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HOMELAND SECURITY

Research & Development Coordination Has Improved, but Additional Actions Needed to Track and Evaluate Projects

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Why GAO Did This Study

Conducting R&D on technologies is vital to enhancing the security of the nation. The Homeland Security Act of 2002, as amended, designates S&T as responsible for coordinating all R&D activities of DHS. Questions have been raised about S&T's ability to demonstrate the impact of its R&D investments. Since DHS began operations in 2003, GAO has made recommendations to help improve DHS's efforts to coordinate and oversee R&D.

GAO was asked to review DHS's R&D efforts. This report examines (1) how much DHS has obligated for R&D and what types of R&D DHS conducts, (2) to what extent S&T coordinates R&D across DHS, and (3) how, if at all, DHS identifies and tracks R&D efforts.

GAO reviewed documentation from DHS related to the conduct, coordination, tracking, and evaluation of R&D projects. GAO interviewed DHS officials with responsibilities related to, among other things, R&D financial reporting, performance evaluation, and the IPT process, including officials from the 10 DHS components that participate in the IPTs. GAO also reviewed DHS R&D budget and obligation data from fiscal years 2010 through 2017.

What GAO Recommends

GAO is making four recommendations, with which DHS concurred, including that DHS: 1) ensure all components participate in the IPT process, 2) develop a mechanism that aligns R&D project tracking sources, and 3) collect feedback from R&D customers.

What GAO Found

The Department of Homeland Security (DHS) obligated more than $10 billion for research and development (R&D) from fiscal years 2010 through 2017. Seven DHS components have budget authority to conduct R&D, and the Science and Technology Directorate (S&T) obligated nearly 80 percent of all DHS R&D funds during this time period. These components conduct a wide range of R&D, from cybersecurity to border security projects. S&T generally leads or funds R&D projects by providing technology and knowledge products to support four homeland security mission areas:

- **Disaster resilience.** Improving community resilience to natural disasters through technology and tools;

- **Critical incidents**. Improving response technological capabilities;

- **Border security**. Improving the nation's ability to detect, interdict and prosecute illegal activity across air, land and sea.

- **Cybersecurity.** Developing technologies and tools to secure systems and critical infrastructures against cyberattacks.

S&T strengthened its R&D coordination efforts across DHS, but some challenges remain. In 2015, DHS established an R&D coordination mechanism, to be led by S&T, and in 2017 issued R&D coordination-related guidance. Specifically, to improve coordination, DHS established an Integrated Product Team (IPT) process to serve as the key R&D coordination mechanism within DHS. All ten DHS components that GAO interviewed stated that the IPT process improved visibility into DHS R&D efforts. However, the component that obligated approximately 17 percent of DHS R&D funds in 2017, or $176 million, did not participate in the IPT process in 2018, as required. Nonparticipation poses a risk to R&D coordination efforts across DHS, including R&D project information not being shared among components. Furthermore, ensuring that all required components participate in the IPT process would help S&T maintain visibility of R&D projects in order to fulfill its statutory role of coordinating R&D, and mitigate the risk of potential duplication of effort.

S&T, in its coordination role for DHS, uses disparate information sources to identify and track R&D project information and faces challenges to track progress and other information for ongoing R&D projects. For example, R&D project information is stored in multiple information sources leading to difficulty in integrating complete R&D project information and resulting in reporting that is not comprehensive. By developing a mechanism to address these challenges, S&T can further improve its efforts to report and analyze R&D project information, and have improved visibility on R&D efforts across DHS. GAO also identified challenges in collecting information related to R&D performance. Among other things, DHS is not well positioned to integrate the results and share lessons learned because limited R&D customer feedback information is collected and analyzed. Of the seven DHS components with R&D budget authority, two reported having formal customer feedback mechanisms. As a result, DHS is unable to more fully understand its customers' perceptions and experience which would allow DHS to better assess the performance of its R&D efforts.

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Abbreviations

CBP	Customs and Border Protection
CWMD	Countering Weapons of Mass Destruction Office
DHS	Department of Homeland Security
GPRA	Government Performance and Results Act of 1993
GPRAMA	GPRA Modernization Act of 2010
IPT	Integrated Product Team
NDAA	National Defense Authorization Act
OCFO	Office of the Chief Financial Officer
OMB	Office of Management and Budget
R&D	Research and Development
S&T	Science & Technology Directorate
TSA	Transportation Security Administration

March 21, 2019

The Honorable Scott Perry
House of Representatives

Dear Mr. Perry:

Conducting research and development (R&D) on technologies for detecting, preventing, and mitigating terrorist and natural threats is vital to enhancing the security of the nation. Since it began operations in 2003, the Department of Homeland Security (DHS) has obligated billions of dollars researching and developing technologies used to support a wide range of missions, including securing the border, detecting nuclear devices, and screening airline passengers and baggage for explosives, among others. Within DHS, the Science and Technology directorate (S&T) is responsible for coordinating and integrating R&D activities across the department while DHS components may also conduct R&D to support their respective missions.

Since 2003, questions have been raised regarding S&T's ability to oversee and coordinate R&D activities across the department as well as to demonstrate the value of these investments over time. In 2012, we found that DHS efforts to coordinate R&D across the department were fragmented and overlapping, which increased the risk of unnecessary duplication.[1] We also reported that DHS did not know how much all of its components invested in R&D, making it difficult to oversee these efforts across the department.[2] We recommended, among other things, that the Secretary of Homeland Security develop and implement policies to include elements such as a definition of R&D that provides reasonable assurance that reliable accounting and reporting of R&D resources and activities are achieved. In response to our recommendation, DHS issued a memorandum in April 2014 that included a definition for R&D. Furthermore, DHS implemented a common appropriations structure to accurately identify the resources it is expending on R&D projects.

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[1]GAO, *Department of Homeland Security: Oversight and Coordination of Research and Development Should Be Strengthened.* GAO-12-837 (Washington, D.C.: Sept. 12, 2012).

[2]As of December 2018, DHS has 14 operational and support components, seven of which have budget authority to conduct R&D activities. In 2012, only three DHS components had budget authority to conduct R&D activities. However, in our 2012 review, we identified an additional $255 million in R&D obligations by other DHS components.

You asked us to evaluate DHS's efforts to coordinate and monitor R&D activities across the department.[3] This report addresses the following questions: (1) how much has DHS obligated for R&D from fiscal years 2010 through 2017 and what types of R&D does DHS conduct; (2) to what extent does S&T coordinate R&D across DHS; and (3) how, if at all, does DHS track and identify R&D efforts and assess R&D performance department-wide.[4]

To determine how much DHS has obligated for R&D, we analyzed federal budget data to identify R&D-related obligations for fiscal years 2010 through 2017. We selected this time frame to analyze multiple years of obligation trend data, and 2017 was the most recent year of available data at the time of our review. To identify the R&D obligations data, we searched the Office of Management and Budget's (OMB) MAX database[5] for DHS accounts with the term "research" in the account title and extracted total obligations for those accounts from the database for fiscal years 2010 through 2017.[6] We assessed the reliability of the data by reviewing OMB guidance and procedures that govern OMB MAX data inputs. We determined that the data were sufficiently reliable for reporting general trends. However, because we previously found that some DHS R&D-related obligation data were not properly identified, and because R&D-related obligations could potentially be reported in other accounts that may not contain the term "research," we report the data as a minimum of the amount that DHS could have obligated for fiscal years 2010 through 2017.[7] We also interviewed DHS officials, including those

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[3]This review was conducted in response to a 2017 request from Representative Scott Perry—then Chairman, House Homeland Security Subcommittee on Oversight and Management Efficiency.

[4]By statute, the Secretary of Homeland Security, acting through the Under Secretary for S&T, is responsible for, among other things, coordinating R&D activities. DHS and its components have responsibility for tracking R&D; for example, the Secretary is required to submit a list to Congress of all R&D projects, and according to a January 2017 DHS Directive, component heads are responsible for, among other things, identifying and reporting R&D activities in progress, funded, planned, or recently completed.

[5]OMB's MAX Portal is one of the several web-based systems that federal agencies are to use to transmit their information. Federal agencies use it to enter data and upload documentation related to a variety of reporting activities, including data required for the President's Budget and Mid-Session review, and federal Information Technology investment information.

[6]We used the word "research" to identify variations of R&D terminology, including "research and development" as well as "research & development."

[7]GAO-12-837.

from the DHS Office of the Chief Financial Officer (OCFO) and the S&T Finance and Budget Division to obtain and corroborate information about R&D-related obligations, budget and expenditure tracking tools and reports. To identify what types of R&D DHS conducts, we reviewed DHS documents including congressional budget justifications and fact sheets. To learn more about the types of R&D activities that DHS components conduct, we also interviewed officials from each of the 10 components that are involved in the Integrated Product Teams (IPT), which is DHS's primary R&D coordination mechanism. Based on IPT charter documents and S&T IPT guidance, we identified the components that are to participate in the IPT process. These components were: the Countering Weapons of Mass Destruction (CWMD) Office, the Federal Emergency Management Agency, the Cybersecurity and Infrastructure Security Agency, the U.S. Secret Service, the Office of Intelligence and Analysis, the Transportation Security Administration (TSA), the U.S. Citizenship and Immigration Services, the U.S. Coast Guard, the U.S. Customs and Border Protection (CBP) and the U.S. Immigration and Customs Enforcement.[8]

To determine the extent to which S&T coordinates R&D across DHS, we analyzed DHS guidance documents, such as management directives, instructions, and memoranda, which assign R&D-related roles and responsibilities and govern certain R&D coordination practices. The guidance documents included a memorandum establishing the IPT process and how the IPT process should coordinate R&D efforts across DHS. We also interviewed DHS officials with roles and responsibilities related to R&D to obtain their perspectives on R&D coordination and the relevant guidance documents, including officials who manage IPT operations. To further understand the IPT process, we conducted interviews with officials from the 10 DHS components that participate in the IPT process to obtain their perspectives on the benefits and challenges of the process. Furthermore, we analyzed IPT-related documentation including charter documents, IPT meeting agendas and minutes, and IPT guidance documents to determine how the process facilitates R&D coordination efforts. We also interviewed DHS officials responsible for department-wide requirements identification.

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[8]In 2018, the National Protection and Programs Directorate was reorganized into the new Cybersecurity and Infrastructure Agency within DHS.

To examine the extent to which DHS tracks and identifies R&D efforts, we interviewed S&T officials to determine what tracking mechanisms are used.[9] We also reviewed existing lists of DHS R&D projects, such as DHS's Report of Coordinated R&D, DHS's responses to congressional inquiries regarding R&D project lists, outputs from electronic tracking systems, such as S&T's Project Tracker Database, and R&D projects listed in congressional budget justification documents, among other things. We also interviewed S&T officials involved in developing the R&D project information sources to determine how the lists are compiled, how information is entered into the sources, and what the benefits and challenges are for each source of R&D project information that we identified. In addition, we interviewed officials from DHS's OCFO and reviewed departmental financial management policies to learn about how the recently-implemented common appropriations structure has affected the transparency of R&D efforts across DHS.

To determine the extent to which DHS components with R&D budget authority collected and reported performance information to assess their R&D efforts, we reviewed applicable laws governing performance reporting in the federal government, including the Government Performance and Results Act of 1993 (GPRA), as updated and expanded by the GPRA Modernization Act of 2010 (GPRAMA), and guidance for implementing these laws.[10] We also reviewed leading practices, identified in our prior work, used by organizations related to R&D performance indicators.[11] In addition, we reviewed leading practices for project,

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[9]A January 2017 DHS Directive specifies that the IPT process, led by S&T, is to identify all R&D activities in progress, funded, planned, or recently completed. To this end, S&T officials who manage overall IPT operations facilitate these R&D data collection and identification efforts. However, the Directive specifies that DHS component heads are responsible for identifying and reporting the R&D activities.

[10]See, for example, GAO, *Managing for Results: A Guide for Using the GPRA Modernization Act to Help Inform Congressional Decision Making*, GAO-12-621SP (Washington, D.C.: June 15, 2012), and *Executive Guide: Effectively Implementing the Government Performance and Results Act*, GAO/GGD-96-118 (Washington, D.C.: June 1996).

[11]See, for example, GAO, *Measuring Performance: Strengths and Limitations of Research Indicators*, RCED-97-91 (Washington, D.C.: March 1997), GAO, *Tax Administration: IRS Needs to Further Refine Its Tax Filing Season Performance Measures*, GAO-03-143 (Washington, D.C.: Nov. 22, 2002) and *Defense Logistics: Improving Customer Feedback Program Could Enhance DLA's Delivery of Services*, GAO-02-776 (Washington, D.C.: September 9, 2002).

program and portfolio management[12] and reviewed DHS documents related to its processes for collecting and reporting its performance information. The documents reviewed included policies and guidance regarding how these processes are to operate, the information to be collected, as well as documents used to communicate performance information, including DHS's Annual Performance Report, as well as DHS's congressional budget justification documents. To illustrate how DHS uses one method to track R&D progress, we analyzed selected milestones in the congressional budget justification documents for 7 of DHS's approximately 132 reported R&D projects. To conduct our analysis, we identified two milestones each from the selection of seven R&D projects that S&T officials consider to be high priority. We selected the two milestones from the most recent year for each project; if there were more than two milestones, we randomly selected two. The milestones, selected from the fiscal year 2018 budget documents, were assessed against DHS guidance that its components are to utilize to develop the milestones. Two analysts independently reviewed the milestones and resolved any disagreements in their assessments. To further understand the information used to assess R&D performance, we interviewed officials from the seven IPT-participating DHS components with R&D budget authority to learn how they collect and report performance information. We also examined guidance to components for collecting and reporting performance information, such as performance goals and milestones, and customer feedback mechanisms.

We also interviewed officials from various DHS offices that are involved in managing, collecting or using R&D performance information from across the department. Specifically, we interviewed officials from DHS's Office of Program Analysis and Evaluation, Office of Policy, and OCFO. DHS's Office of Program Analysis and Evaluation coordinates performance management across DHS components. DHS's Office of Policy develops strategies, operational plans, and leads the development of operational and resource allocation guidance for the department, among other things. Further, we reviewed performance information and documents related to DHS's process for assessing and reporting its annual performance goals. This included performance information reported in DHS's Annual Performance Report for fiscal years 2016 through 2018 and in

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[12]Project Management Institute, Governance of Portfolios, Programs and Projects: A Practice Guide (PMBOK® Guide), 2016 and Project Management Institute, The Standard for Program Management (PMBOK® Guide), 4th ed. Newtown Square, Pennsylvania: Project Management Institute, Inc., 2017.

congressional budget justification documents for fiscal year 2018 for the DHS components that conduct R&D. To conduct our analysis, we compared performance information in the DHS annual performance report and congressional budget justification documents to GPRA requirements and OMB guidelines for agency performance information.[13]

We conducted this performance audit from October 2017 through January 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

DHS R&D Roles and Responsibilities

The Homeland Security Act of 2002, as amended, designates the Under Secretary for Science and Technology as responsible for coordinating all R&D activities of DHS.[14] The Act also provides that nothing in it precludes other department components from carrying out R&D activities as long as the activities are coordinated through S&T.[15] As of September 2018, seven DHS components have budget authority to conduct R&D activities—S&T, the Coast Guard, the CWMD,[16] the Secret Service, the Cybersecurity and Infrastructure Security Agency, TSA, and the Office of the Chief Information Officer within the Office of the Undersecretary for Management. Figure 1 provides an organizational overview of DHS components and offices that are involved in the R&D process as of December 2018.

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[13]GAO, *The Results Act: An Evaluator's Guide to Assessing Agency Annual Performance Plans*, GAO/GGD-10-1.20 (Washington, D.C.: April 1998).

[14]Pub. L. No. 107-296, § 302, 116 Stat. 2135, 2163 (classified as amended at 6 U.S.C. § 182). DHS Delegation Number 10001, Revision 1, "*Delegation to the Under Secretary for Science and Technology*," Annex A, April 28, 2014 specifically states that S&T coordination role pertains to research and development from research through system development for all activities from technology readiness level (TRL) 1 through TRL 7.

[15]Pub. L. No. 107-296, § 306 (6 U.S.C. § 186).

[16]In October 2017, DHS formed CWMD. The new CWMD office subsumed the Domestic Nuclear Detection Office in total, among other DHS offices, but the office's functions remained intact.

Figure 1: Organizational Overview of Department of Homeland Security (DHS) Components and Offices Involved in the Research and Development (R&D) Process
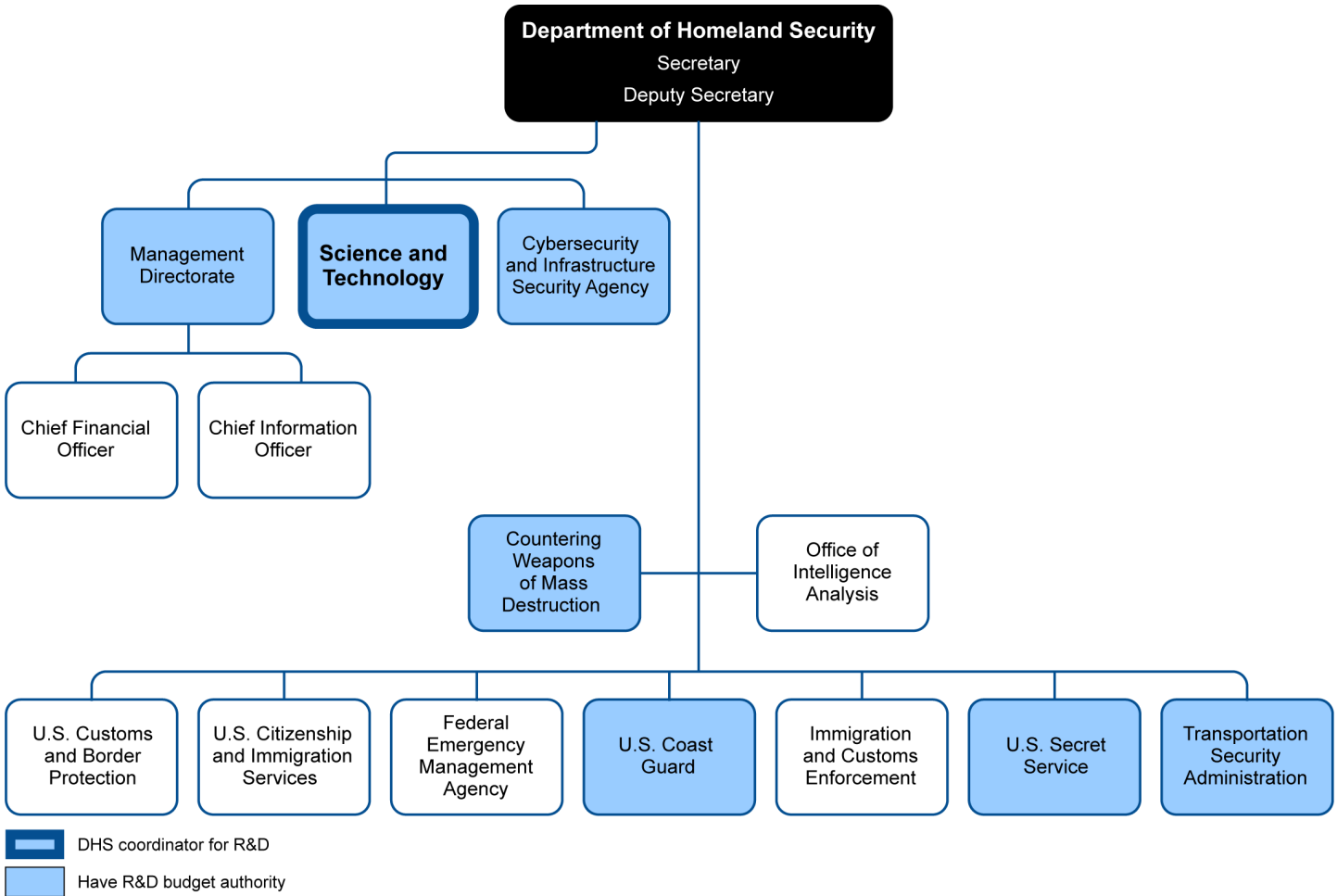
Source: GAO analysis of DHS documents and the Consolidated Appropriations Act, 2018, Pub. L. No. 115-141, div. F. | GAO-19-210

S&T reorganized its structure in September 2018 and currently has three technical divisions responsible for managing R&D programs related to improving border, immigration, and maritime security; supporting first responders; and countering physical and cybersecurity threats among others, as shown in figure 2.

Figure 2: Department of Homeland Security's (DHS) Science and Technology (S&T) Directorate's Organization, September 2018
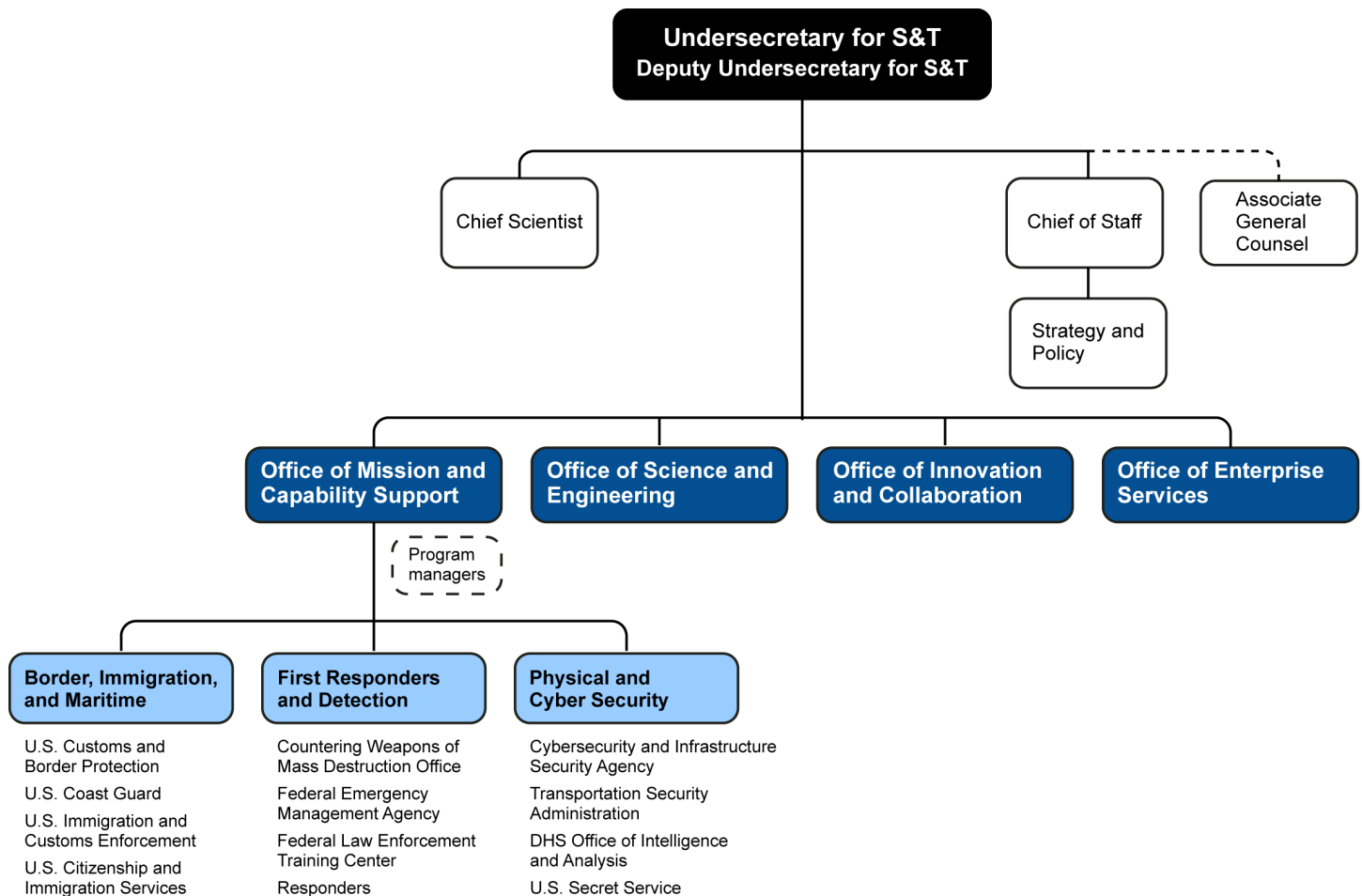
Source: GAO analysis of DHS documents. | GAO-19-210

Most of S&T's R&D portfolio consists of applied and developmental R&D, which can be transitioned to use within 3 years, as opposed to longer-term basic research. In addition to conducting projects for its DHS customers, S&T conducts research for other federal agencies and first responders. S&T is also responsible for conducting basic and applied research, and collaborates with other government agencies, academia, the private sector, and others.[17]

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[17]Pub. L. No. 107-296, §§ 302, 308 (6 U.S.C. §§ 182, 188).

Overview of Past R&D Management Challenges

Questions have been raised about S&T's ability to demonstrate the impact of its investments—in terms of value, tangible products, and advances toward the homeland security mission. Accordingly, for example, House appropriations committee report language has directed S&T to demonstrate how its R&D efforts are timely, with results relatively well defined and to make investment decisions based on clear and sensible priorities.[18] In 2016, Congress passed the National Defense Authorization Act of 2017 (NDAA) which requires DHS to report annually to Congress on the department's R&D projects including details such as the project name, the component carrying out the project, associated funding levels, and expected objectives and milestones for each project, among other items.[19]

Since DHS began operations in 2003, we have made multiple recommendations designed to improve DHS efforts to manage and oversee R&D efforts, as described later in this report. In September 2012, we reported that DHS did not have a department-wide policy defining R&D or guidance directing its components how to report R&D activities.[20] As a result, DHS did not know its total annual investment in R&D, which limited the department's ability to oversee components' R&D efforts and align them with agency-wide R&D goals and priorities. We also reported that DHS's R&D efforts were fragmented and overlapping, which increased the risk of unnecessary duplication. We recommended that DHS develop policies and guidance for defining, reporting and coordinating R&D activities across the department, and that DHS establish a mechanism to track R&D projects. As of August 2017, DHS had implemented these recommendations by, among other things, issuing guidance defining research and development activities and establishing Integrated Product Teams (IPT) as a primary mechanism for coordinating R&D. These actions and others are described in more detail later in this report.

Figure 3 provides a summary of key events related to S&T since its inception.

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[18]H.R. Rep. No. 112-91, at 1227 (2011).

[19]Pub. L. No. 114-328, § 1906(a), 130 Stat. 2000, 2676 (2016) (6 U.S.C. § 195e).

[20]GAO-12-837.

Figure 3: Timeline of Key Events Related to the Science and Technology (S&T) Directorate

Year	Event
2003	DHS Science and Technology (S&T) Directorate began operations.
2004	
2005	
2006	Restructuring of S&T.
2007	
2008	
2009	
2010	S&T is re-structured to align with strategic goals.
2011	
2012	We recommended that S&T develop and implement policies and guidance for defining and overseeing R&D at the department level, including a well-understood definition of R&D, a description of the department's process and roles and responsibilities for overseeing and coordinating R&D investments and efforts, and a mechanism to track existing R&D projects and their associated costs across the department.
2013	
2014	S&T directs its project managers to include milestones to capture formalized feedback from their customers.
2015	S&T Project Management Guide is issued. Integrated Product Teams (IPTs) are established to serve as the primary mechanism for coordinating R&D and consists of S&T and DHS component representatives.
2016	S&T issues a report that lists (1) DHS-wide capability gaps and descriptions; (2) high priority department-wide R&D solutions to address the capability gaps; and, (3) a profile of all R&D work being conducted in DHS. National Defense Authorization Act of 2017 requires the Secretary of Homeland Security to submit a list of all ongoing research and development projects within the department to Congress on an annual basis with appropriate details such as the name of the component leading the effort, funding levels, timeframes and project objectives.
2017	DHS issues Directive 069-02, IPTs for Research and Development Coordination, which establishes the responsibilities and requirements of the IPTs and states that the DHS Office of the Chief Financial Officer in conjunction with S&T will provide guidance on how to report R&D spending to S&T, among other items.
2018	S&T is reorganized in an effort to better understand customer needs and execute more efficient operations.

Source: GAO analysis of DHS and GAO documents and the National Defense Authorization Act of 2017. | GAO-19-210

Past DHS Accounting Challenges

After the consolidation in 2002 of 22 agencies into a single department, DHS had, until recently, different appropriation structures and budget management practices based on agencies' funding structures prior to DHS consolidation. In 2018, we found that, with over 70 different appropriations and over 100 formal program, project, or activity accounts, DHS operated for over a decade with significant budget disparities and inconsistencies across its components.[21] The lack of uniformity hindered visibility, inhibited comparisons between programs, and complicated spending decisions, including for R&D-related programs. For example, in 2012 we reported that S&T, the Domestic Nuclear Detection Office, and Coast Guard were the only three DHS components with budget authority to conduct R&D.[22] However, in 2012, we identified an additional $255 million in R&D obligations by other DHS components at that time. Further, we found in 2012 that the Domestic Nuclear Detection Office did not report certain R&D budget data to OMB, and R&D budget accounts included a mix of R&D and non-R&D spending, which further complicated DHS's ability to identify its total investment in R&D activities.[23]

Role of the Integrated Product Teams in R&D

Within DHS, IPTs – established in 2015 – are to identify and prioritize technological capability gaps, and identify current or future R&D efforts or other solutions to close the gap, among other things.[24] Specifically, the IPT process consists of three activities: 1) Identifying R&D activities in progress, funded, planned, or recently completed; 2) Prioritizing technological capability gaps and corresponding R&D efforts to address those gaps; and 3) Validating and reporting the gaps.

The DHS IPT effort is led by S&T, but the individual IPTs are composed of senior-level officials from across DHS. IPT members prioritize R&D gaps based on departmentwide needs and requirements, and align

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[21]GAO, DHS *Program Costs: Reporting Program-Level Operations and Support Costs to Congress Would Improve Oversight*, GAO-18-344 (Washington, D.C.: Apr. 25, 2018)

[22]The Domestic Nuclear Detection Office transferred into CWMD, as part of an October 2017 reorganization.

[23]GAO-12-837.

[24]According to IPT guidance documents, R&D gaps are vulnerabilities that require research and/or development as part of the mitigation approach in order to address specific technological needs, often because a materiel solution is not available, practical, or affordable or does not meet technological readiness level.

current and planned R&D efforts to the identified gaps. In prioritizing and evaluating the capability gaps, four pre-defined criteria and rating scales are used and are discussed below:[25]

- **Strategic alignment:** assesses the R&D gaps alignment with DHS-level and component-level strategic priorities.

- **Impact:** assesses if addressing the R&D gap would result in enhanced risk or threat reduction capability, among other things.

- **Feasibility:** assesses the feasibility of addressing the R&D gap, given its technical complexity. Considerations include feasibility related to technology, time, and transition.

- **R&D needs:** assesses whether the R&D gap would provide a critical R&D solution in an otherwise unaddressed area.

The IPT's role in coordinating R&D is discussed later in this report.

Overview of DHS's Processes for Assessing R&D Performance

GPRA, as updated and expanded by GPRAMA,[26] requires agencies to establish annual performance goals with target levels of performance against which to measure progress towards those goals.[27] In addition, GPRA requires executive agencies to prepare an Annual Performance Report on program performance for the previous fiscal year. DHS has developed goals and targets to assess and communicate R&D performance. As shown in figure 4, DHS's performance assessment process also includes identifying performance gaps and implementing corrective actions to address unmet performance goals.

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[25]According to S&T documentation, the rating scales correspond to the prioritization standards that DHS components established and align with the prioritization criteria that the IPT participants utilize.

[26]Pub. L. No. 111-352, 124 Stat. 3866 (2011). GPRAMA amends the Government Performance and Results Act of 1993, Pub. L. No. 103-62, 107 Stat. 285 (1993).

[27]We use the term performance goal, which OMB and GPRA define as comprising a measure, a target, and a time frame. This is the term that most federal agencies use to assess and report performance. However, DHS uses the term performance measure instead of performance goal to distinguish its performance measures from high level mission goals. Since DHS uses the term performance measure as also comprising a measure, target and a time frame, they have all the elements of what we consider to be a performance goal, and therefore we evaluated them as such.

Figure 4: Department of Homeland Security Performance Assessment Process

Source: GAO analysis of DHS documents. | GAO-19-210

DHS uses strategic and management performance goals and measures to assess and communicate on the performance of its R&D efforts. In addition, DHS uses milestones to track and communicate progress of its R&D project activities.

- **Milestones:** A milestone is a scheduled event signifying the completion of a major deliverable or a phase of work. Milestones can help agencies demonstrate that they have clear and fully developed strategies and are tracking progress to accomplish their goals. Milestones are often used as the basis of an alternative form of performance goal. Milestones related to DHS R&D efforts are reported to Congress and publicly available through the DHS congressional budget justification.

- **Strategic Goals:** A type of performance goal used to reflect achievement of missions that are publicly reported in the DHS Annual Performance Report. As part of DHS's Annual Performance Report, these goals are subject to GPRA and GPRAMA requirements.

- **Management Goals:** A type of performance goal used to gauge program results and tie to resource requests that are reported to Congress and publicly available through the DHS congressional budget justification along with the strategic goals.

As we previously reported in 1997, experts in research measurement have tried for years to develop indicators that would provide a measure of the results of R&D. However, the very nature of the innovative process makes measuring the performance of science-related projects difficult.[28] For example, a wide range of factors determine if and when a particular R&D project will result in commercial or other benefits. It can also take many years for a research project to achieve results.

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[28]GAO, *Measuring Performance: Strengths and Limitations of Research Indicators*, RCED-97-91 (Washington, D.C.: March 1997).

DHS Has Obligated More Than $1 Billion per Fiscal Year from 2010 through 2017 for Conducting R&D That Aligns with Department Mission Areas across Seven DHS Components

R&D Funding Amounts

DHS is required to report department-wide R&D-related funding to OMB on an annual basis. DHS uses several mechanisms to report the R&D-related funding, including budget authority (the legal authorization to obligate funds), obligations (binding agreements to make a payment for services), and outlays (payments to liquidate obligations representing amount expended).[29] Further, OMB requires agencies to submit data on R&D programs as part of their annual budget submissions on investments for basic research, applied research, development, R&D facilities construction, and major equipment for R&D using OMB's definition of R&D.

Based on our analysis of OMB's federal obligations data, we identified R&D-related obligations data for DHS components for fiscal years 2010 through 2017.[30] Figure 5 depicts the R&D related obligations that were reported for fiscal years 2010 through 2017, which, on average, were about $1.3 billion annually or more than $10 billion overall for that time

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[29]An agency incurs an obligation, for example, when it places an order, signs a contract, awards a grant, purchases a service, or takes other actions that require the government to make payments to the public or from one government account to another. An obligation creates a legal liability of the government for the payment of goods and services ordered or received.

[30]OMB's MAX Portal is one of the several web-based systems that federal agencies are to use to transmit their information. Federal agencies use it to enter data and upload documentation related to a variety of reporting activities, including data required for the President's Budget and Mid-Session review, and federal Information Technology investment information.

frame. Additionally, S&T obligated nearly 80 percent of all DHS R&D funds for that time period.

Figure 5: Department of Homeland Security (DHS) Research and Development (R&D) Minimum Obligations by Fiscal Year and DHS Component

Dollars (in millions)
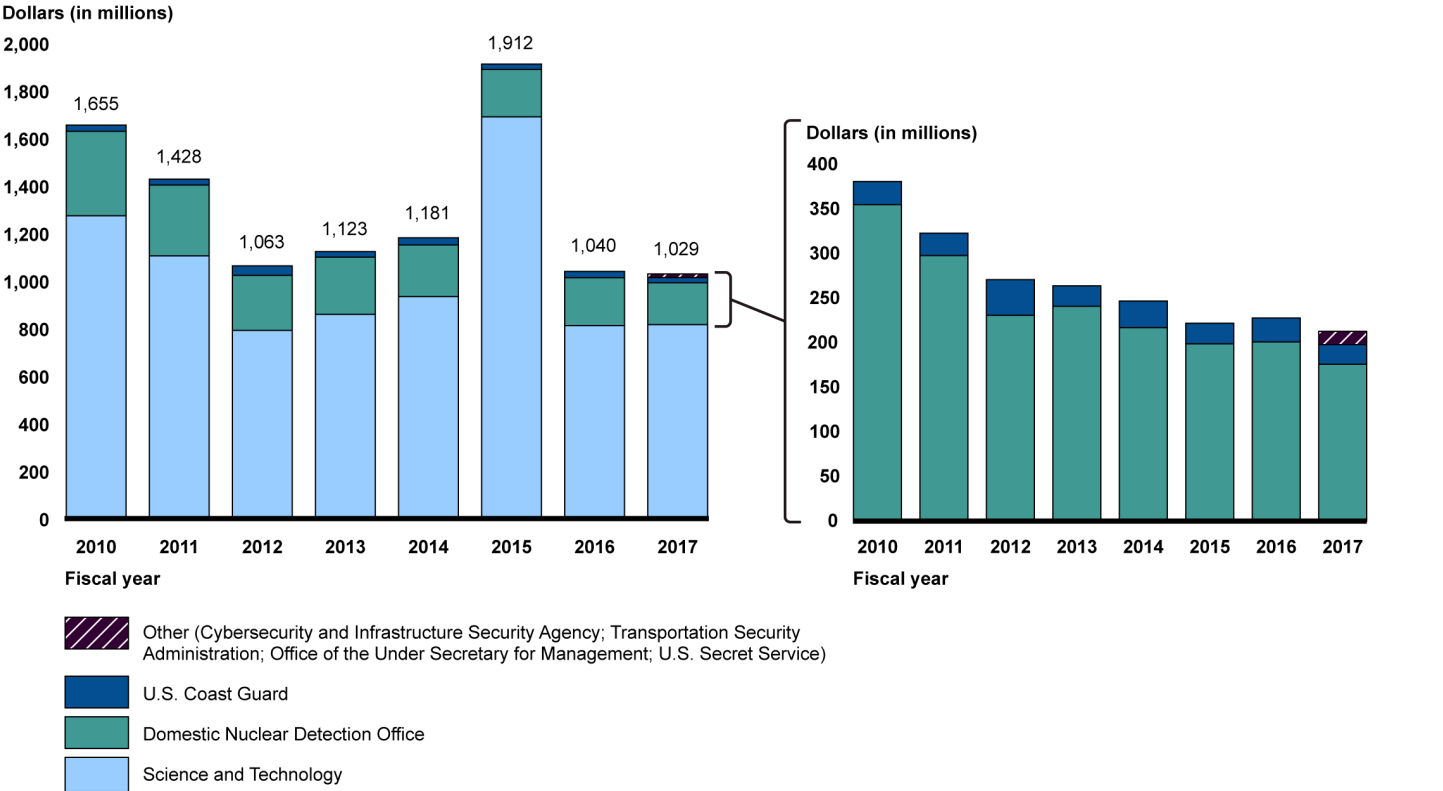
Source: GAO analysis of OMB MAX data. | GAO-19-210

Note: The Domestic Nuclear Detection Office merged with sections of the Office of Health Affairs to form the Countering Weapons of Mass Destruction (CWMD) office in fiscal year 2018. For fiscal year 2015, S&T obligations increased by $722 million (about 43 percent of S&T's 2015 R&D budget) due to land and structure improvements for a R&D laboratory facility in Kansas, according to S&T officials. In 2012, we found that some DHS R&D-related obligation data were not properly identified and were underreported. The R&D obligations listed above represent the minimum R&D-related obligation amounts and therefore these numbers should be interpreted as general trends.

Types of R&D Activities that S&T Conducts

S&T may conduct or fund R&D activities on its own or jointly with other entities. In addition to S&T, six other DHS components currently have budget authority to conduct R&D—the Coast Guard, CWMD, TSA, Secret Service, Cybersecurity and Infrastructure Security Agency, and the

Undersecretary for Management. In August 2018, S&T reported that there were at least 132 ongoing R&D projects across the Department.[31] Some R&D projects aim to produce a specific prototype or piece of technology for an end user, while others might be for developing IT systems, conducting specific training, or providing written reports, or knowledge products.

According to S&T officials, S&T generally leads or funds R&D projects by providing technology and knowledge products for four homeland security areas:

- **Disaster resilience.** Improving community resilience to natural disasters through technology and tools that support planning, decision-making and mitigation efforts;

- **Critical incidents.** Improving technological capabilities during all stages of critical incident response;

- **Border security.** Improving the nation's ability to detect, interdict and prosecute illegal activity across air, land and sea.

- **Cybersecurity.** Developing technologies, tools and techniques to defend, mitigate, and secure current and future systems, networks and critical infrastructures against cyberattacks.

Figure 6 illustrates the types of R&D projects that are either led or funded by S&T for each category. For more in-depth examples and descriptions of S&T projects, please see appendix I.

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[31]DHS officials reported that individual projects conducted within S&T's Centers of Excellence were not tallied for their most recent report in response to the requirement in the NDAA of 2017, but that they will be tallied in the future. Therefore, we report that there are "at least" 132 R&D projects. The NDAA requirement is discussed later in this report.

Figure 6: Examples of Science and Technology (S&T) Research and Development (R&D) Projects by Mission

Disaster resilience

S&T and partners conduct a flood project by designing, developing and testing sensor technology that can provide real-time updates on rising water levels for public safety and citizens. As of 2018, nearly 300 sensors will be delivered to S&T for field deployment, testing and evaluation. The estimated cost of these sensors is 20 times less expensive than what has been used in the past.

Border security

S&T works with U.S Customs and Border Protection to test the Android Team Awareness Kit (ATAK) application that allows hands-free viewing so law enforcement and responders visually track team members and assets in real time during an incident, as well as share encrypted data across jurisdictions, disciplines and components.

Critical incidents

S&T is working with the Transportation Security Administration and surface transportation authorities across the country to develop screening technologies which will enhance security in a wide variety of open, unstructured crowd venues such as a screening technology that can identify potential threats on people and in their bags without physically interacting with them.

Cybersecurity

S&T partnered with the Department of Transportation to create a cybersecurity implementation and operational primer for managers of federal vehicle fleets. DHS has one of the largest civilian vehicle fleets, with primarily law enforcement vehicles, and this project is intended to help improve DHS cybersecurity posture and safety of law enforcement officers and agents in the field.

Source: Department of Homeland Security. | GAO-19-210

In its efforts to determine how to best support the DHS components and first responders, S&T seeks first to identify the end user's needs by discussing operational challenges with components and first responders; then develop prototypes or leverage existing technologies to find solutions; and finally to test and evaluate potential solutions to ensure that they meet the end user's needs and ultimately deploy solutions to the field.

The other six DHS components with R&D budget authority typically lead and fund R&D projects tailored to support their specific operational requirements and respective missions. Examples of R&D projects conducted by DHS components other than S&T are listed below in table 1.

Table 1: Examples of Department of Homeland Security (DHS) Components' Research and Development (R&D) Projects

DHS Component	R&D Program / Project
Coast Guard	**Sensor Optimization, Automation, and Visualization.** The project evaluates various sensor technologies including, chemical, biological, nuclear, radar, electro-optical and infrared sensor systems' effectiveness and impacts to search planning, detection, and mission operations.
Countering Weapons of Mass Destruction	**Shielded Nuclear Alarm Resolution:** This sub-project develops and characterizes advanced technologies required to resolve alarms and to detect Special Nuclear Material, even when heavily shielded or masked. The project has two principal applications: 1) dramatic performance enhancement to commercially or near-commercially available x-ray nonintrusive inspection screening systems by integrating solutions directly into hardware and software to substantially reduce the number of manual inspections while increasing probability of Special Nuclear Material detection; and 2) targeted and chokepoint screening in multiple venues, including vehicle border crossings, checkpoints, rail, air cargo, and general aviation with rapidly relocatable inspection systems.
Transportation Security Administration	**Innovation Task Force.** The task force is a collaboration among TSA, manufacturers, and airports to demonstrate emerging technological, automated, ergonomic, environmental, or aesthetic improvements for checkpoint and checked baggage areas. The task force will provide a mechanism to work with industry to provide more flexible, mature, and standardized "curb to gate" security solutions and techniques that meet the "system of systems" architecture needs for the future of airport security screening and fully address the threat landscape.
Cybersecurity and Infrastructure Security Agency	**Critical Infrastructure Resilience Toolkit.** The toolkit is a suite of tools and resources intended for a broad set of infrastructure partners and focused on infrastructure security and resilience. The purpose of the toolkit is to inform infrastructure investment, development, and operational decisions.
U.S. Secret Service	**Computer Emergency Response Team.** This represents the Secret Service's long-standing commitment to develop mission-critical systems, cybersecurity investigative applications, malware analysis and applications that identify, assess, and mitigate threats to the nation's financial system, critical infrastructure, and persons and facilities protected by the Secret Service. The team developed the current tool suite utilized by the Secret Service's Critical System Protection program. These tools include Kaleidoscope (network defense platform), FlipBook (protective advance expert system application), and NightLight (remote sensing and monitoring platform). The Computer Emergency Response Team also developed the Bank Note Processing System, an application which increased the efficiency of processing counterfeit bank notes in Secret Service field offices.

DHS Component	R&D Program / Project
Office of the Under Secretary for Management	**Cloud Foundations.** These foundations provide a highly automated, secure, reliable set of managed services which are designed to facilitate the rapid deployment and subsequent support to understand and test within a wide variety of environments without the risks associated with traditionally providing these services through internal infrastructure.

S&T Implemented R&D Coordination Mechanism and Directives to Strengthen Collaboration Across DHS, but Challenges Remain in Ensuring Participation

DHS Established a Process to Coordinate R&D Efforts

DHS established its IPT process in August 2015 as the central mechanism to coordinate R&D efforts across the department, in accordance with recommendations we made in 2012.[32] The IPT process works to identify DHS technological capability gaps and coordinate R&D to close the gaps across DHS mission areas.

The IPTs consist of senior representatives from operational components. As of October 2018, IPTs are organized according to the department's identified missions and include the following sub-IPTs, as shown in table 2.

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[32]GAO-12-837.

Table 2: Integrated Product Teams (IPT) for Fiscal Years 2017-2018

IPT	Associated Sub-IPTs
Enhance Security	Air Cargo
	Checkpoint
	Checked Baggage
	Emerging Threat
	Systems Architecture and Integration
	Countering Violent Extremism
Prevent Terrorism	Critical Infrastructure
	Information Sharing
	Vetting, Remote Vetting, and Biometrics
	Explosive Screening
Prevent Terrorism: Chemical, Biological, Radiological, Nuclear	Chemical and Biological Threat Awareness
	Chemical and Biological Surveillance and Detection
	Chemical and Biological Prevention and Protection
	Chemical, Biological, and Radiological Response and Recovery
	Radiological and Nuclear Detection
	Radiological and Nuclear Forensics
Secure Borders	Air
	Land
	Maritime
	Ports of Entry
Secure Cyberspace	Cyber Forensics
	Identity Management
	Mobile Security
	Network (Systems) Security
	Privacy
	Software Security Assurance Delivery
	Critical Infrastructure Security and Resilience
Incident Management	First Responder Incident Management
	National Incident Management

Source: GAO presentation of DHS information | GAO-19-210

Each IPT has an establishing charter document, which formally identifies the IPT component members and responsibilities and lists the corresponding sub-IPTs. IPTs and sub-IPTs are to meet multiple times throughout the year to support the process of identifying and prioritizing R&D capability gaps and R&D efforts. For example, the charter for the "Secure Borders" IPT states that they anticipate meeting at least 2 or 3 times per year, or more frequently to support the annual program planning and budgeting process.

Overall, components reported that the IPT process enhanced collaboration and improved visibility into R&D efforts across DHS. Officials from all 10 of the DHS components we interviewed reported the IPT process has been helpful in various ways, including identifying capability gaps, prioritizing and closing the gaps, and providing transparency and insight into other components' R&D efforts.[33] For example, CBP officials reported that, through the IPT process, they were able to identify R&D projects that the Coast Guard had been pursuing related to maritime security. The R&D projects that Coast Guard was pursuing were also of interest to CBP, and therefore CBP worked through the IPT process to prevent duplicative work and combine some of those efforts. In another example, TSA officials reported that they collaborated with the Secret Service to test explosive screening technologies, and that the IPT process facilitated their ability to collaborate and share information about the screening technologies.

In addition to enhancing collaboration, component officials provided their perspectives on how the IPT process prioritizes technology capability gaps that components have identified. For example, TSA officials reported that the gap identification and prioritization process works well, but that funding R&D activities to close the gaps is more challenging because it is influenced heavily by competing budget priorities, emerging threats, and other DHS senior leadership priorities. TSA officials further reported that departmental resource constraints limit the number of identified capability gaps that can be addressed. However, officials from CBP reported that several R&D projects were successfully implemented after CBP had worked with S&T to identify a capability gap and transition a solution to close the gap, such as certain upgrades needed on CBP trucks. S&T officials stated that they have also taken steps to integrate with the department's Joint Requirements Council and utilize component requirement executives who work with component agencies to provide a basis for requirements and aid the components with the means to track the progress and disposition of each capability gap on a regular basis.[34]

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[33]One of the components we interviewed, CWMD, did not participate in the IPT process during 2018, as discussed later in this report. However, CWMD officials who were previously part of the Office of Health Affairs and participated in the IPT process, found it helpful.

[34]The "component requirement executives" were formerly known as "gap champions."

DHS Issued R&D Coordination Directives but Faces Challenges in Ensuring IPT Participation

In 2012, we found that, among other things, DHS had not developed a policy defining who was responsible for coordinating R&D within the department and what processes should be used to coordinate it. As a result, components did not consistently coordinate with S&T on what R&D was planned or underway, leading to increased risk of unnecessary duplication of R&D efforts. We recommended that DHS develop and implement policies and guidance for overseeing R&D that included, among other things, a description of the department's process and roles and responsibilities for overseeing and coordinating R&D investments. DHS concurred with our recommendation, and, in response, the Secretary for Homeland Security delegated the authority to coordinate and integrate the department's R&D, testing, evaluation efforts to the Under Secretary for Science and Technology in 2014.[35] In 2015 and 2016, DHS issued two guidance documents regarding the establishment and progress of the IPT process.[36] These documents specified how DHS, through the IPT process, is to implement processes and mechanisms to coordinate department-wide R&D efforts. Additionally, in January 2017, DHS issued an R&D directive and associated instruction to formalize R&D reporting and coordination among components, as shown in figure 7.[37]
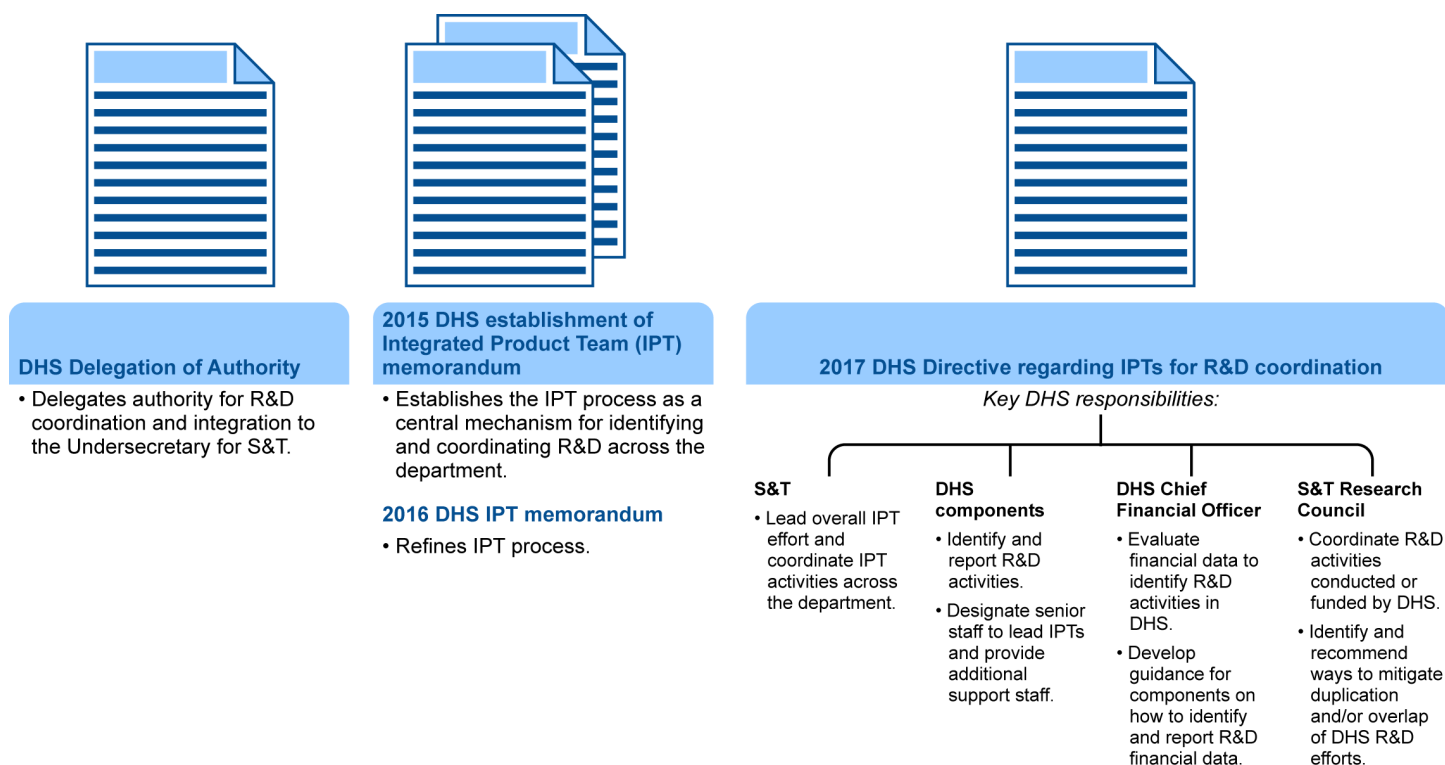
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[35]DHS, *DHS Delegation Number 10001*, Revision 1, April 28, 2014. Signed by the Secretary of Homeland Security, the document specifies that the authorities vested in the Under Secretary for Science and Technology are pursuant to regulation and law, including Chapter 1, Subchapter III of Title 6,United States Code, as may be amended, except for those authorities delegated to the Director of the Domestic Nuclear Detection Office. The document designates other S&T responsibilities related to R&D as well.

[36]DHS, *Establishment of the Integrated Product Teams Memorandum for Component Heads*, August 25, 2015 and DHS, *DHS Integrated Product Teams for FY16-17 Memorandum for Component Heads*, August 24, 2016.

[37]DHS, *DHS Directive 069-02 Revision 01 Integrated Product Teams for Research and Development Coordination*, January 19, 2017 and DHS, *Instruction 069-02-001 Revision 01 Integrated Product Teams for Research and Development Coordination,* January 19, 2017*.*

Figure 7: Department of Homeland Security's (DHS) Science & Technology (S&T) Directorate's Research & Development (R&D) Directives, 2014-2017

DHS Delegation of Authority
• Delegates authority for R&D coordination and integration to the Undersecretary for S&T.

2015 DHS establishment of Integrated Product Team (IPT) memorandum
• Establishes the IPT process as a central mechanism for identifying and coordinating R&D across the department.

2016 DHS IPT memorandum
• Refines IPT process.

2017 DHS Directive regarding IPTs for R&D coordination
Key DHS responsibilities:

S&T
• Lead overall IPT effort and coordinate IPT activities across the department.

DHS components
• Identify and report R&D activities.
• Designate senior staff to lead IPTs and provide additional support staff.

DHS Chief Financial Officer
• Evaluate financial data to identify R&D activities in DHS.
• Develop guidance for components on how to identify and report R&D financial data.

S&T Research Council
• Coordinate R&D activities conducted or funded by DHS.
• Identify and recommend ways to mitigate duplication and/or overlap of DHS R&D efforts.

Source: GAO analysis of DHS documents. | GAO-19-210

The 2017 directive and associated instruction identify the roles and responsibilities, including IPT participation requirements, for key entities involved in R&D across DHS. However, the directive and instruction do not specifically address steps to be taken if components do not adhere to the requirements. For example, the January 2017 DHS instruction states that "to effectively coordinate DHS R&D activities, DHS components are required to follow the DHS IPT process." However, officials from CWMD stated that they do not participate in the S&T-led IPT sessions because they have their own internal process for identifying and prioritizing capability gaps.[38] S&T officials stated that CWMD's predecessor organization, the Domestic Nuclear Detection Office, participated in the

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[38]Officials from the component told us that, although they do not participate in the IPT process, they do respond to IPT-initiated "data calls" for information on R&D projects, discussed later in this report.

IPT process until DHS initiated a reorganization of its weapons of mass destruction programs (resulting in the current CWMD).

Current non-participation by CWMD, which has the second-largest R&D budget within DHS and obligated approximately 17 percent of DHS R&D funds, or $176 million in fiscal year 2017, poses risk of R&D project information not being shared among components.[39] In August 2018, we reported that DHS's chemical defense programs and activities were fragmented and not well coordinated across the department, including R&D activities.[40] We recommended that CWMD develop a strategy and implementation plan to help DHS integrate and coordinate its chemical defense programs and activities, among other things. Additionally, in its 2014-2018 Strategic Plan, DHS states that, to anticipate key threats, DHS should, among other things, prioritize R&D activities related to chemical, biological, radiological, and nuclear terrorism. Given these factors, CWMD's participation in the IPT process is important to ensure that all R&D efforts are fully coordinated thereby mitigating the risk of potential duplication of other DHS R&D efforts.

S&T officials recognize that some components might not be complying fully with the departmental directives and associated guidance documents which require participating in the IPT process – the key R&D coordination mechanism within DHS. S&T officials stated that, despite these challenges, they have strong collaborative relationships with the components, and the existing collaboration mechanisms, such as the IPT process, continue to mature and facilitate R&D-related information sharing. However, DHS guidance documents require that components participate in the IPT process. By ensuring that all required components participate in the IPT process, DHS can help S&T maintain visibility of R&D projects in order to fulfill its statutory role of coordinating R&D.

[39]The Domestic Nuclear Detection Office merged with sections of the Office of Health Affairs, among others, to form the CWMD office in fiscal year 2018. Obligation data presented is from the Domestic Nuclear Detection Office.

[40]GAO, *Chemical Terrorism: A Strategy and Implementation Plan Would Help DHS Better Manage Fragmented Chemical Defense Programs and Activities,* GAO-18-562 (Washington, D.C.: Aug. 22, 2018)

S&T Has Taken Steps to Identify and Track DHS's R&D Project Information, But Efforts Are Disjointed or Do Not Align with DHS Guidance

Since 2012, S&T has taken steps to identify and track information related to ongoing R&D projects across DHS, and in 2017, DHS developed a common appropriations structure that standardized R&D budgeting processes across the department. However, S&T's efforts to identify and track R&D project information have limitations and can result in information that is not comprehensive. We also identified challenges in collecting information related to the achievement of R&D milestones.

DHS Developed the Common Appropriations Structure to Better Streamline and Standardize the Budgeting Process across Components

In 2017, DHS developed a common appropriations structure that allowed it to calculate and monitor its expenses, including R&D expenses, across the department.[41] Officials from DHS's OCFO reported that, prior to the new structure, some components categorized their R&D expenses as other types of expenses, such as "salaries and expenses." These categorizations made it difficult to account for R&D expenses outside of an individual component's budget management division. Furthermore, OCFO officials reported that components previously utilized inconsistent R&D definitions, which often led to discrepancies in how components would report R&D activities.

In our April 2018 report, we found that DHS had operated for over a decade with significant budget disparities and inconsistencies across its components.[42] We found that the lack of uniformity hindered visibility, inhibited comparisons between programs, and complicated spending decisions. According to DHS OCFO officials, the introduction of the common appropriations structure, among other things, has helped improve transparency within DHS and among the components so that R&D can be more readily identified and tracked. DHS is also able to compare R&D funding amounts throughout DHS more easily than in previous years. In addition, of the seven components that have their own R&D funding to report, five indicated that the new structure has improved the department's ability to identify and report R&D activities.

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[41]DHS OCFO officials we interviewed reported that, prior to the common appropriations structure, DHS had a disparate budget structure, due in part to the various account structures it "inherited" from the agencies that were consolidated to form DHS.

[42]GAO-18-344.

S&T's Efforts to Maintain an Inventory of R&D Projects across DHS Have Resulted in Reporting That Is Not Comprehensive

We identified multiple sources of component R&D project information, each posing its own challenges or limitations. As described below, these challenges and limitations include difficulty in collecting and integrating R&D project information, and reporting that is not comprehensive.

DHS's response to the National Defense Authorization Act of 2017: The NDAA, passed in December 2016, required DHS to provide a list of ongoing R&D projects and accompanying milestone information by January 2017, and annually thereafter, to specified congressional committees.[43] In December 2017, DHS officials reported that they had not yet submitted the report, and anticipated that the response to the NDAA requirement would be completed by January 2018. In August 2018, DHS submitted its response to the committee, then 19 months late. S&T officials stated that the reporting delays were due to challenges in collecting and integrating the data. S&T officials also reported that it used the components' congressional budget justification documents as a starting point to identify R&D projects to include in its report in response to the NDAA requirement. However, additional details about the R&D projects had to be collected via a "data call" process from the components. S&T officials told us that it was a challenge to have components report information about their R&D projects consistently and systematically. Furthermore, S&T officials identified terminology-related challenges in their R&D data call efforts, including making distinctions between R&D projects, efforts, and activities. S&T officials also reported that, in its current format, they would not be able to easily identify how many projects were added to the NDAA list across years, or if a given R&D project experienced a large increase or decrease in funding.

Annual Reports of Coordinated R&D: In response to a 2015 request from the Secretary of Homeland Security that the IPTs identify R&D work being performed across DHS, S&T issued a "Report of Coordinated R&D" in 2016 and 2017. The content for the reports was developed through a "data call" process, and the reports identified R&D activities and projects across DHS. The reports – for 2016 and 2017 – contain tables of R&D project names and the component leading the project, among other things. However, during the course of our review, S&T officials reported that these annual reports should not be considered authoritative lists of

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[43]These are the Committee on Homeland Security of the House of Representatives and the Committee on Homeland Security and Governmental Affairs of the Senate.

R&D projects due to inconsistencies in the project information that components reported which led to the reports not being comprehensive. For example, when we asked about some significant variations in the number of projects between 2016 and 2017, S&T officials told us that one DHS component responded to the data call with a list of R&D activities that included a "wish list" of R&D for their component, and not actual ongoing R&D activities. DHS officials acknowledged that they do not have a mechanism to ensure the comprehensiveness of information reported by the components through the data call process. In addition, two components did not respond to S&T's request for R&D project information for the 2017 Annual Report of Coordinated R&D.

Congressional Budget Justifications: In May 2018, in the absence of a single, comprehensive list of R&D projects across DHS prior to the issuance of its report in response to the NDAA, S&T officials referred us to the R&D projects listed within the seven individual congressional budget justifications for the components that currently have budget authority to conduct R&D. Furthermore, as discussed earlier, S&T officials used the congressional budget justifications as their starting point in developing their response to the NDAA. However, S&T officials stated that there may be differences between the projects listed in the NDAA response and the projects listed in the congressional budget justifications. For example, S&T stated that the report in response to the NDAA includes all "ongoing" projects, regardless of the fiscal year in which they received funds; while the congressional budget justifications include R&D projects for which funding was requested for the given fiscal year. In other words, S&T officials clarified, they included all R&D projects in their response to the NDAA that had project activity, regardless of whether funding was requested in a particular congressional budget justification.

S&T's Project Tracker Database and the S&T Analytical Tracking System: A 2014 House Appropriations Committee report noted that the committee had repeatedly raised questions about S&T's prioritization of R&D projects and that, without the ability to easily review and compare detailed information on all S&T projects and activities, the Under Secretary for S&T could not effectively carry out S&T's responsibilities.[44] Accordingly, the Committee directed S&T to develop a method or system

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[44]H.R. Rep. No. 113-481, at 115 (2014).

for tracking all S&T-funded R&D projects.[45] A November 2016 DHS Directive reiterates this requirement, specifying that the list of projects should be updated on at least a quarterly basis throughout the duration of an R&D project. S&T officials told us that, in response to the committee report, they developed the Project Tracker Database, which was in use at the time of our review, but was transitioned to a new system, the S&T Analytical Tracking System, in September 2018. Neither the S&T Analytical Tracking System nor its predecessor system, the Project Tracker Database, is intended to comprehensively collect information on R&D projects across the department, only for R&D projects managed within S&T.[46] Given the recent implementation of the S&T Analytical Tracking System, it is too soon to tell whether it will improve and streamline S&T's efforts to collect and analyze R&D-related information within the directorate.

In addition, S&T officials stated that none of the above R&D information sources are suited to long-term trend analysis or data aggregation of department-wide R&D project information, and that these sources are disparate across DHS. S&T officials also acknowledged that better aligning R&D project information sources is an important aspect of improving how the department collects information DHS-wide.

Standards for Internal Control in the Federal Government call for agencies to maintain quality information that is, among other things, current, accurate, accessible, and provided on a timely basis.[47] Furthermore, the standards call for an agency's management team to process relevant data from reliable sources and utilize it to make informed decisions. The disparate R&D project information sources that S&T maintains, such as DHS's response to the National Defense Authorization Act of 2017 and the Annual Reports of Coordinated R&D discussed above, and the manual data-call process it takes to update the sources limits departmental access to current and reliable R&D project

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[45]The S&T Analytical Tracking System and its predecessor system, the Project Tracker Database, contain information on S&T-funded R&D projects only. Neither system contains information on R&D projects funded by other DHS components with R&D budget authority, such as CWMD or the Coast Guard, among others.

[46]We identified other R&D data repositories, including the S&T Project Sites, and the S&T Collaboration Sites. However, S&T considers these to be archived repositories or meant to be used in conjunction with other systems, such as the Project Tracker Database. Therefore, we do not cover those additional systems in detail.

[47]GAO-14-704G

information. For example, an internal DHS web-based portal with pre-defined fields could provide component officials with a means for reporting information more consistently and comprehensively. Without complete and readily accessible R&D information, DHS may not have the information it needs to make informed decisions about R&D investments, such as which projects are to be prioritized. By developing a mechanism to address challenges and limitations related to the collection, integration, and comprehensiveness of R&D data across the department, S&T can improve its visibility on R&D efforts across DHS in accordance with its role as DHS's coordinator of R&D efforts.

DHS Has Not Effectively Developed Some R&D Performance Management Information, Posing Challenges to Assess and Report on the Progress of R&D Projects

DHS components have processes in place to collect certain indicators of R&D performance, but we found that these processes have limitations. The methods used to assess and report performance and progress of DHS R&D efforts we identified include:[48]

- Milestone information – used to assess and communicate progress to Congress and agency decision makers on individual R&D projects

- Strategic and Management Performance Goals – milestone and other information is aggregated to provide summary information on R&D performance by mission area

- Customer feedback – information gathered by component officials on R&D customer perspectives on the utility of ongoing or completed projects

Below is our analysis of the three methods.

Milestones

Milestones are often used as the basis of an alternative form of performance goal. Performance goals specified in alternative form must be described in a way that makes it possible to discern if progress is being made toward the goal. Milestones related to DHS R&D efforts are reported to Congress and publicly available through the DHS congressional budget justification. A milestone is a scheduled event signifying the completion of a major deliverable or a phase of work, and

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[48]DHS components may also collect additional information to manage and report on their R&D efforts. For example, DHS components report funding (appropriated or requested) and obligation data for research projects in the DHS Congressional Budget Justification. In addition, components, such as CWMD, may also collect information on publications in peer-reviewed journals, presentations at recognized scientific conferences, licenses for software, and awards in recognition of scientific achievements.

can be described in a way that makes it possible to discern if progress is being made toward a goal. Milestones can also help agencies demonstrate that they have clear and fully developed strategies and are tracking progress to accomplish their goals. In our analysis of 14 milestones for seven S&T high-priority R&D projects identified in fiscal year 2018 DHS budget justification documents, we found that 3 of the 14 milestones fully adhered to DHS guidance for milestone descriptions.[49] DHS budget development guidance suggests DHS components, which develop milestones for inclusion in congressional budget justification documents, utilize leading practices provided in the guidance. The leading practices state that successful milestones contain the following characteristics:[50]

1. Specific - provide a clear understanding of expected results;

2. Measurable - the result can be reported in quantitative or qualitative terms;

3. Results-Oriented/Relevant - milestone clearly links to results-oriented activities such as strategy, budget, and/or program/project plans;

4. Time-Bound - milestone specifies a beginning and end date for completion[51]

As shown in table 3, we identified that more than half of the milestones (8 of 14) were not specific and 10 of 14 were not results-oriented. Eleven of 14 milestones we analyzed were measurable and time-bound. While our analysis is not generalizable to all fiscal year 2018 R&D milestones, it illustrates areas where the selected milestones do not fully incorporate the DHS guidance.

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[49]According to S&T officials, certain high-priority R&D efforts are contained within their Apex programs, which represent a significant portion of S&T's R&D budget. Apex programs are a collection of S&T projects designed to improve technological capabilities related to broad homeland-security related goals, such as improving airport security screening speeds and improving border security awareness.

[50]DHS guidance also states that milestones should be attainable—in that they provide a realistic plan of what may be accomplished during the fiscal year considering available resources and other challenges. We did not assess the attainability element because it is beyond the scope of our review to determine what external factors may or may not affect the feasibility of implementing or not implementing specific milestones.

[51]Milestone beginning and end dates may be included as part of project scheduling information submitted in conjunction with the milestone.

Table 3: Analysis of Selected Science and Technology Directorate (S&T) Research and Development (R&D) Project Milestones per Department of Homeland Security (DHS) Guidance

Project and Milestone Name	Specific	Measurable	Results-Oriented / Relevant	Time-Bound[a]
Project: Apex Screening at Speed				
1. Analysis and primary design of a video passenger identity correlation system in an airport environment.	✗	✓	✓	✓
2. Optimized phase contrast imaging prototype design for carry-on screening, including raw data of explosive and benign materials scanned using phase contrast methodologies.	✓	✗	✗	✓
Project: Apex Border Situational Awareness				
3. Perform Spiral 2 requirements analysis and develop requirements focused on tactical response for CBP.	✗	✓	✗	✓
4. Initiate Spiral 3; focused on improving strategic planning for CBP.	✗	✓	✗	✓
Project: Apex Next Generation Cyber Infrastructure				
5. Revalidate Financial Sector Requirements and conduct test & evaluation of technologies in two additional project areas to address cybersecurity gaps in sector	✗	✓	✗	✗
6. Transition proven prototype technologies, all analyses, models and knowledge products, to Financial Services Sector Institutions	✓	✓	✗	✓
Project: Apex Real-Time BioThreat Awareness				
7. Perform baseline biosurveillance workshops and table-tops in local jurisdictions to capture current situational awareness capabilities of state and local governments.	✓	✓	✗	✗
8. Demonstrate tools for capture and analysis of biosurveillance related data sources at the State and local level.	✓	✓	✓	✓
Project: Apex Next Generation First Responder Program				
9. Demonstrate Integration Spiral 3, incorporating additional technologies and functionality from the Spiral 2 and PlugFest events, including environmental and physiological monitoring augmented intelligence-enabled data synthesis, and personal protective equipment.	✗	✓	✗	✓
10. Transition, commercialize, or make available through open source platforms at least three technologies (e.g., Analyses, models, technology prototypes and/or knowledge prototypes).	✗	✓	✗	✓
Project: Apex Flood				
11. Determination on the feasibility of near real-time monitoring of dam/levee integrity by transmitting geo-targeted alerts from deployed dam/levee integrity/breach sensors. Includes creating and testing prototypes of the necessary low-cost, deployable, networked dam/levee sensors.	✓	✓	✓	✓

Project and Milestone Name	Specific	Measurable	Results-Oriented / Relevant	Time-Bound[a]
12. Deploy the first phase of a structure-level data utility service that provides insurers, flood plain managers and consumers with Digital Elevation Models (DEM) of structures whose geospatial footprints have been digitized through aerial imagery.	✓	✓	✓	✓
Project: Apex Cyber.gov				
13. Testbeds and pilot with at least one department or agency.	✗	✗	✗	✗
14. Analysis and inclusion of new technologies to enhance the cybersecurity architecture based upon pilots.	✗	✗	✗	✓
Milestones that did not meet guidance	**8 of 14**	**3 of 14**	**10 of 14**	**3 of 14**

Legend: ✓ = yes; ✗ = no
Source: GAO analysis of DHS fiscal year 2018 Congressional Budget Justification documents | GAO-19-210

[a]To evaluate whether a milestone was time-bound, we also examined schedule information in the Congressional Budget Justification.

Below is more detail on our assessment of the Specific and Results-Oriented guidance.

Specific. Of the 14 milestones we reviewed, eight did not contain specific information that would allow reviewers to have a clear understanding of the result expected in connection with the milestone. For example, one milestone for a cyber-related R&D project states that "testbeds and pilots would be conducted with at least one department or agency." However, the milestone is not specific enough to ascertain what types of testbeds or pilots are being assessed and how the testbed effort would link to a possible end result.

Results-Oriented and Relevant. Ten of the 14 milestones that we reviewed did not clearly link the milestone back to results-oriented activities, such as strategy, budget, or project/program plans. For example, one milestone for a first responder program stated the following: "Transition, commercialize, or make available through open source platforms at least three technologies (e.g., Analyses, models, technology prototypes and/or knowledge prototypes)." It is unclear which technologies would be transitioned or how these technologies would be transitioned and made available.

According to DHS OCFO officials, DHS congressional budget justifications, which include milestones, serve to provide explanation and detail for why DHS believes Congress should support the department's R&D projects. DHS components are instructed by DHS's budget office to routinely submit their congressional budget justifications for internal DHS

review, which is a process and mechanism that results in the supporting justifications for R&D funding requests. DHS OCFO officials also stated that they are not aware of a singular reason for why milestones do not consistently incorporate DHS's guidance and stated that they have also identified instances in which milestones do not align with the guidance. As our analysis indicates, S&T's milestones could better incorporate milestone criteria included in DHS's budget preparation guidance. Without milestone information that more closely aligns with DHS guidance, Congress and DHS decision-makers may not be able to fully assess whether R&D projects are meeting specific goals within assigned time frames or identify what adjustments, if any, may be needed to facilitate the achievement of project goals and the R&D mission overall.

Strategic and Management Performance Goals

DHS has developed 12 performance goals to assess and report on its R&D efforts, DHS is required to identify department-wide goals in its strategic plan and annual performance report. For fiscal years 2016 through 2018, DHS's Annual Performance Report included two strategic performance goals related to S&T's R&D efforts. DHS's congressional budget justification includes the two strategic performance goals as well as 10 related management performance goals. For a detailed listing of the 12 performance goals, see table 4.

Table 4: Information on the Department of Homeland Security's (DHS) Research and Development (R&D) Performance Goals Reported in the DHS Annual Performance Report for Fiscal Years 2016 – 2018 and Fiscal Year 2018 Congressional Budget Justification

DHS Component[a]	Performance Goal	Goal Type[b]	
		Strategic	Management
Domestic Nuclear Detection Office[c]	Number of comprehensive evaluations and demonstrations of new and improved technologies to protect against nuclear terrorism	0	1
	Number of undergraduate, graduate, and post-doctorate fellowships and internships, early-career awards, and academic research awards in nuclear forensics and radiation detection-related specialties	0	1
	Percent of Research & Development program and project milestones successfully achieved	0	1
Science and Technology Directorate	Percent of planned cybersecurity products and services transitioned to government, commercial and open sources	1	0
	Number of SAFETY Act "transition" (new, highly innovative) technologies awarded.	0	1
	Percent of Apex technologies or knowledge products transitioned to customers for planned improvements in the Homeland Security Enterprise	1	0

DHS Component[a]	Performance Goal	Goal Type[b]	
		Strategic	Management
	Percent of Capabilities Development Support Group program milestones that are met, as established in the fiscal year's budget execution plan	0	1
	Percent of Homeland Security Advanced Research Projects Agency program milestones that are met, as established in the fiscal year's budget execution plan	0	1
	Percent of Research and Development Partnerships program milestones that are met, as established in the fiscal year's budget execution plan	0	1
	Percent of the Homeland Security Enterprise and First Responders Group program milestones that are met, as established in the fiscal year's budget execution plan	0	1
	Percent of university programs milestones that are met, as established in the fiscal year's budget execution plan	0	1
	Percent of fiscal year milestones met for the Administration and Support Division governed by applicable laws, regulations and management directives	0	1
Total		**2**	**10**

Source: GAO Analysis of DHS Annual Performance Report for Fiscal Years 2016 - 2018 and DHS Fiscal Year 2018 Congressional Budget Justification | GAO-19-210

[a]Performance goals were reported for the Domestic Nuclear Detection Office and the Science and Technology Directorate. DHS has not developed and reported performance goals for other components' R&D efforts, including the Coast Guard, Transportation Security Administration, Cybersecurity and Infrastructure Security Agency, U.S. Secret Service, or the Office of the Under Secretary for Management.

[b]Strategic goals are used to reflect achievement of missions and are publicly reported in the DHS Annual Performance Report. Management goals are used to gauge program results and tie to resource requests that are reported to Congress through the DHS congressional budget justification, along with the strategic goals.

[c]The Domestic Nuclear Detection Office transferred into the DHS Countering Weapons of Mass Destruction Office, as part of an October 2017 reorganization.

Seven of the 10 management performance goals were for S&T R&D efforts and the remaining three were for Domestic Nuclear Detection Office's R&D efforts, which cover the components that account for 96 percent of DHS' fiscal year 2017 R&D obligations.[52] DHS has performance goals for mission programs that produce operational results that link directly to the DHS Strategic Plan, according to officials from the OCFO's Program Analysis and Evaluation division. DHS also uses milestones to track the progress of the other components' R&D efforts.

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[52]The Domestic Nuclear Detection Office transferred into the DHS Countering Weapons of Mass Destruction (CWMD) Office, as part of an October 2017 reorganization.

R&D Customer Feedback

DHS components that conduct R&D use various methods to collect and analyze customer feedback to assess their R&D efforts, as shown in table 5. However, DHS is not well positioned to integrate the results because limited customer feedback information is collected and analyzed.

Table 5: Methods Used by Department of Homeland Security (DHS) Components to Collect Customer Feedback on Research and Development Efforts

DHS Component[a]	Examples of Customers	Customer Feedback Method			
		Survey	In-Person Interview	External Review[b]	Internal Review[c]
Science and Technology Directorate	DHS operational components and the first responder community	✓	✗	✗	✗
Coast Guard	Coast Guard operational commands	✓	✓	✗	✗
Countering Weapons of Mass Destruction	Private sector, other federal agencies, state, local, tribal, and territory government agencies	✗	✗	✓	✓
Transportation Security Administration	TSA, manufacturers, and airports to support passenger and baggage screening efforts	✗	✗	✗	✓
Cybersecurity and Infrastructure Security Agency	Other departments and agencies as well as private industry	✗	✗	✗	✓
U.S. Secret Service	Secret Service operational units	✗	✗	✗	✓
Office of the Under Secretary for Management	DHS Office of the Chief Information Officer and Office of the Chief Technology Officer to support department-wide missions and activities.	✗	✗	✗	✗

Legend: ✓ = yes;   ✗ = no

Source: GAO analysis of DHS information | GAO-19-210

[a]DHS components listed in this table are those with R&D obligations in FY 2017. The Office of the Under Secretary for Management has R&D obligations, but did not provide documentation indicating customer feedback mechanisms are used.

[b]External review include reviews conducted by eventual end users and contractors.

[c]Internal review includes component officials reviewing R&D project information that may include feedback from R&D customers.

Six DHS components that have R&D-related responsibilities evaluate customers' needs and improve customer satisfaction by listening to customers' feedback about the quality of deliverables they receive—both

good and bad— and making changes necessary to enhance that deliverable. Specifically, officials from S&T, the Coast Guard, CWMD, TSA, the Cybersecurity and Infrastructure Security Agency, and the Secret Service stated they have varying methods in place for gathering customer feedback regarding the progress and the results of R&D activities and deliverables. Below is a summary of these components' efforts to consider customer feedback.

- **S&T.** S&T's project management guide outlines a process for ensuring customer requirements are being adequately met using a customer survey that can be modified and provided to the customer to complete at each major milestone. In addition, proceedings (e.g., minutes) from regularly scheduled meetings with customer and end user groups may be used to gather information regarding value and operational impact in lieu of a survey.[53] The S&T survey asks customers to rate their overall satisfaction with S&T products and services, along with specific aspects of support, such as providing products in time to meet needs and effectively keeping customers informed. However, out of the 97 R&D activities that S&T reported in fiscal year 2017 and the 110 activities in fiscal year 2016, S&T collected one customer survey form.

- **Coast Guard.** The Coast Guard also has a process in place for surveying and interviewing its customers following the completion of an R&D project and officials reported using this information for future R&D planning. The Coast Guard's survey instrument seeks feedback on: customer satisfaction, timeliness, utility, and communications, among other things. The customer service survey is distributed for feedback on deliverables. At least 6 months after an R&D project is completed, Coast Guard also conducts an in-person interview with project sponsors to collect project transition performance success and feedback information. The surveys that Coast Guard uses to obtain feedback elicit a relatively low number of responses from customers, significantly limiting their usefulness in soliciting feedback data. Specifically, the response rates for fiscal years 2013-2017 were 16%, 17%, 27%, 13%, and 17%, respectively. Experts on customer

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[53]We previously recommended in September 2013 that S&T establish timeframes and milestones for collecting and evaluating feedback from its customers to determine the usefulness and impact of its R&D projects and deliverables. S&T concurred with our recommendation and directed S&T Project Managers to, among other things, capture formalized feedback from their customers in July 2014. GAO, *Department of Homeland Security: Opportunities Exist to Better Evaluate and Coordinate Border and Maritime Research and Development*, GAO-13-732 (Washington, D.C.: Sept. 25, 2013).

satisfaction measurement have stated that although survey response rates are never 100 percent, an organization should strive to get its rate as close as possible to that number.[54] They suggest that ideally, organizations can obtain response rates of over 70 percent.

- **CWMD.** CWMD does not have a formal mechanism, such as standard processes and procedures, for collecting and analyzing customer feedback. However, CWMD officials stated that certain informal mechanisms are used to collect customer feedback. For example, CWMD officials reported that the CWMD Office of Policy, Plans, Analysis, and Requirements Directorate communicate with customers and gather customer needs and requirements. In addition, as part of these informal mechanisms, internal and external reviews feedback may be obtained from eventual end users of the R&D technology such as operators from CBP, the U.S. Coast Guard, and the TSA, according to CWMD officials.

- **Cybersecurity and Infrastructure Security Agency.** The directorate does not have a formal mechanism for collecting and analyzing customer feedback. However, periodic control gates are used to gather customer feedback, according to directorate officials. The input received during these reviews is used to make corrective actions and manage R&D efforts as necessary. For example, according to directorate officials, they conduct a comprehensive review of R&D coordination efforts annually to determine what was effective and what can be improved.

- **TSA.** TSA does not have a formal mechanism for collecting and analyzing customer feedback. However, according to TSA officials, informal feedback may be obtained through review of the weekly reports and meetings regarding recent developments and project milestones. In addition, feedback may be obtained during quarterly program management reviews, third party project development, and certification testing.

- **Secret Service.** The Secret Service does not have a formal mechanism for collecting and analyzing customer feedback. However, according to Secret Service officials, informal feedback may be obtained in conjunction with other related internal review activities, including program management reviews.

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[54]See J. Anton and D. Perkins, Listening to the Voice of the Customer, 16 Steps to a Successful Customer Satisfaction Measurement Program, The Customer Service Group (New York City: 1997).

To formalize and improve customer feedback processes for R&D efforts, the National Academy of Sciences has stated that feedback from both R&D failures and successes may be communicated to stakeholders and used to modify future investments. Research on leading practices in the area of customer satisfaction suggests that multiple approaches are needed to effectively listen to customers about their perceptions of quality service and needs. The research also points to a need for centrally integrating all customer feedback so that managers can achieve a better understanding of customers' perceptions and needs. Also, we have previously reported that leading organizations combine quantitative and qualitative listening tools to obtain customer feedback and then centrally integrate the data in one location.[55] Such approaches include the following:

- **Customer satisfaction surveys.** We previously reported that most major organizations use tools such as surveys to periodically capture customers' overall perceptions about their organization and to measure satisfaction with specific transactions soon after they occur.[56] These surveys can be administered through the mail, by telephone, in person, or electronically.

- **Benchmark surveys.** Benchmark surveys gather perceptions of performance from the entire market. These surveys usually gather customer perceptions of performance about top competitors in an industry. This allows the company to examine its customer-perceived strengths and weaknesses in the overall marketplace. While continuous improvement may be a result of this listening tool, the real value, according to the research in this area, comes from breakthrough thinking to gain a sustainable advantage.

- **Focus groups.** Organizations use focus groups to get better information from customers than survey results provide. In these groups, customers are probed about why they answered survey questions the way they did.

- **Customer interviews.** Conducting interviews with customers can provide a way to get very detailed information about their specific needs and problems. Like focus groups, this tool is used by leading

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[55]GAO. *Defense Logistics: Improving Customer Feedback Program Could Enhance DLA's Delivery of Services*, GAO-02-776 (Washington, D.C.: September 9, 2002).

[56]GAO-02-776.

customer service organizations to probe survey respondents as to why they answered survey questions a certain way.

The National Academy of Sciences have stated that evaluating the relevance and impact of R&D is a key stage of the R&D process and that measuring the impact of R&D activities requires looking to the end users and stakeholders for an evaluation of the impact of a research program, such as through polling or systematic outreach.[57] In addition, *Standards for Internal Control in the Federal Government* calls for entities to determine an oversight structure to fulfill responsibilities that are set forth by feedback from key stakeholders, among other things. As a result of the limited customer feedback information that is collected and analyzed, DHS is unable to more fully understand its customers' perceptions and experience to allow it to assess the benefits and performance of its R&D efforts. Moving forward, standard processes and procedures for collecting and analyzing R&D customer feedback would help in assessing R&D efforts.

Conclusions

Since 2010, DHS has obligated more than $10 billion dollars on R&D to develop technologies to support DHS's efforts to prevent, mitigate, and recover from terrorist and natural threats. S&T officials indicated that they have strong collaborative relationships with components; however, it is important that required components fully participate in the IPT process in order for S&T to maintain visibility of R&D projects and successfully fulfill its statutory role of coordinating R&D and to help reduce the risk of potential duplication of R&D efforts across the department. Furthermore, S&T faces challenges and limitations related to the collection, integration, and comprehensiveness of information on R&D projects. Without a mechanism that aligns information sources and results in comprehensive and accurate data, among other things, DHS may not have the information it needs to make informed decisions about R&D investments. S&T also does not fully leverage existing guidance when developing milestones for R&D efforts. Without milestone information that more fully aligns with DHS criteria, Congress and DHS decision-makers may not have a full understanding of R&D progress and challenges. Finally, standard processes and procedures for collecting and analyzing R&D customer feedback would help to assess its R&D efforts.

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[57]National Academy of Sciences, Best Practices in Assessment of Research and Development Organizations. 2012.

Recommendations for Executive Action

We are making the following four recommendations to the Deputy Secretary of the Department of Homeland Security:

The Deputy Secretary of the Department of Homeland Security should ensure that all components adhere to IPT participation requirements, in accordance with the DHS directives. (Recommendation 1)

The Deputy Secretary of the Department of Homeland Security should develop a mechanism that aligns processes and information sources for collecting R&D project data from DHS components to ensure that the information can be collected, integrated and result in a comprehensive accounting of R&D projects DHS-wide. (Recommendation 2)

The Deputy Secretary of the Department of Homeland Security should direct OCFO program officials to ensure that S&T take steps to more fully incorporate leading practices, such as those included in DHS's budget preparation guidance, into R&D milestones. (Recommendation 3)

The Deputy Secretary of the Department of Homeland Security should develop standard processes and procedures for collecting and analyzing customer feedback, applicable to components conducting R&D, for improving the usefulness of existing customer feedback mechanisms to assess R&D efforts and for implementing such mechanisms where absent. (Recommendation 4)

Agency Comments and our Evaluation

We provided a draft of this report to DHS for review and comment. DHS provided written comments which are reproduced in appendix II. In its comments, DHS concurred with our recommendations and described actions planned to address them. S&T, OCFO, CBP, the Cybersecurity and Infrastructure Security Agency, and CWMD also provided technical comments, which we incorporated as appropriate.

With regard to our first recommendation, that the Deputy Secretary of the Department of Homeland Security should ensure that all components adhere to IPT participation requirements, in accordance with DHS directives, DHS stated that S&T's Office of Science & Engineering will revise the relevant DHS directive to require participation in the IPT process by all components. DHS estimated that this effort would be completed by December 31, 2019. This action, if fully implemented, should address the intent of the recommendation.

With regard to our second recommendation, that the Deputy Secretary of the Department of Homeland Security should develop a mechanism for collecting R&D project data in order to complete a comprehensive accounting of R&D projects DHS-wide, DHS stated that S&T's Office of Science & Engineering will revise the relevant DHS directive to include requirements for data collection on all R&D projects across DHS to ensure alignment of the appropriate data elements and existing guidance. DHS estimated that this effort would be completed by December 31, 2019. This action, if fully implemented, should address the intent of the recommendation.

With regard to our third recommendation, that the Deputy Secretary of the Department of Homeland Security should direct OCFO program officials to ensure that S&T take steps to more fully incorporate leading practices, such as those included in DHS's budget preparation guidance, into R&D milestones, DHS stated that the OCFO will continue to work with S&T to incorporate the leading practices and that the OCFO will validate all S&T annual budget submissions and provide S&T feedback, as appropriate. DHS estimated that this effort would be completed by April 30, 2020. This action, if fully implemented, should address the intent of the recommendation.

With regard to our fourth recommendation, that the Deputy Secretary of the Department of Homeland Security should standardize processes for collecting and analyzing customer feedback to aid in assessing R&D efforts, DHS stated that S&T's Office of Science & Engineering will revise the relevant DHS directive to incorporate customer feedback procedures into the IPT process for the recipients of R&D programs. DHS estimated that this effort would be completed by December 31, 2019. This action, if fully implemented, should address the intent of the recommendation.

We are sending copies of this report to the appropriate congressional committees and the Secretary of Homeland Security. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact William Russell at (202) 512-8777 or russellw@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report are listed in appendix III.

Sincerely yours,

W. William Russell
Acting Director,
Homeland Security and Justice

Appendix I: Overview of the Science and Technology Directorate's Research and Development Projects

The following appendix provides a general overview of the Department of Homeland Security's (DHS) Science and Technology Directorate (S&T) research and development (R&D) projects and programs that support the following homeland security mission areas: (1) border security; (2) disaster resilience; (3) critical incidents, and (4) cybersecurity. The examples provided below are illustrative and therefore not intended to provide a comprehensive list of DHS R&D programs or projects.

Border Security

- S&T and the U.S. Coast Guard conducted drone demonstrations and tests at two sites in Mississippi to test unmanned aerial systems before they are deployed to the field.

- The Technical Assessment of Counter Unmanned Aerial Systems Technologies in Cities is designed to help public safety and industry officials identify potential methods for countering nefarious uses of small unmanned aerial systems.

- The Wall System Design Support Tool Independent Verification and Validation seeks to strengthen the U.S. Border Patrol's decision analysis model used to identify the areas of the border where a wall would be most beneficial.

- The Border Research in Instrumented Construction Project is designed to identify cameras, sensors and other technology that can be applied on or near a smart wall via ground, surface/air, subsurface and water to enhance border security and agent safety.

- The Apex Border Situational Awareness program aims to help U.S. Customs and Border Protection access more data sources, develop decision support tools and share information with partner law enforcement agencies to improve situational awareness.

- The Integrated Maritime Domain Enterprise is a platform that seeks to bridge disparate data systems to make it easier for DHS components to share information and collaborate.

- The Adaptive Sensor Analytics Project aims to provide automated data analytics to process satellite imagery, identify patterns of nefarious activity and alert DHS officials.

- Ground-Based Technologies Program seeks to improve the ability to detect illegal activity at the border through stronger situational awareness, automated detection and alerts, target classification and tools to promote agent safety

Appendix I: Overview of the Science and
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Development Projects

- Air-Based Technologies Program is designed to identify, test and
  evaluate unmanned and manned aircraft platforms and sensors for
  law enforcement, search and rescue, and disaster response in both
  land and maritime environments.

- The Expert Tracker training program aims to help U.S. Border Patrol
  agents improve their ability to track movement in rough terrain along
  the nation's borders.

- Port of Entry Based Technology Program seeks to improve illicit cargo
  detection and legitimate cargo throughput by upgrading legacy
  scanning systems and linking them to new analysis and information
  sharing tools that may make the most of personnel resources.

- The Port of Entry People Screening Program aims to identify,
  evaluate and implement combinations of process and technology
  improvements that facilitate the movement of people through the
  nation's air, land and sea ports of entry.

- Autopsy is an open-source digital forensics platform that seeks to help
  law enforcement determine how electronic devices were used in a
  crime and recover evidence.

- Voice Forensics aims to help identify individuals who make hoax
  rescue calls to the U.S. Coast Guard, which may make it easier to find
  and prosecute suspects.

- Child Exploitation Image Analytics seeks to reduce the amount of time
  it takes to identify and rescue children from exploitation, as well as
  identify perpetrators, through automated face recognition algorithms
  and forensic tools.

- The Tunnel Detection and Surveillance Program is designed to help
  border officials detect and locate clandestine tunnels, as well as
  gather forensic data to support investigation and prosecution of drug
  smuggling activities.

- The Port of Entry Forensics and Investigations Program aims to help
  combat transnational crime and investigate child exploitation and
  human trafficking through open source data and forensic analysis of
  material collected from suspicious packages and cargo.

Disaster Resilience

DHS S&T seeks to help improve community resilience to natural disasters
through technology and tools that support planning, decision making and
mitigation efforts.

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- The Canada-U.S. Enhanced Resiliency Experiment series aims to use real-world exercises to demonstrate that seamless communication is possible between responders on either side of the northern border during a large-scale emergency.

- DHS S&T and the Central United States Earthquake Consortium are developing a suite of decision support tools designed to help emergency managers analyze data used when planning, managing, coordinating and communicating during natural disasters

- The Mutual Aid Resource Planner is a prototype application designed to help jurisdictions develop more accurate resource plans by incorporating custom data on geospatial hazards, risk assessments and potential mutual aid partners.

- The National Mutual Aid Technology Exercise seeks to test existing mutual aid systems to improve users' ability to exchange information between systems in real time and develop technical guidance for future use.

- The Coastal Resilience Center of Excellence aims to conduct targeted research and education to address key challenges facing coastal communities in the United States, including storm surge modeling, pre-disaster planning, communicating risk and more.

- The Flood Apex Program is designed to help identify and develop technology that can reduce flood-related fatalities and property loss, increase community resilience and improve flood preparation, response and recovery.

- The Internet of Things Low Cost Flood Inundation Sensors project seeks to develop and test sensor technology that can provide real-time updates on rising water levels.

- The Kentucky Dam Safety project aims to create technology and processes to better monitor dams and alert communities of potential danger, reducing loss of life and property.

- The Advanced CIRCulation modeling tool seeks to accurately predict coastal flooding threats to help emergency managers better coordinate evacuation and response.

- The Hurricane Evacuation -eXtended platform is a decision support tool for emergency managers designed to organize and stage resources for hurricane response.

- The Simulation-Based Decision Support System for Water Infrastructural Safety Lite™ tool is designed to quickly model the

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effects of potential dam breaks, helping officials develop accurate emergency response plans and anticipate evacuation needs.

- The Tunnel Plug is an inflatable device that aims to seal off subway tunnels to prevent water from flowing into the system, minimizing damage to critical transportation systems.

- The Linking the Oil and Gas Industry to Improve Cybersecurity project seeks to facilitate cooperative research, development, testing and evaluation procedures to improve cybersecurity in petroleum industry digital control systems

- The Homeowner Flood Insurance Roundtable aims to help reduce future uninsured flood losses by identifying decision support and research and development needs.

- The Automated National Structures Inventory project is seeking to build a comprehensive list of private and commercial property at risk for flood damage, which may help promote proper insurance and more effective flood protection efforts.

- The Smart Cities IoT innovation project is designed to help first responders improve their situational awareness through advances in autonomous drone navigation, intelligent building sensors and body-worn interoperability platforms.

- The Wireless Emergency Alerts Research, Development, Testing and Evaluation program aims to inform changes to the Federal Communications Commission's alerting system, including increased character length and adding URLs, pictures, videos and geo-targeting capabilities.

- The System Assessment and Validation for Emergency Responders program seeks to evaluate available responder technology on affordability, usability, and other criteria to help agencies understand which equipment will best fit their needs.

- The Urban Operational Experimentation program is designed to let responders test new technologies in real-world settings, and may help provide developers with direct feedback on how their products can better meet operational needs.

- The Enhanced Dynamic Geo-Social Environment training platform is a free virtual tool that aims to allow responders to practice responding to an active shooter incident, whether within a single agency or with multiple jurisdictions and disciplines.

- The Surface Transportation Explosives Threat Detection program is aiming to develop screening technology that can identify potential

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threats on people and in their bags without physically interacting with them.

- The Explosives Detection Canine program is designed to help detection canine teams identify new explosive compounds through non-hazardous training aids and increase their proficiency through realistic self-assessment and training events across the country.

Critical Incidents

- The Datacasting project aims to help responders send encrypted video, data files, and other critical information through existing public broadcast television signals, which helps prevent other communication channels from being overwhelmed.

- The Next-Generation Incident Command System, a web-based platform, seeks to allow responders to share data and request assistance in real-time, and also allows officials to observe and make critical decisions during evolving situations to better support preparation, response, and recovery.

- The Android Team Awareness Kit, a free app, is designed to help responders visually track team members and assets in real time during an incident, as well as share encrypted data across jurisdictions, disciplines, and components.

- The Assistant for Understanding Data through Reasoning, Extraction and Synthesis platform aims to help responders overcome information overload by providing actionable insight based on up-to-the-minute sensor data.

- The First Responder Electronic Jamming Exercise seeks to identify mitigation tactics against intentional or accidental communications jamming, which responders were able to practice implementing in realistic scenarios.

- The Telephony Denial of Service program is designed to help improve 911 emergency call centers' ability to defend against attacks through cyber security technologies that can analyze incoming calls and may help determine potential threats in real time.

- The Finding Individuals for Disaster and Emergency Response is designed to detect human heartbeats under up to 30 feet of rubble, which may help responders more effectively target rescue efforts.

- The Rapid DNA technology can complete a DNA test within 90 minutes or less from the field, which seeks to help officials identify victims and inform family members in a timely manner.

- The Forensic Video Exploitation and Analysis tool aims to help responders quickly analyze video to identify potential suspects by allowing users to tag a person to a left-behind item and reconstruct that individual's path across multiple camera views.

Cybersecurity

- The Cyber Risk Economics program seeks to fund applied R&D, knowledge products by gathering stakeholders across government, industry and academia to discuss cyber risk economics capability gaps and needs. Through these stakeholder discussions, along with scholarly cybersecurity economics research literature reviews and authoritative U.S. federal government documents, DHS S&T developed the newly released Cyber Risk Economics Capability Gaps Research Strategy which aims to consider business, legal, technical and behavior factors impacting cyber risk.

Appendix II: Comments from the Department of Homeland Security

U.S. Department of Homeland Security
Washington, DC 20528

Homeland
Security

March 11, 2019

W. William Russell
Acting Director, Homeland Security and Justice
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Re: Management Response to Draft Report GAO-19-210, "DHS RESEARCH AND
       DEVELOPMENT: Coordination Has Improved, but Additional Actions Needed
       to Track and Evaluate Projects"

Dear Mr. Russell:

Thank you for the opportunity to review and comment on this draft report. The U.S.
Department of Homeland Security (DHS) appreciates the U.S. Government
Accountability Office's (GAO) work in planning and conducting its review and issuing
this report.

The Department is pleased to note GAO's positive recognition that the Science and
Technology Directorate (S&T) has strengthened its Research and Development (R&D)
coordination efforts across DHS. For example, new R&D coordination-related directives
were issued and an Integrated Product Team (IPT) process established to serve as the key
R&D coordination mechanism within DHS. DHS and S&T remain committed to
delivering effective and collaborative insight, methods, and solutions for the critical
needs of the Homeland Security Enterprise to ensure our Nation's safety, security and
resilience.

The draft report contained four recommendations with which the Department concurs.
Attached find our detailed response to each recommendation. Technical comments were
previously provided separately.

Again, thank you for the opportunity to review and comment on this draft report. Please feel free to contact me if you have any questions. We look forward to working with you in the future.

Sincerely,

JIM H. CRUMPACKER, CIA, CFE
Director
Departmental GAO-OIG Liaison Office

Attachment

2

**Attachment: Management Response to Recommendations
Contained in GAO-19-210**

GAO recommended that the Deputy Secretary of the Department of Homeland Security:

Recommendation 1: Ensure that all Components adhere to IPT participation requirements, in accordance with the DHS directives.

Response: Concur. In FY 2018, the DHS Joint Requirements Council and S&T collaborated on integrating processes, including those for IPTs. As part of this collaboration, S&T's Office of Science & Engineering (OSE) will revise DHS Directive 069-02, "IPTs for R&D Coordination" to require participation in the IPT process by all components. S&T will submit a proposed revised directive to the DHS Management Directorate by June 20, 2019 to begin the Headquarters review and clearance process. Estimated Completion Date (ECD): December 31, 2019.

Recommendation 2: Develop a mechanism that aligns processes and information sources for collecting R&D project data from DHS components to ensure that the information can be collected, integrated and result in a comprehensive accounting of R&D projects DHS-wide.

Response: Concur. S&T's OSE will revise DHS Directive 069-02, "IPTs for R&D Coordination" to include requirements for data collection on all R&D projects across the Department to ensure alignment with data elements collected through the Common Appropriations Structure used for the DHS budget. S&T will submit a proposed revised directive to the DHS Management Directorate by June 20, 2019 to begin the Headquarters review and clearance process. ECD: December 31, 2019.

Recommendation 3: Direct OCFO [Office of the Chief Financial Officer] program officials to ensure that S&T take steps to more fully incorporate leading practices, such as those included in DHS's budget preparation guidance, into R&D milestones.

Response: Concur. OCFO will continue working with S&T to incorporate leading practices into R&D milestones. The OCFO Budget Office will validate all S&T materials submitted for DHS annual budget submissions to the Office of Management and Budget and the Congress, and provide S&T feedback, as appropriate. ECD: April 30, 2020.

Recommendation 4: Develop standard processes and procedures for collecting and analyzing customer feedback, applicable to components conducting R&D, for improving the usefulness of existing customer feedback mechanisms to assess R&D efforts and for implementing such mechanisms where absent.

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Response: Concur. S&T's OSE will revise DHS Directive 069-02, "IPTs for R&D Coordination" to incorporate customer feedback procedures into the IPT process for the recipients of R&D programs. S&T will submit a proposed revised directive to the DHS Management Directorate by June 20, 2019 to begin the Headquarters review and clearance process. ECD: December 31, 2019.

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Appendix III: GAO Contact and Staff Acknowledgements

GAO Contact	William Russell, (202) 512-8777 or russellw@gao.gov.
Staff Acknowledgements	In addition to the contact named above, Ben Atwater (Assistant Director), Melissa Hargy (Analyst-in-Charge), Nanette Barton and Gary M. Malavenda made key contributions to this report. In addition, key support was provided by Chris P. Currie, Dominick Dale, Michele Fejfar, Richard Hung, Benjamin Licht, John Mingus, Janet Temko-Blinder, and Sarah Veale.