three divisions, is basic research. The allocation of funds for basic research, both among and within divisions, has remained basically the same since the initial allocation was made at the time of the 2006 reorganization.[49]

Identification and Prioritization of Requirements

Basic research is less "customer driven" than transition research and development. Officials explain that, unlike transition, where customers have a solid understanding of near term needs, customers are not likely to be able to articulate long-term future needs, to have knowledge of emerging research, or to recognize the potential benefits of specific types of research. But the IPT process appears to have informed the basic research portfolio to a limited extent. According to the DHS Inspector General, some basic research projects have been modified to better meet the needs articulated by the IPTs.[50] The division research leads interviewed unanimously reported that they look to requirements identified by customers in the IPTs—requirements that are not appropriate for the transition portfolio because of the time needed or the existing level of development of the technology—as potential areas for basic research. The division research leads also expressed concern, however, that even if an IPT identifies a capability gap that

[48] As explained in Appendix B, the Infrastructure/Geophysical Division's basic research budget includes significant funding for two Congressionally directed research centers. If that funding is included, that Division would allocate the highest amount, 53 percent, to basic research.
[49] Interviews with S&T officials.
[50] DHS, OIG, the Science and Technology Directorate's Processes, p. 26.

requires basic research, funding for basic research is not necessarily increased to allow that research to be done.

The division research leads described many other sources of ideas for potential projects and for obtaining information relevant to prioritizing them, but they did not articulate clear criteria or processes for doing so. Sources include, for example, the Centers of Excellence; emerging issues from universities; other federal agencies, such as the National Science Foundation; various offices within DHS and S&T; the National Laboratories; the private sector; and unsolicited proposals. Some division research leads noted that they look for opportunities to leverage what other research organizations are doing. One research lead said that a broad research agenda had been published for his subject area before the 2006 reorganization and he follows that to the extent he has the opportunity to fund new work. The DHS Inspector General pointed to a clear need for S&T to develop and document a repeatable process with objective criteria for prioritizing and selecting basic research projects.[51] There is currently no external peer review of the research portfolio or the projects in it.[52]

S&T has recognized the need to improve the process for identifying and prioritizing basic research. An official in the Office of Research indicated that, although the divisions continue to apply individual processes and criteria, the Director of Research is developing a basic research strategic plan—in part to identify best practices—and is working to encourage appropriate consistency among divisions. The Director has also commissioned a short term effort by the National Defense University, in part to help refine approaches to prioritization and selection.

The Director of Research also has established a Science and Technology Research Council composed of the Deputy Director for Research, representatives of the Office of National Laboratories and the Office of University Programs, the Program Executive for Counter-IED, and the technical division heads and research leads. The Council provides a forum for the interchange of ideas among research representatives from the member offices. The division research leads developed detailed basic research focus areas and vetted them through this Council. The focus areas are being processed for publication, with the intent to have them available for the May 2009 Stakeholders Conference.[53]

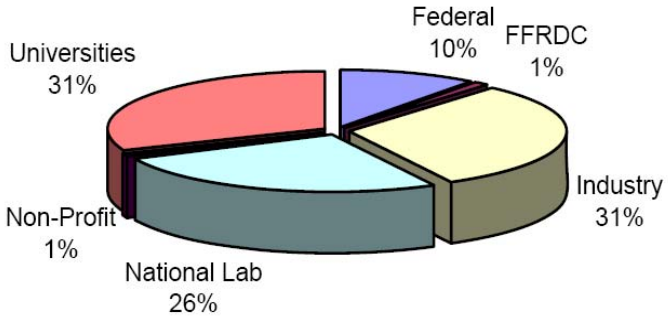
Selecting Performers for Basic Research

In 2009, as shown in Figure 7.1, over one-half of S&T's basic research was conducted by universities (31 percent) and the National Laboratories (26 percent). The remaining performers included: other federal laboratories (10 percent); industry (31 percent); Federally Funded

[51] DHS, OIG, the Science and Technology Directorate's Processes, p. 26.
[52] As discussed in Chapter IX, other research agencies use external peer review to assess the appropriateness, performance, and impact of their research.
[53] Among the other topics discussed by the Council are terrorism risk workshops, DOE Office of Science programs, and differentiating basic research from transition.

Research and Development Centers (1 percent); and non-profits (1 percent). With the exception of funding for the Centers of Excellence, discussed below, the technical divisions drive this funding distribution.[54]

Figure 7-1: S&T Basic Research Performers



Source: Graphic provided by S&T, March 2009

The extent to which the divisions select performers through a competitive process, instead of directing funding to a particular performer for a particular purpose, is unclear. However, discussions with division research leads and others in S&T indicate that much of the work is not competed. The Director of Research estimated that 20 percent of the basic research portfolio is competed through Broad Area Announcements (in addition to the Center of Excellence selections discussed below). Officials repeatedly said that they know "who can do the work they need," and that very often there are only a few performers who can meet their needs. One limitation to competition often mentioned is the relatively few facilities that can handle the classified research DHS needs. Division research leads stated that they do sometimes use competitive processes, especially when they are initiating a new program area of work or when private performers are most likely to be the best choice. They stated that, given the limited funding for new research projects each year and the limited number of performers capable of doing the work, an extensive competitive review process for basic research would not be worthwhile.

Most ongoing basic research projects are "legacy" projects that began before the 2006 reorganization. Officials explained that, because of the length of time required for basic research, there has been limited opportunity to award new basic research projects in recent years, though some new projects have been started. No research programs have been terminated since the reorganization. Officials explained, however, that they manage "programs" of work, which include a variety of specific "project" efforts. Thus, individual basic research projects may have been terminated and others begun in support of the overall program.

[54] According to data provided by S&T, the proportion of research conducted by universities and National Laboratories remained essentially the same between 2008 and 2009. However, the proportion performed by industry increased from 13 percent in 2008 to the 31 percent shown here, while all other categories declined. A program official said that the 2009 industry data probably are incorrect and may be the result of a change in categorization of accounts.

S&T did not provide information about how many new projects began after the reorganization, or about how many basic research projects have been completed and whether they had effectively fed into the transition portfolio.

Other federal research agencies use scientific peer review to evaluate research proposals. It is standard operating procedure to compete and peer review grant awards at the National Science Foundation. The Foundation has a large pool of experts in various fields who review proposals for over 90 percent of the research awards it makes. (See highlights of the 2008 process in box below.) Likewise, the National Institute of Justice's Office of Research and Evaluation uses a competitive process, with reviewers outside the Institute, for almost all the research it funds. In both cases the scientific peer reviewers evaluate the proposals based on merit along specific criteria and make recommendations to the selecting officials in the agency.

HIGHLIGHTS
NATIONAL SCIENCE FOUNDATION'S
2008 MERIT REVIEW PROCESS

MERIT REVIEW CRITERIA

- **WHAT IS THE INTELLECTUAL MERIT OF THE PROPOSED ACTIVITY?**
- **WHAT ARE THE BROADER IMPACTS OF THE PROPOSED ACTIVITY?**
- **ADDITIONAL AREA-SPECIFIC CRITERIA MAY BE ADDED.**

PROPOSALS

- **44,400 PROPOSALS**
- **11,162 AWARDS**

REVIEWERS

- **SCIENTISTS, ENGINEERS AND EDUCATORS THROUGHOUT THE WORLD**
- **248,000 AD-HOC REVIEWERS**
- **50,000 SERVED ON REVIEW PANELS**

Program Executive Office for Counter-IED

The Program Executive Office for Counter-IED is somewhat unique within S&T because it works to set priorities across divisions. It was created to oversee the Counter-IED portfolio, which spans three technical divisions—Explosives, Human Factors/Behavioral Science, and Infrastructure and Geophysical. All this work is in the basic research portfolio and the Office is housed in the Office of the Director of Research. Total funding for this program increased from $15 million in fiscal year 2008 to $35 million in fiscal year 2009. These funds are specifically designated by Congress for counter-IED work.

The Counter-IED program director receives input from a number of sources to focus the program. From outside S&T, insights come from interactions with the subcommittee on domestic IEDs within a committee of the National Science and Technology Council. The director is one of three "tri-chairs" of this subcommittee.

Within S&T, proposals come from the three technical divisions that carry out the projects. An internal Counter-IED IPT was created after officials were unsuccessful in gaining consensus about project priorities on their own. The membership includes representatives from the three divisions supporting the counter-IED effort, the three portfolio directors, and the Deputy U/S. The IPT adjudicates disputes among the divisions, and program officials say it has improved communication and transparency and reduced the influence of personalities in the process. Once the Program decides to fund a project, the division research leads and program managers in the division are responsible for the effort, including selecting performers and monitoring progress, keeping the Counter-IED Program Executive Office informed.

According to a Counter-IED Program official, there are five aspects of the Counter-IED strategy—deter, predict, detect, defeat, and mitigate. The bulk of the funding is focused on detection (in the Explosives Division). However, officials said that S&T wants to focus more on deterrence and prediction, but expects the change will be slow, being accomplished as ongoing projects end and new projects are begun.

Centers of Excellence

DHS currently funds 12 university-based Centers of Excellence. Awards for operating these Centers constitute about 21 percent of S&T's total funding for basic research. The Centers also receive other funding for specific activities through the divisions.[55]

The Centers bring together leading experts and researchers to conduct multidisciplinary research and education for homeland security solutions. The Centers are authorized by Congress and chosen by S&T through a competitive external scientific peer review selection process. Each Center is led by a university in collaboration with partners from other educational institutions, agencies, laboratories, think tanks, and the private sector.

The Centers work to leverage funding from many sources to further research needed in support of homeland security. In 2007, the Centers leveraged over $20 million from other sources.[56]

Five of the existing Centers were first awarded in 2008, in response to gaps identified in the extent to which the existing Centers were addressing the needs of the six technical divisions.[57] Eleven selection criteria were published in the funding opportunity announcements for the new Centers, among them, scientific quality, mission-related significance, and geographical distribution. (See box at right for full list of criteria.) As described by S&T officials, the process used in 2008 to select the Centers had three phases.

- An external panel of experts reviewed proposals for scientific merit.
- The highest rated proposals were then reviewed internally by S&T staff.
- Applicants for a relatively few proposals rated highest by the staff received site visits by S&T and DHS component agency staff.

[55] Overall, universities conduct about 31 percent of S&T's basic research. Over 80 percent of the funding comes from the Office of University Programs as awards for Centers of Excellence and for educational programs, such as stipends for Homeland Security Fellows and grants to Minority Serving Institutions. Most of the remainder is awarded by the divisions in accord with their individual needs. There is extensive literature related to arrangements similar to Centers of Excellence. For example see Bozeman, B. and Boardman, C. (2003) Managing the new Multipurpose, Multidiscipline University Research Centers: Institutional Innovation and Academic Research. Washington, D.C. IBM Endowment of the Business of Government.

[56] Briefing by Office of University Programs.

[57] The number of Centers continues to change. For example, in early 2009, two existing centers, the Discrete Science Centers and the Regional Visualization Centers were replaced with a new Command, Control and Interoperability Centers of Excellence, bringing the total to 12. Other changes are also expected as S&T continues to align the Centers with division needs.

Internal deliberations resulted in final selections. The process began in February 2007 with a Broad Area Announcement and ended with awards in the summer of 2008.

The Centers of Excellence are aligned with the six divisions in terms of research subject matter. After Centers are selected, the overall scope of work is negotiated and the award is made. The specific projects undertaken are decided by the Center, although S&T research officials said that they are in contact with the Centers and may consult with them about planned work. They also pointed out that the Centers are reviewed every two to three years and the likelihood of continuation is reduced if their overall body of work is not supportive of the divisions' priorities.[58]

DHS CENTERS OF EXCELLENCE
SOURCE SELECTION CRITERIA FOR 2008 AWARDS

1. **TECHNICAL MERIT AND QUALITY**
2. **MISSION-RELATED SIGNIFICANCE**
3. **GEOGRAPHICAL DISTRIBUTION OF CENTERS AND PARTNERS**
4. **QUALIFICATIONS OF PRINCIPAL INVESTIGATORS AND OTHER PERSONNEL**
5. **ADEQUACY OF FACILITIES AND EQUIPMENT**
6. **ABILITY OF LEAD INSTITUTION TO MANAGE THE CENTER AND ADEQUACY OF MANAGEMENT PLAN**
7. **EVIDENCE THAT APPLICANT IS FAMILIAR WITH RESEARCH AND RESOURCES OF OTHER RESEARCH INSTITUTIONS**
8. **ABILITY OF APPLICANT TO ESTABLISH AN ENDURING AND COMPREHENSIVE PLAN OF STUDY**
9. **ADEQUACY OF STRATEGY TO TRANSITION RESEARCH RESULTS TO END USERS**
10. **ABILITY AND COMMITMENT TO PARTNER WITH MINORITY SERVING INSTITUTIONS**
11. **APPROPRIATENESS AND ADEQUACY OF THE PROPOSED BUDGET**

The Office of University Programs has recognized the need to coordinate Center efforts with other researchers to share ideas and prevent unnecessary duplication. It has sponsored several conferences and workshops to bring together staff from the Centers, as well as other researchers. In 2008, the Office sponsored a University Network Summit on Research involving 500 participants from the academic and federal research communities; another such summit is being planned for 2009. It has also sponsored other subject-specific meetings and workshops, such as one on risk communication. The Office of University Programs is also developing an electronic data base of all ongoing University Program research projects.

The National Laboratories

S&T's Office of National Laboratories works with the National Laboratories, and other federal laboratories, to provide DHS with science, technology, and engineering expertise to support its research needs. About 26 percent of the basic research budget goes to the National Laboratories. Excluding funds awarded for Centers of Excellence and education programs such as fellowships, 34 percent of S&T basic research funding is awarded to the National Laboratories. As with the Centers of Excellence, DHS expects that working through the National Laboratories will leverage funding, allowing S&T to fund work that builds on research underway or planned by the National Laboratories to further S&T's research mission. Though overall numbers were not available, division research leads said they had been successful in doing so.

[58] See Chapter IX for more information on the review of Centers of Excellence.

The Homeland Security Act of 2002 authorizes DHS to draw on the expertise of all government laboratories—with an emphasis on DOE's National Laboratories—in support of achieving its mission.[59] The Act specifically directs DHS and DOE to enter into cooperative agreements regarding DHS's use of the National Laboratories, authorizes the National Laboratories to accept work from DHS on an equal basis with DOE work, and directs DOE to charge DHS the DOE rate for administrative and personnel costs at the Laboratories. The Act also established the S&T Office for National Laboratories to coordinate S&T use of the National Laboratories.[60]

The extent to which the National Laboratories are awarded funding through competition is unclear. However, division research leads and others in S&T indicate that funding often is directed to a specific laboratory without competition. Citing the legislative provision giving DHS equal footing at the Laboratories with DOE, some officials said that they believe Congress intended DHS to use the National Laboratories whenever possible. They pointed to key benefits of working through the National Laboratories, including the Laboratories' recognized expertise; their ability to handle very sensitive classified information and materials; their ability to perform the supercomputing often required; and their significantly higher budgets for basic research, upon which S&T can build. They also pointed out that, once funding is given to one of the Laboratories, that facility sometimes forms a consortium of what the officials saw as the few capable performers in a given area or otherwise involve them in the research without the need for S&T to make individual awards. The division research leads also qualified these comments, however, noting that at times the National Laboratories compete for S&T funding, submitting white papers or proposals, in some cases even though no formal S&T announcement has occurred.

S&T officials are seeking opportunities to leverage funding by building on the work of the Laboratory-Directed Research and Development funding available to DOE labs. At the same time, DOE officials are interested in working more closely with S&T to understand and to affect S&T's research agenda. Both are interested in leveraging funding and making the most effective and efficient use of their funds while meeting the missions of both agencies. In 2008, S&T began aligning the National Laboratories with its six technical divisions.[61]

INNOVATION PORTFOLIO

Currently, about four percent of S&T funds are allocated to the Innovation Portfolio, which explores "game changer/leap ahead results." Though these projects may produce potentially high payoffs, they also are high risk. Program officials said they believe funding must be fenced off for this type of high-risk research because both the S&T customers and Congress are "risk averse." The level of funding allocated is an S&T decision, based, at least in part, on a judgment

[59] 6 U.S.C. 189.
[60] Without this provision, DOE laboratories would be able to accept work from DHS only if it did not interfere with DOE's mission. See GAO, *DHS Needs a Strategy to Use DOE's Laboratories for Research on Nuclear, Biological, and Chemical Detection and Response Technologies*, May 2004, GAO-04-653, p. 7.
[61] See Chapter VIII for more information on the alignment of National Laboratories and S&T divisions.

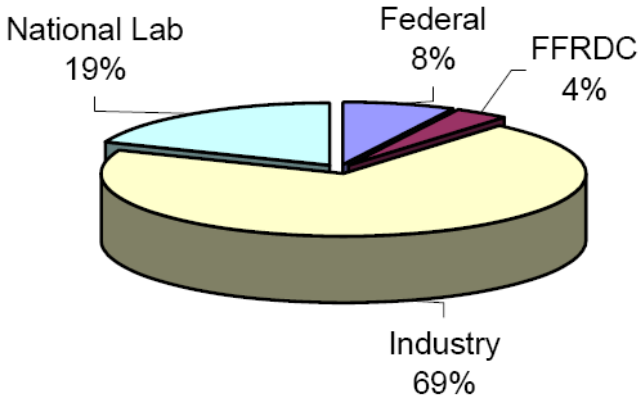
about the extent to which DHS customers will accept funding to be directed to research not focused on meeting their near-term (transition) needs.

Congress established the Homeland Security Advanced Research Projects Agency (HSARPA) in the Homeland Security Act of 2002. The Act mandates that, among other things, the Director of HSARPA fund homeland security research to: 1.) support both basic and applied research that promotes revolutionary changes in technologies; 2.) advance development, testing, and evolution of critical technologies; and 3.) accelerate prototyping and deployment of technologies that address homeland security vulnerability.[62]

Projects are expected to deliver either prototypes—within two to five years—or proof-of-concept level demonstrations—within one to three years. In creating the new S&T organization in 2006, the U/S included HSARPA in the Innovation Portfolio. However, the review of ongoing projects conducted at that time determined that none of the on-going HSAPRA projects were "revolutionary," so they were assigned to the Transition or Basic Research Portfolios.[63]

Like basic research, innovation projects are run out of the technical divisions, but unlike basic research, they are funded by Innovation/HSARPA. Also, there are no division leads for innovation programs. Program managers responsible for innovation projects report both to the Director, Innovation/HSARPA, and to their technical division director. Some program managers are division staff and some are staff of Innovation/HSARPA.[64] As shown in Figure 7-2, almost three quarters of the performers of innovation projects are from private industry.

Figure 7-2: S&T Innovation/HSARPA Performers



Source: Graphic provided by S&T, March 2009

[62] 6 U.S.C. 187 (b) (3).
[63] DHS, OIG, T*he Science and Technology Directorate's Processes*, p. 15. The report further states that this left the Innovation/HSARPA Portfolio with Small Business Innovative Research Program and the Small Business Technology Transfer Program projects, which are not discussed in this chapter and are not included in the four percent figure cited for the Innovation Portfolio.
[64] Ibid p. 10.

S&T described several sources of guidance and of project recommendations for innovation project funding. They include: 1.) DHS Secretary goals and priorities; 2.) guidance from the Office of Management and Budget and the White House Office of Science and Technology Policy; 3.) U/S goals; 4.) Congressional drivers; 5.) IPT-identified needs; 6.) DHS component input regarding capability gaps; 7.) other agencies, and 8.) proposals submitted in response to Broad Area Announcements.

Program officials explained that priorities are established once all potential projects are reviewed, primarily by the Director and Deputy Director of Innovations/HSARPA.[65] These reviews are to ensure that potential projects are credible, mission relevant, and have a risk profile appropriate to the Innovation Portfolio. Proposed projects are assessed for cost, schedule, programmatic risk—factors such as the organization and practices of the performer—and technical risk. As described by a program official, the recommendations are then vetted through the U/S chain of command and final decisions are made by the U/S. Once projects are selected, a program plan is developed and briefed to the Technology Oversight Group.

In August 2008, the DHS Inspector General criticized S&T for a lack of clear processes and criteria for selecting projects and performers in this portfolio, in part because selection of the initial projects and performers made by the U/S was subject to the appearance of conflict of interest. The report also recommended that project selection responsibility be transferred to the Director/HSARPA.[66] Commenting on the draft report, S&T described the process it had established, specifying that: 1.) the recommendations of the Director of Innovations/HSARPA are briefed to the Corporate Board, which can make recommendations for changes; and 2.) the Deputy U/S and U/S are then briefed and the U/S then takes proposals to the Technology Oversight Group for approval, prioritization, and funding as part of the DHS budget development process.[67] Nevertheless, the final Inspector General report continued to recommend an action plan to clearly document not only the process but also the criteria for identifying, prioritizing, and selecting prototype and demonstration projects, and transfer of project selection responsibility to the Director of Innovations/HSARPA.[68]

The high risk nature of these projects requires an ability to identify unproductive projects and to terminate them. Innovation/HSARPA terminated 5 of 18 active projects in 2008. One S&T official said this is the only office that actively terminates projects that are not producing results.

In order to achieve a necessary level of realism, customers must be actively involved in prototype demonstrations. Program officials point to this involvement as evidence that, if successfully demonstrated, the prototypes have a realistic possibility of being transitioned. Over the two year history of the Innovation Portfolio one project has transitioned. This is a forensic camera that has been transitioned to the Transportation Security Administration for further development.

---

[65] A three member panel, which includes the Deputy for Innovations/HSARPA, reviews all proposals received in response to a Broad Area Announcement for mission relevance and credibility before they are included among projects to be prioritized.

[66] DHS, OIG, the Science and Technology Directorate's Processes, p. 28 and 33.

[67] Ibid. p. 35 and 41.

[68] Ibid. p. 35.

CONCLUSIONS

The allocation of funding to basic research—in total, across, and within divisions—appears to rest primarily on the historical allocation made at the time of the 2006 reorganization. That allocation may have made sense then but may not be appropriate in the future. There may be no permanent "right" level of funding for basic research. However, it is difficult to confidently conclude that the current allocation for basic research S&T-wide, among the divisions, or within the individual divisions is appropriate. Further, S&T has only general criteria for selecting basic and innovation research projects and no process by which to prioritize basic research across divisions or within divisions. The experience of the Counter-IED Program—facing difficulties setting priorities across divisions—demonstrates the validity of these concerns. The DHS Inspector General raised these issues in August 2008, and recommended that S&T develop clear criteria and a repeatable process for selecting basic research and innovation projects.

The insular nature of S&T's approach to designing and carrying out its research agenda is a major concern. External scientific peer review of proposed S&T basic research is needed. Scientific peer review is critical to ensure quality research. Evaluating the impact of basic research is not possible over the short term, so ensuring quality in design and execution of the work is critical. Additionally, competition for funding is a major factor in expanding the pool of researchers interested in working in certain areas—in this case homeland security—and consequently, expanding the capacity for that research. But solicitation and peer review of competing proposals is not the norm in S&T for selecting performers. In most cases, decisions about the content, quality, and selection of performers are made by small groups or individuals.

Some of the reasons cited for directing work to specific National Laboratories demonstrate the insularity of S&T officials' thinking. They emphasize the unique abilities of the National Laboratories to perform supercomputing and to undertake classified projects. However, a significant, and growing, number of universities have the capacity to carry out both supercomputing and classified work.

S&T officials responsible for basic research recognize the need to interact with the wide community of researchers doing work relevant to homeland security. They sponsor and attend meetings of various kinds and are developing additional approaches to coordination, such as the effort to align S&T divisions with Centers of Excellence and National Laboratories. These alignments have the potential to support more productive relationships, increase S&T's success in leveraging National Laboratory and university work related to homeland security, and increase efficiencies. However, the realignments, along with S&T's practice of designating a laboratory to do the work, may further reduce competition, thereby creating greater insularity that could fail to optimize the identification of new ideas and reduce the likelihood of building new capacity for homeland security research.

Adding outside input from experts in the many fields pertinent to homeland security research will increase S&T's confidence, and that of its clients and appropriators, that the extent and nature of its basic research is thoroughly vetted and that the research being conducted is of the highest standards of excellence.

RECOMMENDATIONS

7-1. Develop and implement clear and transparent processes and criteria for identifying basic research and innovation needs, prioritizing projects, and selecting performers.
The work of the recently created Research Council and the results of the effort by the National Defense University, if they result in establishment of solid criteria and are effective in articulating and carrying out priorities across divisions, may improve S&T's prioritization practices. However, the insular nature of S&T's basic research effort should be addressed as well.

The U/S can use a variety of approaches to assess and change the total allocation of funding to basic research, as well as allocations among divisions. A sound strategic plan would help to guide funding. The U/S could hold out a portion of funding in the budget process to allow higher S&T priorities to be addressed. A panel of experts could be brought together to review the allocations and make recommendations.

7-2. Ensure S&T builds on current efforts to integrate research across the National Laboratories, Centers of Excellence, and others.
Continued and expanded efforts to involve outside scientific experts in setting agendas, such as the efforts of the Office of University Programs and meetings among the aligned divisions and National Laboratories, could improve the quality of the basic research program. More integrated research should ensure better knowledge transfer and greater efficiency of effort and allow external expert views to be considered in decisions about the overall program of research, including the adequacy of resource allocations to basic and innovation research efforts.

7-3. Make competitive processes that include external scientific peer review the norm for basic research and all other awards as appropriate.
In addition to processes used by other agencies, such as the National Science Foundation and the National Institute of Justice, the process of scientific peer review used in selecting the Centers of Excellence could serve as a model to guide future S&T efforts.

CHAPTER VIII: LEVERAGING INVESTMENTS AND AVOIDING UNNECESSARY DUPLICATION THROUGH COORDINATION AND COLLABORATION

The DHS Science and Technology Directorate (S&T) operates in the context of a federal homeland security mission that is broad and demanding. Mission responsibilities, funding authority, and other resources are spread across multiple entities within DHS and across the federal government. Also, other countries possess important expertise relevant to accomplishing the mission. It is critical that S&T coordinate its activities externally and seek out opportunities for collaboration to identify research gaps, leverage existing research efforts, and avoid unnecessary duplication of effort.

This chapter describes and evaluates how the S&T Directorate and its components coordinate and collaborate with other DHS R&D components, other federal agencies, and foreign governments. Coordination, for the purposes of this review, includes such things as working with other agencies to define each other's roles and responsibilities, identifying areas for possible collaboration, and adapting policies and procedures to enable collaboration. It may involve formal tools and mechanisms, such as Memoranda of Understanding, international agreements, and interagency working groups, as well as informal interactions among professional colleagues. Collaboration is often used interchangeably with coordination, but is used here to indicate joint activity, such as joint funding and conduct of projects.

COORDINATION AND COLLABORATION BETWEEN S&T AND OTHER DHS R&D COMPONENTS

The Homeland Security Act gives S&T the responsibility for "coordinating and integrating all research, development, demonstration, testing and evaluation activities" within DHS. In addition to R&D supported by S&T, nuclear/radiological R&D is supported by the Domestic Nuclear Detection Office (DNDO).[69] Also, the U.S. Coast Guard and the U.S. Secret Service retain small R&D budgets to support work specific to their respective missions.

To help ensure coordination between S&T and DNDO on nuclear/radiological R&D, Congress passed the Security and Accountability for Every Port Act of 2006.[70] This law directs DNDO to coordinate with S&T on research related to both agencies' missions and for the agencies to submit a joint annual report to Congress on nuclear and radiological technology strategies and plans. The second annual report was submitted in October 2008. It does not include a substantive discussion of coordination between DNDO and S&T. It only notes that a chapter on radiological and nuclear threats will be included in a revision of S&T's *Coordination of*

[69] Responsibility for radiological/nuclear countermeasures research was transferred from S&T to DNDO in 2005. Radiological/nuclear countermeasures research accounted for 25 percent of total DHS R&D in FY 2008. See Appendix B for more details.
[70] PL 109-347

Homeland Security Science and Technology,[71] planned for release in FY 2010, and that this chapter will "align with the Department's technology roadmap for nuclear and radiological detection."

DNDO officials said that they coordinate very little with S&T on R&D. The two agencies operate in very different technical fields and draw on different expertise. However, S&T and DNDO appear to be working closely in two areas of mutual interest: (1) developing the integrated Chemical/Biological/Radiological/Nuclear assessment; and (2) setting standards to enable data interchange among first responders responsible for different types of detection.

S&T funding for homeland security R&D has allowed the Secret Service to focus its limited R&D resources on its core mission as well as participate in shaping research in technical areas relevant to the requirements of the Secret Service and other federal agencies. The U.S. Coast Guard enjoys a good working relationship with S&T as a customer participating in the Capstone IPT process.

INTERAGENCY COORDINATION AND COLLABORATION

Interagency coordination is always difficult given the different missions, priorities, legislative mandates, presidential directives, and constituency/customer demands to which individual agencies must respond.[72] Over nine other federal agencies/entities support homeland security related R&D.[73] While assigned a lead role in coordinating R&D in some areas,[74] S&T has no direct authority over other agency R&D decision-making and must rely on their willingness to cooperate to fulfill this task. The ability of S&T to play an effective coordinative role is further complicated by the fact that it has only the third largest homeland security R&D budget in the federal government.[75] Thus, S&T has a broad responsibility for coordination with limited authority and resources to exert leverage on the actions of its fellow agencies.

To accomplish the difficult task of interagency coordination, S&T personnel have drawn on personal and professional ties as well as formal mechanisms to identify opportunities for

[71] *Coordination of Homeland Security Science and Technology* was initially delivered to Congress in December 2007 and revised in January 2008. It was submitted in partial fulfillment of Section 302 of the Homeland Security Act of 2002, which calls for S&T to develop a strategic plan for coordinating homeland security R&D across the Federal government.

[72] See, for example, Jennifer Sue Bond, et al., OSTP 2.0 Critical Upgrade: Enhanced Capacity for White House Science and Technology Policymaking: Recommendations for the Next President, (Washington, DC: The Woodrow Wilson International Center for Scholars), June 2008, p. 18.

[73] The American Association for the Advancement of Science (AAAS) identified nine other federal agencies funding at least $1million in homeland security related R&D. Together with DHS, these agencies account for over 99 percent of total federal homeland-security related R&D in FY 2008. Also, DOJ's National Institute of Justice reports funding a small amount of homeland security related R&D.

[74] For instance, DHS is directed to take the lead coordinating role in by Presidential Homeland Security Directives and federal statutes in certain areas of chemical and biological defense. DHS mission responsibilities and the role of S&T in these areas is discussed in this chapter's section on interagency coordination and collaboration.

[75] AAAS data show that the three largest funders of federal homeland security related research in FY 2008 are the Department of Health and Human Services, the Department of Defense, and the Department of Homeland Security, in that order. See Appendix B for a more detailed analysis.

collaboration and enable coordination. S&T participates in a range of formal coordination entities and activities, including interagency committees and working groups, sponsorship of interagency meetings and conferences, and joint strategy development.[76] To illustrate, Appendix E provides a listing of the formal interagency entities in which a sample of S&T components participate.

S&T's role in these different groups varies considerably depending on the field of activity. In some fields, S&T has taken a lead role in coordination reflecting an officially designated leadership role or particular expertise. In other cases, S&T simply participates in order to follow developments and identify opportunities.

While S&T coordinates with many federal agencies, much of its interaction is centered on: (1) the Department of Defense, the second largest funder of homeland security-related R&D after Health and Human Services (HHS); (2) HHS and other agencies related to S&T's responsibilities for chemical and biological defense; and (3) the Department of Energy, which through its National Laboratories is the second largest performer of S&T R&D after industry.

Department of Defense

S&T interaction with DOD is broad-based. The extent of interaction between S&T and DOD reflects the range of technical fields in which both agencies are active and intersections between their homeland defense and homeland security missions.

Much of the S&T leadership, including the heads of the Interagency and First Responder Division and the Portfolio offices—Research, Innovation, and Transition—came to S&T from the military R&D community. They have been able to exploit their professional relationships and familiarity with the military R&D community to identify targets of opportunity and enable collaborations.

Also, S&T leadership has been able to take advantage of some formal coordinating mechanisms. One such coordination mechanism is the Capability Development Working Group (CDWG). The CDWG is a forum at the DOD and DHS Undersecretary level that is concerned primarily with acquisition, but also addresses science and technology issues. Members are the DOD U/S for Acquisition, Technology and Logistics, the DHS U/S for Management, and the DHS U/S for S&T. The CDWG meets quarterly to discuss areas of mutual interest and opportunities for strengthening coordination and collaboration. A broad range of officials are invited to the quarterly meetings, including leadership from Defense Research and Engineering, the United States Northern Command (NORTHCOM), and DHS agencies such as the U.S. Coast Guard, Customs and Border Protection, and the Office of Intelligence and Analysis, depending on the issues at hand. The CDWG is supported by a staff group that briefs leadership on issues to be considered at CDWG meetings.

[76] CRS, The DHS Directorate of Science and Technology, p. 32.

S&T also participates in a number of working level coordination entities. One of these groups is the Technical Support Working Group (TSWG),[77] which covers a range of technical areas and is charged in part with addressing the technology needs of state and local first responders. TSWG is an interagency forum funded by DOD and the State Department that develops "dual use" technologies[78] based on requirements solicited from federal agencies and state and local first responder organizations. S&T participates primarily in two technical groups: (1) Chemical, Biological, Radiological, and Nuclear Countermeasures; and (2) Explosives Detection.

The 1401 Program, established under Section 1401 of the 2003 Defense Authorization Act,[79] is focused primarily on identifying and transferring technologies in DOD laboratories that meet the requirements of other federal agencies and state and local first responders. S&T works with the 1401 Program to communicate customer requirements, identify technologies of possible interest, and enable technology transfer. S&T also participates in working level coordination groups organized around particular technical areas such as Counter-IED.

S&T works closely with DOD to identify opportunities for collaboration in technical areas where S&T's homeland security mission intersects with the homeland defense mission of DOD. A particular focus of this interaction is NORTHCOM, which is engaged in a range of technical fields related to its homeland defense mission. NORTHCOM and S&T have briefed each other on their respective portfolios, and S&T will participate in NORTHCOM's annual field testing of early stage technologies in June.

At least five of the six technical divisions, the Office of Innovation, and the Special Programs Division are participating as a partial funder in collaborative R&D projects with DOD agencies. Collaborative R&D projects with DOD agencies account for at least half of total collaborative projects by each of these S&T components. Also, S&T components are involved in collaboration with DOD agencies where DOD or S&T share expertise and other capabilities, but no funding is exchanged. For instance, the Space and Naval Warfare Systems Command is providing S&T with technical expertise and contracting support for cargo security IPT projects.

HHS and other Federal Agencies with Responsibilities for Chemical and Biological Defense

Chemical and biological defense related R&D is the largest focus of S&T R&D spending, accounting for 25 percent in FY 2009.[80] The organization of S&T biological and chemical R&D activities and its coordination with federal agencies reflects direction from four Homeland Security Presidential Directives (HSPDs)[81] and federal statutes that define the roles and

[77] TSWG is part of the Combating Terrorism Technical Support Office under the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict and Interdependent Capabilities.
[78] This term refers to technologies with both military and civilian applications.
[79] The Act (P.L. 107–314) mandated that the Secretary of Defense designate a senior official to oversee the transfer of DOD's technology to federal, state, and local first responders. Congress was concerned that DOD's investment was not being adequately leveraged by others, especially first responders.
[80] See Appendix B.
[81] The four HSPDs are: (1) HSPD 9: The Defense of United States Agriculture and Food; (2) HSPD 10: Biodefense for the 21st Century; (3) HSPD 18: Medical Countermeasures against Weapons of Mass Destruction; and (4) HSPD 22: Chemical Defense (Classified). A full listing of HSPDs, including abstracts and full text of the unclassified directives is provided on the DHS website at http://www.dhs.gov/xabout/laws/editorial_0607.shtm.

responsibilities of DHS with respect to defense against biological, chemical, radiological, and nuclear threats, including naturally emerging infectious diseases and pandemic threats.

Interagency coordination is discussed with regard to selected S&T responsibilities:

- Assessing biological and chemical threats to inform the development of countermeasures by HHS.

  The Project Bioshield Act of 2004 gave DHS the lead in determining material threats to public health and national security.[82] The Material Threat Determinations do not address prioritization, which is done by DHS in the form of risk assessments by S&T. These risk assessments are tools for other agencies to use in prioritizing threats and, in the case of HHS, to inform decisions about vaccine and other countermeasures development. The three HSPDs that direct DHS to conduct risk assessments are: (1) HSPD-10, which mandates a biological threat risk assessment every two years (the first was completed in 2006); (2) HSPD-18, which directs DHS to conduct an integrated assessment of Chemical, Biological, Radiological, and Nuclear threats; and (3) HSPD-22, which directs DHS to conduct a chemical threat risk assessment.

  An important area of coordination between DHS and HHS is participation in the risk assessment process. A particular focus of coordination is communication between the National Biodefense Analysis and Countermeasures Center (NBACC) and HHS's Biomedical Advanced Research and Development Authority (BARDA). BARDA is charged with developing medical countermeasures and must be able to communicate its requirements effectively as a customer of NBACC.

  S&T also coordinates with the National Institutes of Health (NIH) on biodefense research in a number of other ways. For example, the Enhanced Threat Agent Working Group examines issues and identifies gaps in scientific knowledge for NBACC. An important issue is defining and assigning classified research that NIH does not do as a matter of policy.

- Developing monitoring and detection technologies and operational guidance to decision-makers.

  S&T coordinates primarily with the Centers for Disease Control and Prevention (CDC) in the development of detection technologies and operational guidance for decision-makers on how to evaluate and act on detection information. Also, S&T has coordinated with CDC in the development of a National Laboratory response network. This includes the development of common capabilities and operating procedures.

- Developing technologies and operational guidance for decision-makers to enable effective decontamination and recovery following attacks.

[82] P.L. 108-276.

S&T coordinates with EPA, the overall lead in this area, and DOD in planning and developing operational guidance and training decision-makers and first responders.

- Coordination of animal disease R&D

  Under HSPD 9, DHS has the lead responsibility for coordination in the field of Agriculture Defense. S&T coordinates primarily with the U.S. Department of Agriculture in this mission area and directs the Joint Agriculture Defense Organization (formulated by the National Science and Technology Council), which is responsible for coordinating research in this mission area.

S&T has collaborated with the U.S. Department of Agriculture in the development of requirements for the design of a new research facility, the National Bio-Agriculture Facility. S&T's Office of National Labs is responsible for the design and construction of research facilities and also was involved in developing the NBACC discussed above.

The Chemical and Biological Division is a partial funder of ten collaborative R&D projects with other agencies: five with DOD agencies and one with DNDO through its Chem/Bio R&D branch; and four projects with the U.S. Department of Agriculture, NSF, and NIH through its Agricultural Defense branch.

Department of Energy

DOE national laboratories are major performers of R&D funded by DHS S&T. In FY 2009, they account for 20 percent of S&T's Transition portfolio spending and 26 percent of its Research portfolio spending.[83] S&T's efforts to coordinate with DOE are focused primarily on the efficient and effective utilization of DOE national laboratories.

The Office of National Labs (ONL) is responsible for coordination regarding S&T's use of the National Laboratories and other federal government laboratories. ONL is working with DOE on two coordination initiatives. Both involve discussions between S&T and DOE at the Under Secretary level. The first initiative aims to "align" DOE National Laboratories with S&T technical divisions based on matches between the mission requirements of the divisions and the technical capabilities of the various National Laboratories. Toward this end, an agreement was reached that allowed each Laboratory to pick up to three technical focus areas that best reflect its capabilities. ONL then hosted meetings of staff from the technical divisions and the self-selected National Laboratories organized around the technical focus areas of the individual technical divisions. The intent of these "aligned laboratory meetings" is for individual technical divisions to learn more about what the National Laboratories have to offer and for the Laboratories to learn more about the technical divisions' needs that can inform project development and performer selection. Aligned laboratory meetings have been hosted by ONL for each of the six technical divisions. The initial success of aligned laboratory meetings in facilitating discussion led ONL also to include staff from S&T-funded Centers of Excellence associated with individual technical divisions.

[83] See Appendix B.

The second initiative is to develop a mutually acceptable arrangement whereby S&T may work with individual National Laboratories to identify opportunities for collaboration on research projects funded through Laboratory-Directed R&D (LDRD) budgets. Each Laboratory is authorized by law to set aside up to eight percent of its budget in a discretionary fund for supporting basic research. R&D at the Laboratories is funded by DOE and other agency customers reflecting a variety of programmatic objectives. The Laboratories prize the LDRD budget, which allows them to support innovative research and build future lab capabilities. DOE officials encouraged S&T officials to look more broadly for opportunities to leverage DOE investments in basic research, including the large basic research portfolio funded by DOE's Office of Science.

An important mechanism for coordinating S&T interaction with DOE is the Business Forum, an interagency group hosted by DOE's Office of Counterterrorism in the National Nuclear Security Administration (NNSA). NNSA has jurisdiction for coordinating between DHS and DOE on a broad range of issues, including access to the National Laboratories.[84] This group meets "as needed," to solve specific problems or identify better ways of doing business. Invitees include: DOE (represented by the Office of Science), NNSA, S&T, as well as other DHS agencies, depending on the issue at hand. S&T is represented by the Director of the Office of National Labs.

Some issues handled by this group include: (1) developing standard requirements for DHS contracting with the National Laboratories; and (2) resolving a dispute over liability assumed by DHS in contracting for work at the National Laboratories.

S&T's Office of Innovation and the Command, Control, and Interoperability Division (together with the Infrastructure and Geophysical Division) are each funding collaborative projects with DOE at the National Laboratories. The projects relate to security and reliability of the national electrical grid.

Coordination and Collaboration with Other Federal Agencies

S&T coordinates with a number of other federal agencies in various technical areas. Although not a large funder of homeland security related research, the Justice Department's National Institute of Justice (NIJ) is an important partner in the development of technologies for first responders. NIJ coordinates with S&T through the internal DOD 1401 Program Working Group and the Technical Support Working Group discussed above, as well as the Interagency Council for Applied Homeland Security Technology.[85] NIJ also participates in S&T's Integrated Product Teams doing work related to first responders.

[84] Responsibility for coordination across DOE National Laboratories is placed within NNSA, because three of the Laboratories, which are devoted primarily to nuclear weapons research, must operate under NNSA authority by law.

[85] The Interagency Council for Applied Homeland Security Technology (ICAHST) is an unofficial body. The ICAHST "consists of US Government sponsors of homeland security and counterterrorism information technology research from the Department of Homeland Security, the Defense Department, the Intelligence Community, various Law Enforcement Agencies, and Federal Civil Agencies. The ICAHST provides its membership with a government-wide forum to discuss critical homeland security and counterterrorism issues related to information technology, convey the technology research and development needs of their respective communities, and describe current research and development initiatives, pilot experiments and proposed courses of action for future research

S&T participates in a number of interagency groups concerned with biometrics and plays a lead coordinating role in this area, in particular as it relates to people screening. A representative of S&T's Human Factors/Behavioral Sciences Division co-chairs the RDT&E[86] Coordination working group of the National Science and Technology Council's Technology Subcommittee on Biometrics and Identity Management.[87]

Another example of interagency coordination is provided by S&T's participation in the interagency working group concerned with the development of Multi-Phase Array Radar technology, which is intended to develop a next-generation radar system that can address multiple agency requirements related to detection and tracking of weather events, commercial aviation, and aerial threats. Participating agencies include the National Oceanic Atmospheric Administration (NOAA), Federal Aviation Administration (FAA), and DOD agencies.

S&T technical divisions and the Office of Innovation are funding more than ten collaborative R&D projects, in addition to those related to S&T's interaction with DOD, DOE, and HHS and other agencies concerning chemical and biological defense. Partner agencies include NSF, NASA, NIST, NOAA, FAA, and several intelligence agencies. Collaborations range from a biometrics project with the Intelligence Advanced Projects Research Agency[88] to a broader collaboration with NSF to administer and support a joint program for basic research on computer analysis of data sets and visualization of data.

Allocation of Responsibility within S&T for Interagency Coordination

Interagency coordination is the responsibility of various parts of S&T, depending on the level and focus of the coordination. Individual technical divisions are engaged in significant interagency coordination in their respective spheres, but the Interagency and First Responder Programs Division (IAD) and other divisions handle coordination with agencies and programs engaged in technical activities that relate to multiple technical divisions or that demand special arrangements.

Primary responsibility for coordination of interagency liaison at the corporate level of S&T is vested in the IAD. However, other divisions have significant assigned roles and responsibilities. The Office of National Labs is responsible for coordinating with DOE to ensure full and effective utilization of the National Laboratories by DHS. The Special Programs Division

---

investments. By participating in the ICAHST, coalition sponsors obtain and share valuable information that will help focus their homeland security research programs, identify potential interagency collaboration opportunities, identify high-leverage, high-value research targets of opportunity, and minimize duplication of research." (Charter, June 20, 2007) The chair of the ICAHST rotates among Council members. An NIJ representative currently chairs the ICAHST.

[86] Research, Development, Testing , and Evaluation.

[87] The National Science and Technology Council was established by Executive Order on November 23, 1993. This Cabinet-level Council is the principal means within the executive branch to coordinate science and technology policy across the diverse entities that make up the Federal research and development enterprise. Information on NSTC committees can be found on the internet at http://www.ostp.gov/cs/nstc/committees.

[88] The Intelligence Advanced Research Projects Agency is an R&D agency within the Office of the Director of National Intelligence.

coordinates with other federal agencies for those government initiatives and programs identified as especially sensitive, classified, or deserving of extraordinary security protection.

IAD coordination efforts focus primarily on work with DOD agencies, including Combatant Commands, especially NORTHCOM, and with state and local first responder agencies. The Office of Transition, which is responsible for addressing first responder technology requirements, also plays a coordinating role with two DOD entities—the Technical Support Working Group and the DOD 1401 Working Group—whose missions include addressing first responder technology needs.

The allocation of responsibility within S&T for interagency coordination and its rationale are not obvious from looking at publicly available materials. And, interviews with the principals did not always provide a clear-cut explanation. Assigned responsibilities of IAD, the Office of Transition, and the Special Programs Division are stated in the Science and Technology Organization Regulation Manual (STORM), but this document has not been released publicly and its statements of responsibility do not fully reflect practice and are scattered among the descriptions of each office's responsibilities.

The allocation of responsibility between IAD and the Office of Transition for coordinating with the DOD entities charged with the development and transfer of technology to meet first responder needs is not entirely clear. The recent expansion of IAD's role in reaching out to the first responder community could complicate S&T's coordination with DOD in this area if the respective roles of IAD and the Office of Transition are not clearly defined.

Interagency coordination at the corporate level of S&T lacks a strategic orientation. Coordination appears to be *ad hoc*, in response to opportunities as they arise. This reflects in part the scale of the coordination task and limited staff. Also, S&T has not yet developed a strategic plan for coordinating with federal agencies. However, as noted earlier in this chapter, S&T has developed and is revising a planning document, the *Coordination of Homeland Security Science and Technology* ("Coordination Plan"). Although, it is not the national strategic plan called for in the Homeland Security Act, it could be considered a first step in that direction.[89] S&T officials responsible for interagency coordination were unaware of the Coordination Plan.

Avoiding Unnecessary Duplication and Leveraging Investments

An important objective of coordination is to avoid unnecessary duplication of effort, especially given S&T's relatively small budget. However, it is not appropriate to eliminate all areas of overlap. For example, DOD and DHS may be working on similar technologies, but with differing requirements for military and civilian applications. In addition, multiple efforts can improve innovation, as long as it is being carried out with an awareness of what others are doing and with a clear rationale.[90]

[89] The document's foreword describes it as "a descriptive baseline for homeland security research and development measures across the Federal government.

[90] These rationales include the replication of research to validate results or the pursuit of alternative approaches to see which is superior.

The Academy team probed the issue of unnecessary duplication in all interviews with officials at other federal agencies, and with outside experts. Other federal agency officials as well as independent experts interviewed generally reported that S&T is doing a good job of identifying and coordinating with the relevant entities in the different technical areas in which S&T supports R&D. None identified instances of unnecessary duplication of effort.

Also, internal DHS agency customers generally are satisfied with S&T's efforts to coordinate with other agencies, avoid duplication of effort, and keep components informed of related R&D, as well as conferences, seminars, and product demos. In fact, some customers said S&T was uniquely situated and qualified to perform this function and that S&T had been very proactive in avoiding duplication and making sure their projects were complementary with other work being done.

Whatever frustrations agency officials may express, they agree that interaction with S&T has become easier and more productive since the reorganization of S&T in 2006-2007. A common reason given was that it was more clear who at S&T they needed to work with.

S&T technical divisions and the Office of Innovation are participating in almost 40 collaborative projects with other federal agencies in FY 2009, thus leveraging their investments. All of Innovation's R&D spending goes to collaborative interagency projects.[91]

Many federal agency officials identified collaborative R&D projects as an important result of coordination with S&T. Without exception, these officials indicated that the collaboration was going well. However, none of the projects were complete at the time, and interviewees could not point to concrete outputs. Some officials said that good experience in collaborating with S&T had led to broader cooperation, on additional projects and other activities.

INTERNATIONAL COORDINATION AND COLLABORATION

In recent years, there has been a trend across the federal government to work more closely with international partners. The International Cooperative Programs Office (ICPO) was established by the Implementing Recommendations of the 9/11 Commission Act of 2007.[92] The Act assigned the following responsibilities to the ICPO: developing mechanisms for international cooperation on R&D; setting priorities for international cooperation; identifying international partners; and engaging in activities to address identified priorities. In carrying out this mission, the office is to coordinate with the Department of State, DOD, DOE, and other relevant agencies or interagency entities.

ICPO sponsors and participates in annual international conferences that help "set the global agenda," facilitate scientist and engineer exchange programs, and develop cooperative programs between S&T technical divisions and partner countries for conducting joint projects or "in

[91] The Homeland Security Act of 2002 specifically gives the Homeland Security Advanced Research Projects Agency (HSARPA) the authority to enter into joint projects with agencies conducting related research.
[92] P.L. 110-53

response to a crisis."[93] Information exchange is further facilitated by participation in dozens of workshops and meetings, travel to foreign countries, and S&T's international liaisons, of which there are now two—one covering Europe and one covering Pacific-Asia.

A major objective of ICPO is to identify science and technology in foreign countries that supports the work of S&T's six technical divisions and three portfolios. It is important to draw on the expertise of countries that have more experience than the U.S. in particular areas (e.g., Israel and the United Kingdom regarding IEDs).

Substantive collaboration between the United States and a foreign government generally requires a bilateral agreement. Bilateral agreements facilitate information exchange and cooperative activities by providing for appropriate security arrangements and intellectual property protections to be undertaken by both parties. Also, by providing a framework for information exchange, these agreements help avoid unnecessary duplication of effort. Bilateral agreements are intended for use by all federal agencies, not just DHS. Therefore, they are vetted by all relevant federal agencies before receiving approval.

Since 2004, ICPO has entered into international agreements with eight countries: Australia; Canada; Israel; Mexico; Singapore; Sweden; the United Kingdom; and France. Another is being negotiated with Germany. The agreements, which are very similar, have the broad purpose of facilitating information exchange and cooperative activities. They also list the types of joint activities in which the countries will engage (e.g., threat assessments, testing and evaluation, and exchange of best practices) and categories of potential joint projects (including research projects, task forces, product demonstrations, etc.). Typically, these foreign partners do not have agencies equivalent to DHS, but usually have agencies with similar missions to S&T or other DHS components, such as FEMA. In addition to bilateral agreements with individual governments, ICPO is negotiating an agreement with the European Union to facilitate access to information about homeland security related research being funded by the European Union.[94]

ICPO awards grants, primarily for basic research, at universities. Funded projects must be conducted by a partnership between U.S. and foreign institutions and may include non-university partners. Proposals are solicited by grant announcements, which are posted on the internet at www.grants.gov. ICPO is now in its third round of grant competitions.

Table 8-1 summarizes the awards ICPO made in FY 2008. S&T plans to fund six to eight additional international projects in FY 2009. The ICPO FY 2009 budget for grants is $1.2 million.

[93] DHS, S&T, Science and Technology for a Safer Nation, March 2008, p. 16.
[94] This research program has a budget of 1 billion Euros (approximately $1.3 billion as of April 29, 2009).

Table 8-1: ICPO Awards in FY 2008

Project Title	Primary Institution	International Component	S&T Division
Intelligent Food Defense Systems for International Supply Chains: The Case of Mexican Fresh Product in the United States.	Arizona State University	Caades/CIDH, CIAD Unidad Cullacán, and Tecnológico de Monterrey, Mexico	Chem/Bio
Visual Analytics Applied to Automated Multimedia Content Analysis	University of North Carolina at Charlotte	University of Konstanz, Germany	Command, Control, and Interoperability
Novel Explosives Sensor Using Signal-Amplifying Molecularly Imprinted Conducting Polymer	University of Connecticut	Nanyang Technological University, Singapore	Explosives
The Impact of Israeli Counterterrorism Interventions on Rate and Intensity of Terrorist Activity: Hazard Modeling and Time Series Approaches	University of Maryland COE (START)	Institute for Counterterrorism, Herzliya, Israel	Human Factors/Behavioral Sciences
Developing a New Glass Window Panel for Security Against Projectile and Small Explosion Threats at Close Proximity	University of Missouri	Monash University, Australia	Infrastructure and Geophysical

The ICPO also provides limited funding for collaborative projects, such as workshops. It has an FY 2009 budget of $300,000 for collaborative projects.

CONCLUSIONS

The Academy team probed the issue of unnecessary duplication in all interviews with officials at other federal agencies, and with outside experts. Interviewees generally are satisfied that S&T is doing a good job of identifying and exploiting opportunities to leverage investments, and identified no instances of unnecessary duplication of effort. However, the team identified some opportunities for improvement related to the allocation of responsibility within S&T for interagency coordination.

The allocation of responsibility within S&T for interagency coordination and its rationale are not obvious from looking at publicly available materials. Assigned responsibilities of IAD, the Office of Transition, and the Special Programs Division are in the Science and Technology Organization Regulation Manual (STORM), but this document has not been released publicly and its statements of responsibility do not fully reflect practice and are scattered among the descriptions of each office's responsibilities.

The allocation of responsibility between IAD and the Office of Transition for coordinating with the DOD entities charged with the development and transfer of technology to meet first responder needs is not entirely clear. The recent expansion of IAD's role in reaching out to the first responder community could complicate S&T's coordination with DOD in this area if the respective roles of IAD and the Office of Transition are not clearly defined.

Interagency coordination at the corporate level of S&T lacks a strategic orientation. Coordination appears to be ad hoc, in response to opportunities as they arise. This reflects in part the scale of the coordination task and limited staff. While S&T does not yet have a strategic plan for coordinating with other federal agencies, it has developed an interagency coordination planning document for Congress. S&T officials responsible for interagency coordination were unaware of this document.

RECOMMENDATIONS

8-1. Provide a single, unified explanation of the allocation of responsibilities in S&T for interagency coordination at S&T in a readily available public document.
S&T should clearly define component roles and responsibilities for interagency coordination and communicate this information internally and externally. One approach would be to publicly release a single unified explanation in a revised version of the STORM.

8-2. Clarify the allocation of responsibility within S&T for interagency coordination about the development and transfer of technologies related to first responder needs.
IAD and the Office of Transition should work together to define their respective roles and responsibilities for interagency coordination relating to first responder technology needs. The resulting definition should be included in the unified statement of responsibilities in a revised STORM.

8-3. Improve the internal communication about coordination planning and work to ensure responsibility for interagency coordination reflects the strategic plan when it is developed.

This Page Left Intentionally Blank.

CHAPTER IX: PERFORMANCE MEASUREMENT

Program monitoring and evaluation are both important performance measurement strategies to ensure program efficiency and effectiveness. The former is intended to track program progress to ensure that they do not go off course and to hold contractors or others accountable for achieving goals. Program expenditures are also monitored to ensure spending is appropriate and timely.[95] Thus program monitoring is an ongoing process that spans the timeframes of entire projects and is not a one-time undertaking.

Program evaluations can be either process or impact assessments. Process evaluations focus on whether and how a program is delivering what it was expected to deliver and whether there are more efficient ways of making progress. Impact evaluations determine whether the project has achieved the desired result. Thus, impact evaluations focus on what happens after a program is completed and whether it has had the planned effect.

PROJECT MONITORING

Program managers across the six S&T divisions vary somewhat in how they monitor the projects within their programs, although all engage in a combination of site visits, phone and e-mail contact, and review of written progress reports to assess progress. Each project also has project-level milestones that program managers track.[96] Program managers periodically report to IPTs on project and program status. In addition, every six months the U/S S&T conducts program review meetings with each IPT to discuss selected projects.

As described by officials in the Chemical/Biological Division, program managers attend an on-site kick-off meeting with R&D performers (contractors or grantees) when the contract or grant is awarded. They may revisit at intervals over the course of the project. The frequency of visits depends on project complexity, level of experience with the performer, and availability of travel funds, among other factors. A major purpose of the initial meeting, according the Division officials, is to ensure an understanding of requirements for regular progress reporting to S&T.

On a monthly basis, Chemical/Biological Division project managers review short summary reports that are submitted by performers. These reports include a discussion of progress, problems encountered, and intended activities for the following month. This performer input, along with information from phone and e-mail contacts, is used by project managers to compile Monthly Reports and Quarterly Reports for the division. Project managers also participate in "critical design reviews" that are intended as a final review for all project decisions and to assess their appropriateness.

Two Chemical/Biological and two Explosives projects were selected for review to determine whether project monitoring had occurred as described by S&T. The projects were selected from

[95] Financial monitoring is discussed in Appendix F.

[96] Project managers are likely to have multiple projects within a program with a single set of overall goals. Some project managers have monitoring responsibilities for multiple programs that can each have multiple projects.

a list of Chemical/Biological and Explosives projects that had been on-going for at least a year, did not contain classified content, and were not known to have other anomalies that would render them unrepresentative of Chemical/Biological and Explosives projects in general. The final project selection was by agreement with S&T. The Chemical/Biological Division provided access to project files, and the review confirmed that the monitoring occurred and was appropriately documented. However, the Explosives Division provided examples of monitoring documents, rather than the complete monitoring file. This approach did not provide sufficient basis for comment on the thoroughness of monitoring activities in the Explosives Division.

S&T'S USE OF MILESTONES TO MEASURE PROGRESS

S&T uses milestones to measure progress on different levels. At the most basic level, program managers set and monitor specific project milestones as part of oversight of individual projects. Milestones at a more macro level are used to gauge the performance of research programs that include multiple projects. Milestones are intended to be measurable indicators of progress towards a goal. Although they can be either qualitative or quantitative, they should be specific enough so that they allow an assessment of real progress.

S&T has used milestones to track progress at least since February 2004, when, in Congressional testimony, the then U/S of S&T discussed S&T performance goals and laid out specific milestones for S&T programs in a number of subject areas. For example, for the Chemical High Explosives project, the FY 2005 milestone was "pilot test of standoff detection technologies," and for work on biological countermeasures an FY 2005 milestone was "establishment of a national capability in biodefense analysis and agro-terrorism countermeasures."[97]

In these early years, S&T milestones were criticized as inconsistent across portfolios, too output oriented, not appropriately tracked, and changed without consequence. DHS management expressed concern about the need for S&T to make progress in aligning its portfolio with overall agency strategic goals and encouraged S&T to develop meaningful milestones as part of the effort to achieve that outcome. After the 2006 reorganization that established a new division structure, additional emphasis was placed on developing and tracking milestones.

Program managers received training on how to set appropriate milestones for projects, and S&T has made an effort to standardize project milestones to make them as consistent as feasible. S&T is currently pilot testing a new project data collection and analysis data base, the Project Execution System, that is intended to make it easier for both program managers and division management to monitor milestones.[98]

The box below outlines basic requirements for effective milestones that can both assist a project or program in achieving goals and provide the foundation for measuring progress over time.

---

[97] These are only examples of milestones described in this testimony. The entire context for these milestones, including the relevant long-term performance goals, performance measures, and the FY 2005 targets are provided in the February 25, 2004 testimony of U/S Charles McQueary before the Subcommittee on Cybersecurity, Science, and Research and Development, U.S. House of Representatives.

[98] The new system is intended to facilitate the collection and analysis of multiple workflow indicators. Development of this data base was initiated in September 2008 and it is unlikely to be operational until FY 2010.

Requirements For Effective Milestones

Valid: Milestones, whether for measuring progress on a project or higher level program of work, must be valid measures of progress. To be valid, a milestone must state a single objective to be achieved in clear, concise language. A milestone need not be completion of a project, but should be an unambiguous indicator of progress. Milestones that are vague, such as "start to develop," "improve capability," or "make progress on planning…" do not allow for a clear determination of whether they are met because "start," "improve," and "make progress" are in the eyes of the beholder and can have multiple interpretations. Milestones that involve completion of more than one task can be improved if they are divided to focus on completion of a single task.

Reasonable: Milestones must represent reasonable, but stretch goals, for achievement of objectives. "Easy" milestones that everyone meets or "hard" milestones that are almost never met are both problematic. Tracking milestones over time, and analysis of that information, can provide the basis for setting milestones at reasonable levels.

Consequences: Milestones must have consequences. If missing a milestone merely results in setting a new milestone, then there is no incentive to take them seriously.

In more recent years, S&T has improved the clarity of its milestones. A comparison of the milestones enumerated in U/S S&T's 2004 Congressional testimony with the milestones listed in the 2007 Five Year Plan shows improvement in developing milestones that measure progress towards goals.[99] Examples of improved milestone formulation from the current Five Year Plan are:

For the Explosives Standards Program

- Milestone—Complete the development of trace explosive standards test materials for RDX and C4 explosives.

For a Center of Excellence program for Border Security and Immigration

- Milestone—Develop a framework to inform DHS policymakers with empirical immigration research to increase the efficiency of immigration enforcement.

For the Infrastructure/Geophysical Standards Program

- Develop protocols for the testing and evaluation of protective equipment.

It is difficult to determine the extent to which S&T milestones are reasonable and stretch goals, either at the project or the program level, because necessary detailed data on milestone achievement has not yet been collected. Recently, more emphasis has been placed on diagnosing the reasons for missing milestones before setting new ones, and an S&T official also said that they are continuing to work on improving project milestones. However, systematic information is not being collected to build a body of experience that could fine-tune milestone setting and assessment to understand underlying factors that prevent the meeting of milestones and to lay the groundwork for establishing appropriate consequences for meeting, or not meeting, milestones. S&T officials indicated that, to date, consequences for failing to meet milestones have been minimal. In many cases milestones are pushed forward when it becomes evident they will not be met.

[99] Hundreds of milestones are listed in the Five Year Plan. Some are more specific and measurable than others.

PERFORMANCE ASSESSMENT AND EVALUATION

DHS has been less attentive to issues of overall performance assessment and evaluation—assessment of outputs and impacts—for both for S&T as a whole and for individual divisions and programs, than to issues of progress and expenditures. With few exceptions, S&T does not involve outside scientific experts to help assess and evaluate the overall performance of its work, either at an individual project level or more comprehensively. S&T is working, however, to improve its performance assessment metrics and has enlisted the help of outside experts.

S&T-wide and Program Reviews

The Homeland Security Science and Technology Advisory Committee (HSSTAC) provides advice to S&T, including identifying potential research projects, and conducting an annual review of S&T performance. The Annual Performance Report to the Office of Management and Budget under the Government Performance and Results Act also reports the status of efforts against articulated metrics and targets for key S&T divisions and offices.

Advisory Committee Performance Review

HSSTAC's size and membership is congressionally mandated. It has 20 members who are appointed by the U/S for S&T. Membership includes scientists, engineers, and medical researchers as well as first responders and representatives of organizations that represent first responders and citizen groups. The members serve three-year terms. The Advisory Committee meets quarterly as a whole, and its three panels, meet as often as monthly. The three existing panels address the following topics:

- Annual assessment of S&T programs (required by Congress);
- S&T's response to Homeland Security Presidential Directive 23 (Cyber Security); and
- Maritime Counter-IED

The deliberations of the panels are closed. However, a portion of virtually every quarterly meeting is open to the public.

According to an S&T official, the annual program assessment conducted by the Advisory Committee compares the composition of S&T's portfolio of projects to the requirements submitted by the Capstones in order to identify gaps and projects that could fill them, as well as to identify duplicative efforts and "missed opportunities." In preparing the annual assessments, the Committee interviews the portfolio directors, technical division heads, IPT leads, and others with an interest and role in S&T. The most recent annual assessment was completed in October 2008, but is still undergoing internal S&T review as of May 2009.[100]

An S&T official said that S&T management considers the Committee's advice when making various decisions, although the impact is not always evident. One exception is the creation of the

[100] A program official said that, in the future, the Program Assessment Panel will assess two to three Capstone IPTs per year.

Counter-IED Program Executive Office, which S&T created in response to a Committee report indicating the need for S&T to look at counter-IEDs from a domestic perspective.

Annual Performance Report

As required under the Government Performance and Results Act, S&T establishes high-level metrics and reports progress against targets as part of an annual reporting process. Major programs establish and report on metrics that are combined into an S&T-wide report.

In its 2008 Annual Performance Report, S&T reported on 21 metrics. At least one metric was reported for each of 11 S&T divisions, offices, or programs.[101] Of the 18 metrics for which progress against targets was reported, S&T met targets for 15.

About half of the metrics reported were output-related, such as:

- Number of new technologies available for transition to customers at TRL 6 or above(Explosives Division);
- Number of proof-of-concept technologies demonstrated (Command, Control, and Interoperability Division); and
- Percent of high priority chemical and biological agents detectable in target operations scenarios (Chemical and Biological Division).

Milestones are also a cornerstone of this annual performance report. About half (11) of the metrics reported in 2008 were composites of the project milestones set in the annual spending plan. The project level milestones used for monitoring are combined across projects to gauge the overall performance of research programs. The metric is stated as the percent of those milestones met for a given reporting unit (division/office/program). S&T has added two percent-of-milestones met metrics for 2009 and beyond.

Each year, targets are set for the percent of milestones that will be met. In 2008, S&T met the targets for nine of eleven "milestone" metrics, as shown in Table 9-1.

[101] Metrics are reported for each of the six S&T technical divisions.

Table 9-1: S&T Milestones Results in 2008

Reporting Unit	Target (percent)	Actual	Met Y or N	Action/New 2009 Target (percent)
Border and Maritime Security	95	99	Y	Target raised to 96
Human Factors/Behavioral Sciences	90	100	Y	Target remained At 90
Chemical and Biological	90	93	Y	Target raised to 93
Laboratory Facilities	100	93	N	Target lowered to 90
Explosives	85	77	N	Target lowered to 80
Infrastructure and Geophysical	90	90	Y	Target remained At 90
Innovation Performance Goal	50	88	Y	Target raised to 60
Testing Evaluation and Standards	70	70	Y	Target raised to 80
Transition	85	100	Y	Target raised to 86
University Programs	85	100	Y	Target remained at 85
Command, Control and Interoperability	90	94	Y	Target raised to 95

*A percent-of-milestones met measure was added for Infrastructure/Geophysical and Laboratories for 2009 and beyond.

A composite measure of milestones met can be a valid indicator of performance, especially when, as with S&T, it is combined with other more specific output measures. S&T officials recognize that not all milestones are created equal and, as discussed above, they hope to further improve the milestones set. Currently, meeting a targeted percent of milestones may mask significant issues if, for example, one or more of the milestones not met is critical to program performance and success.

Also, as with individual milestones, the composite target for the portion of milestones met should be reachable, but a "stretch." It is not clear that S&T's targets meet that standard. As shown above, S&T raised the 2009 target for 6 units and lowered it for 2. Overall, the 2009 targets for 6 of 11 of the milestone measures were below the 2008 actual. In one case (Laboratory Facilities), the explanation for not meeting the target related to an unexpected level of comments on a specific draft Environmental Impact Statement. Even though this explanation appears to indicate that this was a unique occurrence that prevented the unit from meeting its' target, the target for the next year was reduced, below even the actual level for 2008. S&T indicated that the 2008 target was 100 percent and that targets of 100 percent are "widely regarded in the field of

performance" as unrealistic. While this generally may be true, absent changed program expectations, targets set below actual levels do not constitute stretch goals. Additionally, goals set where actual results are already at 100 or 99 percent are questionable.

PROGRAM ASSESSMENT RATING TOOL (PART)

PART is a diagnostic tool created by the Office of Management and Budget to conduct periodic reviews of an agency's program performance in selected areas in order to achieve better results. The Office of Management and Budget selects the programs to be examined each year. Program examiners, in conjunction with S&T staff, rate the programs in four areas: 1.) Program Purpose and Design; 2.) Strategic Planning; 3.) Program Management; and 4.) Program Results/Accountability. The program results area accounts for 50 percent of the total score.

Overall, programs can be rated:

- Effective
- Moderately Effective
- Adequate
- Ineffective
- Results Not Demonstrated.

Programs can be rated "Adequate" with a PART score of 50 percent.

Nine S&T programs have been reviewed since S&T was formed. S&T's more recent scores have improved, though it is difficult to conclude this constitutes an overall trend. There are no ongoing PART reviews; the next PART review is expected after the 2009 transition.

Table 9-2: PART Results for S&T Programs

Reporting Unit	Year	Rating
Threat and Vulnerability, Testing and Assessment	2004	Results Not Demonstrated
Standards Development for Homeland Security Technology	2004	Adequate
Emerging Homeland Security Threat Detection	2005	Moderately Effective
Rapid Prototyping of Countermeasures	2005	Moderately Effective
Homeland Security University Fellowships	2005	Moderately Effective
Command, Control and Interoperability	2006	Results Not Demonstrated
Chemical and Explosive Countermeasures	2006	Results Not Demonstrated.
SAFETY ACT	2008	Effective
Chemical and Biological	2008	Effective

The 2006 PART review of the Chemical and Explosives Countermeasures Program identified the need for an external review of the program. In response, the Division initiated such a review, first for the Countermeasures Program alone, and, more recently, for the Chemical/Biological Program as a whole. The 2008 PART review of the entire Chemical/Biological Program identified this review as a positive step, noting that the annual review process will ensure continued technical performance and maintain its alignment with prevailing guidance and national strategies.[102]

The 2008 PART review of the SAFETY ACT Office measured, among other things, whether the program had specific long-term performance measures that focus on outcomes and meaningfully reflect its purpose; whether independent evaluations are conducted to support program improvements; and whether the program had taken meaningful steps to correct its strategic planning deficiencies. One of the several follow up actions taken by the Office was to develop a five-year plan that lays out planned activities and milestones that feed into the larger S&T strategic planning document.[103]

The 2008 PART scores of "Effective" for the SAFETY ACT Office and the Chemical and Biological Program are better than past S&T PART scores. Though the PART reviews assess key program attributes, they cover different programs at different times, which does not allow for a general assessment of a trend in S&T performance.

[102] PART Review: S&T Chemical and Biological 2008 Assessment, www.ExpectMore.gov, accessed April 2009.
[103] PART Review: S&T SAFETY Act 2008 Assessment, www.ExpectMore.gov, accessed April 2009.

Difficulties in Assessing and Evaluating R&D Programs

Retrospective process evaluations of program efficiency, as well as evaluations of overall quality and impact are important to ensure maximum return on investment and the fulfillment of agency missions. Although all agencies face significant obstacles in conducting evaluations of research and development, some agencies have found ways to obtain meaningful assessments of the quality of their work.

Process Evaluations

Process evaluations are in-depth reviews of program operations to assess whether they are working as intended, and whether improvements can be made to make them more efficient. Unlike monitoring, which is ongoing, process evaluations are generally a special effort. For example, S&T could design and conduct a process evaluation of how IPTs function to fine-tune the process, ensure consistency across divisions, and promote customer satisfaction. S&T has not conducted any formal process evaluations during the lifetime of the new organizational structure and processes—the last two years. Process evaluation may, in fact, not have been very helpful during this time because the new structure and functions were in a start-up period that would not be representative of the mature state of these processes. But now that the new structure has matured, such evaluations could provide essential knowledge to help fine tune it and maximize its effectiveness and efficiency in supporting S&T's research and development mission.

Impact Evaluations

Ideally impact, or outcome, evaluations would assess the effectiveness of new S&T-developed technology once it is deployed by customers, and compare that effectiveness with levels of effectiveness without the technology. Any unintended effects would be considered as well. This is extremely difficult in most settings, but is particularly so in the science and technology arena. The five year life of S&T, and in particular the two year life of S&T in its current configuration, is too short to afford the opportunity for impact analysis related to the use and value of products that have been transitioned to components and first responders through the new customer-focused process. S&T has not undertaken any impact evaluations to date. But alternatives to this sophisticated impact evaluation exist and could be used.

Many factors complicate impact evaluations of scientific research programs. These include lag times of many years between the conceptualization of projects and eventual development and use of products, taking outcomes far into the future. Some meaningful outcomes may differ from the initially intended outcome but still be significant. Myriad factors during the life of the project can affect outcomes. These can include everything from environmental changes that could render a potential discovery or product obsolete, to instability in funding that can disrupt or curtail progress. A recent edition of the American Evaluation Association publication, *New Directions for Evaluation*, was devoted to the discussion of problems and strategies for evaluations in these settings.[104]

[104] American Evaluation Association, New Directions for Evaluation, *Reforming the Evaluation Process.* Chris L.S. Coryn and Michael Scriven, Editors, No. 118, Summer 2008.

The Office of Management and Budget has recognized the unique nature of research and development programs. (See, for example, the box at right.) The guidance for PART reviews specifies unique requirements and approaches for these programs. It speaks, for example, to the difficulties in establishing meaningful annual outcome performance measures, and sets unique criteria for relevance, quality, and performance for research and development programs.[105]

> "While the criteria are intended to apply to all types of R&D…predicting and assessing the outcomes of *basic* research in particular is never easy. Serendipitous results are often the most interesting and ultimately may have the most value. Taking risks and working toward difficult-to-attain goals are important aspects of good research management, and innovation and breakthroughs are among the results. However, there is no inherent conflict between these facts and a call for clearer information about program goals and performance toward achieving those goals." (*Guidance for Completing 2008 PARTs; OMB January 29, 2008; p. 72)*

Research programs throughout the government face the same difficulties in assessing the quality and value of program efforts. In spite of these issues, agencies have developed several approaches to program evaluation. The most important is external scientific peer review. Another is measuring quantitative indicators of quality, such as publications and awards.

Scientific Peer Review

Independent scientific peer review is widely used by research and development agencies to ensure the soundness of their programs and portfolios, the quality of their work, and, in some cases, the impact of their research and development results. Independent scientific peer review lies at the core of performance assessment of basic research and is essential to applied research as well. With only a few exceptions, S&T has not involved outside experts in either development of its projects and programs or assessment of their quality and impact.

The Role of Peer Review

Given the recognized difficulty in formal analysis and evaluation of the impacts of research and development, peer review is seen by many as the best way to ensure quality research is done and return on investment is maximized. The value of peer review in assessing research quality has been documented in multiple studies.[106]

The Committee on Science, Engineering, and Public Policy of the National Academies of Science has recommended that programs of basic and applied research be evaluated regularly through expert review, using the performance indicators of quality, relevance, and, where

[105] *Program Assessment Rating Tool Guidance No. 2008-01*, from Deputy Director for Performance and Personnel Management, January 29, http://www.whitehouse.gov/omb/part/fy2008/part_2008.pdf.

[106] For example see, National Research Council. (1999) "Peer Review in Environmental Technology Development Programs." Committee on the Department of Energy, Office of Science and Technology's Peer Review Program, Board on Radioactive Waste. Washington, D.C.; National Academy Press.

appropriate, leadership. The definition of experts include more than scholars in the field, but also users of the research, such as industry and non-governmental organizations.[107]

In evaluating research efficiency at the U.S. Environmental Protection Agency, A committee of the National Academies of Science emphasized the need for external peer review, stating that "**the best mechanism for measuring investment efficiency is the expert-review panel."** The report defined research program investment efficiency as "doing the right research and doing it well," that is, gauging portfolio management in terms of whether the investment is relevant to the agency's mission and long-term plans and is being performed at a high level of quality.[108]

In line with these findings, the Office of Management and Budget also emphasizes the need for external review of research and development programs. Its guidance states that retrospective review—to determine whether research investments are well-directed, efficient, and productive—is essential for validating program design and instilling confidence that future investments will be wisely made. The guidance includes requirements that:

- Program relevance to the needs of the nation, of fields of science and technology, and of program "customers" be assessed periodically through retrospective review; and
- Program quality be assessed periodically through retrospective expert review.

One specific question asked during the PART review in 2008 was: *Do independent evaluations of sufficient scope and quality indicate that the program is effective and achieving results?*

Other Agencies' Use of Peer Review

Many federal and other research organizations use peer review to help guide and assess their programs and to ensure credibility of their work in the research community. The following discussion describes how the National Science Foundation and the National Institute of Justice use peer review to assess the quality of their programs.

National Science Foundation

The National Science Foundation uses both prospective and retrospective peer review to ensure the soundness of its programs. Over 90 percent of its awards are based upon merit review of proposals by expert peer reviewers. Peer review also is performed at the end of projects, and it also uses retrospective peer review at the program and agency level as a cornerstone in its quality assurance efforts.

---

[107] *Implementing The Government Performance and Results Act for Research: A Status Report;* Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, Institute of Medicine; National Academies Press (2001); http://books.nap.edu/catalog/10106.html (accessed April 20, 2009).

[108] *Evaluating Research Efficiency in the U.S. Environmental Protection Agency;* Committee on Evaluating the Efficiency of Research and Development Programs at the U.S. Environmental Protection Agency, National Research Council; National Academies Press (2008), http://www.nap.edu/catalog.php?record_id=12150 (accessed April 9, 2009).

The annual performance review required under the Government Performance and Results Act has, for many years, been done at the Foundation by a committee of outside reviewers (the Advisory Committee for GPRA Performance Assessment). In 2008, according to the Foundation's Annual Performance Report, the committee was composed of 20 members, each of whom had strong academic credentials and substantial experience in academia, government, and/or industry. The Committee meets once a year and assesses the Foundation's accomplishments under its three broad mission areas (Discovery, Learning, and Research Infrastructure). The Foundation does not set specific objectives, goals, or targets in these areas. An official said that the Foundation has such a broad mission that setting goals and targets, especially quantitative goals and targets, is very difficult.

To make its assessment, the Committee receives "highlights" prepared by program officers each year in April. There are about 900 of these highlights; 300 for each of the three mission areas. The highlights are designed to show what progress has been made and do not include discussion of problems or failures. The Committee does not review individual divisions or programs.

Individual program areas, and some cross-cutting areas, are reviewed, however, every three years by an outside Committee of Visitors. These reviews are a full critique of the program, including management, balance of research portfolio, and overall impact of the work.[109] Divisions can add specific issues as well. The reviews include a random sample of individual projects. The Committee of Visitors is composed of individuals selected by the program officers. Usually these are individuals who have knowledge of the Foundation, are willing to spend the necessary time, and do not have any conflicts of interest.

National Institute of Justice

The two major operating components of the National Institute of Justice, the Office of Science and Technology and the Office of Research and Evaluation, both use external scientific peer review to ensure the quality of their efforts, though in different ways. The Institute maintains an extensive, on-line list of potential peer reviewers.

The Office of Science and Technology primarily performs applied, transitional research and development. It awards funds through a competitive external peer review process that includes practitioners as well as researchers, both from within and outside the Institute. Also, the Office of Science works with 19 Technology Working Groups, which are focused on key subject areas (such as aviation and biometrics) and are composed of both mid-level practitioners knowledgeable of technology needs in the area as well as scientists from the Institute's science centers. These working groups participate throughout the program life cycle, including determining technology needs, developing solutions, and building capacity in the criminal justice community. Final research products are also peer reviewed. The reviews include an assessment of how well the final product fills the identified requirements.

[109] The 2008 Government Performance and Results Act review found that these reviews by Committees of Visitors were not effectively covering program impact, and suggested that the Committees either cease or enhance their efforts in this area. See *Report of the Advisory Committee for GPRA Performance Assessment FY 2008,* July 31, 2008, p. 4. http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf08064

The Institute's Office of Evaluation and Research also uses competitive peer review to review proposals before awards are made. Grantee final reports are also peer reviewed. This Office does not have peer review at the program level, but noted that the Institute's work is generally presumed to be of high quality because of the extensive peer review at the project level.

Quantitative Measures

In addition to peer review, quantitative measures are recognized as being indicators of research quality. Use of these output measures could add to assurances that future outcome evaluations will find positive outcomes. For example, measures such as the number of conference presentations and professional publications can be indicators of scientific value. Although by no means perfect indicators, they do denote recognition of work by others in the field. These indicators can be put in use fairly quickly.

The National Institute of Justice uses these kinds of measures in its Annual Performance Reports. In 2008 the Institute reported the following output or outcome metrics:

- Number of fielded technologies;
- Number of citations or Institute products in peer reviewed journals;
- Total number of Institute electronic and hard copy documents/publications/other requested;
- Percent reduction in the DNA backlog (Casework/offender);
- CODIS (the FBI's Combined DNA Index System) hits resulting from convicted offender funds; and
- Number of new Institute final grant reports, Institute research documents, and grantee research documents published.

Institute officials explained that the first metric—number of technologies fielded—speaks to successful completion of research and development, but recognizes that there could be significant lag time before a completed technology is actually employed. They also considered this metric to be appropriate because the Institute does not have responsibility for, or control over, what its criminal justice community customers do with the technology the Institute delivers.

Another quantitative measure related to quality is customer satisfaction. S&T's mission is directly related to serving the needs of DHS component customers and first responders. In its 2007 Strategic Plan, S&T indicated that it would undertake customer surveys to assess satisfaction. Such surveys have not yet been conducted.

S&T's Use of External Scientific Peer Review

S&T does not routinely use peer review and other quality metrics to assess its research efforts. However, S&T does have some experience with peer review and several program managers said that they hoped to institute such a review in the future. External peer review is used for initial

selection and periodic review of DHS Centers of Excellence. In addition, the Chemical and Biological Division has implemented an annual external scientific peer review of its Chemical and Biological Program. Also, S&T has recently looked outside S&T for help in developing, among other things, better assessment criteria and processes.

Centers of Excellence

S&T uses external scientific peer review in the process for selecting Centers of Excellence.[110] Centers are re-competed every five to six years and also are reviewed every two to three years. This interim review is conducted by outside reviewers against specified criteria. There are 33 separate criteria, covering six broad areas:

- Research quality and influence;
- Relevance;
- Management and administration;
- Education (e.g. number of students and theses supported, degrees awarded);
- Results communication and transitioning; and
- Integration (e.g. multi-institutional projects, collaborations with industry).

The external panels that conduct the reviews include academics, DHS and other federal and state agency officials, and end users. Reviewers' comments are discussed with Center officials and S&T's decision about whether to extend the Center is based in part on their response and, if needed, the extent to which they agree to redirect their research efforts. As of April 2009, five of the Centers had been evaluated against these criteria.

Chemical and Biological Division

The Chemical and Biological Division has also implemented an annual peer review. Though reviews began in 2006, 2008 was the first year that the entire Chemical and Biological Program was reviewed. According to program officials, the independent panel is comprised of current or former upper level managers from other agencies, or independent experts, for example, from academia. During the review, program managers present information on each project. The panel provides feedback at the program and project level on two key issues:

- Strategy: How is funding allocated to meet program goals?
- Technical quality: Is the research of high quality and how does it compare to that of other agencies?

Division officials use the peer review results to demonstrate and provide credible evidence of the quality of their work.

[110] See Chapter VII for information on how peer review is used in selecting Centers of Excellence.

S&T-Wide Efforts

Finally, S&T has looked outside DHS to help it develop assessment criteria. On April 1, 2009, at the request of the Director of Research, DHS signed a contract with the National Academies of Science to develop a framework of metrics for S&T. This study is to address metrics for all six divisions and all three portfolios and is expected to last two years.

In its interim report to S&T, the Panel suggested that more immediate steps be taken to establish and use performance criteria, rather than waiting for the two-year long National Academies study. The S&T Director of Research reports that he is pursuing other, more-rapid options to help refine metrics and approaches to prioritization, selection, and performance assessment. The Director of Research has commissioned a shorter-term, less-expansive study by the National Defense University in related areas, with panel members including prior directors of research organizations within the federal government. The kickoff meeting for that study was scheduled for early April 2009.

CONCLUSIONS

S&T has made progress in developing clear and measurable milestones and monitoring project progress. But the use of milestones can be improved. S&T can learn from its own experience to set more appropriate milestones and targets, and can make their use more effective by holding performers and program managers accountable for meeting them.

Current program assessments are useful, but do not offer the scientific credibility that other federal research agencies gain—and that policymakers, customers, and appropriators expect—through external scientific peer review. S&T has taken steps to improve its ability to evaluate its programs. But the insular nature of S&T's work is of great concern. Although the membership of the Homeland Security Science and Technology Advisory Committee includes researchers, its primary role is to provide an end user perspective. Additionally, it is not independent, since members are appointed by the U/S, and it cannot have sufficient scientific expertise to assess the wide range of subjects addressed by S&T's research. Likewise, though the Annual Performance Report and PART reviews do address quality and impact of research to some degree, they are not sufficiently independent or scientific. The annual performance report is very high level and, while it may point to areas where goals are not met, it does not provide independent scientific feedback with regard to issues that should be addressed. The PART reviews, though somewhat independent—given the Office of Management and Budget's lead—are intermittent and do not get to the scientific quality of the research.

Quantitative indicators of quality can also be used to supplement peer review. Such output indicators are widely recognized in the research field and can be fairly easily documented. Given concerns about the limited extent of products coming out of S&T, measures of output at the S&T and program levels seem appropriate. A metric such as the "number of fielded technologies" used by the National Institute of Justice's Office of Science and Technology could also be a meaningful metric for S&T programs. S&T's Annual Performance Report includes some output measures. For example, for the Explosives Program, the number of new technologies available for transition to customers at a specified transition readiness level. Also,

given the important role of S&T customers in actually using the products of S&T's research, a measure of customer satisfaction could be very valuable in assessing the quality and usefulness of S&T's work

RECOMMENDATIONS

9-1. S&T should ensure that milestones are valid measures of progress, represent reasonable but stretch goals, and are tied to appropriate consequences when they are not met.

A review of all milestones to ensure that they meet that standard would be useful. Further, S&T should systematically collect information concerning milestones—both met and unmet—to develop the type of information necessary to set milestones at appropriate levels. Failure to meet milestones should have consequences appropriate to the situation and should not result only in setting a new milestone. Information from milestone failures should be collected and analyzed to fine-tune the milestone setting process, and also to determine whether there are patterns of problems that could be corrected.

9-2. S&T should conduct process evaluations of selected critical functions to maximize S&T's efficiency and effectiveness.

Now that the new structure has matured, such evaluations can be an important tool to improve S&T's ability to accomplish its mission. As processes and procedures continue to evolve, such evaluations should also continue. The assessment of IPT customers using logic models, recommended earlier in this report, should provide an important basis for analysis of the IPT process. But many other financial and operational processes should be reviewed.

9-3. S&T should use independent external scientific peer review to ensure S&T's research is well managed, is appropriately balanced among the three portfolios, and is of high quality.

This review would be most useful initially at the division level or, where divisions conduct multiple programs focused on significantly different subjects, at the program level. This review should include, as appropriate, both scientists and practitioners. Ongoing work with the National Defense University to develop metrics and approaches to performance assessment and with the National Academy of Sciences to develop performance metrics should make it easier for S&T to implement external scientific peer review. S&T should ensure that these agencies consider in their work with S&T how the results would support peer review.

It also will be especially important for S&T to improve its strategic plan, as recommended earlier in this report, to articulate clear goals and objectives that can then be used by the peer reviewers in assessing S&T's overall research effort. Conversely, feedback from peer review will help in establishing meaningful milestones to measure progress, as recommended above. Finally, as S&T matures—and completes more research projects and fields more technologies—it will need to move beyond measures of quality to develop ways to assess the impact of its work.

9-4. S&T should use quantitative indicators of quality—as an adjunct to peer review—to help assess the overall quality of S&T's research.

Indicators that might be appropriate for S&T include, for example, the number of peer reviewed journal articles that report on S&T efforts, the number of scientific awards given to S&T researchers, and the number of S&T conference presentations and citations in peer reviewed journals. A measure of "technologies ready for transfer" would also relate directly to S&T's mission. Such metrics stop short, however, of assessing the usefulness of the technologies. An assessment of customer satisfaction could help. Measuring satisfaction of internal DHS customers should be fairly easy, while obtaining a valid assessment of first responder satisfaction presents more challenges.

This Page Left Intentionally Blank.

CHAPTER X: OPPORTUNITY COSTS[111]

Concern has been expressed by Congress that the increasing prominence of homeland security priorities in federal research portfolios may have resulted in reductions of funding for other significant research programs.[112] In theory, the selection of a particular array of research projects and proposals in a resource-constrained environment necessarily requires the rejection or delay of other projects and proposals that are ongoing or have been proposed. Thus, the question is whether there has been such an emphasis across the federal government on funding homeland security-related research proposals that funding for research in energy, criminal justice, environmental, non-biodefense medical research, and other important areas has suffered and resulted in lost opportunities to pursue research that might have proven to be very important.

To explore whether there have been such opportunity costs in federal funding of research, the relationship between funding in homeland security-related research and funding of other research areas over time must be examined to determine whether there has been a pattern of increases in funding of homeland security-related research and a decrease in funding for other research areas. Even if such a pattern exists, however, there are other potential causes that must be considered:

- A decreasing level of interest in a research area for reasons not related to an increased interest in homeland security-related research;
- Reclassification of research from non-homeland security to homeland security-related with no change in the actual projects themselves. For example, earthquake research and border-control related research may now be included as homeland security-related research, whereas they previously were included in other categories; and
- Reclassification of research from non-homeland security to homeland security-related with modifications in the project to provide benefits in both research arenas. For example, some money laundering research can have the dual benefit of finding ways to curtail funds for terrorist organizations and also for drug cartels.

It is also important to note that all research spending competes for funds with all other government spending priorities. Thus, a decrease in spending for research might not result in an increase in another, but may instead benefit a non-research federal spending priority. Likewise, an increase in a research spending area could result in a decrease in another area unrelated to other types of research. One documented instance of a controversy related to changes in research priorities at NIH has been identified and is discussed in this chapter.

[111] Opportunity costs are traditionally understood to be the difference between the actual value of using resources for one purpose and the value that would have resulted from an alternative use. In the context of the question the Academy was asked to explore, we understood the use of the term opportunity costs to mean the extent to which funding for homeland security-related research is crowding out funding for other important research areas.

[112] House Appropriations Committee Report H.R.110-181.

METHODOLOGY

Budget data, written material related to the issue, internet searches, and interviews provide insights into this issue. Budget data available from 10 federal agencies that fund R&D research was available to track patterns of research spending over time. At every interview with federal agency staff (excluding DHS) and outside experts, individual perspectives and opinions concerning this issue were collected. In addition, individuals conducting research and experts in a variety of science policy fields were identified and responded to questions concerning the opportunity cost issue.

BUDGET TRENDS

It is difficult to compare budget information for homeland security-related research and other types of research because of inconsistency in budget categories across agencies. However, the American Association for the Advancement of Science has categorized and tracked homeland security-related R&D spending for 10 federal agency R&D funders (including DHS) since FY 2004. These data were used to compare homeland security R&D spending with non-homeland security R&D spending for each agency over time. (Graphs of R&D spending for the nine agencies other than DHS are provided in Appendix G.) This analysis covers the five-year period FY 2004 to FY 2008.[113]

In our analysis of these data, we identified three instances in which homeland security-related R&D increased while non-homeland security R&D spending dropped or remained the same at a federal agency. However, it is very difficult to draw conclusions from this for two reasons. First, the analysis is based on data for total R&D spending by departments and independent agencies (e.g., DOD, HHS, EPA, and NSF) with large R&D budgets that are often spread across multiple sub-agencies.[114] HHS, for example, includes several agencies that fund R&D, including the National Institutes of Health (NIH), the Biomedical Advanced Research and Development Agency, and the Centers for Disease Control. This level of aggregation makes it very difficult to know where in the agency budget a shift may have occurred.

Second, even if a shift could be located, there would be no way to establish a causal linkage to the increase in homeland security-related research. The congressional appropriations committees and Office of Management and Budget divisions making budget decisions do so in relative isolation from each other. Therefore, it is unlikely that increases in homeland security-related research would have a direct effect on funding for other research areas.

The overall growth in homeland security-related research funding in recent years means that if there is an across-the-board cut in federal funding for research, homeland security research may fair better than other areas, just because it will have grown more in prior years. However, a uniform cut across research areas seems most unlikely. It is far more likely that there would be

[113] AAAS estimates of the homeland security portion of FY 2009 agency R&D spending await the release of a detailed version of the FY 2010 Budget Request containing updated FY 2009 agency spending data.

[114] AAAS analyses are based on data issued by OMB, which does not report R&D budget data at the sub-agency level consistently across agencies.

variable changes in funding across research areas as perceived national needs change over time. Thus, predicting the impact on other research areas of any possible growth in homeland security-related research in the future is not feasible.

NIH CONTROVERSY

In March 2005, more than 750 researchers who had previously been members of NIH's Microbial Physiology and Genetics and Bacterial and Mycology Initial Review Groups, or had received grants from these groups, signed a letter to NIH which was published in *Science*.[115] In the letter, the researchers charged that an unintended consequence of a 2001 agency decision to focus on biodefense had been the siphoning of funds from research concerning non-biodefense agents. The scientists argued that the decision by the NIH National Institute for Allergy and Infectious Diseases (NIAID) to make biodefense research its priority emphasized an area of low risk to public health and put non-biodefense research in "crisis."

To back up their assertions, the researchers presented data showing a large jump in the number of projects on bioweapons agents when comparing the time period of 2001-2005 to 1996-2000. Comparing these two time periods, the number of grants for studies of both non-biodefense microorganisms and non-biodefense pathogenic microorganisms dropped significantly.

NIAID responded that the grant data used by the researchers was neither accurate nor complete and that the researchers were not taking into account several factors, including: the increase in biodefense funding was largely paid for with an influx of $1.5 billion to NIAID's budget, not through the diversion of funds from other research; basic research in biodefense has applications to all microbiology and immunology research; and non-biodefense research has benefitted from the influx of new biodefense funds because it freed up more resources for non-biodefense research.[116]

In May 2005, under the leadership of the American Society of Microbiology, a meeting was held with NIH and NIAID officials and researchers involved in the controversy. NIH staff and researchers at the American Society of Microbiology meeting asserted that the primary cause of the controversy was the researchers' lack of understanding that NIH's biodefense spending was funded through a new influx of money specifically dedicated to biodefense research. NIH funding of certain other kinds of research did go down, but that is because NIH's non-biodefense budget had remained relatively flat for several years and there were changes in the focus of the non-biodefense research driven by the research community. Therefore, it did not appear that homeland security-related research at NIH caused a reduction in funding for other important research. For the most part, the NIH researchers attributed the decline in research funding overall to factors other than an increased focus on homeland security.

[115] "An Open Letter to Elias Zerhouni," *Science*, v. 307, no. 1409, March 4, 2005.
[116] NIAID, NIH, "Open Letter in *Science* Regarding NIH Biodefense Funding: Questions and Answers," March 17, 2005, http://www3.niaid.nih.gov/news/newsreleases/2005/scienceletter.htm.

The result was an agreement between NIH and the researchers to stop focusing on grant data and explore research opportunities being missed.[117] Most researchers in the field were satisfied with the meeting outcomes and concern over this issue dissipated considerably. As agreed at the meeting, a follow-up workshop was convened by the American Society for Microbiology and the National Institutes of Health in November 2005 to explore gaps and opportunities in basic bacterial research.[118]

INTERVIEW RESULTS

A total of 53 individuals, including federal agency staff, university researchers, science policy experts, and research association staff, were asked if they had observed shifts in funding toward homeland security-related research and away from other important research fields. Of these, 13 declined to comment, saying they had no opinion or information to contribute. Researchers who were interviewed conducted either: research in homeland security; research that was not previously considered to be homeland security-related, but now is (e.g., earthquakes, emergency preparedness); non-homeland security-related research; or research in fields that fall into both homeland security and non-homeland security-related research categories.

All researchers interviewed who are working on homeland security said that their field is well-funded. Researchers in all categories said that there has been a shift in emphasis in research proposals to make research eligible for homeland security research grants or that research has been expanded to include homeland security concerns (e.g., research on protecting drinking water systems may expand its focus to include a terrorist attack on drinking water). However, these shifts were viewed as marginal, resulting in small changes in findings and outcomes, but with the underlying research remaining largely unchanged.

In addition, many researchers had observed re-categorization of research that had not previously been considered homeland security-related as homeland security-related. None of the researchers interviewed, however, were aware of funding decreases that had occurred in other areas as a result of increased funding in homeland security-related research.

Federal researchers in homeland security did not report being aware of evidence or complaints about shifts in funding from non-homeland security-related research to homeland security-related research. NIH staff reported that their agency has successfully focused homeland security-related research on activities that benefit homeland security and traditional public health. Outside observers agreed that NIH has been successful in doing this. Similarly, DOD researchers report that homeland defense research focuses on broadening the applicability of traditional defense research to address both the needs of the warfighter and homeland defense.

One exception appears to be in the area of criminal justice research. When National Institute of Justice terrorism funds were shifted to DHS, the objectives changed and research objectives NIJ would have pursued were no longer funded. In addition, some researchers have complained that

[117] "Détente Declared on NIH Biodefense Funding," Jocelyn Kaiser, *Science*, v. 308, no. 5724, p. 938.
[118] ASM, NIH, *Basic Research on Bacteria: The Essential Frontier*, February 2007, http://www.asm.org/ASM/files/ccLibraryFiles/Filename/000000002932/NIHASMBacteriaReport.pdf.

some traditional criminal justice research is now terrorism research and, in general, funding for social science research on criminal justice issues has diminished. This is noteworthy because this research was largely focused on meeting the needs of first responders. Researchers also noted that a shift in funding to homeland security has occurred not only in the research area, but across the federal justice community. For example, the FBI has shifted its priorities from more traditional crime areas to preventing terrorism. This indicates a possibility that shifts toward homeland security-related research and away from other research areas may be happening within agencies.

Researchers do not say that funding currently devoted to homeland security-related research would otherwise go to funding other types of research. Researchers also made the following related observations:

- Some researchers noted that funding for environmental and social science research had declined in recent years. However, this decline was attributed to lack of interest in these areas by the previous Administration, not to the increased emphasis on homeland security.
- Some interviewees noted a shift away from basic research following 9/11, due to a sense of urgency to get technologies out as soon as possible. However, these researchers noted that the situation is gradually changing and believe that the balance of funding between basic and other types of research will return to its "natural state" in the near future.
- Some researchers believe the question of opportunity costs is now moot because of the large increase in research funding resulting from the stimulus package. However, stimulus funding is a one-time infusion and does not necessarily predict future funding trends.

CONCLUSIONS

With the possible exception of research in the field of criminal justice, interviews with experts, internet searches, and analyses of budget trends uncovered very little evidence of opportunity costs. Specifically:

- There is no evidence of a shift in funding toward homeland security-related research at the expense of other important research areas. Although funding for criminal justice research seems to have diminished, causal linkage to increases in homeland security-related research funding cannot be established.
- In a few instances, homeland security-related research increased while non-homeland security research spending dropped or remained the same at federal agencies. However, available information does not provide sufficient basis for identifying and explaining these funding shifts.
- Apart from the 2005 controversy at NIH, federal agencies contacted report that they have not received complaints from researchers that their field of research is not being adequately funded because of a shift in funding to homeland security-related research.

- Some researchers have been shifting and expanding their research focus to make it eligible for homeland security-related research funding. However, the underlying science is largely unchanged.
- There has been some re-categorization of research that was not previously considered homeland security-related research. This research has not changed; it has merely moved to a different budget category.
- Researchers in those fields that have experienced decreased funding levels in recent years attribute the drop in funding to other factors, such as lack of interest on the part of the previous Administration, rather than an increased focus on homeland security-related research. Criminal Justice researchers are the exception and feel that, in part, the increases in homeland security-related research have reduced support for their work.
- The majority of researchers interviewed do not believe that current funding for homeland security-related research would be shifted to other research areas if funding for homeland security-related research declined.

APPENDIX A: R&D SPENDING BY S&T

This Appendix reviews S&T's R&D funding[119] during the period FY 2006-FY 2009,[120] in the context of other federal funders of homeland security-related R&D and DHS R&D funding. The composition of S&T's Research and Transition portfolio spending is reviewed, including its distribution by performer type.

FUNDING OF FEDERAL HOMELAND SECURITY-RELATED RESEARCH

Three agencies—HHS, DOD, and DHS—account for 85 percent of all federal homeland security-related R&D funding ($4.969 billion total in FY 2008):

- HHS accounts for 39 percent ($1.94 billion);[121]
- DOD accounts for 26 percent ($1.294 billion); and
- DHS accounts for 20 percent ($992 million).

Since FY 2006, DHS's share of total federal homeland security-related R&D has decreased in absolute terms and relative to HHS and DOD, falling to third place in FY 2007. Changes over time in the respective agency shares of total homeland security-related R&D funding are depicted in Figure B-1. Absolute funding figures are presented in Table B-1.[122]

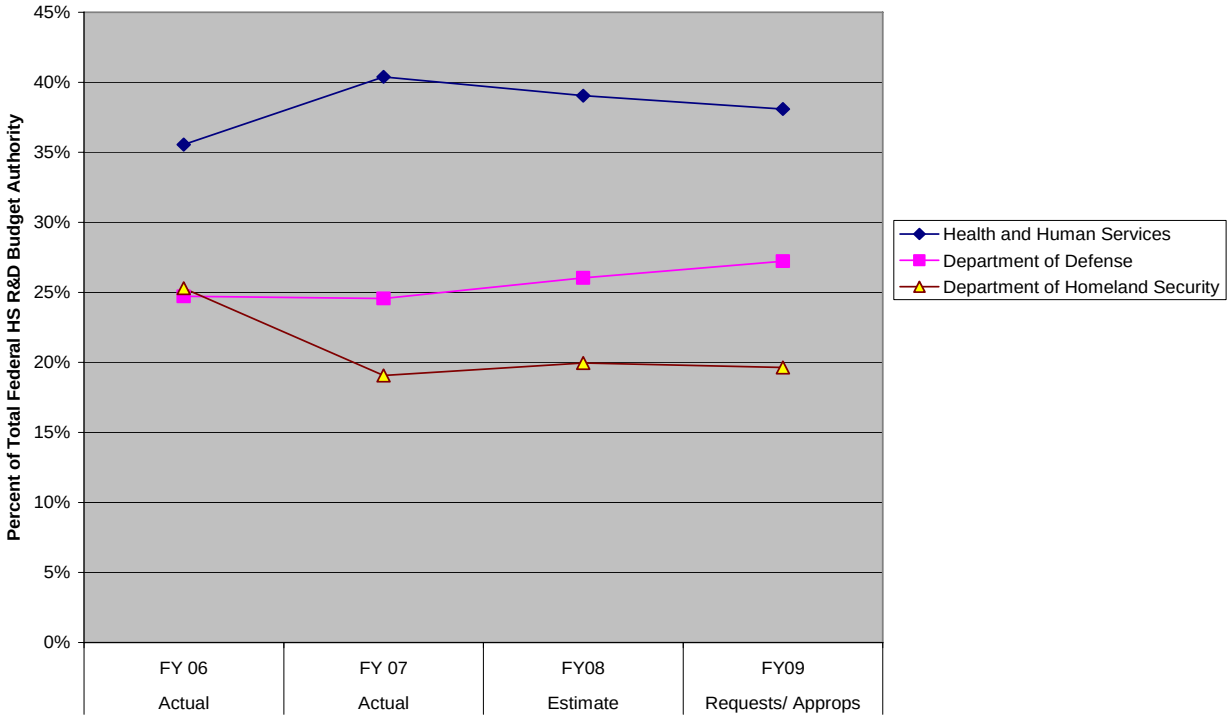
[119] R&D funding data presented in Figures B-1 and B-2 and Tables B-1, B-2, and B-3 are drawn from analyses issued by the American Association for the Advancement of Science (AAAS). However, R&D funding data for FY 2007 have been adjusted to reflect a significant transfer of funds: $84.1 million in funding for operational activities was transferred from S&T's Chemical and Biological Division to the DHS Office of Health Affairs.

[120] A new budget structure for S&T was introduced in the President's FY 2008 request for DHS, reflecting the reorganization undertaken at the end of 2006.

[121] Almost all homeland security related R&D at HHS is conducted or funded by the National Institutes of Health (NIH). However, the newly created Biomedical Advanced Research and Development Authority (BARDA) may account for as much as 13 percent of total HHS funding for homeland security-related research if the Administration's FY 2009 request ($275 million) is fully funded. BARDA is charged with facilitating the research, development, and acquisition of medical countermeasures for chemical, biological, radiological, and nuclear agents and emerging infectious diseases, including pandemic influenza.

[122] Final appropriations for DOD and HHS have been signed into law, but updated figures for the homeland security share of DOD and HHS R&D funding cannot be updated until the detailed version of the President's FY 2010 budget is released.

Figure A-1: Largest Federal Funders of Homeland Security-Related R&D
FY 2006 – FY 2009



Source: Based on data from American Association for the Advancement of Science (AAAS) and the President's FY 2008 Budget Request.

Table A-1: Federal Funding of Homeland Security-Related R&D
FY 2006 – FY 2009
($millions in budget authority)

Agency	FY 2006 Actual		FY 2007 Actual		FY 2008 Estimate		FY 2009 Requests/Approps	
	Amt	% of Total	Amt	% of Total	Amt	% of Total	Amt	% of Total
HHS	1,827	**36%**	1,932	**40%**	1,940	**39%**	2,106	**38%**
Nat'l Institutes of Health	1,827		1,828		1,837		1,856	
DOD	1,270	**25%**	1,175	**24%**	1,294	**26%**	1,505	**27%**
DHS	1,300	**25%**	912	**19%**	992	**20%**	1,085	**20%**
All Other	741	**14%**	764	**16%**	743	**15%**	831	**15%**
Total Federal	5,138	**100%**	4,783	**100%**	4,969	**100%**	5,527	**100%**

Source: Based on data from AAAS and the President's FY 2008 Budget Request.
Note: Figures may not sum exactly due to rounding.

DHS R&D FUNDING

In FY 2006, S&T accounted for over 98 percent of all DHS R&D, excluding only R&D by the U.S. Coast Guard and the U.S. Secret Service. In FY 2007, funding for nuclear/radiological R&D was transferred from S&T to the newly created Domestic Nuclear Detection Office (DNDO). In FY 2008, 98.5 percent of the DHS R&D budget resided in two organizations primarily devoted to R&D—S&T (73.7 percent) and the DNDO (24.8 percent). The U.S. Coast Guard accounts for most of the remainder (1.5 percent).

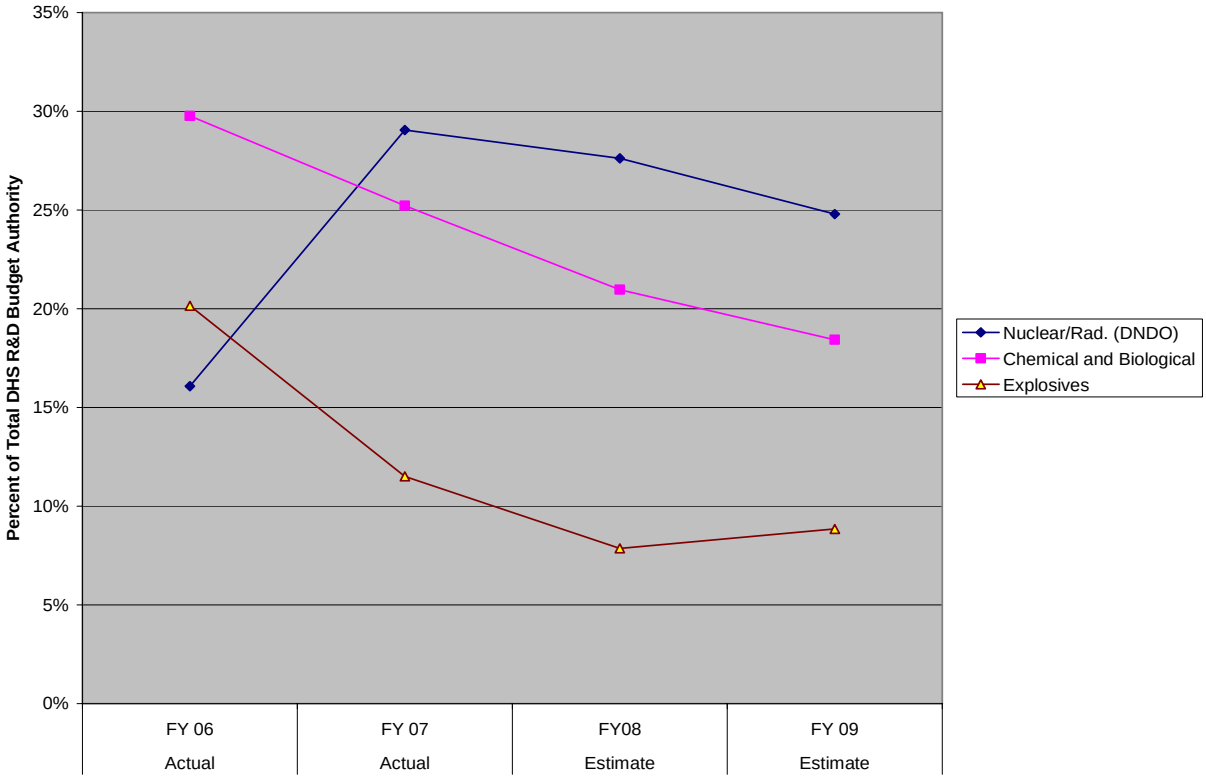
DHS's R&D portfolio has shifted significantly in the period FY 2006-FY 2008:

- Chemical/biological R&D decreased as a share of DHS R&D by almost one third (from 30 to 21 percent) in FY 2008. The large decline reflects in large part the transfer of operational activities from the S&T division to the newly created DHS Office of Health Affairs in FY 2007.
- Nuclear/radiological R&D increased as a share of DHS R&D by over two thirds (from 16 percent to 28 percent) in FY 2007 and surpassed chemical and biological R&D as a percentage of total DHS R&D to become the biggest DHS R&D program. Nuclear/radiological R&D is performed by DNDO within DHS.
- Explosives R&D dropped by more than half to eight percent of total DHS R&D. The decline in funding for Explosives reflects a sharp drop in funding for the Man Portable Air Defense Systems (MANPADS) project following the completion of its development phase.[123] MANPADS had been the major focus of S&T's explosives R&D.

Funding for chemical/biological R&D continued to decline as a share of DHS R&D in FY 2009, dropping from 21 to 18 percent. The share of DHS funding for nuclear radiological R&D declined from 28 to 25 percent in FY 2009, while explosives R&D increased its share of DHS R&D by 1 percentage point. This information is depicted in Figure B-2 and Table B-2.

[123] *AAAS R&D Funding Update on DHS FY 2007 Conference Appropriations* (http://www.aaas.org/spp/rd/dhs07c.htm). MANPADS are shoulder-mounted portable surface to air missiles that have been used against passenger aircraft.

Figure A-2: Largest DHS R&D Focus Areas
FY 2006 - FY 2009



Source: Based on data from AAAS and the President's FY 2008 Budget Request.

Table A-2: DHS R&D Funding
FY 2006 – FY 2009
($ millions in budget authority)

R&D Account	FY 2006 Actual		FY 2007 Actual		FY 2008 Estimate		FY 2009 Estimate	
	Amt	% of Total	Amt	% of Total	Amt	% of Total	Amt	% of Total
Nuclear/Rad. (DNDO)	209	**16%**	265	**29%**	274	**28%**	269	**25%**
Chemical and Biological	387	**30%**	230	**25%**	208	**21%**	200	**18%**
Explosives	262	**20%**	105	**12%**	78	**8%**	96	**9%**
All Other	442	**34%**	312	**34%**	432	**44%**	520	**48%**
Total DHS	1,300	100%	912	100%	992	100%	1,085	100%

Source: Based on data from AAAS and the President's FY 2008 Budget Request.
Note: Figures may not sum exactly due to rounding.

S&T R&D FUNDING

S&T's R&D budget dropped in absolute terms by more than 31.3 percent from $1.281 billion in FY 2006 to $750 million in FY 2007. It dropped again by 7.7 percent in FY 2008. The decline in FY 2007 included the rescission of $126 million of unobligated funds, the transfer of operational activities to the Office of Health Affairs, and the transfer of responsibility for nuclear/radiological R&D to the DNDO.

The two year decline in S&T R&D funding was reversed in FY 2009 when it rose by 15.8 percent. The largest part of this increase (over 39 percent) is due to the large increase in funding for the construction and startup of new S&T laboratory facilities.[124] Significant increases in support for the S&T divisions funding explosives and command, control, and interoperability R&D account for another 33 percent of the increase.

Despite the sharp decline in funding for chemical and biological R&D as a share of DHS and S&T R&D in FY 2008, it remains S&T's largest R&D program, accounting for 25 percent of total S&T R&D. It also represents almost 41 percent of R&D funding administered through S&T's six technical divisions. (See Table B-3.)

Table A-3: S&T R&D Funding
FY 2006 - FY 2009
($ millions in budget authority)

Budget Account	FY 2006 Actual		FY 2007 Actual		FY 2008 Estimate		FY 2009 Estimate	
	Amt	% of Total	Amt	% of Total	Amt	% of Total	Amt	% of Total
Six Technical Division Accounts								
Borders and Maritime	43	**4%**	33	**4%**	25	**4%**	33	**4%**
Chemical and Biological	387	**35%**	230	**31%**	208	**30%**	200	**25%**
Command, Control, Interop	108	**10%**	58	**8%**	57	**8%**	75	**9%**
Explosives	262	**24%**	105	**14%**	78	**11%**	96	**12%**
Human Factors/ Behavioral Sci	6	**1%**	7	**1%**	14	**2%**	12	**2%**
Infrastructure/ Geophysical	86	**8%**	75	**10%**	65	**9%**	76	**10%**

[124] Funding is provided for the startup of the National Biodefense Analysis and Countermeasures Center (NBACC), part of a biodefense complex of DHS, NIH, and DOD facilities at Fort Detrick, Maryland and for detailed design of the National Bio and Agrodefense Facility, for which construction is planned to begin in 2010 (*AAAS R&D Funding Update on R&D in DHS in the FY 2009 DHS Budget*, http://www.aaas.org/spp/rd/dhs09p.htm). Also, funding for R&D staff of S&T laboratories was shifted to the Laboratory Facilities account in FY 2009.

Budget Account	FY 2006 Actual		FY 2007 Actual		FY 2008 Estimate		FY 2009 Estimate	
	Amt	% of Total	Amt	% of Total	Amt	% of Total	Amt	% of Total
Portfolio Office and Specialized Functional Office Accounts								
University Programs*	62	**6%**	49	**7%**	49	**7%**	50	**6%**
Innovation	0	**0%**	38	**5%**	33	**5%**	33	**4%**
Transition	19	**2%**	24	**3%**	25	**4%**	29	**4%**
T&E and Standards	35	**3%**	25	**3%**	29	**4%**	29	**4%**
Laboratory Facilities*	83	**8%**	106	**14%**	104	**15%**	162	**20%**
Homeland Security Inst.	--	**--**	--	**--**	5	**1%**	5	**1%**
Total S&T	1,091	100%	750	100%	692	100%	800	100%

Source: Based on data from AAAS and the President's FY 2008 Budget Request.

Note: Figures may not sum exactly due to rounding.

* The University Programs and Laboratory Facilities accounts correspond to two offices within the Office of Research—University Programs and the Office of National Laboratories, which administers the budget for the construction and operation of laboratory facilities.

S&T R&D Spending[125] by Portfolio

S&T places its R&D activities into four categories—Research, Transition, Innovation, and Other, a catch-all category that includes laboratory operations and construction, testing and evaluation, and standards.

S&T definitions of Research and Transition appear to correspond with OMB and NSF definitions of basic research and development, respectively. The S&T category of Innovation does not correspond to standard federal R&D reporting categories, but describes the projects in its portfolio in terms of their relatively high-risk/high-reward profile.[126] Data on the Innovation portfolio's share of S&T R&D presented in Congressional testimony include Small Business Innovation Research (SBIR) program R&D funding.[127] However, the SBIR program, while located in the Office of Innovation, is not linked programmatically to the Innovation portfolio.

A comparison of FY 2008 and FY 2009 indicates shifts in the shares of the S&T R&D spending accounted for by the Transition, Research, and Innovation portfolios:

[125] Discussion of R&D spending is based on S&T spend plan data, which may not coincide exactly with funding amounts appropriated by Congress for individual budget accounts.

[126] Innovation funding is provided through two programs: High Impact Technology Solutions (HITS) and Homeland Innovative Prototypical Solutions (HIPS). HITS and HIPS are described as funding proof of concept and prototype demonstrations, respectively. See Chapter V for further discussion of these programs.

[127] Under Secretary for DHS S&T testimony before the House Science and Technology Subcommittee on Technology and Innovation, *DHS R&D Budget Priorities for FY 2009*, March 8, 2008.

- Transition decreased from 53 to 48 percent;
- Research increased from 20 to 23 percent; and
- Innovation decreased from 5 to 4 percent.

The increase in Research funding as a share of S&T R&D is in keeping with S&T's goal of moving toward a greater commitment to basic research and exceeds the original target of 20 percent. Funding for Innovation R&D, however, falls short of the target of 10 percent.

Transition Portfolio Spending

Transition projects funded by the six technical divisions account for the vast majority of Transition portfolio spending (91 percent). Office of Transition programs account for 7 percent. The Office of Transition spending includes TechShare projects, which account for between one and two percent of total Transition portfolio spending. The remaining two percent of Transition portfolio spending is split roughly between spending on Special Programs projects and programs, and spending on DHS' Federally Funded R&D Center, the Homeland Security Institute.

Table A-4: Distribution of Transition Portfolio Spending FY 2009

Components of Transition Spending	% of Total
Six Technical Divisions	91
Office of Transition	7
Homeland Security Institute	1
Special Programs Division	1

Source: Based on data from S&T's FY 2009 spend plan.

Transition R&D funding for the six technical S&T divisions is allocated across twelve Integrated Product Teams organized around high priority technology needs that have been identified by S&T in consultation with internal DHS customers and other stakeholders.[128] Each IPT is funded by one division, but four of the six divisions administer more than one IPT.[129]

The allocation of funding to IPTs varies widely, ranging from less than $3 million for Maritime Security, a new IPT created in FY 2008, to over $150 million for Chemical/Biological, which accounts for over 47 percent of total funding for IPTs. (See Table B-5.)

[128] See DHS, S&T, High Priority Technology Needs, June 2008.

[129] The Counter-IED IPT is funded through the Explosives Division, but three divisions – Explosives, Infrastructure Protection, and Human Factors, participate in decision-making regarding the development and funding of projects.

Table A-5: Spending by IPT
FY 2009

Parent Division	Capstone IPT	Amount	% of total IPT $
Borders/Maritime	Border security	11,925,000	**3.7%**
	Cargo Security	13,198,000	**4.1%**
	Maritime security	2,585,000	**0.8%**
Chemical/ Biological	Chemical/ Biological	150,620,959	**47.3%**
Command, Control & Interoperability	Info sharing	20,434,556	**6.4%**
	Interoperability	10,876,575	**3.4%**
	Cyber security	21,701,719	**6.8%**
Explosives	Transportation Security	34,069,360	**10.7%**
	Counter-IED	14,055,820	**4.4%**
Human Factors/Behavioral Sciences	People Screening	6,919,400	**2.2%**
Infrastructure/ Geophysical	Infrastructure Protection	16,098,608	**5.1%**
	Incident management	15,633,939	**4.9%**

Source: Based on data from S&T's FY 2009 spend plan.

Research Portfolio Spending

In FY 2009, most S&T Research spending (over 73 percent) is accounted for by projects funded and managed by the six technical divisions. The remaining 26-27 percent is administered separately by University Programs in the Office of Research. (See Table B-6.) Over three quarters of University Programs funding goes to multi-year awards to university-based Centers of Excellence.

Two technical divisions–Infrastructure and Geophysical and Chemical and Biological—account for 40 percent of total S&T Research spending. Another 19 percent is accounted for by an "internal" research IPT created by S&T in FY 2008 to govern Research programs carried out by three technical divisions in support of the Counter-IED IPT. The funding administered by this internal IPT is allocated to a separate spending account, to which the three divisions contribute. (See Table B-6.) Counter-IED Research spending accounts for over a quarter of Research spending by all six technical divisions.

Research spending as a share of R&D spending varies widely across the six technical divisions, ranging from 2.2 percent (Borders/Maritime) to 52.9 percent (Infrastructure/Geophysical). The large Research share of Infrastructure/Geophysical R&D reflects Congressionally-directed funding for two programs totaling $34.8 million.[130] This funding constitutes 75.7 percent of the division's entire R&D budget.

[130] See section on S&T Research, Development, Acquisition, and Operations in explanatory statement accompanying FY 2009 Continuing Resolution funding for DHS, DOD, and VA.

Table A-6: Research Spending by Component
FY 2009

Component	Amount	Research as % of Div R&D	% of S&T Research
Borders/ Maritime	650,000	2.2%	0.4%
Chemical/ Biological	33,052,760	16.8%	19.1%
Command, Control, & Interoperability	10,441,936	15.7%	6.0%
Counter-IED	32,900,000	100%	19.0%
Explosives	7,917,620	13.8%	4.6%
Human Factors	4,499,690	38.4%	2.6%
Infrastructure/ Geophysical	37,753,287	52.9%	21.8%
Total Research by Six Divisions	127,215,293	N/A	**73.4%**
University Programs	45,997,050	N/A	**26.6%**
Total Research	173,212,343	N/A	100.0%

Source: Based on data from S&T's FY 2009 spend plan.

Distribution of Research and Transition Portfolio Spending by Performer Type

Industry is the largest recipient of Transition spending (43 percent), which would be expected given that industry is the predominant performer of development-oriented work. DOE National Laboratories and Federal performers (mostly federal agency laboratories) both are significant recipients of Transition spending, 20 and 17 percent respectively. Universities are one of the largest recipients of Research spending (31 percent), which is consistent with their role as the predominant performer of basic research. However, it is surprising that industry accounts for an equal share of Research spending (31 percent). Moreover, industry's share of Research spending in FY 2009 is more than double that in FY 2008 (13 percent).[131] The DOE National Laboratories also are a major recipient of Research spending (26 percent). The National Laboratories are the largest performer of Research spending by the six technical divisions (34 percent).[132]

[131] S&T officials say the industry share of FY 2009 Research spending is inaccurate, but have not yet provided revised figures. At the same time, industry's share of Transition spending dropped by 23 percent from 56 percent in FY 2008 to 43 percent in FY 2009.

[132] This share is calculated based on Research spending, excluding University Programs spending, which is devoted to university-based research (primarily Centers of Excellence) and is administratively separate from the technical divisions R&D project budgets.

Table A-7: S&T Research and Transition Spending by Performer Type FY 2009

Performer Type	% of Transition Spending	% of Research Spending
Federal	17	10
FFRDC*	15	1
Industry	43	31
National Laboratory**	20	26
Non-Profit	2	1
University	3	31

Source: Based on share data provided by S&T.

* Federally-funded R&D Center (e.g., DHS' Homeland Security Institute)

**DOE National Laboratories are also FFRDCs, but are accounted for separately by S&T.

APPENDIX B: S&T WORKFORCE

This Appendix provides a summary analysis of the S&T workforce with a focus on S&T headquarters divisions. This analysis includes the composition of the workforce by personnel type and grade structure, in the case of federal employees; staffing of authorized FTE positions and turnover; and distribution of the workforce by division. The workforce analysis is based on data obtained from the S&T personnel database at the end of FY 2008. Figures for the staffing of authorized FTE positions and turnover at S&T are based on March 2009 data provided by S&T's Human Capital Officer. These data show a net change of one federal employee.[133]

COMPOSITION OF THE S&T WORKFORCE

S&T's total workforce numbers 1,087, including employees and contractors[134] in S&T headquarters divisions as well as S&T laboratories. Employees include federal employees of S&T, "DHS Matrix" (other DHS employees working in S&T), Public Health Service Officers, detailees from other federal agencies, IPAs, and "Scholars/Fellows/Interns."[135]

S&T Headquarters

Headquarters (HQ) divisions account for 71 percent of the S&T workforce. Contractors account for the majority of the S&T HQ workforce (56 percent). A breakdown of the HQ workforce is provided in Table A-1.

[133] Due to small size of this change, the Academy team decided that updating the workforce analysis was unwarranted.

[134] The count of contractors excludes all those identified as "FFRDC" (Federally Funded Research and Development Center) and "surge." "FFRDC" indicates contractors employed through the Department's FFRDC, Homeland Security Institute. Approximately 100 Homeland Security Institute contractors are included in the S&T personnel database, but the database does not indicate which of these contractors work in S&T components. "Surge" contractors are not included in the tally of contractors because they do not work at S&T on a regular basis.

[135] Students and professors working at S&T under Interagency Agreements with DOE's Oak Ridge Institute for Science and Education program.

Table B-1: HQ Workforce by Personnel Type

Personnel Type	Number	% of Total HQ Workforce
Contractors	429	56%
SETA* support	277	36.1%
Other contract support	152	19.8%
Employees	338	43%
Federal Employees (of S&T)	226	29.5%
DHS Matrix	69	9.0%
Public Health Service Officers	3	0.4%
Detailees	19	2.5%
IPAs	12	1.6%
Scholar/Fellow/Intern	9	1.2%
HQ Workforce Total	767	100.0%

Source: Based on data from S&T Personnel Database
* Systems Engineering and Technical Assistance

Over 13 percent of federal employees at S&T headquarters are designated as either Senior Executive Service (SES) (5.8 percent) or Senior Technical (ST) personnel (7.5 percent). The Director and Deputy Director of Innovation and the federal employee program managers that report to them were hired under 1101 authority, the authority under which DARPA hires its program managers. These federal employees have pay plans designated Administratively Determined (AD). They account for over 5 percent of S&T headquarters federal employees.

Table B-2: HQ Federal Employees by Pay Plan

Pay Plan Type	Number	% of Total HQ Federal Employees
Executive Service (SES)	13	5.8%
Senior Technical (ST)	17	7.5%
Administratively Determined (AD)	12	5.3%
General Schedule (GS)	181	80.1%
Other*	3	1.3%
All Federal Employees	226	100.0%

Source: Based on data from S&T Personnel Database
*"Other" includes employees with pay plans designated SL, WG, and N/A.

Eighty-two percent of S&T headquarters federal employees on the General Schedule are either GS-14 or GS-15. Of these, 79 percent are GS-15s.

ON-BOARD STAFFING RATIO AND TURNOVER RATE FOR FEDERAL EMPLOYEES AT S&T (Headquarters and Labs)

In a June 2007 report, the GAO found that S&T was inadequately staffed—35 percent of total authorized FTE positions (383) were vacant. S&T has made progress in addressing this staffing shortfall. Over 90 percent of its authorized FTE positions were filled as of March 2009.

Turnover rates among federal employees at S&T were relatively high around the time of the S&T headquarters reorganization, 11 percent in FY 2006 and 13 percent in FY 2007. Turnover declined to 7.9 percent in FY 2008 and stands at just 2.9 percent as of March 2009.

DISTRIBUTION OF S&T HEADQUARTERS WORKFORCE BY DIVISION

This section presents the distribution of S&T headquarters workforce among the twenty divisions identified in the S&T personnel database. These include the Office of the Under Secretary and the divisions identified in the official S&T organization chart as direct reports to the Under Secretary. Workforce data for each division is summarized in three categories: (1) Contractors (includes both SETA support and other contract support); (2) Federal Employees (federal employees of S&T only); and (3) Other Employees (includes all categories of employees except for federal employees of S&T). See Table A-1 for a full breakdown of contractor and employee categories.

The twenty S&T divisions are presented below in three groups: (1) The Office of the Undersecretary and management support offices (Table A-3); (2) portfolio and specialized functional offices related directly to S&Ts' support for R&D (Table A-4); and (3) the six technical divisions (Table B-5).

Table B-3: Under Secretary and Management Support Offices

Personnel Type	Division				
	Under Secretary	Strategy, Policy, Budget	Corporate Communications	Associate General Counsel	Business Operations
Contractors	3	49	9	14	90
Federal Employees	5	29	8	0	20
Other Employees	0	29	2	6	26
Total	8	107	19	20	136

Source: Based on data from S&T Personnel Database

Table B-4: Portfolio and Specialized Functional Offices

Personnel Type	Division						
	Research	Transition	Innovation	T&E/ Standards	Special Programs	Inter-Agency Programs	International Programs
Contractors	17	38	8	6	3	2	2
Federal Employees	19	9	17	8	3	6	10
Other Employees	11	0	1	3	5	3	1
Total	47	47	26	17	11	11	13

Source: Based on data from S&T Personnel Database

Table B-5: Six Technical Divisions

Personnel Type	Division					
	Borders/ Maritime	Chemical/ Biological	Command, Control, and Interoperability	Explosives	Infrastructure/ Geophysical	Human Factors
Contractors	12	50	47	45	14	5
Federal Employees	12	24	20	11	8	14
Other Employees	7	8	5	5	2	0
Total	35	82	73	61	24	19

Source: Based on data from S&T Personnel Database

APPENDIX C: INTEGRATED PRODUCT TEAM EXAMPLES

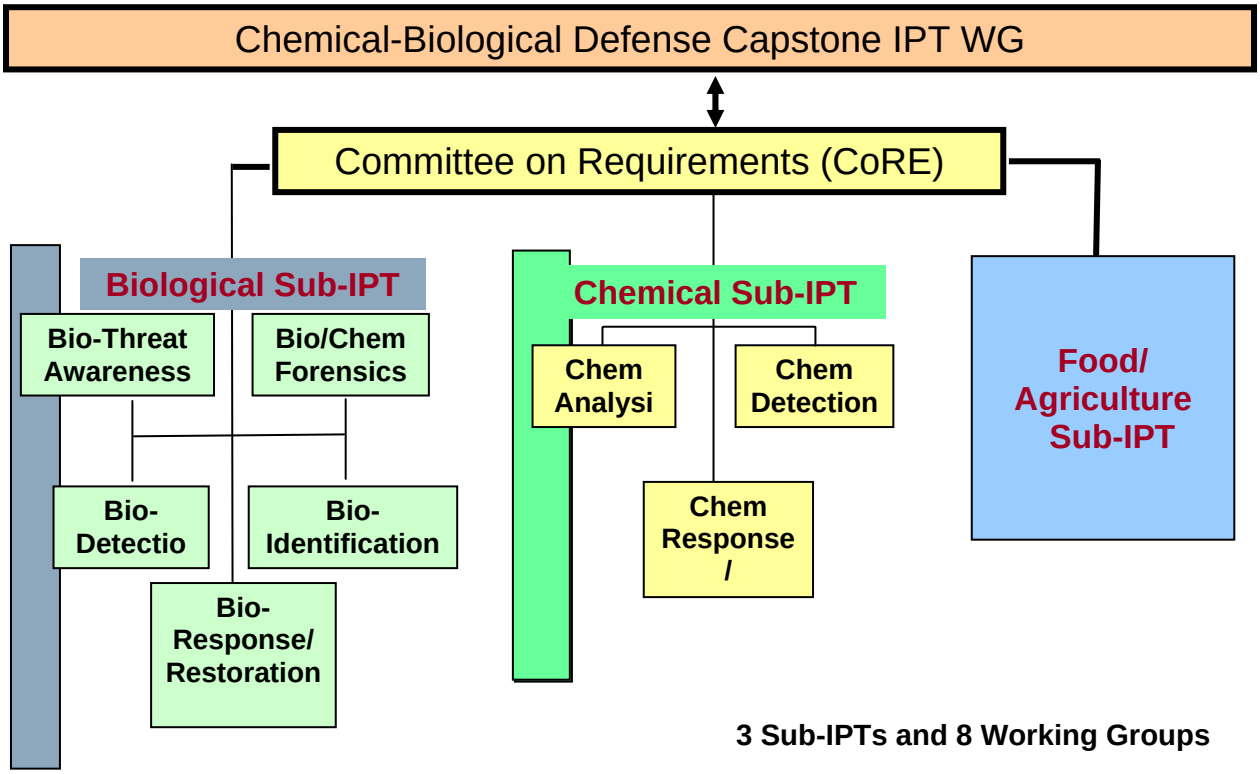
In the generic IPT model (described in detail in Chapter V), the Capstone IPTs collect and prioritize capability gaps, S&T develops an R&D plan, and the Capstone decides which projects will move forward based on cost and other factors. Most of the IPTs have a structure and process that differ to varying degrees from the generic model. Below are two examples of how IPTs have been adapted to meet the needs of customers.

EXAMPLE 1: STRUCTURE AND PROCESS OF THE CHEMICAL/BIOLOGICAL DEFENSE IPT

The Chemical/Biological Division is the S&T lead for the Chem/Bio IPT, while the Office of Infrastructure Protection and the Office of Health Affairs are the customer leads. The IPT has added layers to the standard structure, including a Committee on Requirements (CoRE) between the Sub-IPTs and the Capstone IPT, and Working Groups under the Sub-IPTs.[136] (See Figure D-1.)

[136] As of March, 2009, the Chem/Bio Division was considering disbanding the Sub-IPTs due to lack of customer participation.

Figure C-1: The Chemical and Biological Division IPT Structure



Source: DHS S&T

Members of the CoRE are a subset of the Sub-IPT membership; Sub-IPT members are drawn from the Working Group members.

The Chem/Bio IPT process for identifying, refining, and prioritizing capability gaps requires approximately six months. The following is a rough description of the process:

- A kick-off Capstone IPT meeting.
- Components submit capability gaps to the CoRE.
- The CoRE submits capability gaps to the appropriate Working Group for review, edit, and refinement.
- The Working Group submits edits to capability gaps and a Summary Chart to the Bio/Chem transition manager, which are then reviewed by the CoRE with input from the Working Groups.
- Working Groups prioritize capability gaps.
- The capability gaps are consolidated by the Bio/Chem transition manager.

- The consolidated capability gaps are submitted to the Sub-IPTs.
- The Sub-IPTs prioritize all of the capability gaps submitted by the Working Groups.
- The prioritized capability gaps are submitted to the Capstone IPT.

The CoRE meets once a month, but members are in regular contact with each other via phone and e-mail. The purposes of the CoRE are to: monitor and support the development and signing of TTAs; provide guidance to the Capstone on the development, validation, and prioritization of capability gaps; serve as a conduit for information to and from the Capstone IPT and Working Group meetings; ensure that customers/components are engaged in the IPT process; and define working relationships and clarify procedures (for example, the transition manager worked with the CoRE to finalize a process for prioritizing capability gaps).

The Working Groups have 20-25 members, including agencies outside of DHS (e.g., US Department of Agriculture and the Federal Bureau of Investigation), and have primary responsibility for collecting information on capability gaps. The Office of Health Affairs and the Office of Infrastructure Protection receive capability gaps from many sources, including the National Infrastructure Protection Plan process (see Example 2, below). The Office of Health Affairs may also collect gaps from state and local health departments or work with the Centers for Disease Control and Prevention to identify gaps. A broad range of agencies, both within and external to DHS, submit capability gaps.[137] The Chem/Bio transition manager estimates that the number of organizations providing gaps to the Chem/Bio IPT through IPT participants could easily be 100. Approximately 85 capability gaps were submitted during the FY 2008 Chem/Bio IPT round.

Working Groups also are responsible for the initial review and validation of capability gaps, with a particular focus on whether:

- the gap is in Chem/Bio's mission;
- the capability gap template is filled in completely and is easily understood;
- it is a "need" or a "want";
- the solution has been prematurely specified; and
- it is in conformance with HSPD requirements.

Gaps judged suitable for consideration as an S&T project, but outside Chem/Bio's mission, are referred to other IPTs.

The capability gaps that are validated as a result of the initial Working Group review process are prioritized based on the following criteria: operational impact; threat assessment; level of complexity; criticality of need; and probability of success. To support Working Groups in prioritizing capability gaps, the Chem/Bio transition manager provides them with a Capability

[137] Chem/Bio also receives capability gaps from both TechSolutions and the IAD. These are assigned to program managers who determine whether or not research relating to the gap is already being conducted. If not, and if the gap does not meet the TechSolutions criteria, it may be included in the Chem/Bio IPT capability gap process.

Gap Prioritization Process template that includes instructions to the Working Group chairs on the prioritization process, a scoring/weighting sheet, and a ballot for reviewers to assess the capability gaps based on the criteria listed above. In response to concerns by customers that some voices were not being heard, Chem/Bio instituted a policy that each agency gets an equal vote. The ballots are available electronically, so they can easily be submitted even if a member cannot attend a meeting.

The process is all but complete by the time the Capstone IPT meets; capability gaps are vetted, discussed, and confirmed before they are submitted to the Capstone. Final decisions are made by the Capstone IPT, which can overrule priorities set by the Working Groups and Sub-IPTs.

EXAMPLE 2: INFRASTRUCTURE PROTECTION PRIORITIZATION PROCESS

The Office of Infrastructure Protection is the customer lead for the Infrastructure Protection IPT, and the Infrastructure and Geophysical Division is the S&T lead. The Office of Infrastructure Protection's requirements are driven by Homeland Security Presidential Directive 7, *Critical Infrastructure Identification, Prioritization, and Protection*. This Directive requires the development of a National Infrastructure Protection Plan that addresses the 18 sectors that the federal government has designated as critical infrastructure. Under the Plan, the Office of Infrastructure Protection is responsible for leading six of the sectors (emergency services, chemical, commercial facilities, dams, nuclear, and critical manufacturing) and S&T is responsible for the Critical Infrastructure Protection R&D Plan. As part of the R&D Plan's development, S&T and the Office of Infrastructure Protection created a matrix populated with data concerning research that has been done and progress that has been made across the 24 agencies and 18 sectors in nine theme areas. This effort made it possible to identify research gaps.

As a result of Homeland Security Presidential Directive 7, the process for identifying priorities for the Infrastructure Protection IPT is very formalized. The critical infrastructure sectors are required by Congress to publish Sector Specific Plans and Sector Annual Reports. As part of the process for developing the Reports and Plans, the Office of Infrastructure Protection and S&T help the sectors identify and articulate their capability gaps. The Office of Infrastructure Protection then reviews and prioritizes the gaps using a variety of criteria, including risk assessment. The Homeland Infrastructure and Threat and Risk Analysis Center conducts annual risk assessments for all sectors. The Office of Infrastructure Protection and S&T align the prioritized capability gaps with the IPT process and S&T submits the gaps to the appropriate IPT. By having S&T involved from the beginning of the process, sectors now have a better understanding of what a capability gap is and S&T can cull inappropriate gaps (e.g., acquisitions gaps v. technology gaps) from the list earlier in the process. As a result, the number of capability gaps submitted by the sectors has dropped by about two-thirds, but the quality has improved significantly.

For all the IPTs that the Office of Infrastructure Protection leads or co-leads, a similar method is used to prioritize all of the capability gaps submitted by IPT members within each IPT. S&T

adds several criteria, including whether: S&T is able to perform the work; the technology is already available; and any other organization is already working on it.

The Infrastructure and Geophysical Division and the Office of Infrastructure Protection work closely enough together that the Infrastructure and Geophysical Division is not required to evaluate the requirements identified through the IPT very closely. The Office of Infrastructure Protection recognizes that many gaps do not require technology solutions and will cull those from the list. If there are gaps that do not belong in an IPT, S&T provides advice on what to do with them. For example, it may be an acquisition issue or fall within DOD's mission areas. If the requirement deserves basic research, S&T may refer the project to a Center of Excellence or National Laboratory. These back-and-forth discussions regarding the requirements take place in the Capstone IPT or in face-to-face meetings that include S&T, the Office of Infrastructure Protection, and sector representatives.

This Page Left Intentionally Blank.

APPENDIX D: LOGIC MODELS

Chapters V and VI of this report discusses the value of using logic models to identify IPT customers. Each IPT may have different sets of customers depending on the nature of the effort. A logic modeling exercise can ensure that the customer base is appropriately identified in each case, so that meaningful input can be obtained from the most relevant customers, work can be focused on meeting customer needs, and the impact on customer's ability to perform their tasks can be measured.

In fact, logic models can serve a broader purpose in ensuring that work is focused on the goals of the organization, that all involved have a clear understanding of how the program is supposed to or does operate, and that the program can be explained to all interested parties. This can include S&T staff, DHS staff from component agencies, state, local and tribal governments, first responders, Congress, and other federal agencies.

A logic model is simply a structured way of describing the work of an organization.[138] It sequentially maps the program with the intention of ensuring that the logic of the program will be clear. Programs are broken into five model component categories. These components are shown below with S&T-relevant examples of their potential content.

Inputs → Activities → Outputs → Outcomes → Impacts

- Inputs (Resources)
  S&T staff, appropriated funds, equipment, facilities, etc.
- Activities (What the Program Does)
  determine research priorities, fund and monitor research, promote research by others, etc.
- Outputs (Products or Services)
  technologies, models, risk assessments, etc.
- Outcomes (Immediate Benefits)
  adoption of outputs by customers, etc.
- Impacts (Changes or Long-Term Outcomes)
  Improvements in preventing terrorism and/or natural disasters, and improving recovery efforts, etc.

Logic models are useful for both planning programs and evaluating them. For planning, the starting point is to determine the desired impact (starting at the far right of the model and working towards the left), and work backward through the model to identify the outcomes, outputs, activities, and inputs will be needed achieve the impact. It is this planning application

[138] For additional information concerning logic models see "Using Logic Models to Bring Together Planning, Evaluation, and Action: Logic Model Development Guide," W.K. Kellogg Foundation, January 2004. This guide is available at www.wkkf.org. See also Bozeman, B. (2007) "Public Values and Public Interest: Counter-balancing Economic Individualism. Washington, D.C.: Georgetown University Press, and Bozeman, B. "Public Value Mapping of Science Outcomes: Theory and Method." In D. Sarewitz, et. al. "Knowledge Flows and Knowledge Collectives: Understanding the Role of Science and Technology Policies in Development." 2(1).

that can be used by S&T to ensure that appropriate customers are identified for each IPT.[139] Starting with impact, it would be difficult or impossible to consider impact without considering the customer. Whose hands does the technology have to be in to have an impact on homeland security? For example, if the technology is intended to ensure that weapons of mass destruction are detected if hidden in a cargo container, then the technology would have to be in the hands of Customs and Border Protection personnel at foreign or domestic ports. If the intended impact of the technology is to ensure that individuals with mal-intent are prevented from taking action, then the technology may need to be in the hands of Customs and Border Protection and also federal, state and local law enforcement personnel. When desired impacts have been identified, the process requires working back to outcomes, outputs, activities, and finally inputs that would be needed to achieve the impact.

These two examples are simplified versions of the process of identifying the customer in relation to the intended impact. They also show that different IPTs may have different intended customers, and thus would benefit from different sets of customers in considering capability gaps and setting priorities.

In addition to the benefit of customizing the consideration of customers, the development of a logic model can ensure that the processes planned to achieve results is logical. That is, that inputs, activities, outputs, etc. are reasonable for achieving results. The process of building a logic model ensures that all involved fully understand the reasoning behind the organization of work, that all have had the opportunity to propose and consider alternatives, and that there is agreement on goals.

[139] To use the logic model for evaluation purposes, the process generally starts with inputs, on the left side of the model, and proceeds to the right to assess, among other things, whether the program is organized to work in a way that is likely to produce desired outcomes, what outcomes are likely to be produced, and what measures are appropriate to measure outcomes.

APPENDIX E: PARTICIPATION IN INTERAGENCY COORDINATION ENTITIES BY SELECTED S&T COMPONENTS

This table provides a snapshot of participation by S&T components in formal interagency coordination entities. It is based on information provided by S&T in August 2008, with the exception of information on the Human Factors Division provided in comments by S&T on a previous version of this table in the Academy's interim report.

S&T Participation by Division/Office
Chemical/Biological Division
Federal
BioShield Biological Working Group
BioShield Enterprise Executive Committee
BioShield Executive Governance Board
Chemical Security Analysis Center Interagency Steering Committee
Diagnostics Working Group
Environmental Anthratics Validated Sampling Plan Technology Working Group
Environmental Chemical Laboratory Response Technical Working Group
First Responder-Anthrax Vaccine Policy Group
Integrated Consortium of Laboratory Networks
Joint Biological Point Detection System Working Group
Joint Science and Technology Office Proposal Review Panel
Non-Proliferation Arms Control Technical Working Group
Response and Restoration Sub Policy Coordination Committee
Other
Laboratory Response Network-American Public Health Laboratories Advisory Group
Command, Control & Interoperability Division
Federal
Comprehensive National Cyber Initiative Senior Steering Group
Communications and Outreach Committee
Cyber Security and Information Assurance Working Group
Cyber Security Principal Investigators
Cyber Security Quarterly Agency Review
Domain Name System Security Working Group
Emergency Communications Preparedness Center Clearinghouse Working Group
Emergency Response Council
Health Information Technology Standards Panel Technical Committee
Information Security Research Council
Interagency Board for Equipment Standardization and Interoperability
Policy and Plans Steering Group
Project 25 Compliance Assessment Governing Board
Secure Protocols Working Group
Spectrum Working Group
Technical Support Working Group (project coordination)
Technology Policy Council
Wireless Working Group

State and Local
All Hazards Consortium
Practitioner Steering Group
Human Factors/Behavioral Sciences Division
NSTC Subcommittee on Biometrics and Identity Management (Co-chair)
NSTC Subcommittee on Human Factors (Co-chair)
DOD Human Factors Engineering Technical Advisory Group (Executive Board)
NSTC Subcommittee on Domestic Improvised Explosive Devices
Strategic Multilayer Assessment Group, Joint Integration and Preparation of the Operational Environment
Socio-cultural and Behavioral Science Research Group
Radicalization and Violent Extremism Working Group
Biometrics and Identity Management Working Group
Inter-Agency and First Responder Programs Division (IAD)
Federal
Army Counter-IED Task Force
Capabilities Development Working Group
Capabilities Development Working Group Senior Steering Committee
Transportation Sector R&D Working Group
State and Local
FEMA Region I Regional Advisory Committee
FEMA Region I Regional Interagency Steering Committee
FEMA Region II Managers' Meeting
FEMA Region II Regional Advisory Committee
FEMA Region II Regional Interagency Steering Committee
FEMA Region III Regional Advisory Committee
FEMA Region III Regional Interagency Steering Committee
FEMA Region IV Regional Interagency Steering Committee
FEMA Region V Regional Advisory Committee
FEMA Region V Regional Interagency Steering Committee
FEMA Region VI Regional Interagency Steering Committee
FEMA Region VII Radiological Assistance Meeting
FEMA Region VII Regional Interagency Steering Committee
New Jersey Center for Public Health Preparedness Advisory Council
New Jersey Regional Homeland Security Technology Committee
Urban Area Security Initiative Working Group (New York City metropolitan area)
Urban Area Security Initiative Working Group (Northern New Jersey)
Other
Adjutants General Association of the United States Homeland Security Committee
National Guard Association

APPENDIX F: FINANCIAL MONITORING WITHIN THE DEPARTMENT OF HOMELAND SECURITY'S SCIENCE AND TECHNOLOGY DIRECTORATE

Financial monitoring assists in planning, maintaining efficiencies, and fulfilling project requirements. In order to properly plan for upcoming years, financial monitoring helps S&T management track the status of obligated funds. As projects are executed, it helps managers reestablish priorities and redirect available funds. Moreover, financial monitoring helps ensure that transactions are properly made, not double-counted, and that the right level of decision-making is used to execute them. Finally, because S&T funds can be carried over to subsequent years, strict financial monitoring helps S&T with the performers' tendency to lag in spending when executing S&T funding if they also have funding from additional sources.

Prior to Under Secretary Cohen joining S&T, there were congressional complaints about lack of fiscal accountability. Currently, there are no such criticisms. In fact, the 2008 Senate Appropriations Report expressed the Senate's pleasure with the rapid progress S&T appears to be making in resolving past deficiencies.

S&T has established a multi-tier system of financial monitoring which is coordinated through the Chief Financial Officer (CFO): Weekly Status of Funds Reports and weekly Execution Reports; Quarterly Resources Reports (QRR); and division Spend Plans. Divisions themselves have also developed internal informal weekly and monthly execution tracking mechanisms.

The *Execution Report* of actual expenditures is provided to all of the divisions so that they can track finances themselves. The Report provides data by division and goes down to the project level, including how projects are executing their budgets, commitments, obligations, expenditures, and balance.

The *Status of Funds Report* demonstrates the current status of S&T in executing its appropriated funds. It shows the commitments, obligations, and expenditures against the Spend Plan to ensure that spending is on schedule. It is distributed to all fund holders, helping everyone track the funds and informing them if there are problems with executing the funds, such as a lag in contract awards, or invoices paid. Lags between commitments and obligations, and even worse, between obligations and expenditures, often occur.

The *Spend Plan* is a planning and execution tool for the divisions, CFO, and the Acquisitions Office to track progression of division spending and procurement for the upcoming year. The Spend Plan is developed before an appropriation is received in order to plan procurements through the fiscal year. However, after an acquisition is received, procurement requests are tracked against the Spend Plan. Along with the Status of Funds reports, Spend Plans inform the S&T staff when it is not on target for committing and obligating funds.

The *Quarterly Resources Report* is an internal review to check the status of spending toward the identified project milestones. The CFO tries to match the milestones against the funding execution to ensure that everyone is satisfied with the progress towards the goal for each project.

The QRR is reviewed by the CFO with the division directors who provide explanations and justifications if milestones were not met as scheduled. CFO is currently reviewing the QRR process to focus on the project progression and potentially identify any funding changes that need to be taken if projects are changed or eliminated. To do so, the CFO needs to analyze the specifics in the contracts—deliverables, invoices, and matching execution against initial spend plans. Then, if the CFO detects an "anomaly," it can meet with the respective division to clarify the situation.

S&T undergoes an annual internal controls review and a financial audit directed by the DHS CFO. The former is a self-assessed review of S&T's internal controls over financial reporting. The results are summarized in an assurance statement to the DHS Secretary from the S&T Under Secretary. The annual financial statement audit includes an audit of the internal controls over financial reporting. The 2008 audit is currently active and the audit findings are due November 15, 2008. (We have requested the 08 findings and will add these results when they are received.)

APPENDIX G: FEDERAL AGENCY HOMELAND SECURITY R&D SPENDING FY 2004 – FY 2008

The American Association for the Advancement of Science (AAAS) has categorized and tracked homeland security-related R&D spending for 10 federal agency R&D funders (including DHS) since FY 2004. These data are used to compare homeland security (HS) R&D spending with non-homeland security (non-HS) R&D spending over time for each the nine agencies other than DHS.[140] This appendix presents graphs for each of these agencies during the time period FY 2004 – FY 2008.[141]

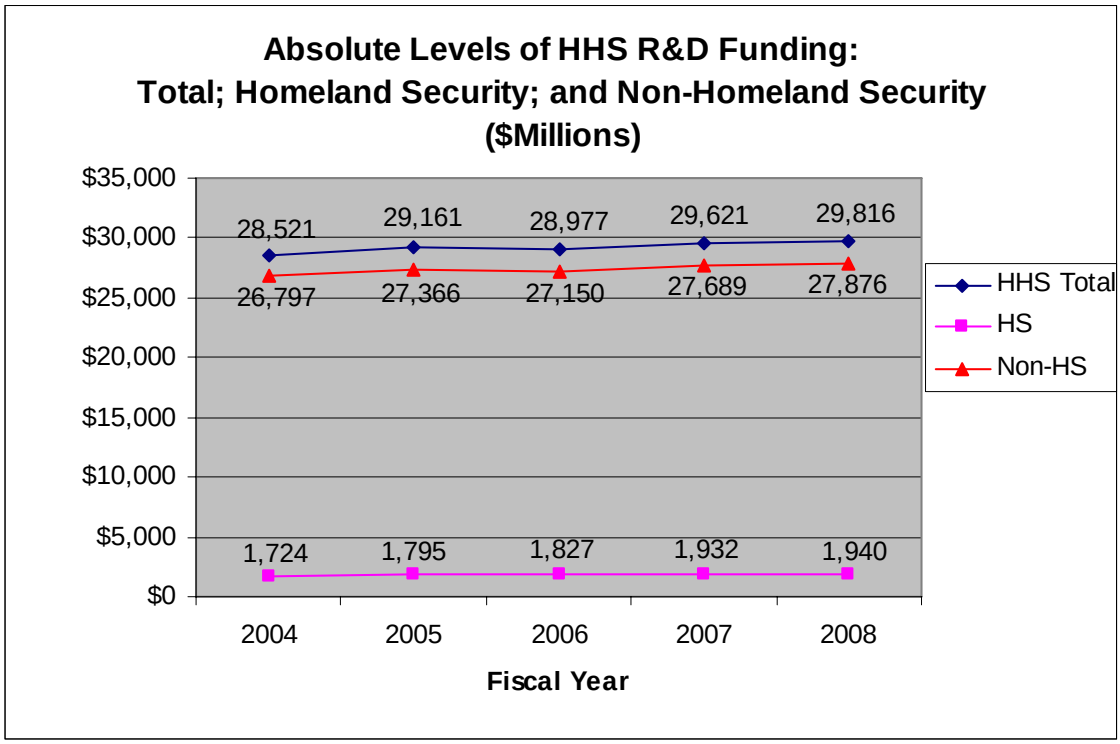
For each of the nine agencies, two graphs are presented. The first shows absolute amounts of funding for homeland security and non-homeland security related R&D along with total agency R&D funding. The second shows funding for homeland security-related and non-homeland security-related R&D as percentages of total agency R&D funding. The order in which agency R&D funding data is presented follows the ranking of these agencies by total funding of homeland security-related R&D in FY 2008. This ranking is presented in Table G-1 below.

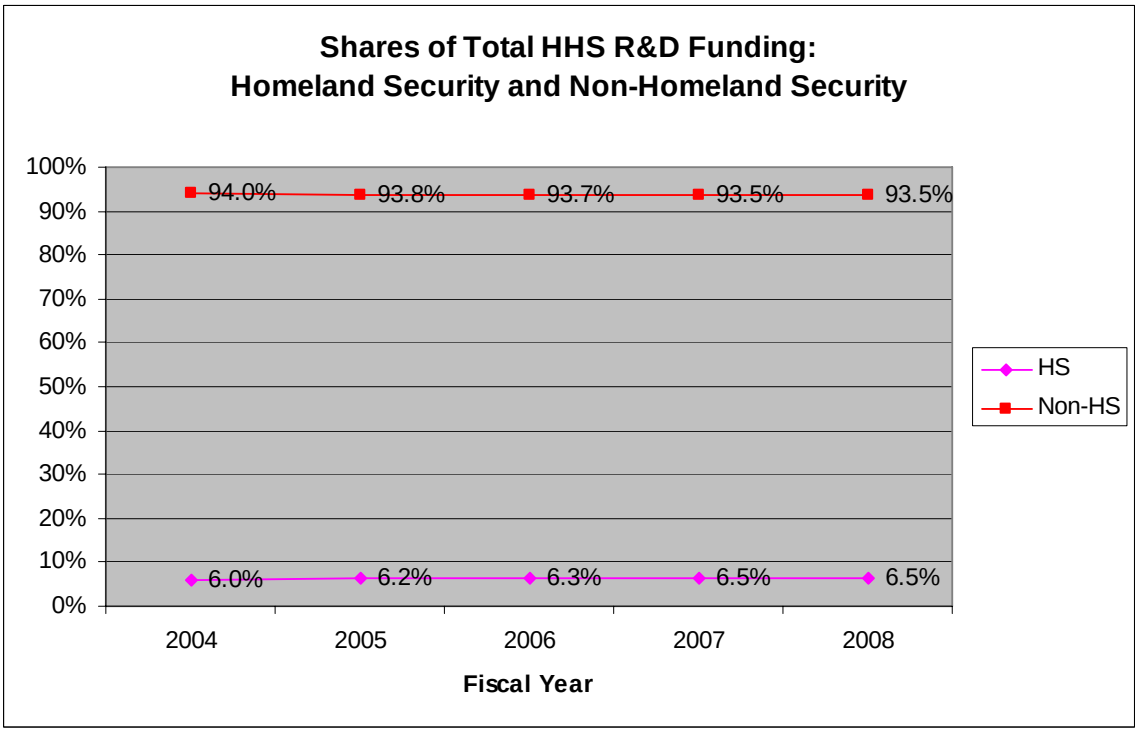
Table G-1
Top Ten Agency Funders
of Homeland Security-Related R&D
FY 2008

Rank ($Amt of HS-related R&D)	**Agency**	**HS-related R&D Funding** ($Millions)
1	Dept of Health & Human Services	1,940
2	Dept of Defense	1,294
3	Dept of Homeland Security	992
4	National Science Foundation	356
5	Nat'l Aeronautics & Space Adm.	102
6	Dept of Energy	70
7	Dept of Commerce	65
8	Environmental Protection Agency	54
9	Dept of Agriculture	51
10	Dept of Transportation	2

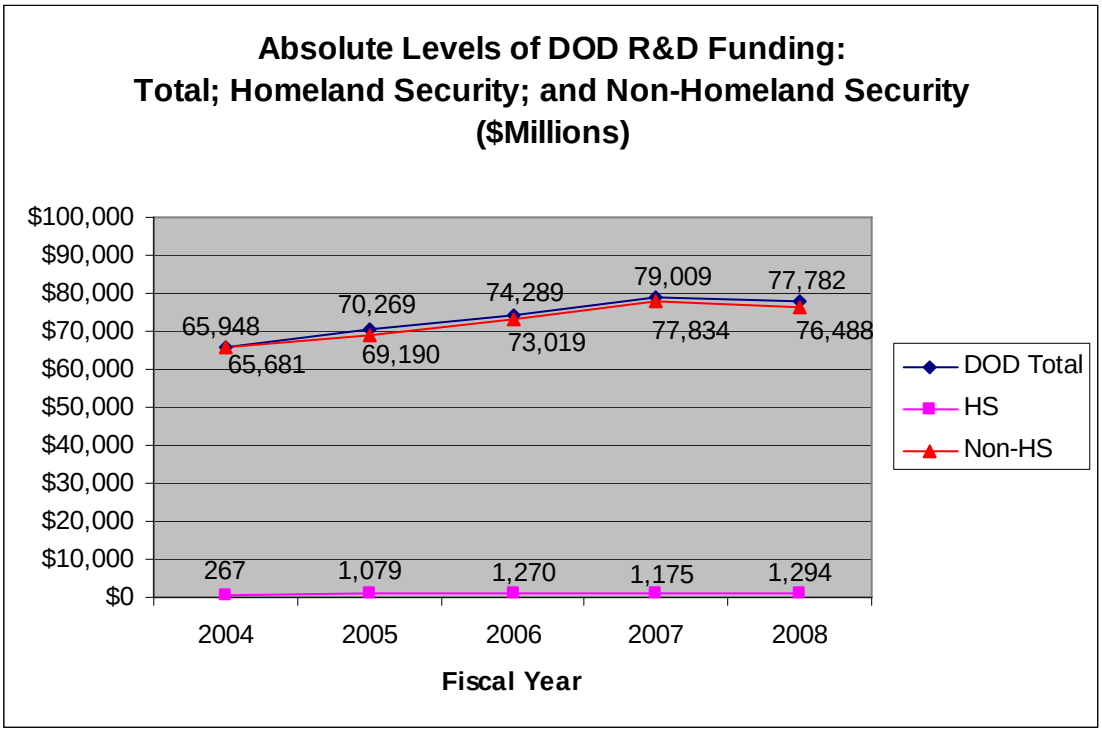
[140] AAAS categorizes all DHS R&D as homeland security.
[141] FY 2008 is the most recent year for which AAAS has categorized the homeland security portion of agency R&D spending. Agency R&D spending figures for FY 2008 are estimates.

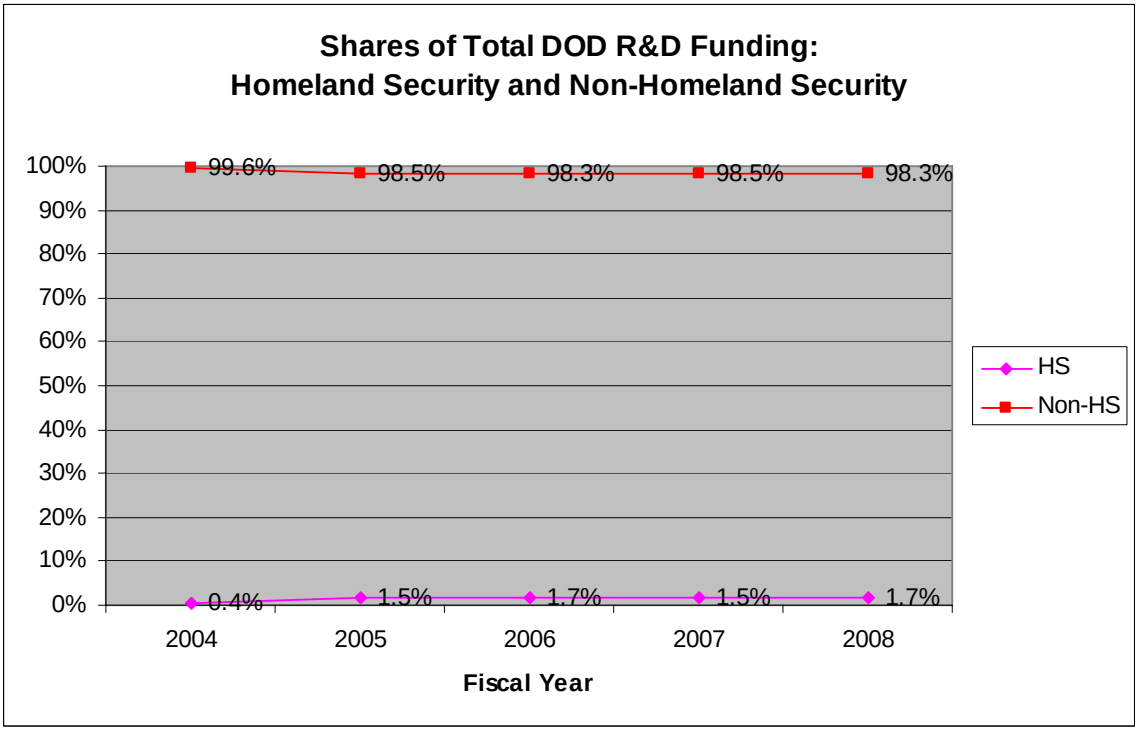
DEPARTMENT OF HEALTH AND HUMAN SERVICES (HHS)





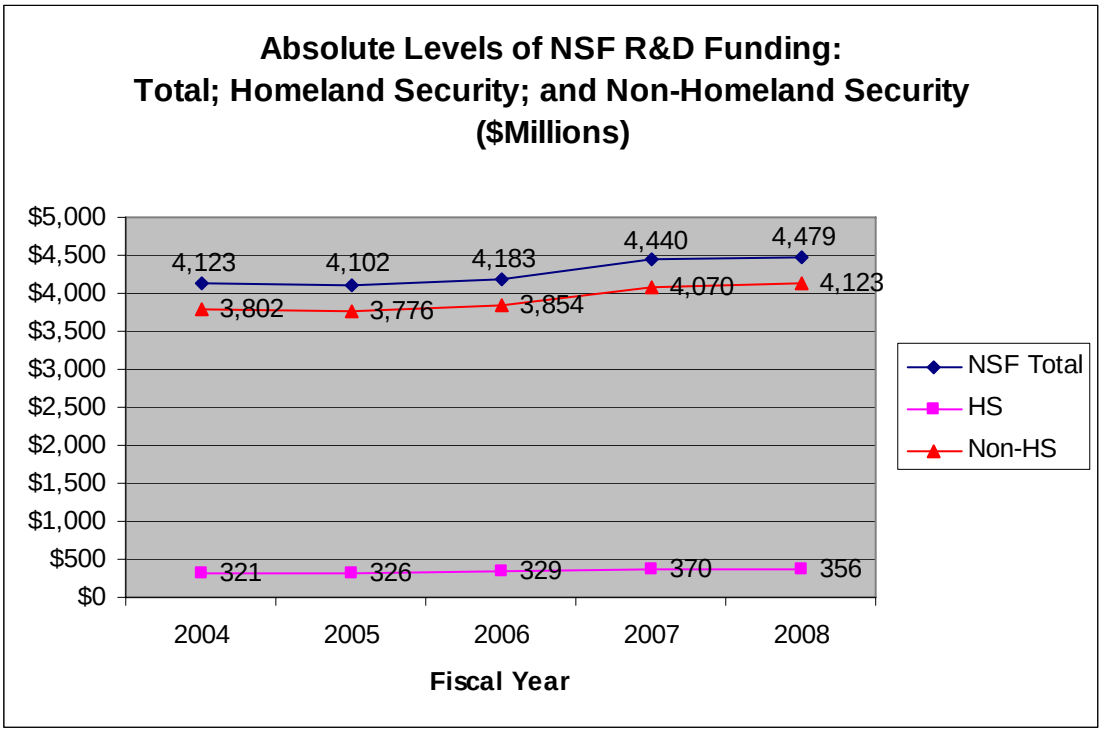
DEPARTMENT OF DEFENSE (DOD)[142]

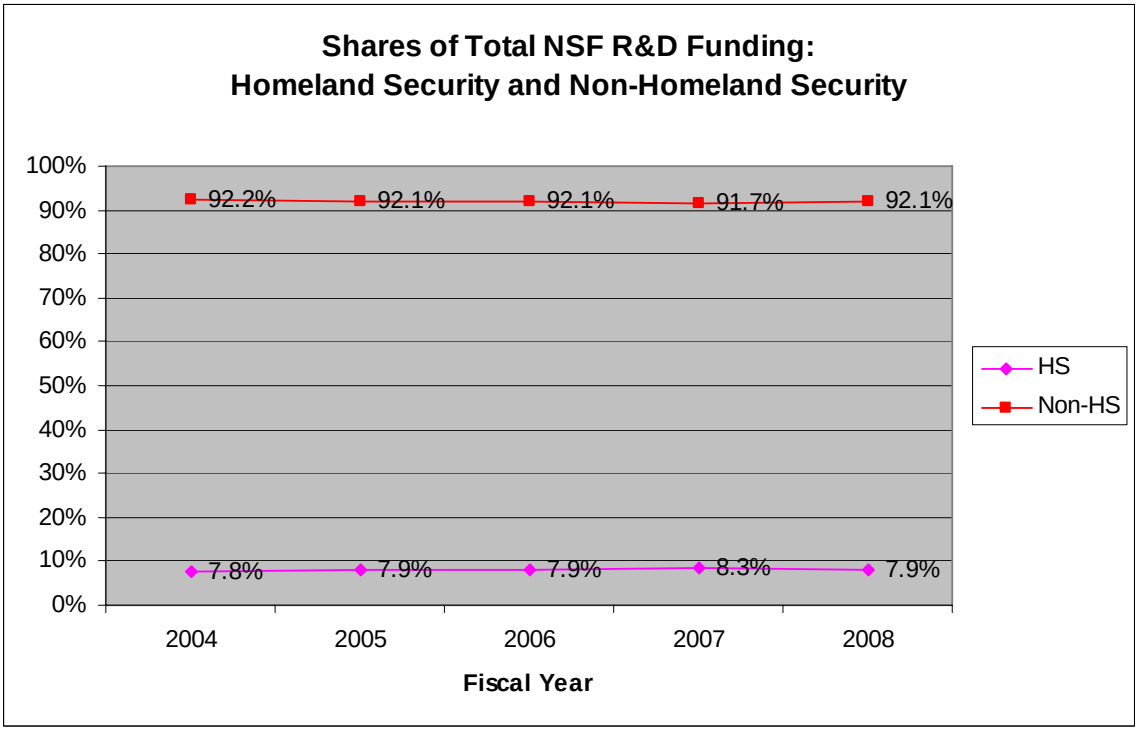




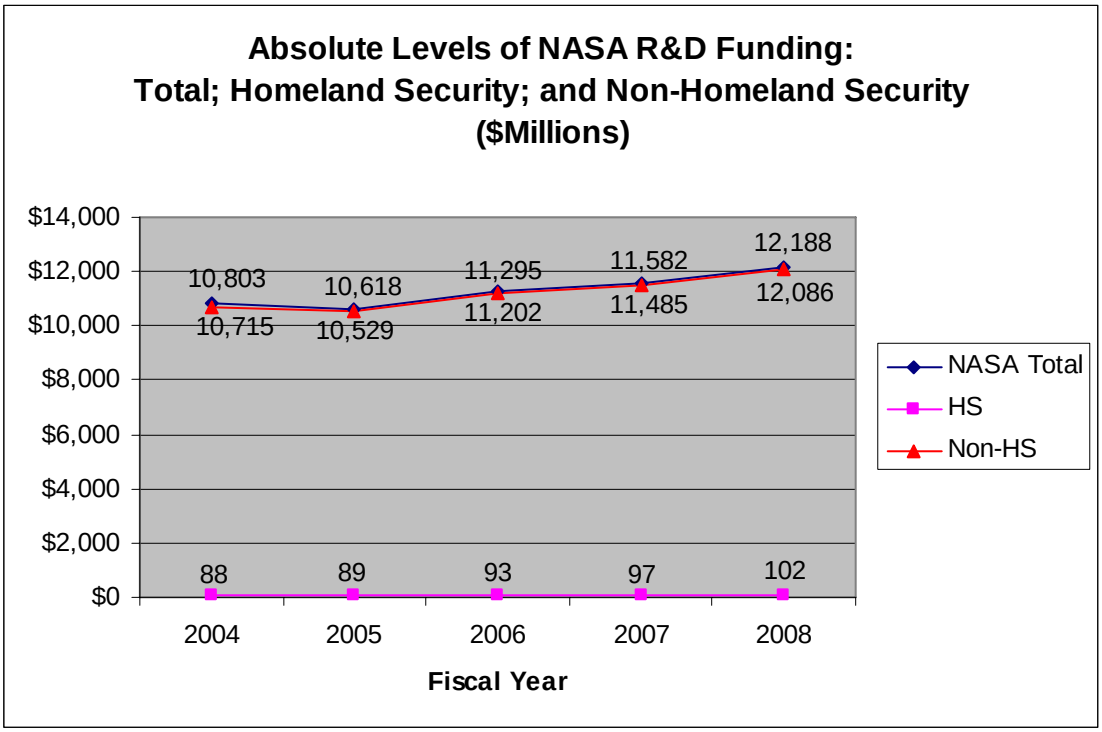
[142] DOD expanded its reporting of homeland security spending beginning in FY 2005.

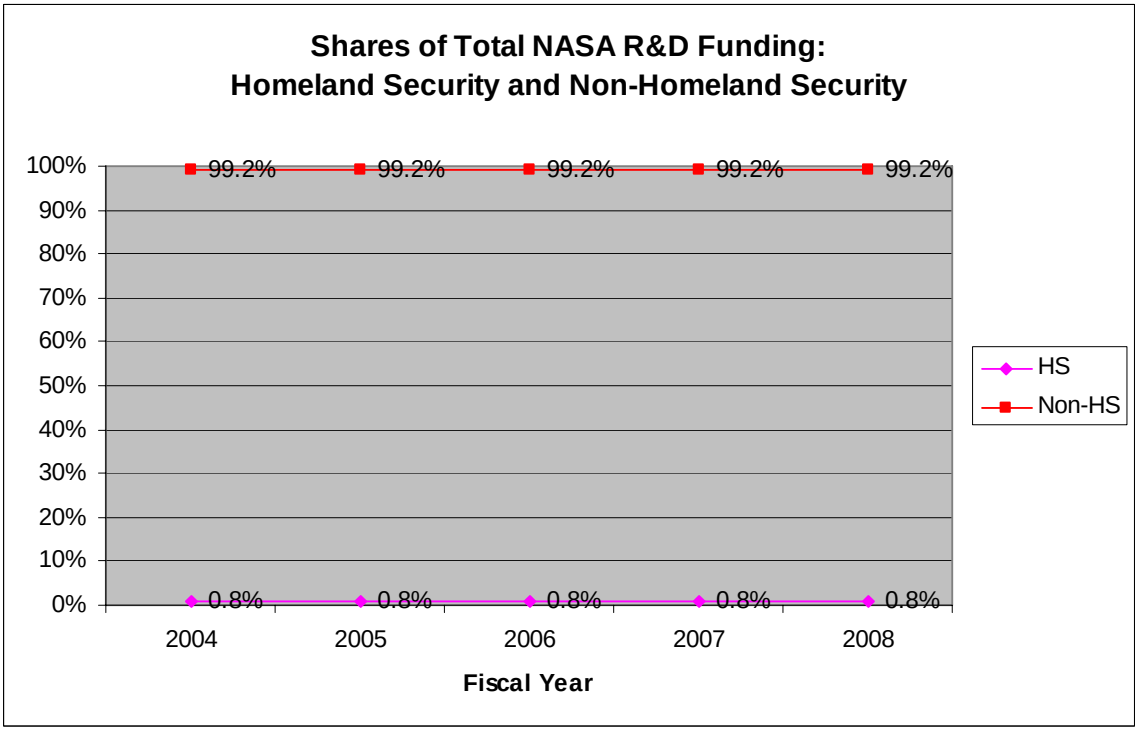
NATIONAL SCIENCE FOUNDATION (NSF)



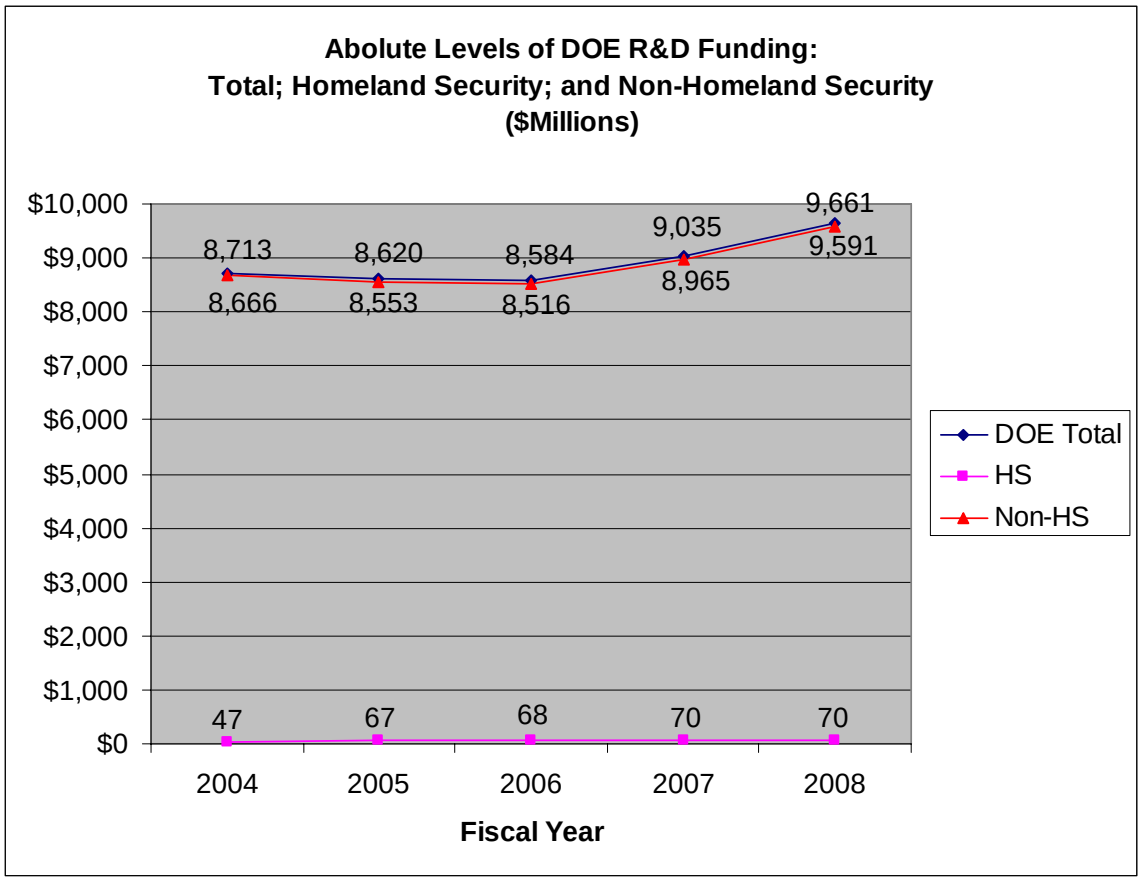


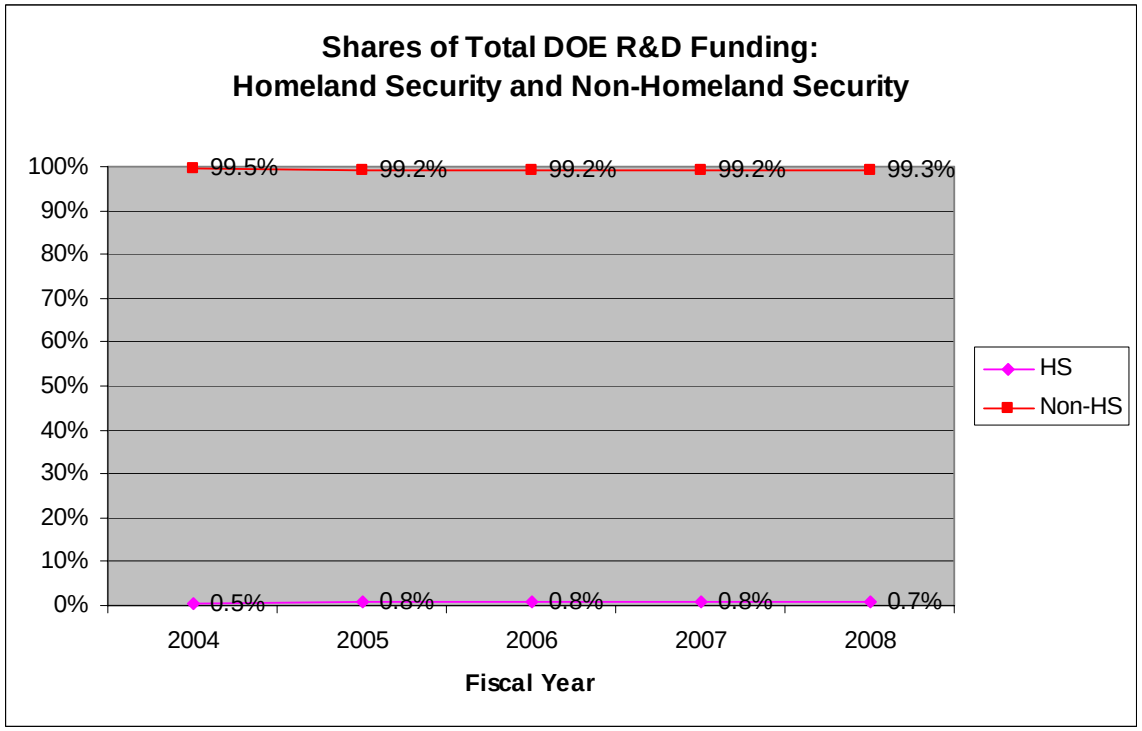
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)



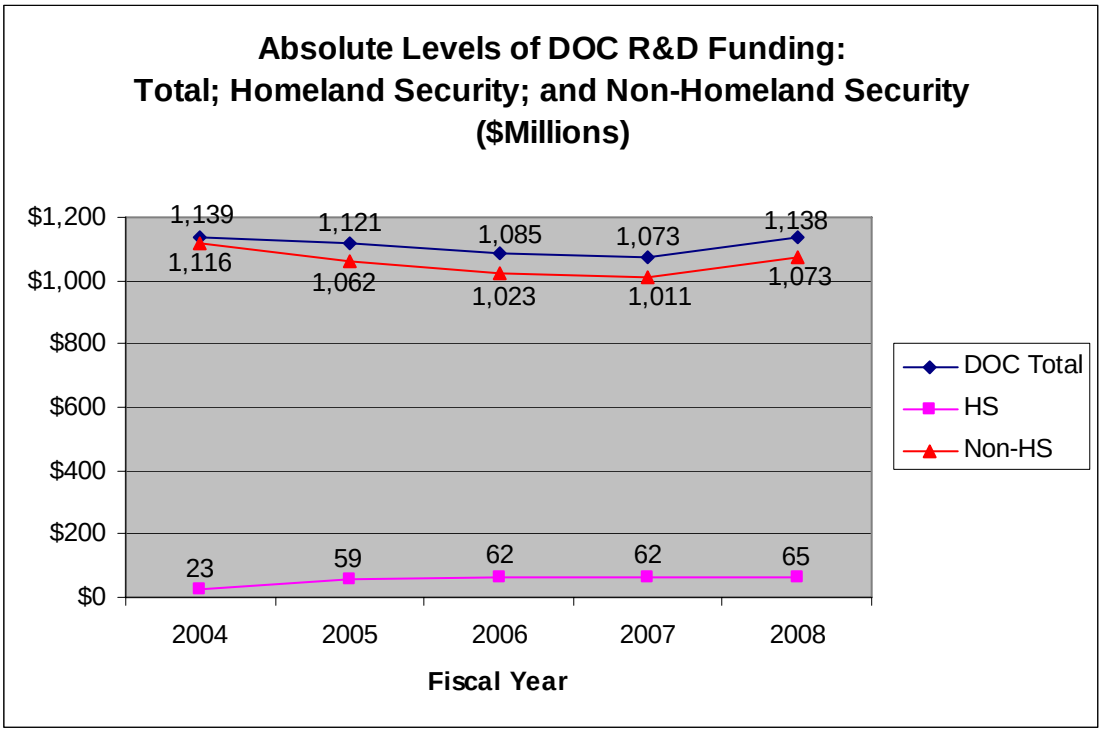


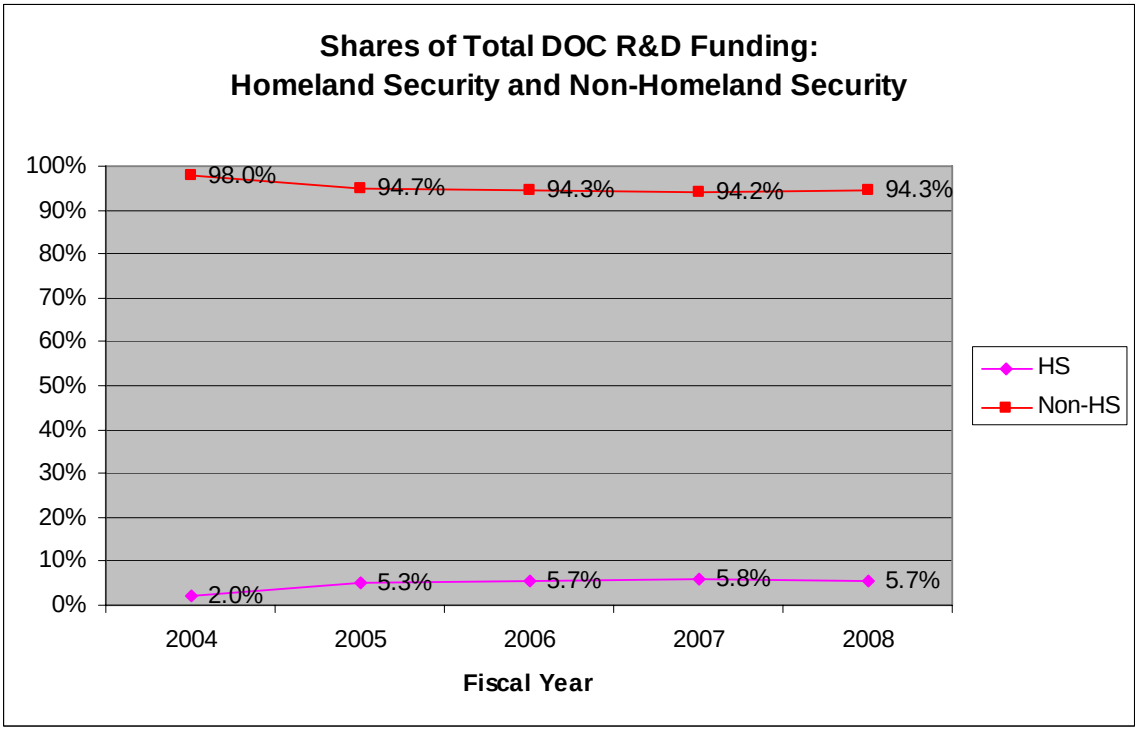
DEPARTMENT OF ENERGY (DOE)



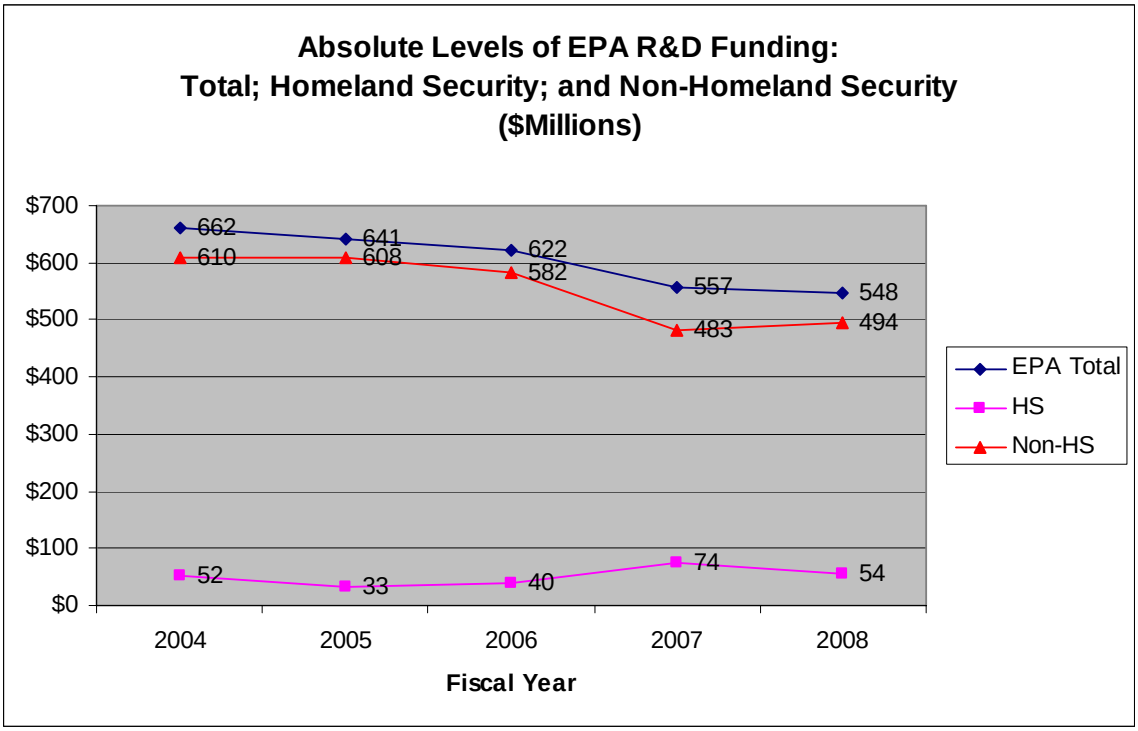


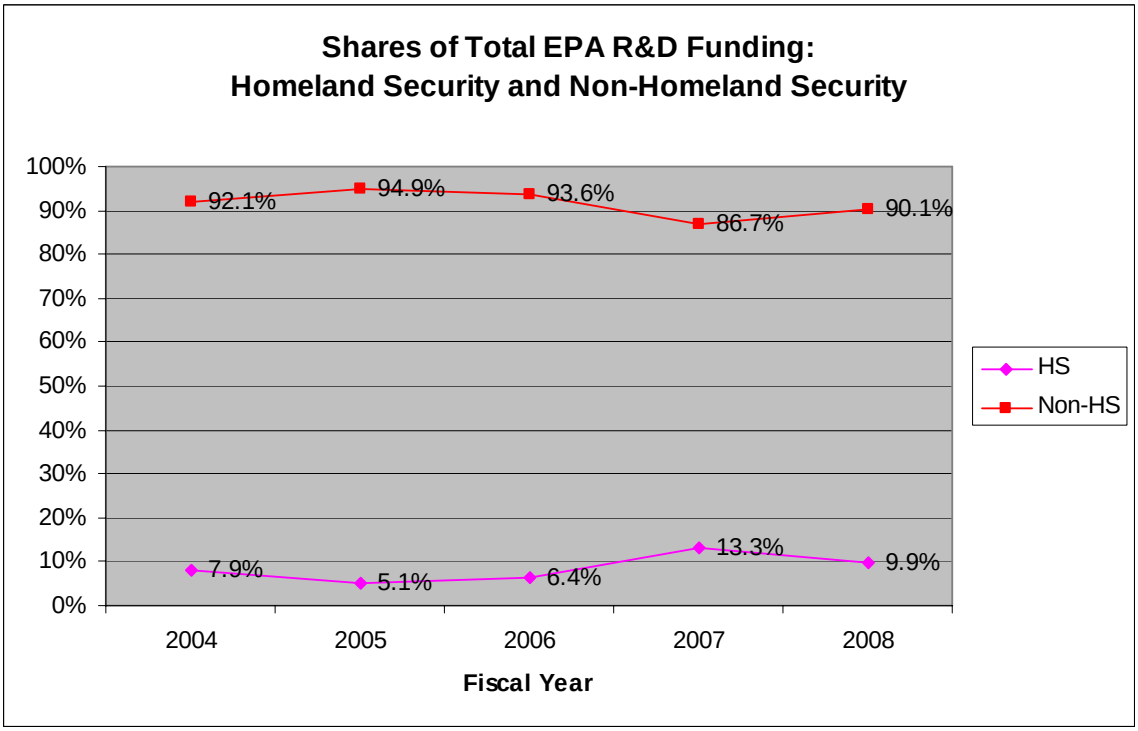
DEPARTMENT OF COMMERCE (DOC)



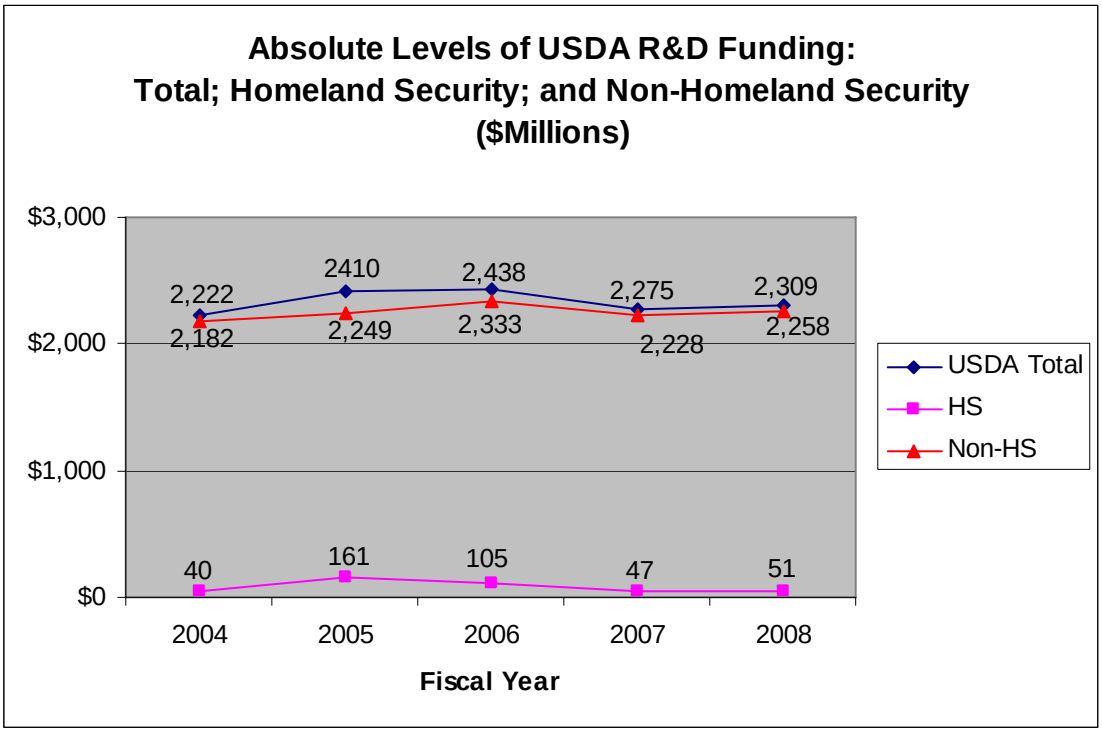


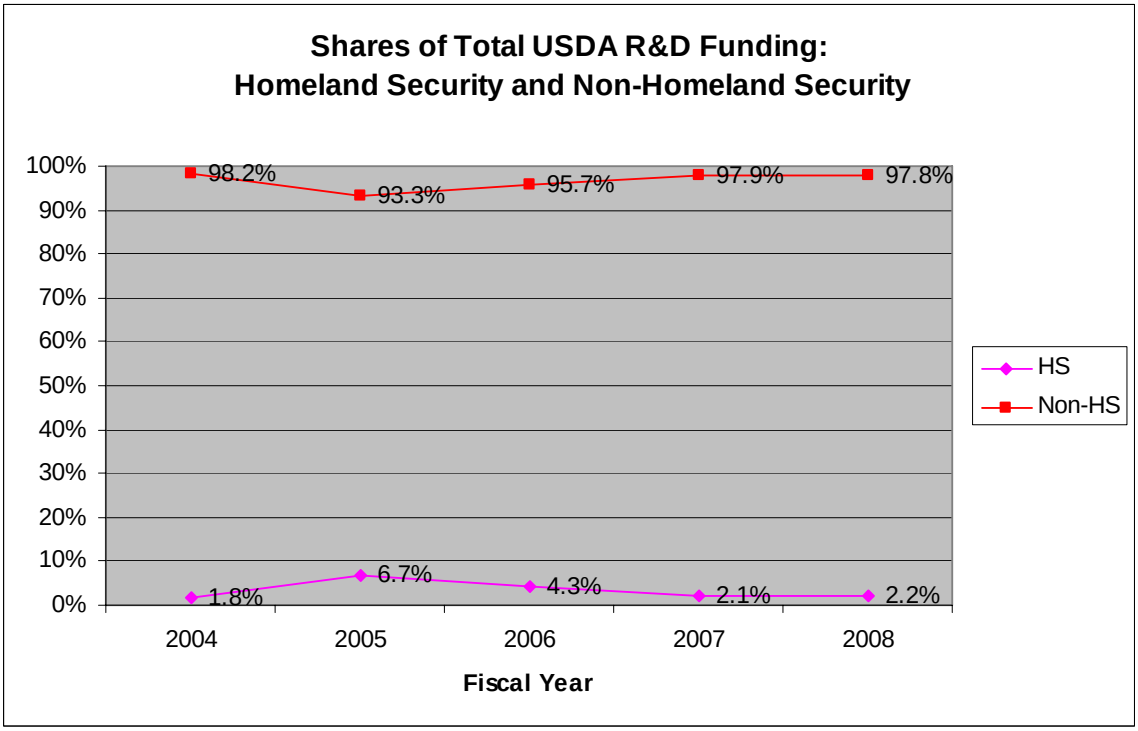
ENVIRONMENTAL PROTECTION AGENCY (EPA)



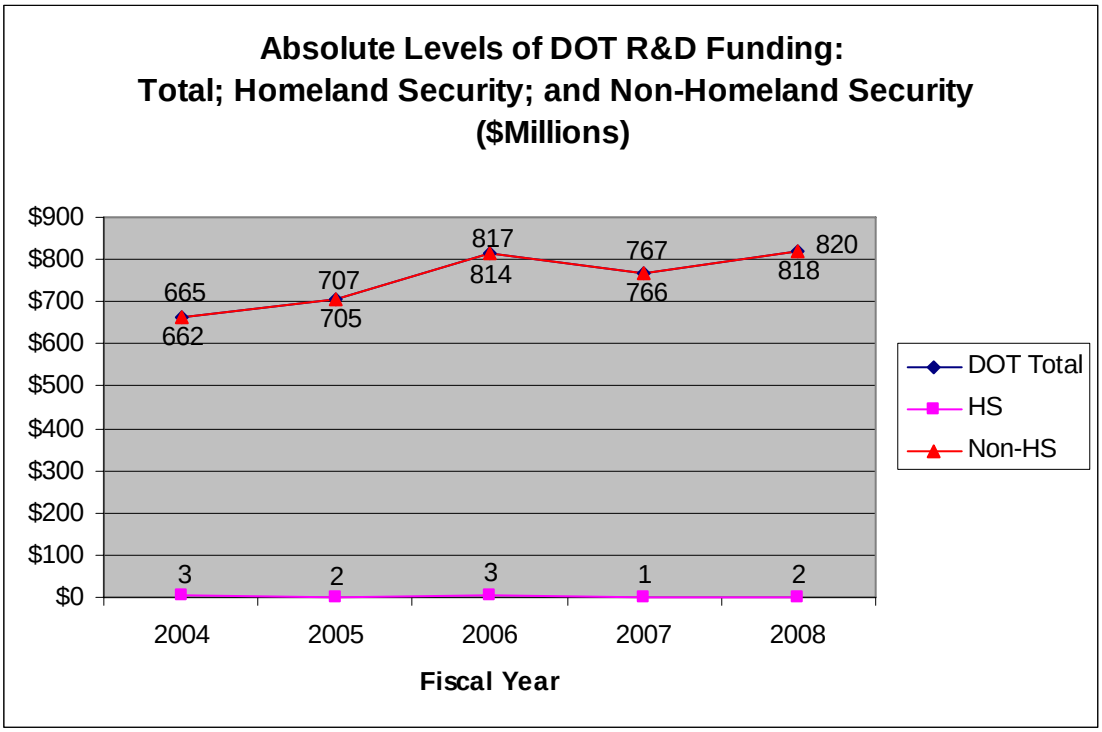


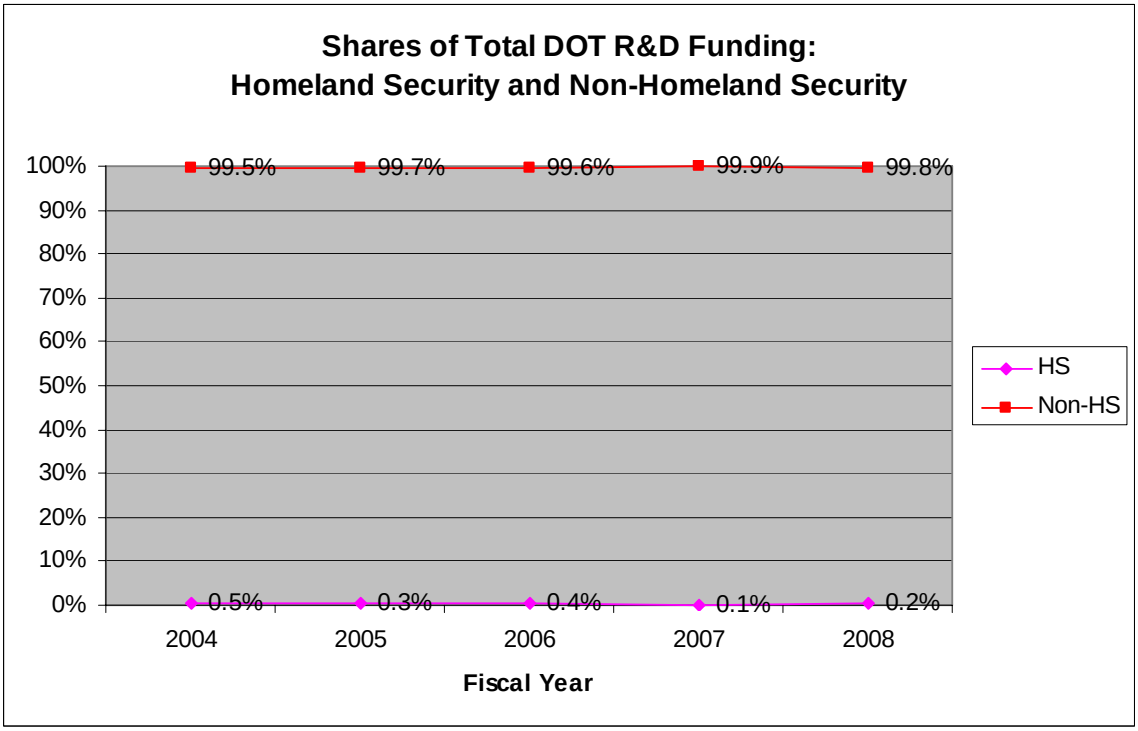
DEPARTMENT OF AGRICULTURE (USDA)





DEPARTMENT OF TRANSPORTATION (DOT)





APPENDIX H: PANEL AND STAFF

PANEL

Cindy L. Williams, *Chair*[*]—Principal Research Scientist, Security Studies Program, Massachusetts Institute of Technology. Former Assistant Director, National Security Division, Congressional Budget Office. Former positions with The MITRE Corporation: Director, C2 Integration Environment; Associate Technical Director, Continental Command, Control, and Communications Division; Department Head, Strategic Air Command Systems Department; Associate Department Head, Strategic Defense Initiative. Former positions with U.S. Department of Defense: Director, Strategic Offensive Forces Division, Program Analysis and Evaluation, Office of the Secretary; Operations Analyst. Former positions with RAND Corporation: Mathematician, Strategic Forces Project; Project Leader, Force Operations Team, Automated Wargaming Center.

Barry Bozeman[*]—Ander Crenshaw Chair, Department of Public Administration and Policy, University of Georgia. Former Regents' Professor of Public Policy, School of Public Policy and Director, Research Value Mapping Research Program, Georgia Institute of Technology; Director, Center for Technology and Information Policy, Maxwell School of Citizenship and Public Affairs and L.C. Smith College of Engineering, Syracuse University; Director, Doctoral Program in Public Administration, Maxwell School of Citizenship and Public Affairs, Syracuse University.

Louise K. Comfort[*]—Professor, Graduate School of Public and International Affairs, and Director, Center for Disaster Management, University of Pittsburgh. Visiting Professor, Department of Geography, Ritsumeikan University, Kyoto, Japan; Visiting Professor, Center for Urban Safety and Security, School of Engineering, Kobe University, Japan; Associate Professor, School of Public and International Affairs, University of Pittsburgh; Visiting Professor, Department of Public Administration, Leiden University, Netherlands.

David F. Garrison[*]—Non-Resident Senior Fellow, Brookings. Deputy Director, Greater Washington Research, Metropolitan Policy Program, Brookings. Former Vice President, National Academy of Public Administration. Former positions with U.S. Department of Health and Human Services: Counselor to the Deputy Secretary; Acting Director, Office for Civil Rights; Principal Deputy Assistant Secretary for Planning and Evaluation; Deputy Director and Senior Advisor, Intergovernmental Affairs. Former Director, The Urban Center, Levin College of Urban Affairs, Cleveland State University. Former positions with the U.S. Department of Housing and Urban Development: General Deputy Assistant Secretary, Office of Policy Development and Research; Deputy Assistant Secretary, Office of Policy Development and Research. Former Budget Analyst, Committee on the Budget, U.S. House of Representatives; Legislative Counsel, National League of Cities/U.S. Conference of Mayors.

Sally T. Hillsman[*]—Executive Officer, American Sociological Association. Former Deputy Director, National Institute of Justice, Office of Justice Programs, U.S. Department of Justice;

[*] *Academy Fellow*

Vice President for Research & Technology National Center for State Courts. Former positions with the Vera Institute of Justice (New York City): Project Director; Assistant Director of Research; Director of Research; Associate Director.

Caroline Purdy—Principal Deputy Assistant Director for Systems Engineering and Evaluation Directorate, Domestic Nuclear Detection Office in Department of Homeland Security (DHS). Former positions in the DHS Science and Technology Directorate: Director of Infrastructure/Geophysical Division, Acting Deputy Director for Office of Research and Development, and Director of Office of National Laboratories. Positions held at the Department of Energy in the Office of Environmental Management: program manager in the Office of Science and Technology for the Characterization, Monitoring and Sensor Technology program and Accelerated Site Technology Deployment Program.

STAFF STUDY TEAM

Lena E. Trudeau, *Vice President*—Ms. Trudeau leads the National Academy's service delivery organization, supervises the conception and execution of strategic initiatives, opens new lines of business and drives organizational change. In addition, Ms. Trudeau is a founder of the Collaboration Project, an independent forum of leaders committed to leveraging web 2.0 and the benefits of collaborative technology to solve government's complex problems. Ms. Trudeau's previous roles include: Program Area Director, National Academy of Public Administration, Vice President, The Ambit Group; Marketing Manager, Nokia Enterprise Solutions; Principal Consultant, Touchstone Consulting Group; Consultant, Adventis Inc.; and Associate, Mitchell Madison Group.

Rick Cinquegrana, *Program Area Director*—Former legal Counsel and Special Counsel to the Inspector General, Office of Inspector General, Central Intelligence Agency; Deputy Staff Director/Chief Investigative Counsel, Joint Senate Select Committee on Intelligence-House Permanent Select Committee on Intelligence Inquiry into September 11, United States Congress; Special Counsel for Policy, Intelligence Community Management Staff; Chief Counsel, National Commission to Review the Performance of the National Reconnaissance Office; Chief Investigative Counsel, House Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China, United States House of Representatives; Deputy Inspector General for Investigations, Office of Inspector General, Central Intelligence Agency; Deputy Counsel for Intelligence Policy, Office of Intelligence Policy, U.S. Department of Justice; Assistant General Counsel, CIA Office of General Counsel; Associate Attorney, Day, Berry & Howard.

Laurie E. Ekstrand, *Project Director*—Former Director of Justice Issues and of Health Care at the United States Government Accountability Office. Former positions with the Government Accountability Office include: Chief Social Scientist, General Government Division; Group Director, Human Resources Division; and Statistician, Program Evaluation and Methodology Division. Dr. Ekstrand also served as Senior Evaluation Officer at The World Bank's Operations Evaluation Division, and as Senior Analyst at Westat Inc. Dr. Ekstrand received her Ph.D. from Florida State University in Political Science, Research Methods and Statistics and a BA from the

University of Maryland in Political Science and Philosophy. Dr. Ekstrand received a Distinguished Service Award for excellence from the Government Accountability Office, Results Through Teamwork awards and Special Commendation Awards.

Ruth Ann Heck, *Senior Advisor*—National Academy of Public Administration. Private consultant. Has participated in Academy studies in areas such as DoD's Joint Land Use Study, Small Business Administration, the Corps of Engineers, federal transportation and wildfire mitigation programs. Former Assistant Director, Health, Education and Human Services Division of the U.S. General Accounting Office. Oversaw studies in a wide range of government programs, including elementary and secondary education grant programs and veterans benefits. Served in staff capacities as co-director of GAO's entry-level training program and as report review assistant to HEHS Division Director.

Zlatko B. Kovach, *Senior Advisor*[143]—Evaluation specialist and senior researcher and analyst with experience in conducting program evaluations for impact and developing and managing programs at the U.S. Chamber of Commerce, International Republican Institute, Center for the Study of the Presidency. Former positions included at the World Bank and International Crisis Group. Mr. Kovach holds an M.A. in Law and Diplomacy from the Fletcher School of Law and Diplomacy, B.A. in Economics, Politics, and Philosophy, Pomona College, and International Baccalaureate, United World College.

Maria Rapuano, *Senior Advisor*—Former Project Director, Alliance for Healthy Homes. Former positions with the Overseas Development Council and State Services Organization. Rapuano serves on the Board of Directors for the Trust for Lead Poisoning Prevention. Rapuano received her M.A. from The American University in International Affairs, with concentrations in International Development and International Economic Policy, and a B.A. in Government from the College of William and Mary.

Jonathan C. Tucker, *Senior Research Analyst*—National Academy for Public Administration. Former positions include: Analyst, Technology Partnership Practice, Battelle Memorial Institute; Intern, Committee on Science, Engineering and Public Policy, National Academies; Program Analyst, Advanced Technology Program, National Institute of Standards and Technology; Analyst, Office of Policy and Research, New York State Department of Economic Development.

Caroline M. Epley, *Research Associate*—Former positions include Intern at the Department of Veterans Affairs in the Office of Congressional and Legislative Affairs. Bachelor of Arts, Communication and Political Science, Virginia Tech.

Anna V. Tkachenko, *Research Associate*[144]—Former positions include Research Assistant, Public and International Affairs, George Mason University; Graduate Intern, Human Resources, Development Alternatives, Inc.; Resource Coordinator, The Nature Conservancy; Intern, U.S. Senate Committee on the Judiciary; Intern, Speaker of the House Office, Pennsylvania House of Representatives. Master of Public Administration, George Mason University; Bachelors of Arts

[143] Zlatko Kovach was a member of the team until January 2009.
[144] Anna Tkachenko was a member of the team until October 2008.

in Political Science, Mansfield University of Pennsylvania; Bachelors of Arts in Jurisprudence, Volgograd State University, Russia.

Martha S. Ditmeyer—Senior Administrative Specialist. Staff member providing technical support for a wide range of Academy studies. Former staff positions at the Massachusetts Institute of Technology, Cambridge, MA and the Communications Satellite Corporation, Washington D. C. and Geneva, Switzerland.

APPENDIX I: INDIVIDUALS INTERVIEWED

Science and Technology Directorate Personnel at the U.S. Department of Homeland Security

Lawrence Ash, Deputy Director, Transition Office

Donald Bansleben, Program Manager, Research & Development, Chemical and Biological Division

Douglas Bauer, Research Lead, Explosives Division

Tanya Buttress, Support Contractor, Research and Development Section, Chemical and Biological Division

R. Glenn Bell, Transition Branch Lead, Command, Control and Interoperability Division

David Boyd, Director, Command, Control and Interoperability Division

Brad Buswell, Under Secretary (Acting); Deputy Under Secretary

Gary Carter, Deputy Director, Test & Evaluation and Infrastructure, Test & Evaluation and Standards Division

Thomas Cellucci, Chief Commercialization Officer

Matthew Clark, Director, University Programs, Office of Research

Bert Coursey, Director, Office of Standards, Test & Evaluation and Standards Division

Adam Cox, Chief of Staff, Office of Strategy, Policy, and Budget

Debbie Cox, Deputy Director, Test & Evaluation Policy and Procedures, Test & Evaluation and Standards Division

Nancy Crawford, Human Capital Officer

Stan Cunningham, Transition Manager, Borders and Maritime Security Division

Trent DePersia, Deputy Director, Command, Control and Interoperability Division

Rolf Dietrich, Deputy Director, Office of Research

Ruth Doherty, Program Executive Office—Counter-Improvised Explosive Device

Christopher Doyle, Director, Infrastructure and Geophysical Division

Douglas Drabkowski, Transition Manager, Chemical and Biological Division

Anh Duong, Director, Borders and Maritime Security Division

Mitchell Erickson, Northeast Operations Interagency and First Responders, Interagency and First Responder Programs Division

Frank Filipkowski, Branch Head, Strategy, Planning and Integration Branch

S. Elizabeth George, Division Head, Chemical and Biological Division

Anne Hultgren, Program Manager, Research and Development Section, Chemical and Biological Division

Mary Ellen Hynes, Research Lead, Infrastructure and Geophysical Division

Jamie Johnson, Director, Office of National Labs, Office of Research

Ervin Kapos, Director, Operations Analysis Division

Joe Keilman, Research Lead, Command Control and Interoperability Division

Richard Kikla, Deputy Director, Office of Transition

Quintin Krueger, Program Staff for Research, Explosives Division

Susan Law, Central US Region Interagency Coordination, Interagency and First Responder Programs Division

Jeanne Lin, Research Lead, Borders and Maritime Security Division

Richard Lempert, Deputy for Research, Human Factors/Behavioral Sciences Division

David Masters, Deputy Director, Office of Innovation

Jonathan McEntee, Research and Development Business Specialist, Borders and Maritime Security Division

Rebecca Medina, Senior Policy Advisor, Explosives Division

Milton Nenneman, Director, First Responder Coordination West, Interagency and First Responder Programs Division

David Newton, Deputy Director, Borders and Maritime Security Division

Marlene Owens, Program Manager, Technology Transfer Office, Office of Transition, Science and Technology Directorate, U.S. Department of Homeland Security

Brandt Pasco, Assistant General Counsel for Science and Technology

Terry Pierce, Liaison to U.S. Northern Command, Special Advisor for Disruptive Innovations, and HSARPA for the Western United States, Director, U.S. Air Force Academy Center for Innovation.

Segaran Pillai, Chief Medical and Science Advisor, Chemical and Biological Division

Kevin Prestwich, Chief Information Officer, Business Operations, Services, and Human Capital Division

Greg Price, Director of Tech Solutions, First Responder Technologies (R-Tech), Office of Transition

Paul Ragsdale, Science Advisor, International Programs Division

Lilia Ramirez, Director, International Programs Division

Sharla Rausch, Director, Human Factors Division

Karen Ray, Director, Program Analysis & Evaluation

Sherry Reichow, Analyst, Science and Systems Division, Homeland Security Institute

Donald Roberts, Deputy Program Manager, Aircraft Protection Program, Explosives Division

Kenneth D. Rogers, Chief Information Officer

George Ryan, Jr., Director, Test and Evaluation and Standards Division

Vincent Schaper, Director, Small Business Innovation Research Program

Gregory Simmons, Senior Project Manager, Analytical Research, LLC, Office of Innovation, Homeworks

Michael Smith, Senior Advisor to the Undersecretary, Interagency and First Responder Programs Division

Christopher Turner, Deputy Director, Human Factors Division

Jim Tuttle, Director, Explosives Division

Stephen Vargas, Associate, Booz Allen Hamilton Inc., Infrastructure and Geophysical Division

Jose Vazquez, Director, First Responder Technologies (R-Tech), Office of Transition

Starnes Walker, Director, Office of Research

Keith Ward, Leader, Research and Development Section, Chemical and Biological Division,

Phil Waters, Director, Tech Clearinghouse, First Responder Technologies (R-Tech), Office of Transition

Richard Williams, Director, Strategy, Policy and Budget

David Winters, Director, Office of Procurement Operations, Acquisition Division

Randel Zeller, Director, Interagency and First Responder Programs Division

Department of Homeland Security Component Agency Personnel

R. Tim Baden, Program Specialist, Federal Emergency Management Agency

Diane Berry, Director of Threat Characterization and Countermeasures, Office of Health Analysis

Pat Burt, Technologies and Future Requirements Section Chief, Office of Bombing Prevention

Glen Cannon, Assistant Administrator, Disaster Operations Directorate, Federal Emergency Management Agency

Patty Cogswell, Executive Director, Office of Policy (Screening Coordination and Operations)

Steve Evans, Chief, Enforcement and Information Technology Division, Customs and Border Protection

Bob Farmer, Director of Program Analysis, Federal Emergency Management Agency

Peter Fonash, Chief Technology Officer, Office of Cyber Security and Communications, National Protection and Programs Directorate

Gordon Fullerton, Katrina Core, Federal Emergency Management Agency

Chuck Galloway, Deputy Director (Acting), Domestic Nuclear Detection Office,

Patricia Hawes, Science Officer, Laboratories and Scientific Services, U.S. Customs and Border Protection

Taylor Heard, Chief of Staff and Acting Deputy Director, Office of Emergency Communications

Ted Kim, Chief, Growth Management Oversight Unit, U.S. Citizenship and Immigration Services

Kimberly Koeppel, Program Analyst, Domestic Nuclear Detection Office

Robert King, Assistant Special Agent in Charge, Office of Protective Research, U.S. Secret Service

Dave Kountney, Deputy Director, Office of Bombing Prevention

Merrick Krause, Director**,** Infrastructure Analysis and Strategy Division, National Protection and Programs Directorate

John Macaluso, Research and Development Program Manager, U.S. Coast Guard

Jack McCready, Chief, Command, Control, Communications, and Computers, Intelligence, Surveillance, and Reconnaissance, Research and Development Center, U.S. Coast Guard

Ron Molway, Lead, Requirements Management, Office of Security Technology, Transportation Security Administration

Carter Morris, Director, Informational Sharing and Knowledge Management, Office of Intelligence and Analysis Office of Intelligence and Analysis

Mark Mullen, Lead Systems Architect, Systems Engineering and Architecture, Domestic Nuclear Detection Office

Charlie Payne, Chief, Office of Bombing Prevention

Robert Pryor, Program Manager, Surface Protection, Transportation Security Administration

Ira Reese, Executive Director, Laboratories and Scientific Services, U.S. Customs and Border Protection

Patricia Stahlschmidt, Director, Strategic Planning and Evaluation, Federal Emergency Management Agency

Bob Stephan, Assistant Secretary for Infrastructure Protection, Office of Infrastructure Protection

Department of Defense Personnel

Bob Baker, Deputy Director, Defense Research and Engineering

Susan Brandon, Defense Counter-Intelligence and Human Center, Defense Intelligence Agency

Stephen Bury, Camber Corporation, Army

Joel Carter, Program Analyst, Improvised Device Defeat, Technical Support Working Group, Combating Terrorism Technical Support Office, Office of the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict and Interdependent Capabilities

Bob Campbell, Principal, Touchstone Consulting, 1401 Technology Transfer Program, Office of the Assistant Secretary of Defense for Homeland Defense

Patricia Daniel, Explosives Detection, Technical Support Working Group, Combating Terrorism Technical Support Office, Office of the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict and Interdependent Capabilities

Dan Dickson, Military Technology Assistant, Plans and Programs, Defense Research and Engineering Office of the Undersecretary for Defense Research and Engineering

Jeff David, Co-chair, Technical Support Working Group, Combating Terrorism Technical Support Office, Office of the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict and Interdependent Capabilities

Ed Doray, Chief, Concepts and Capabilities Division, U.S. Northern Command

Paul Gido, Assistant Vice Chief, Office of Naval Research, Department of the Navy

Jeffrey Hupy, Chief, Air and Missile Defense Future Concepts and Capabilities Division, U.S. Northern Command

Thomas H. Killion, Deputy Assistant Secretary for Research and Technology/Chief Scientist, Office of the Assistant Secretary of the Army, (Acquisition, Logistics & Technology)

Dan Kowalski, Senior Consultant, Touchstone Consulting, 1401 Technology Transfer Program, Office of the Assistant Secretary of Defense for Homeland Defense

Don Lapham, Director, 1401 Technology Transfer Program, Office of the Assistant Secretary of Defense for Homeland Defense

Joseph Lawrence, Director of Transition, Office of Naval Research, Department of the Navy

Susan Levine, Principal Deputy for Policy & Strategy, Joint Non-Lethal Weapons Directorate, US Marine Corps

Stephen Mangino, Deputy Division Chief, Center for Combating Weapons of Mass Destruction, Interagency Coordination Division, U.S. Strategic Command

Berndt McConnell, Director, Interagency Coordination Directorate, U.S. Northern Command

Barbara McQuiston, Director, Strategic Technology Office, Defense Advanced Research Projects Agency

Jim McDonald, Director, Defense Technology Analysis Office, Office of the Director of Defense Research and Engineering

Mindy Montgomery, Deputy Director for Investment, Plans and Programs Division, Office of the Director of Defense Research and Engineering

Christopher K. Murphy, Joint IED Defeat Organization, Technology & Requirements Integration Division Initiatives & Technology Branch

Adam Nucci, Deputy Director for Technical Intelligence, Office of the Director, Defense Research and Engineering, Plans & Programs Office

Hannah Pack, Program Manager, Improvised Device Defeat, Technical Support Working Group, Combating Terrorism Technical Support Office, Office of the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict and Interdependent Capabilities

Philip J. Palmer, InterAgency Coordinator, Center for Combating Weapons of Mass Destruction InterAgency Coordination Division, U.S. Strategic Command,

Gabriel Ramos, Program Manager, Chemical, Biological, Radiological, & Nuclear Countermeasures, Technical Support Working Group, Combating Terrorism Technical Support Office, Office of the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict and Interdependent Capabilities

Michael Reaves, Senior Engineer, Space and Naval Warfare Systems Command

William Rees, Deputy Assistant Secretary, Laboratories & Basic Science, U.S. Department of Defense

Ben Riley, Director, Rapid Reaction Technology Office, Office of the Undersecretary of Defense for Advanced Systems and Concepts

Alan Shaffer, Principal Deputy Director, Defense Research and Engineering Director (Acting), Plans and Programs, Defense Research and Engineering Office of the Undersecretary for Defense Research and Engineering

Steven Smolinski, Division Director, Technology Transition Initiatives, Office of Naval Research, Department of the Navy

Thomas Troyano, Homeland Defense Coordinator, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics

Peter Vandenbosch, Chief, Analysis Division, U.S. Northern Command

Bill Waugaman, National Laboratories Liaison (Sandia National Labs) to U.S. Northern Command

Lou Wassersug, Program Manager, Explosives Detection, Technical Support Working Group, Combating Terrorism Technical Support Office, Office of the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict and Interdependent Capabilities

Ngai Wong, Detection Senior S&T Manager, Joint Science and Technology Office for Chemical and Biological Defense, Defense Threat Reduction Agency

Other Federal Agency Personnel

Nancy Adams, Director, Decontamination and Consequences Management Division, National Homeland Security Research Center, Office of Research and Development, U.S. Environmental Protection Agency.

David Balshaw, Program Administrator, Emerging Technologies, Sensors, Systems Biology, National Institute for Environmental Science, National Institutes of Health, U.S. Department of Health and Human Services

Duane Blackburn, Policy Analyst, Executive Office of the President, Office of Science and Technology Policy

Teresa Fryberger, Director, Applied Sciences, Earth Sciences Division, National Aeronautics and Space Administration

Cathy Girouard, Social Science Analyst, National Institute of Justice, U.S. Department of Justice

Adrianne Gould, Deputy Director of Transition, Office of Naval Research, U.S. Department of the Navy

Jay Greer, Communication Liaison, Public Affairs Office, U.S. Department of State

Jonathan Herrmann, Director, National Homeland Security Research Center, U.S. Environmental Protection Agency

David A. Jett, Program Director, CounterACT Research, National Institute for Neurological Disorders and Stroke, National Institutes of Health.

Peter Jutro, Deputy Director, Science and Policy, National Homeland Security Research Center, Environmental Protection Agency

Steve Kappes, Deputy Administrator, Animal Programs, Agricultural Research Service, U.S. Department of Agriculture

Richard B. Kellogg, Coordinator and Interagency Liaison, Laboratory Response Network, Division of Bioterrorism Preparedness & Response, National Center for Preparedness, Detection and Control of Infectious Diseases, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services

Robert Kovac, Managing Director, Defense Trade and Controls Division, U.S. Department of State

Michael G Kurilla, Director, Office of BioDefense Research Affairs, Associate Director for BioDefense Product Development, Division of Microbiology and Infectious Diseases, National Institute of Allergies and Infectious Diseases, National Institutes of Health, U.S. Department of Health and Human Services.

Carol Linden, Principal Deputy Director, Biomedical Advanced Research and Development Authority, Office of the Assistant Secretary for Preparedness and Response, U.S. Department of Health and Human Services

Jennifer Law Marshall, Analyst, U.S. Department of Commerce

John McGowan, Deputy Director for Science Management, National Institute of Allergy and Infectious Diseases, National Institutes of Health, U.S. Department of Health and Human Services

Kim Mickus, Director, Office of Counterterrorism, National Nuclear Security Administration, U.S. Department of Energy

Daniel Morgan, Specialist in Science and Technology Policy Resources, Science and Industry Division, Congressional Research Service

John Morgan, Deputy Director for Science and Technology, National Institute of Justice, U.S. Department of Justice

Derek Orr, Program Manager, Public Safety Communication Systems, Office of Law Enforcement Standards, National Institute of Standards and Technology

Winnie Reed, Chief, Crime Control and Prevention Research Division, Office of Research and Evaluation, National Institute of Justice, U.S. Department of Justice

Lawrence Rosenblum, Program Director, Graphics and Visualization Division of Computing and Communication Foundation, National Science Foundation

David Schatzer, Explosives Enforcement Officer, Bureau of Alcohol, Tobacco, Firearms, and Explosives, Department of Justice

Daniel T. Shaughnessy, Program Administrator, Susceptibility and Population Health Branch, Division of Extramural Research and Training, National Institute for Environmental Health Science, National Institutes of Health.

Dana Shea, Specialist in Science and Technology Policy Resources, Science and Industry Division, Congressional Research Service

Chuck Shotwell, Policy Director, Defense Trade and Controls Division, U.S. Department of State

Devon Streit, Associate Director, Laboratory Policy and Evaluation, Office of Science, U.S. Department of Energy

Jerry D. Thomas, Medical Officer Emergency Response and Air Toxicants Branch, Division of Laboratory Sciences, Coordinating Center for Environmental Health and Injury Prevention/National Center for Environmental Health, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services

Chris Tillery, Associate Deputy Director for Science and Technology, National Institute of Justice, U.S. Department of Justice

Pat Tsuchitani, Senior Advisor for Performance Assessment, Budget Division, Office of Budget, Finance, and Award Management, National Science Foundation

Ed Watkins, Director, Non-proliferation Research and Development, National Nuclear Security Administration, U.S. Department of Energy

Samuel Williamson, Federal Coordinator for Meteorology, Office of the Federal Coordinator for Meteorological Services and Supporting Research.

George Wilson, Legislative Specialist, Office of Legislative and Public Affairs, National Science Foundation.

Margaret Zahn, Acting Director, Office of Research and Evaluation, National Institute of Justice, U.S. Department of Justice

Lisa-Joy Zgorski, Office of Legislative and Public Affairs, Office of the Director, National Science Foundation

First Responders

Russ Decker, President, United States Council of the International Association of Emergency Managers; Emergency Manager, Allen County, Ohio

Edward A. Flynn, Chief, Milwaukee Police Department, Wisconsin

John Gustoffson, Interoperability Telecommunications Manager, State of Connecticut

Jim Hansen, Chair, National Bomb Squad Commanders Advisory Board

David Heaven, TSWG/NIJ/DHS Support to National Bomb Squad Commanders Advisory Board

Will May, Jr., Director of Public Safety, Alucha County, Florida.

Ernest Mitchell, Past President, International Association of Fire Chiefs; Member, Homeland Security Science and Technology Advisory Committee

Eddie Reyes, Sector Two Commander, Alexandria Police Department, Virginia; Member SAFECOM Emergency Responder Council

James Schwartz, Fire Chief, Arlington County, Virginia

Trina Sheets, Executive Director, National Emergency Management Association

Ellis Stanley, Emergency Management Consultant; Former General Manager, Emergency Preparedness Department, Los Angeles California

Science and Policy Experts

Peri Arnold, Professor of Political Science, Department of Government, University of Notre Dame

Stuart Bretschneider, Associate Dean and Chair, the Maxwell School of Citizenship and Public Affairs, Syracuse

Lisa Blomgren Bingham, Keller-Ruden Professor of Public Service, School of Public and Environmental Affairs, Indiana University

Seth Carus, Deputy Director, Center for Counter-proliferation Research, National Defense University

John Carroll, Morris A. Adelman Professor of Management, Professor of Behavioral and Policy Sciences and Engineering Systems and Co-Director, Lean Advancement Initiative, Massachusetts Institute of Technology

Beverly Cigler, Professor of Public Policy and Administration, School of Public Affairs, Penn State University

Amr Elnashai, Professor, School of Engineering, University of Illinois, Urbana-Champaign and Director of the Mid-America Earthquake Center

Gerald Epstein, Senior Fellow for Science and Security, Homeland Security Program, Center for Strategic and International Studies

Irwin Feller, Professor Emeritus, Department of Economics, University of Pennsylvania

Julie Fisher, Senior Associate, The Henry L. Stimson Center

Robert Greenberg, President, G&H International Services, Inc.

Dewitt John, Director, Environmental Studies Program, Browndoin College

Kei Koizumi, Director, R&D Budget and Policy Program, American Academy for the Advancement of Science

Gary LaFree, Director, National Consortium for the Study of Terrorism and Responses to Terrorism, University of Maryland

Richard Larson, Mitsui Professor of Engineering Systems and Civil and Environmental Engineering, Director, Center for Engineering Systems Fundamentals, Massachusetts Institute of Technology

Alan Leshner, Chief Executive Officer, American Association for the Advancement of Science

Bruce McConnell, President, McConnell International and Government Futures

Kenneth Meier, Charles Puryear Professor of Liberal Arts and Professor of Political Science, Texas A&M University

Michael Moodie, President, Chemical and Biological Arms Control Institute and Consultant, Science Applications International Corporation

Jonathan Morell, Senior Policy Analyst, NewVectors LLC

Norman Polmar, Chairman, Homeland Security Science and Technology Advisory Committee (HSSTAC)

Karlene Roberts, Professor in the Graduate School, Haas Organizational Behavior and Industrial Relations Group, University of California Berkeley

Ellen Schall, Dean and Martin Cherkasky Professor, Wagner Graduate School of Public Service, New York University

Howard Silver, Executive Director, Consortium of Social Science Associations

Kathleen Smarick, Executive Director, National Consortium for the Study of Terrorism and Responses to Terrorism, University of Maryland

Brad Smith, Senior Associate, Center for Biosecurity, University of Pittsburgh Medical Center

Jim Tiedje, University Distinguished Professor and Director, Center for Microbial Ecology, Michigan State University; former President of the American Microbiological Society

Kathleen Tierney, Director, Natural Hazards Center, University of Colorado at Boulder

William Wallace, Engineering Management, Center for Infrastructure and Transportation Studies, Rensselaer Polytechnic Institute

Greg Wilson, Legislative Specialist, Office of Legislative and Public Affairs, National Science Foundation

Charles Wise, Director, The John Glenn School of Public Affairs, Ohio State University

This Page Left Intentionally Blank.

APPENDIX J: ACRONYMS

Acronym	Description
AAAS	American Association for the Advancement of Science
Academy	National Academy of Public Administration
BAA	Broad Agency Announcement
BARDA	Biomedical Advanced Research and Development Authority
CID	Command, Control, and Interoperability Division
IED	Improvised Explosive Device
CoRE	Committee on Requirements
CRS	Congressional Research Service
DARPA	Defense Advanced Research Projects Agency
DHS	Department of Homeland Security
DNDO	Domestic Nuclear Detection Office
DOD	Department of Defense
DOE	Department of Energy
DOJ	Department of Justice
FEMA	Federal Emergency Management Agency
FFRDC	Federally Funded Research and Development Center
FTE	Full Time Equivalent
FY	Fiscal Year
GAO	Government Accountability Office
HHS	Department of Health and Human Services
HIPS	Homeland Innovative Prototypical Solutions
HITS	High Impact Technology Solutions
HSARPA	Homeland Security Advanced Research Projects Agency
HSPD	Homeland Security Presidential Directive
HSSTAC	Homeland Security Science and Technology Advisory Committee
IAB	Inter Agency Board for Equipment Standardization and Interoperability
IAD	Interagency and First Responder Programs Division
IND	International Cooperative Programs Office
IPA	Intergovernmental Personnel Act
IPT	Integrated Product Team

Acronym	Description
LDRD	Lab-Directed Research and Development
MANPAD	MAN-Portable Air Defense System
NASA	National Aeronautics and Space Administration
NBACC	National Biodefense Analysis and Countermeasures Center
NIAID	National Institute of Allergy and Infectious Diseases
NIH	National Institutes of Health
NIJ	National Institute of Justice
NIPP	National Infrastructure Protection Plan
NSF	National Science Foundation
NSTC	National Science and Technology Council
OIG	Office of Inspector General
OMB	Office of Management and Budget
ONL	Office of National Laboratories
ONR	Office of Naval Research
OPO	Office of Procurement Operations
OSTP	Office of Science and Technology Policy
PART	Program Assessment Rating Tool
QHSR	Quadrennial Homeland Security Review
R-Tech	First Responder Technologies Program
S&T	Directorate of Science and Technology
SAR	Sector Annual Report
SBIR	Small Business Innovation Research
SES	Senior Executive Service
SME	Subject Matter Expert
ST	Senior Technical
START	National Consortium for the Study of Terrorism and Responses to Terrorism
STORM	Science and Technology Organizational Regulation Manual
T&E	Testing and Evaluation
TOG	Technical Oversight Group
TOGWG	Technical Oversight Group Working Group

Acronym	Description
TSWG	Technical Support Working Group
TTA	Technology Transition Agreement
U/S	Under Secretary
USDA	U.S. Department of Agriculture

This Page Left Intentionally Blank.

APPENDIX K: SELECTED BIBLIOGRAPHY

Bartlett, C. and Ghosal, S. *Managing Across Borders.* Boston, Harvard Business School Press, 1998.

Bond, Jennifer Sue, et al., *OSTP 2.0 Critical Upgrade: Enhanced Capacity for White House Science and Technology Policymaking: Recommendations for the Next President,* Washington, D.C.: The Woodrow Wilson International Center for Scholars, June 2008.

Bozeman, B. and Broadman, C. *Managing the New Multipurpose, Multidiscipline University Research Centers: Institutional Innovation and Academic Research.* Washington, D.C.: IBM Endowment of the Business of Government 2003.

Brown, Dustin, Deputy Director for Performance and Personnel Management, Office of Management and Budget. Memorandum on *Guidance for Completing 2008 PARTs.* Program Assessment Rating Tool Guidance No. 2008-01. Washington D.C.: January 29, 2008.

Coryn, C and Scriven, M., Editors. *Reforming the Evaluation Process."* New Directions for Evaluation, American Evaluation Association, No 118, Summer 2008.

Department of Homeland Security, Domestic Nuclear Detection Office, Science and Technology Directorate. *Department of Homeland Security (DHS): Annual report to review the roadmap for nuclear and radiological detection.* Washington D.C.: October 2008.

Department of Homeland Security, Office of Inspector General, Office of Inspections, Evaluations & Special Reviews. *Survey of the Science and Technology Directorate,* OIG-04-24. Washington D.C.: March 2004.

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, Washington D.C.: August 2008.

Department of Homeland Security. Interoperability Capstone IPT Status Review PowerPoints. Washington D.C.: January 14, 2009.

Department of Homeland Security Science and Technology Council. *IEDs: Coming to America*. Washington D.C.: February 29, 2008.

Department of Homeland Security. *Strategic Plan — One Team, One Mission, Securing Our Homeland, Fiscal Years 2008-2013.* Washington D.C.: September 16, 2008.

Galbraith, J. et. al., *Designing Dynamic Organizations: A Hands-On Guide for Leaders at All Levels.* New York: AMACOM, 2002.

Galbraith, J., *Designing the Customer-Centric Organization: A Guide to Strategy, Structure, and Process.* San Francisco: Jossey-Bass, A. Wiley Imprint. 2005.

General Accounting Office. *A Model of Strategic Human Capital Management.* Exposure Draft, GAO-02-373SP. Washington D.C.: March 2002.

Government Accountability Office. *Department of Homeland Security, A Strategic Approach Is Needed to Better Ensure the Acquisition Workforce Can Meet Mission Needs.* Report to Congressional Requesters. GAO-09-30. Washington D.C.: November 2008.

General Accounting Office. *Executive Guide, Effectively Implementing the Government Performance and Results Act.* GAO/GGD-96-118. Washington D.C.: June 1996.

General Accounting Office. *Homeland Security, DHS Needs a Strategy to Use DOE's Laboratories for Research on Nuclear, Biological, and Chemical Detection and Response Technologies.* Report to the Chairman, Subcommittee on Emerging Threats and Capabilities, Senate Committee on Armed Services. GAO-04-653, Washington D.C.: May 2004.

General Accounting Office. *Major Management Challenges and Program Risks, Department of Homeland Security.* GAO-03-102. Washington D.C.: January 2003.

Government Accountability Office. *Project BioShield: Actions Needed to Avoid Repeating Past Mistakes.* Highlights of GAO-08-208t, a testimony before the Senate Committee on Homeland Security and Governmental Affairs. Washington D.C.: October 23, 2007.

General Accounting Office: Resources, Community, and Economic Development Division. *Memorandum to Representative James Sensenbrenner on Government Performance and Results Act: Information on Science Issues in EPA's Performance Report for Fiscal Year 1999 and Performance Plans for Fiscal Years 2000 and 2001.* GAO/RCED-00-270R. Washington D.C.: August 31, 2000.

Government Accountability Office. *Homeland Security, DHS Needs to Improve Ethics-Related Management Controls for the Science and Technology Directorate.* Report to the Ranking Minority Member, Senate Committee on Homeland Security and Governmental Affairs. GAO-06-206. Washington D.C.: December 2005.

Gottron, Frank. *CRS Report for Congress Project BioShield: Purposes and Authorities*. Congressional Research Service. Washington D.C.: June 12, 2007.

Homeland Security Institute, *Comprehensive Integrated Product Team Gap Analysis*. Washington D.C.: May 31, 2007, p. 19.

Jennifer E. Lake et al. *Homeland Security Department: FY2009 Request for Appropriations.* Congressional Research Service, RL34482. Washington D.C.: May 6, 2008.

Masse, Todd, Siobhan O'Neil, and John Rollins. *The Department of Homeland Security's Risk Assessment Methodology: Evolution, Issues, and Options for Congress.* Congressional Research Service, RL33858. Washington D.C.: February 2, 2007.

National Academy of Sciences. *Implementing The Government Performance and Results Act for Research: A Status Report*, 2001.

Office of Management and Budget. *PART Review: S&T Chemical and Biological 2008 Assessment.* http://www.whitehouse.gov/omb/expectmore/summary/10002394.2008.html, accessed April 2009.

Shea, Dana, and Daniel Morgan. *The DHS Directorate of Science and Technology: Key Issues for Congress.* Congressional Research Service. RL34356 Washington D.C.: February 1, 2008.

Spencer, David B., and Sharon Dawes. Report of the Advisory Committee for GPRA *Performance Assessment FY 2008.* Government Performance and Results Act Review 2008, National Science Foundation. Washington D.C.: July 31, 2008, p. 4. http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf08064.

Statement of Bradley Buswell, Acting Under Secretary of the Department of Homeland Security Science and Technology Directorate. Hearing on *Developing and Transitioning Homeland Security Research Projects into Use.* Testimony before the U.S. House of Representatives Committee on Appropriations, Subcommittee on Homeland Security. March 26, 2009.

Statement of Charles McQueary, Under Secretary of the Department of Homeland Security's Science and Technology Directorate. Hearing on *Research and Development Activities of the Department of Homeland Security.* Testimony before the Subcommittee on Cyber Security, Science, and Research and Development, U.S. House of Representatives. February 25, 2004.

Statement of David M. Walker. *Managing for Results, Using GPRA to Help Congressional Decisionmaking and Strengthen Oversight.* General Accounting Office, Testimony before the Subcommittee on Rules and Organization of the House, Committee on Rules, House of Representatives. GAO/T-GGD-00-95. Washington D.C.: March 22, 2000.

Statement of William O. Jenkins, Jr., Director Homeland Security Justice Issues. Government Accountability Office. *Homeland Security, Applying Risk Management Principles to Guide Federal Investments.* Testimony before the Subcommittee on Homeland Security, Committee on Appropriations, House of Representatives. GAO-07-386T. Washington D.C.: February 2007.

The National Academies, National Research Council, Policy and Global Affairs Division and Division on Earth and Life Studies, Committee on Science, Engineering and Public Policy and Board on Environmental Studies and Toxicology, and the Committee on

Evaluating the Efficiency of Research and Development Programs at the U.S. Environmental Protection Agency. *Evaluating Research Efficiency in the U.S. Environmental Protection Agency*, 2008. http://www.nap.edu/catalog.php?record_id=12150 (accessed April 9, 2009).

W.K. Kellogg Foundation. *Logic Model Development Guide.* Battle Creek, Michigan: January 2004.

National Academy of
Public Administration®
900 7th Street, N.W.
Suite 600
Washington, DC 20001
Phone: (202) 347-3190
Fax: (202) 393-0993
Web: www.napawash.org