Integrated Product Teams for Department of Homeland Security R&D

FY16 Report

Homeland Security

To be quicker, smarter, and more adaptable to all hazards, the Department of Homeland Security (DHS) relies on innovative and effective technologies. As a result, our approach to research and development (R&D) must support identifying and implementing the best solutions for the homeland security enterprise. This is a complex but necessary endeavor that keeps our field personnel safe while also protecting our homeland.

To ensure this is happening in the most efficient and effective way across the Department, I signed a memo in August 2015 re-establishing integrated product teams (IPTs) to coordinate R&D efforts across DHS. The initial IPTs covered the following mission areas: Aviation Security, Biological Threat, Counterterrorism, Border Security, and Cyber Security.

The IPTs brought together some of the best operational and technical minds in the Department, and the governance structure established for the IPTs truly embraced a culture of collaboration. Drawing on expertise resident in the IPTs, sub-IPTs, and the Science and Technology Research Council, the IPT process compiled information on R&D activities across DHS in a way that was unprecedented until now. This information provides an invaluable tool for DHS as we work together to manage our vast mission space and make wise technological investments.

This report describes the structure, methodology, and results of the fiscal year 2016 (FY16) IPT process. In my August 2015 memo, I directed the IPTs to identify 1) ongoing R&D activities across the Department; and 2) high-priority capability gaps and corresponding technology solutions. The DHS Science and Technology Directorate compiled and submitted this information to me earlier this year. Due to the sensitive nature of the homeland security mission, this information must be protected from broad public release. As a result, this report does not include all the supporting information generated through the FY16 IPT process but it does inform the public of the important work being done by the IPTs to coordinate DHS R&D activities to address priority homeland security needs.

In years to come, the structure that the IPTs bring to DHS R&D efforts will continue to identify effective and innovative solutions to address the most pressing challenges facing the homeland.

Sincerely,

Jeh Charles Johnson

Table of Contents

Executive Summary 1

I. Introduction 6

II. Goals and Objectives 8

III. Integrated Product Team Process 9

Definition of R&D 9

IV. Technological Capability Gaps and Corresponding R&D 10

Technological Capability Gaps 10

R&D Efforts to Develop Technology Solutions 12

Resilience as a Factor in Priority Ranking 12

V. Implementation: A Department-wide Approach 13

The IPT Process in Future Years 13

Ensuring Continuous Improvement through Future Cycles 14

Alignment of the IPT and JRC Processes 15

Development and Transition of Solutions to Address Priority Gaps 17

Technology Assessments and Acquisition Programs 17

VI. IPTs in Summary: Current and Next Generation 19

Acronym List 20

Appendices 21

Appendix A - Integrated Product Team Structure and Functions

Appendix B - Development and Transition of Solutions to Address Priority Gaps

Executive Summary

As the homeland security mission continues to evolve, the Department of Homeland Security (DHS) must focus its research and development (R&D) efforts to develop technology solutions that address the most critical needs. The breadth and complexity of the DHS mission space pose challenges for tracking all ongoing R&D efforts and aligning those efforts to Department goals and priorities. In late 2012, the Government Accountability Office (GAO) recommended that DHS develop policies for coordinating R&D activities and establish a mechanism for tracking R&D projects. The DHS Science and Technology Directorate (S&T) worked with other DHS components to improve R&D tracking and coordination, including issuing a DHS Directive and Instruction that provide definitions for R&D and establish policies for coordinating R&D activities across the Department.

To reinforce these ongoing efforts, the Secretary of Homeland Security issued a memorandum in August 2015 directing S&T to establish Integrated Product Teams (IPTs) to identify and coordinate DHS R&D efforts in priority mission areas. The initial IPTs covered the following DHS missions: Aviation Security, Biological Threat, Counterterrorism, Border Security, and Cyber Security. In response to the Secretary's direction, S&T established an operational framework and process to support the stand-up, governance, and ongoing operations of the IPTs. The IPTs are explicitly linked to the work of the DHS Joint Requirements Council (JRC) and will serve as the central mechanism by which the Department identifies technological capability gaps and coordinates R&D efforts to close those gaps. The level of direct interaction between the IPTs and the JRC will increase over time as both processes evolve and the JRC processes for joint assessment of requirements and operational capability gap prioritization continue to mature.

The IPT process facilitates improved R&D coordination by:

- Promulgating a standardized approach for identifying and tracking DHS R&D efforts, thereby addressing GAO's recommendations to improve R&D coordination across the Department;
- Establishing a common mechanism and procedures for gathering and reporting priority gaps and corresponding R&D efforts to develop solutions;
- Providing a technology review platform to identify and mitigate duplicative and overlapping R&D efforts within DHS; and
- Helping to fulfill longstanding statutory requirements for DHS and S&T to align Departmental R&D efforts with DHS acquisitions.

The IPT process was designed to be a truly collaborative, cross-component endeavor. While S&T is responsible for leading the overall effort, the individual IPTs were led by senior executives from DHS components, with representatives of the JRC participating at various levels. In this way, the IPT process supports and strengthens the Department's Unity of Effort Initiative. Table ES-1 shows the component leads and members of the fiscal year 2016 (FY16) IPTs and sub-IPTs.

IPT Name	Component IPT Chairs/Co-Chairs	Component Membership
Aviation Security	TSA	CBP, DNDO, NPPD, USCG, USSS
Biological Threat	FEMA and OHA	CBP, MGMT, NPPD, TSA, USCG, USSS
Border Security	CBP	DNDO, ICE, USCG
Counterterrorism	I&A	CBP, DNDO, ICE, NPPD, TSA, USCG, USSS
Cybersecurity	NPPD and MGMT/CISO	CBP, CRCL, FEMA, I&A, ICE, PLCY, Privacy, TSA, USCG, USCIS, USSS

Table ES-1. Component Representation on the IPTs and Sub-IPTs

The IPT process established for FY16 included three main implementing bodies—sub-IPTs, IPTs, and the S&T Research Council (SRC)—plus an advisory body, as illustrated in Figure ES-1. The IPT process informed products that were provided to the Under Secretary of S&T (USST) for review and ultimate delivery to the Secretary of Homeland Security.

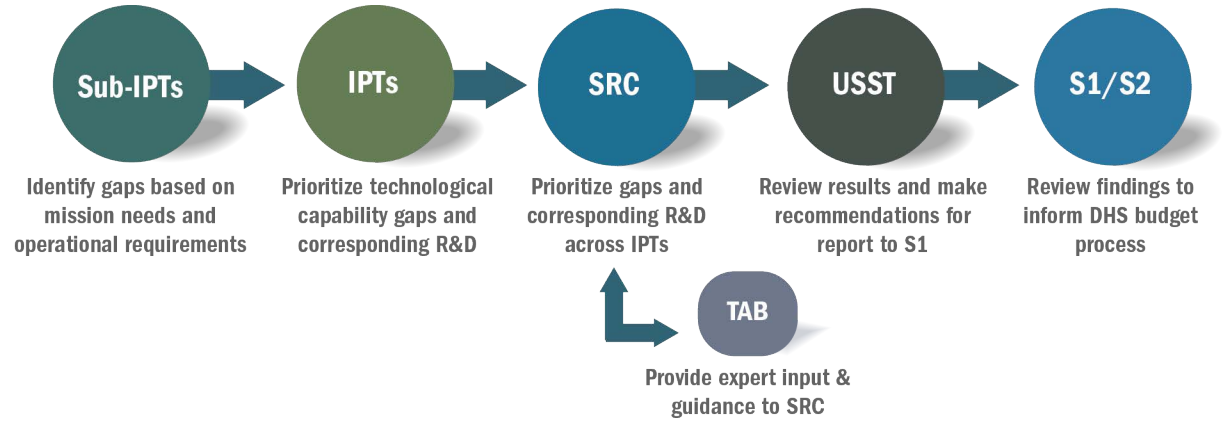

Figure ES-1. IPT Governance Structure

The sub-IPTs included component and S&T representatives with expertise in specific topical areas within the broader mission area of each IPT. JRC representatives also participated in the sub-IPTs to ensure alignment with the JRC process and the consideration of operational capability gaps at the sub-IPT level. IPTs consolidated the gaps identified by their sub-IPTs and determined the top high-priority technological capability gaps within their IPT mission areas.

During the FY16 cycle, the SRC included the senior component leads of the IPTs, a senior representative of the JRC, and a chair from S&T. To ensure broad unity of effort, the SRC convened a Technical Advisory Board (TAB) consisting of senior representatives from DHS HQ offices that were not represented on the IPTs. The TAB reviewed and provided expert input on SRC recommendations and draft products. The SRC reviewed the top-priority gaps from four of the five IPTs[1] and then voted to identify the highest-priority gaps across the IPTs.

The highest-priority DHS technological capability gaps identified in FY16 are listed in Table ES-2.

[1] *Due to time limitations during the FY16 cycle, the SRC identified high-priority technological capability gaps across four of the five IPTs.*

IPT	Technological Capability Gap
Aviation Security	Capability to accurately identify and screen checked baggage based on the owners Passenger Clearance Ranking
	Capability to verify a passenger's identification
	Enhanced ability to conduct primary screening of passengers in aviation security screening checkpoints (currently performed by advanced imaging technology and walk-through metal detectors) that provides the ability to distinguish threats from non-threats that are placed on the body
	Enhanced risk-based screening algorithms development for security technology to support operator and associated policy decisions
	Improved capability to allow operators to screen passengers' carry-on and checked bags for prohibited items to protect against sophisticated IED attacks (various explosive types)
	Improvement needed for screening methods against attacks using cargo IED, one or more, when in flight (various explosives types)
Biological Threat	Compact Personal Protective Equipment (PPE); Emergency/Escape Hood
	Decision Support for Operational Decision Making, including PPE use
	Means for field agents to detect, identify and classify the presence of biological agents
	Biological dispersion event modeling
	Data assimilation and predictive analysis to inform decision making in the field and operations centers
	Advances to allow for better timeliness to verify a biological attack
Border Security	Biometric Entry and Exit (counting and measuring)
	Improve performance of non-intrusive inspection (NII) detectors and/or sources
	Small Dark Aircraft Detection and Timely Interdiction
	Sensor and Intelligence Information Sharing and Data Analytics
	Land/In-Between Ports-of-Entry Situational Awareness
	Tunnel Detection, Surveillance, and Forensics
	Maritime Surveillance and Communications in Remote Environments
	Small Dark Vessel Detection
Cybersecurity	Distributed Cloud-Based Communications and Monitoring
	ICS Control Systems, Cyber Sensors, Analytics, and Prevention Capabilities
	Method for forensic examiners to capture user data from networked devices (the "Internet of Things")
	Lack of cybersecurity effectiveness, severity, and comparative metrics

Table ES-2. Highest-Priority Gaps Resulting from the FY16 IPT Process

The Secretary also charged the IPTs with identifying R&D activities being performed across DHS. The sub-IPTs and IPTs documented R&D efforts as they worked to identify priority capability gaps within their mission areas. In addition, S&T initiated a data call to all DHS components requesting information on ongoing research and/or development activities. The information compiled through these efforts represents the ***Report of Coordinated DHS R&D***, which S&T delivered to the Secretary in March 2016, in accordance with the August 2015 memorandum.

The IPTs then identified R&D efforts that addressed the high-priority gaps. The SRC reviewed these R&D efforts and recommended ongoing analysis of the technical solutions for high-priority gaps. The SRC also recommended that additional or new R&D be considered for high-priority gaps with insufficient or no associated R&D. The identified high-priority gaps and the R&D efforts that address those gaps are captured in the ***High-Priority Technology Solutions*** document, which S&T also delivered to the Secretary in March 2016.

The results of the FY16 IPT process will inform a DHS acquisition profile aligned to the highest-priority gaps, thus providing a blueprint that will support a common appropriations structure to Congress. This will ultimately lead to full transparency of R&D activities and benchmark the necessary steps for producing a comprehensive and integrated DHS-wide acquisition program for R&D.

IPTs in Action

During the Bio Threat sub-IPT meetings on Detect, Identify and/or Classify, representatives from CBP, FEMA, and USSS identified the requirement for rapid warning, identification, and characterization of biological threats. While these components would field such technology for differing uses, including force protection, public safety, and decision support, the Bio Threat IPT chose to consolidate these otherwise independent requirements into joint projects. This resulted in improved communication among components and a more focused R&D acquisition profile.

The IPTs worked closely with legal, policy, civil liberties, and privacy advisors to ensure that appropriate protections were built into planned outcomes and issues were addressed through review and adjudication cycles.

The IPT process established for the FY16 cycle is both repeatable and flexible and provides a strong foundation for future evolution of the process. To enhance future iterations of the IPT process, an independent after-action review will follow each annual cycle to identify lessons learned and recommend process improvements for implementation in future years.

Perhaps most important, the IPT process facilitates cross-Department collaboration. Executives from across DHS now have an established mechanism for coordinating and prioritizing R&D activities that will result in effective solutions for near- and longer-term mission challenges.

I. Introduction

The Department of Homeland Security (DHS) relies on innovative and effective technology solutions to address the priority needs of the homeland security enterprise (HSE). Title III of the Homeland Security Act of 2002, as amended, gives the Under Secretary for Science and Technology the responsibility for identifying priorities and coordinating research and development (R&D) activities in support of the Department's mission.

The size and scope of the homeland security mission make it difficult to track all R&D efforts across DHS and align those efforts to Department goals and priorities. In 2012, the Government Accountability Office (GAO) recommended that DHS establish policies and guidance for defining, reporting, and coordinating R&D efforts across the Department. The DHS Science and Technology Directorate (S&T) worked with other DHS components to improve R&D coordination through various means, including developing a DHS Directive and Instruction that define R&D and establish policies for identifying and reporting R&D activities.

Building on the efforts to date, the Secretary of Homeland Security issued a memorandum in August 2015 establishing Integrated Product Teams (IPTs) as the central mechanism by which DHS identifies and coordinates its R&D efforts in priority mission areas. The initial IPTs focused on the following DHS missions: Aviation Security, Biological Threat, Counterterrorism, Border Security, and Cyber Security. Supporting the broader Unity of Effort Initiative, the IPTs brought together cross-component teams to align the Department's R&D investments with priority technological capability gaps. While S&T was charged with leading the overall effort, the individual IPTs were led by senior representatives of the components. Subject matter experts from the DHS Joint Requirements Council (JRC) also participated at various levels. Figure 1 illustrates the cross-component collaboration and unity of effort inherent in the IPT process.

In addition to the five IPTs established for fiscal year 2016 (FY16), S&T continues to support the First Responder Resource Group (FRRG), a working group that helps to identify the priority needs of State and local responders in the field, as well as the Domestic Nuclear Detection Office (DNDO). Given the breadth and depth of DHS mission space and the associated R&D needs, the IPT process will continue to be refined to meet the most pressing homeland security demands.

The FY16 IPTs identified technological capability gaps to gain a better understanding of current and emerging R&D needs. The IPTs then identified R&D efforts to develop solutions that address the most critical gaps to support the security and resilience of the Nation.

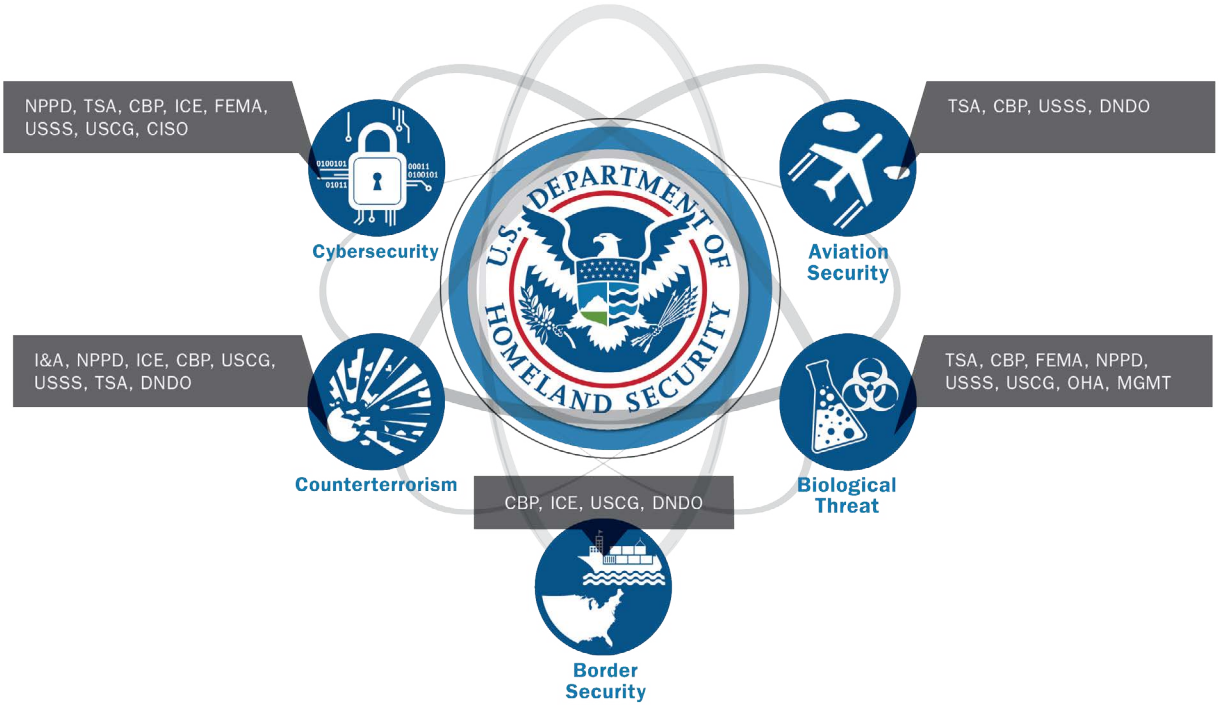

Figure 1. Integrated Product Teams Unity of Effort

The results of the FY16 IPT process informed the following two products identified in the Secretary's August 2015 memo:

- The ***Report of Coordinated DHS R&D***, which captures ongoing DHS R&D activities.
- The ***High-Priority Technology Solutions*** document, which captures high-priority gaps and the R&D efforts to develop solutions that address those gaps.

The outcomes of the IPT process outlined in this report will focus DHS R&D to reflect the evolving landscape of homeland security threats and hazards. By identifying R&D efforts that address high-priority gaps, the component-driven IPT process will influence resource allocation for DHS R&D activities.

II. Goals and Objectives

While many DHS components provide methods and solutions to address homeland security challenges, previous efforts to coordinate DHS R&D activities were limited to ad hoc arrangements that were not necessarily aligned to specific mission areas or component acquisitions. Within DHS, only DNDO, the United States Coast Guard (USCG), and the S&T Directorate are granted R&D responsibilities by law. Other DHS components may pursue and conduct their own R&D, so long as those activities are coordinated through S&T. As responsible stewards of taxpayer dollars, DHS has made it a priority to identify and coordinate R&D efforts across the Department to ensure mission alignment and the proper use of Federal Government appropriations.

Going forward, the IPT process can assist the Department in prioritizing its essential R&D programs and core capabilities, which will ultimately lead to a traceable and executable DHS R&D plan. From a funding perspective, IPTs provide information that supports the development of a DHS acquisition profile that aligns to the highest-priority gaps, thus providing a blueprint that will support a common appropriations structure to Congress. Most important, the IPT process facilitates broad collaboration across DHS components, opening new channels for executives to discuss and coordinate R&D activities to address the highest-priority needs of their operational staff.

The Secretary outlined five objectives for the IPTs (presented in the box on the right), which provide a roadmap for achieving the overall goal of the effort. They are designed to promote understanding of the Department's most pressing R&D needs and how best to meet those needs. These objectives foster transparency and collaboration to validate technology solutions and leverage R&D investments for the greatest benefit to DHS missions.

Overall Goal of IPT Effort
Coordinate DHS-wide R&D to address priority missions.
Objectives for the IPTs
Identify and prioritize DHS technological capability gaps and corresponding solutions to close those gaps.
Identify R&D work being performed across DHS, both in traditional R&D funding lines and that occurring within component acquisition programs.
Ensure technology being acquired will meet DHS and component mission needs.
Identify and de-conflict duplicative R&D efforts.
Develop and report metrics for the transition of technological solutions to close capability gaps.

The IPT process was designed to achieve each of these objectives and will help to address the GAO recommendations to improve coordination of DHS R&D activities.

While delivery of the two documents identified in the August 2015 memo addresses the first two objectives, the IPT process established for FY16 provides the foundation to achieve the remaining three objectives in future annual **cycles.**

III. Integrated Product Team Process

In response to the Secretary's direction, S&T established an organizational framework and functional process in FY16 to support the stand-up, governance, and ongoing operations of the IPTs. Figure 2 shows the governance structure and the main entities involved in implementing the IPT process. More details on the structure and functions of the IPT process are provided in Appendix A.

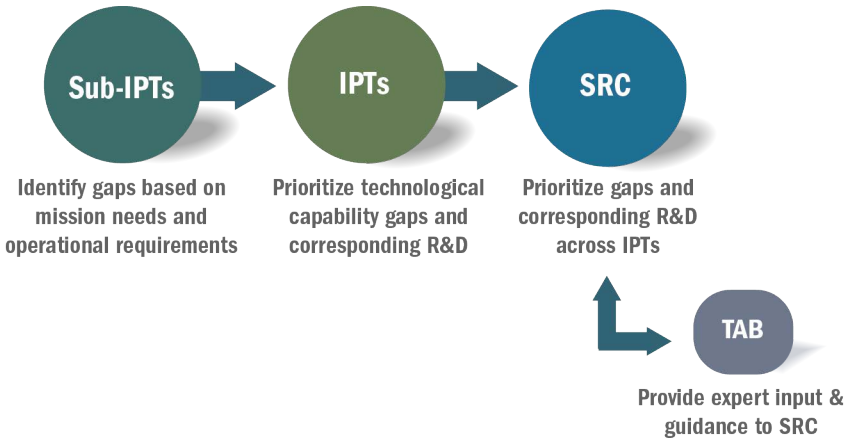

Figure 2. IPT Governance Structure

Definition of R&D

For purposes of identifying R&D activities across DHS, the IPT process used the following definition of R&D:

- **Basic and applied research** includes systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and/or observable facts. The difference between basic and applied research is that basic research is normally conducted without specific applications toward processes or products in mind, while applied research is conducted to determine the means by which a recognized and specific operational need may be met.[2]
- **Development** is the systematic application of knowledge toward the production of useful materials, devices, and systems or methods that leverage the results of applied research activities. Development activities include the following: validation and demonstration of a chosen technology in laboratory, representative, and operational environments; improvement on research prototypes; integration into systems and subsystems; addressing manufacturing, producibility, and sustainability needs; and independent operational test and evaluation.[3]

[2] *Id.* Department of Homeland Security Instruction 069-02-001, Revision 01 (DRAFT), June 2016. See also Delegation to the Under Secretary for Science and Technology; Annex A, DHS Delegation 10001 Revision 1, April 28, 2014.

[3] *Id.*

IV. Technological Capability Gaps and Corresponding R&D

Technological Capability Gaps

In keeping with the Secretary's direction, the IPT effort engaged R&D stakeholders from across DHS in identifying technological capability gaps that impact priority homeland security missions. Knowledge of these gaps provides context for understanding ongoing and needed R&D activities across the DHS enterprise.

Sub-IPT and IPT Identification and Priority Ranking. IPTs were tasked with identifying technological capability gaps in need of research and/or development in their respective mission areas. The initial identification of gaps occurred at the sub-IPT level. To guide and structure this effort, S&T provided the sub-IPTs with a template for consistent data collection. The sub-IPTs ranked each of the identified gaps as a high, medium, or low priority for R&D-based capability development within their specific topic area.

Moving up one level, the IPTs performed a second round of priority ranking of identified gaps. Compiling the priority gaps from across their sub-IPTs, each IPT validated the lists and identified additional gaps as applicable. The IPTs then assigned a ranking of high, medium, or low priority to each gap on the list.

Real-world events in 2015 (i.e., the attacks in Paris and San Bernardino) delayed the establishment of the Counterterrorism (CT) IPT. As a result, the CT IPT did not submit gaps for consideration by the SRC in FY16, though some of the CT sub-IPTs did convene to identify priority gaps within their specific topic areas.

SRC Priority Ranking. The SRC performed the final priority ranking of gaps from each IPT that completed the process for FY16. As a result, the SRC voted on the high-priority gaps submitted by four of the five established IPTs. The SRC convened a meeting to review and discuss the top-priority gaps from each IPT to identify the gaps determined to be most important for DHS R&D investment. As part of the SRC voting process, each IPT chair presented the high-priority gaps nominated by his/her IPT and the SRC members voted to validate each gap as a high priority or re-designate it as medium or low. Through this process, the SRC identified a total of 24 high-priority technological capability gaps in need of research and/or development across the IPTs. General descriptions of the high-priority DHS technological capability gaps identified for FY16 are provided in Table 1.

IPT	Technological Capability Gap
Aviation Security	Capability to accurately identify and screen checked baggage based on the owners Passenger Clearance Ranking
	Capability to verify a passenger's identification
	Enhanced ability to conduct primary screening of passengers in aviation security screening checkpoints (currently performed by advanced imaging technology and walk-through metal detectors) that provides the ability to distinguish threats from non-threats that are placed on the body
	Enhanced risk-based screening algorithms development for security technology to support operator and associated policy decisions
	Improved capability to allow operators to screen passengers' carry-on and checked bags for prohibited items to protect against sophisticated IED attacks (various explosive types)
	Improvement needed for screening methods against attacks using cargo IED, one or more, when in flight (various explosives types)
Biological Threat	Compact Personal Protective Equipment PPE; Emergency/Escape Hood
	Decision Support for Operational Decision Making, including PPE use
	Means for field agents to detect, identify and classify the presence of biological agents
	Biological dispersion event modeling
	Data assimilation and predictive analysis to inform decision making in the field and operations centers
	Advances to allow for better timeliness to verify a biological attack
Border Security	Biometric Entry and Exit (counting and measuring)
	Improve performance of non-intrusive inspection (NII) detectors and/or sources
	Small Dark Aircraft Detection and Timely Interdiction
	Sensor and Intelligence Information Sharing and Data Analytics
	Land/In-Between Ports-of-Entry Situational Awareness
	Tunnel Detection, Surveillance, and Forensics
	Maritime Surveillance and Communications in Remote Environments
	Small Dark Vessel Detection
Cybersecurity	Distributed Cloud-Based Communications and Monitoring
	ICS Control Systems, Cyber Sensors, Analytics, and Prevention Capabilities
	Method for forensic examiners to capture user data from networked devices (the "Internet of Things")
	Lack of cybersecurity effectiveness, severity, and comparative metrics

Table 1. Highest-Priority Gaps Resulting from the FY16 IPT Process

The following section provides amplifying information about the gaps listed in Table 1. This includes a description of the relevant IPT mission area and the need(s) associated with each high-priority gap. Taken together, this information provides context to help industry and the public understand the Department's priority needs, which can lead to the identification of potential technology solutions that address our most pressing homeland security challenges.

Aviation Security: The aviation security environment presents a constant demand to detect evolving threats while promoting a positive passenger experience. The end goal is to reach non-invasive security screening at our nation's airports while meeting its mission of preventing terrorist attacks and ensuring speedy and lawful trade and travel. The aviation needs of the department focus around detection of threats on passengers and in baggage, in addition to authenticating the identity of passengers.

- As passengers receive a Transportation Security Administration (TSA)-defined passenger clearance ranking, it would be advantageous to link the ranking to a passenger's checked baggage to assist operators in the baggage screening process.
- Passengers can present a variety of forms of identification to Transportation Security Officers for security screening at the airport. The ability to quickly and accurately identify and verify these multiple types of identification is a key part of aviation security. Improved capabilities to verify a passenger's identity against the provided identification would help to expedite this process.
- Screening of passengers for threats concealed under clothing allows Transportation Security Officers to identify and mitigate threats to aviation security. DHS seeks an enhanced capability to conduct primary screening of passengers at aviation security checkpoints that results in reduced divestiture and expedited screening.
- TSA has shifted to a risk-based, intelligence-driven security model. TSA looks to improve capabilities to support operator decision making in passenger and carry-on baggage screening and enhance the ability to adjust security posture based on risk.
- Security threats are constantly evolving and present new challenges in screening passengers and baggage. DHS is looking to improve its efficiency in screening passengers' carry-on and checked baggage for prohibited items.
- Cargo security threats continue to evolve, making it necessary for DHS to identify enhanced screening methods against cargo threats.

Biological Threat: Biological threat security focuses around the prevention of release as well as detection of and protection against priority biological threats and hazards known to pose particularly high risk to the nation. Operators related to this threat area play a variety of roles and require personal protective equipment, detection and warning tools, and modeling and predictive analytics capabilities.

- In the event DHS operators are exposed to a biological threat, improvements in current escape hood personal protective equipment (PPE) will be beneficial. The PPE must be compact, portable, and quickly deployable while providing a full spectrum of protection.

- In the event of a biological attack or release, knowing what to do next is key and requires improved decision support tools. Improved decision support systems that integrate planning assumptions, formulas, and algorithms into one tool are required to translate situational awareness and intelligence into guidance to inform decision making. This also includes the use of PPE.
- For a wide range of DHS field agents, identifying a biological agent is critical to the overall response. The Department is interested in identifying improved means for field agents to detect, identify, and classify the presence of specific agents in a variety of settings. The overall process must be cost-effective and must not impede operations.
- The way a biological agent behaves once released is a major factor in responding to an event. Dispersion event modeling is needed across various media and environments for a wide array of biological agents, as well as human and animal diseases that are transmissible via air, water, and non-organic hosts. The modeling must include the transport of biological agents within the soil, surface, and atmosphere continuum, and provide numerical estimates and graphical analysis of their dispersion.
- It is essential that the Department expand its data assimilation and predictive analysis to inform decision making in the field and operations centers. This includes assimilation and analysis of situational awareness, models, planning assumptions, and surveillance data in a manner that provides real-time trend analysis and intelligence to predict operational risks and capability requirements. The capability must include a scalable, mathematical algorithm that estimates risks for individual trade and travel entities and provides: 1) "pattern of concern" recognition; 2) associations between entities from various port of entry environments (e.g., cargo, passenger, express consignments, international mail); and 3) alerting capabilities.
- The Department is seeking advancements in its ability to quickly verify biological attacks or releases by improving technologies and processes from the point of sampling and detection to testing. This capability should include the ability to obtain immediate confirmation of a biological incident that will allow for improved protective measures and deployments.

Border Security: DHS is responsible for securing our borders while expediting lawful trade and travel. This includes the security of 7,000 miles of terrestrial border with Mexico and Canada, air domain awareness within the United States, the security of the maritime approaches of the United States, and security of the nation's air, land and sea ports of entry. Border security presents complex challenges due to geographic locations, modes of transportation, trade and travel volume, and transnational criminal organizations.

- The Department is seeking to strengthen security and increase efficiency of DHS Traveler Inspection Operations at entry to and exit from the country by more effectively using information, new technologies, and process optimization to recognize dangerous individuals and facilitate rapidly growing lawful travel, trade, and tourism. Advancements in biometric and identity technologies, mobile capabilities, and other complementary capabilities will enable access to real-time information, increase situational awareness, and enable holistic improvements for travelers and DHS officers as well as airport, airline, and other stakeholders. The capabilities must be suitable for use by a demographically diverse traveler population, cost-effective, simple, transparent, and able to integrate seamlessly into the inspection/travel process.

- Non-intrusive inspection technologies allow DHS border agents and officers to detect contraband and illegal activity at air, land, and sea ports of entry while expediting lawful trade and travel. The Department is looking to increase the performance of existing inspection systems while also developing new non-intrusive inspection capabilities.
- Criminal organizations fly small aircraft at low altitudes across U.S. borders and within the U.S. to transport illegal drugs and support other illegal activity. The Department is looking to expand its ability to detect these aircraft and enable their timely interdiction. This ability must provide reliable and accurate detection, tracking, and classification of small, low-flying aircraft, including unmanned aircraft systems (UAS) and non-traditional aviation technologies (NTAT), such as ultralights or gyrocopters. Additionally, once a UAS/NTAT has been captured, law enforcement needs the ability to perform forensics to aid in the investigation and prosecution of any criminal activity.
- DHS is looking to increase the Department's sensor and intelligence information-sharing and data analytics capability. The goals include: 1) providing the ability to collect, identify, prioritize, characterize, and integrate existing maritime, land, air, and port of entry data from Federal, State, local, tribal, and international sources; 2) performing data analytics to turn the data into actionable intelligence; and 3) sharing that actionable intelligence with Federal, State, local, tribal, and international law enforcement partners.
- Border security along the northern and southern terrestrial borders of the United States presents a host of challenges. DHS is seeking to expand its situational awareness of the land border in-between land ports of entry. Improvements should include proficiency in detecting, tracking, and classifying illegal smuggling or immigration activity in difficult terrain, during harsh weather, and in remote locations along the northern and southern borders.
- Cross-border tunnels are dug by transnational criminal organizations to smuggle contraband, people, and potentially weapons of mass destruction into and out of the United States. The Department is seeking to improve the detection of cross-border tunnels, exploit them after they are found, and perform forensics and other investigative actions required to identify the organizations and people responsible.
- Remote maritime smuggling routes present challenges for DHS law enforcement. The Department is looking to advance its maritime surveillance and communications capability for remote, off-shore, illegal smuggling routes and U.S. statutory areas of responsibility, including the Atlantic, Pacific, Gulf of Mexico, Great Lakes, and Arctic regions. This includes improving shore-based sensors and exploiting offshore detection capabilities to increase DHS's maritime situational awareness.
- Small vessels can go undetected by law enforcement and be used to smuggle people or contraband, perform reconnaissance, or convey weapons of mass destruction. The Department is seeking enhancements to its small vessel detection capabilities to reliably and accurately detect, track, and classify small vessel threats (including pangas, semi-submersibles, go-fast boats, and other vessels) to enable their timely interdiction.

Cybersecurity: Cyber-threats could have detrimental impacts to the nation's economy and security. Integrated into our nation's critical infrastructure across the government and the private sector, cybersecurity is a top concern for DHS. The growth of the Internet of Things, cyber criminals, and a growing dependence on digital devices bring layers of complexity to cybersecurity that require technological advances.

- To ensure the security of cloud-based solutions, it is essential to have the capability to identify malicious and/or anomalous behavior and quickly mitigate the potential damage that behavior could cause. The Department is seeking to increase and improve distributed cloud-based communications and monitoring agents for identifying the malicious behavior of other entities within a distributed system. In addition, DHS would like an expanded ability to characterize the limitations of actionable analysis of different levels of administrative access; develop algorithms capable of operating at different privilege levels; and provide the capability to identify and characterize threat vectors specific to use and communicate with cloud-based computational clusters and storage.
- Securing industrial control systems that enable the operation of the nation's critical infrastructure is an essential element of our nation's security. DHS is looking for more robust sensor data collection, analysis, and prevention capabilities for industrial control systems and their associated systems.
- To solve cases, forensic examiners increasingly rely on the data stored on a variety of digital devices. To expand its support for law enforcement operators, DHS is looking to improve existing or develop new methods to extract and analyze data from networked devices (the "Internet of Things") for examination and use as evidence in criminal cases.
- Understanding the effectiveness of cybersecurity efforts is essential to any successful cybersecurity program. The Department is looking for improved methods to measure cybersecurity effectiveness, including the ability to measure incident severity and to compare security metrics. DHS is seeking methodologies that can compare security metrics (algorithms, efficiency, completeness, and correctness) such that disparate metrics can be combined to improve security situational awareness and help inform future capability deployment and funding decisions.

R&D Efforts to Develop Technology Solutions

The FY16 IPT process also identified existing R&D efforts that address the highest-priority technological capability gaps. DHS R&D efforts were identified in two ways. The sub-IPTs and IPTs documented R&D projects as they worked to identify priority capability gaps within their mission areas. In addition, S&T initiated a data call to all DHS components requesting information on ongoing research and/or development activities. The information compiled through these efforts represents the ***Report of Coordinated DHS R&D***.

The IPTs then identified R&D efforts that address high-priority gaps. For gaps with insufficient or no corresponding R&D, the SRC recommended additional or new R&D investments to address those gaps. The specific additional or new R&D will be addressed through various S&T and component resource allocation processes and is expected to influence the Resource Allocation Plan for FY18 and beyond. The SRC-identified high-priority technological capability gaps and the existing R&D efforts that address those gaps are presented in the ***High-Priority Technology Solutions*** document.

Resilience as a Factor in Priority Ranking

Resilience continues to evolve as a factor influencing R&D efforts across multiple DHS missions. Resilience is defined as *the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions*.[4] The IPTs identified technological capability gaps and ranked them as high, medium, or low priority within their specified mission areas. As the IPT process evolves, the priority ranking methodology will incorporate an ability to evaluate gaps and related R&D efforts based on the extent to which they enhance resilience at a national, community, or individual asset level.

During the FY16 IPT cycle, DHS conducted an additional analysis focused specifically on identifying resilience-oriented efforts. Each of the described gaps and corresponding R&D efforts was evaluated for its contributions toward building resilience. An initial set of weighted resilience indicators aided in the process of identifying and classifying these efforts. This analysis lays the groundwork for linking resilience considerations to the priority ranking of gaps in future IPT cycles.

[4] Presidential Policy Directive 21, Critical Infrastructure Security and Resilience, February 2013.

V. Implementation: A Department-wide Approach

The IPT Process in Future Years

The IPT process outlined in this report proved effective in producing results in FY16, despite the abbreviated timeline and the effort required in establishing the IPTs. Consistent with the Secretary's guidance, the process must be repeatable and flexible to provide a robust foundation for current IPT operations and future evolution of the process. Figure 3 illustrates how the IPT process will continue as an annual cycle.

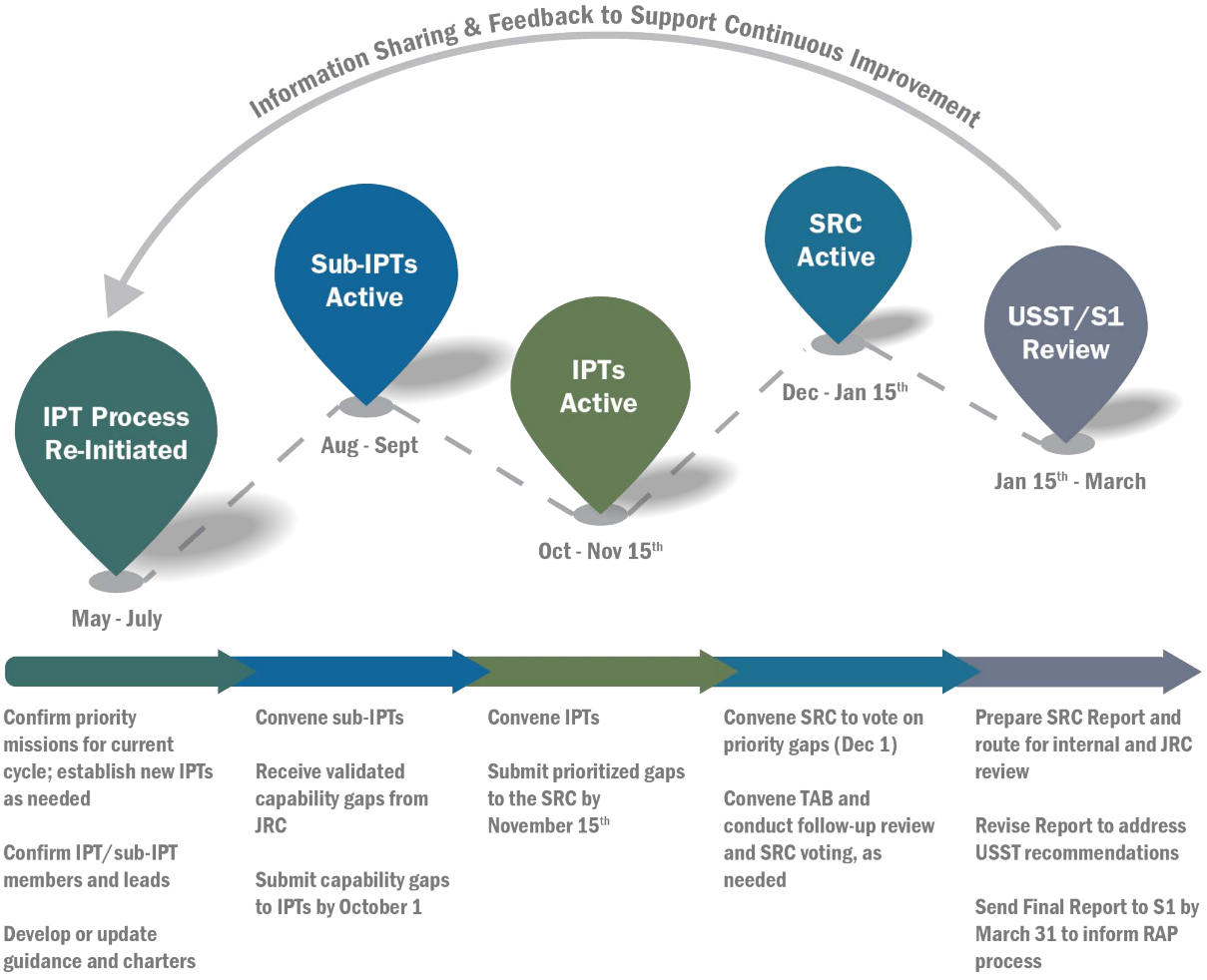

Figure 3. IPT Annual Process and Timeline

It is important to note that the timeline depicted here reflects only the sub-IPT and IPT efforts that focus on developing final lists of high-priority gaps for consideration and ranking by the SRC for a given fiscal year. The IPTs and sub-IPTs are free to meet throughout the year, as they deem necessary, to collaborate on identifying and consolidating high-priority technological capability gaps within their mission areas.

The DHS enterprise continues to strive toward institutionalizing a systematic, component-driven approach that leverages a well understood and accepted definition of R&D to provide consistent outcomes in successive years.

The DHS IPT process is designed to:

- Identify duplicative DHS R&D activities and recommend ways to reduce duplication;
- Provide an oversight platform to coordinate cross-component collaboration and track the investment profile of each project to ensure progress and schedule maintenance; and
- Result in the development and transition of effective solutions to address priority technological capability gaps across the Department.

Because the priority ranking of gaps may lead to R&D investment decisions involving multiple components, it is critical that the process for determining priorities be credible, transparent, and as objective as possible. This will help to instill confidence among component and external stakeholders that DHS is identifying and addressing critical homeland security research needs.

Ensuring Continuous Improvement through Future Cycles

IPTs are used effectively across the Federal Government to bring together diverse stakeholders to work collaboratively toward a common goal. Despite the success of many well executed IPTs, the IPT approach is often poorly understood, defined, designed, and implemented. The DHS IPT process includes a series of steps to ensure the identification, prioritization, and coordination of all R&D within the Department. These steps include:

- Defining clear objectives and outcomes for the IPTs;
- Developing a common process and approach for the IPTs;
- Establishing a governance structure that allows for growth and improvement while maintaining foundational guidance and metrics to achieve targeted outcomes;
- Executing IPT activities, which requires gaining component consensus while maintaining IPT process integrity; and
- Providing ongoing management and evaluation to ensure that the process remains effective over the long term.

The last step above is the most critical to the sustainability of the DHS IPT process. The IPTs and S&T representatives will document lessons learned throughout the process. Because evaluation of the IPT process should not rest with one entity, S&T initiated an annual, independent After Action Review (AAR) of the IPT process. The AAR will provide an objective assessment of the process and validate linkages to the priorities of DHS components, to demonstrate credibility with internal and external stakeholders.

The AAR will provide recommendations for ensuring a sustainable, defensible IPT process for future years by:

- Evaluating the priority ranking methodology and any metrics used to assess component needs, for validity and transparency;

- Evaluating the results of each IPT cycle, to assess whether it produced a reasonable set of high-priority gaps and corresponding R&D efforts (investments); and
- Identifying lessons learned and providing recommendations for corrective actions and process improvements that can be implemented in future IPT cycles.

Alignment of the IPT and JRC Processes

The IPTs and the JRC follow two distinct but mutually supportive and interdependent processes. The IPTs focus on R&D efforts while the JRC focuses on operational requirements, but there are several touch points that present important information-sharing opportunities for the IPTs and JRC. Figure 4 on the next page illustrates the touch points between the two processes.

Through the Joint Requirements Integration and Management System (JRIMS) process, the JRC reviews and validates component-submitted operational capability gaps, associated requirements, and proposed courses of action to mitigate those gaps.

As noted earlier in this report, during the FY16 cycle, JRC representatives participated in the sub-IPTs and had a voting seat on the SRC to provide expertise in requirements and gap identification and facilitate information sharing between the two processes.

By sharing information, the IPTs and JRC can leverage one another's expertise and reduce the reporting burden on DHS components. As the JRC builds out processes for operational capability gap collection and requirements validation and prioritization, resulting information outputs can be shared with the IPTs. Similarly, the IPTs can inform the JRC of capability gaps that may require R&D.

R&D efforts identified by the IPTs may develop solutions that are transitioned to component users through acquisition programs or used to fill a JRC-identified operational capability gap. In future cycles, the IPTs will continue to share information on current and planned R&D efforts and inform the JRC of technologies that are approaching transition readiness.

The JRC continues to mature its processes for joint assessment of requirements and operational capability gap prioritization. The level of direct interaction between the IPT and JRC processes will increase over time as the JRC assumes a lead role in prioritizing joint operational capability gaps and requirements. Future iterations of the IPT process will leverage existing analysis from other organizations in DHS to enhance the translation of JRC-identified operational capability gaps to IPT-identified technological capability gaps.

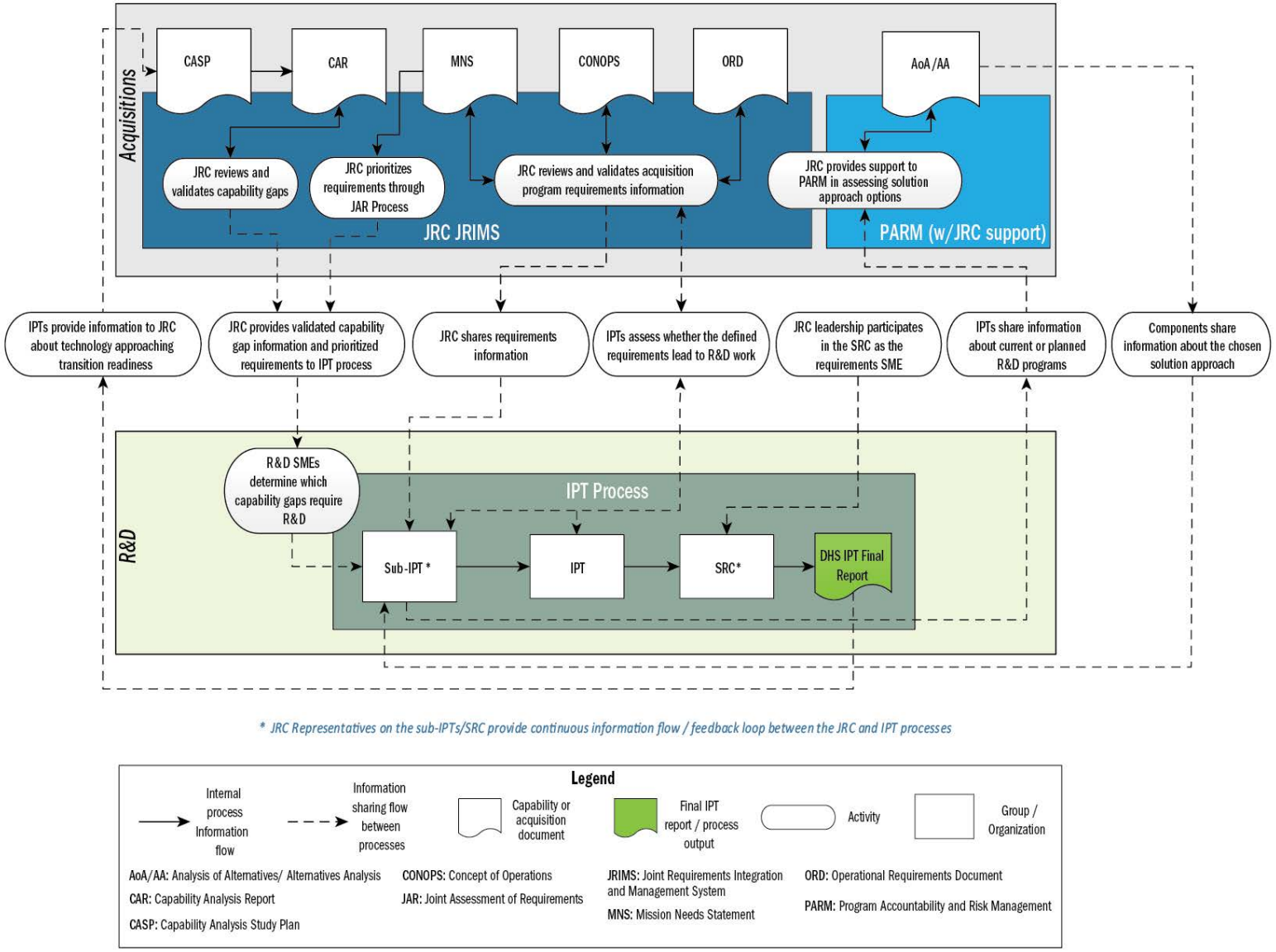

Figure 4. Alignment of IPT and JRC Processes

Development and Transition of Solutions to Address Priority Gaps

The Secretary charged the IPTs with developing and reporting metrics for the transition of technological solutions to close capability gaps. To support this objective, DHS developed a process (see Figure 5) for assessing high-priority gaps to inform decisions on solution development and transition. Each step in the process requires coordination among the three appropriated R&D entities within DHS (DNDO, USCG, and S&T) and other DHS components with equities in a given gap.

The first step ensures an understanding of the mission need associated with a priority gap to support further analysis. During the second step, analysts identify existing technology opportunities and market information that may support a gap.

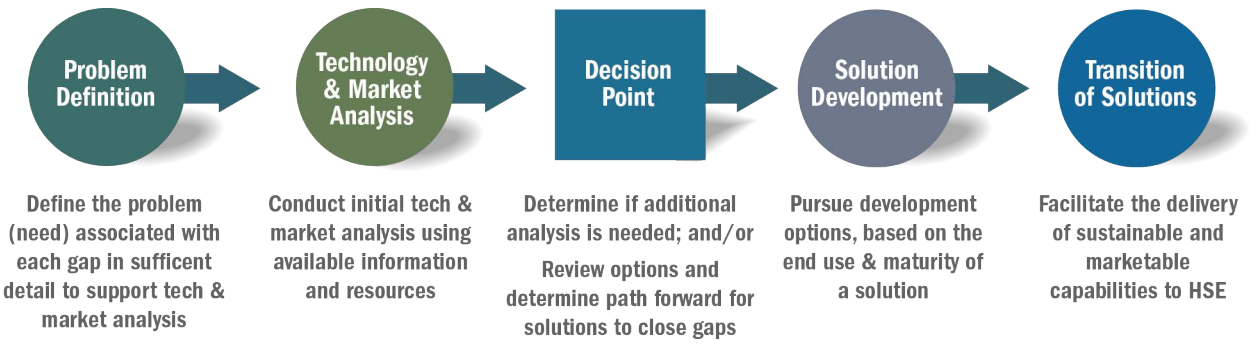

Figure 5. Assessing High-Priority Gaps to Support Solution Development and Transition

A decision point occurs between the second and third steps in the process, when sufficient information exists to support decisions on solution development or refinement. If sufficient information does not exist, a decision can be made to perform additional analysis. Based on initial findings, component and S&T representatives will coordinate with other DHS and external partners to review options and support an appropriate path forward to close priority gaps. Transition planning is an integral consideration throughout the process to ensure the proposed solution can and will be appropriately transitioned for use.

Appendix B provides more information on developing and transitioning solutions to address high-priority gaps.

Technology Assessments and Acquisition Programs

In the August 2015 memo, the Secretary directed S&T to conduct a systems engineering review and technology assessment of the technical solutions in major DHS acquisition programs and provide a report to the Chief Acquisition Officer and the JRC prior to the decision to enter the "obtain" phase of the Acquisition Life Cycle. The results of the IPT process can inform a DHS acquisition profile that aligns to the high-priority technological capability gaps across DHS mission areas. Technology assessments help to ensure the technical readiness and feasibility of solutions intended to address those high-priority gaps.

S&T has begun to conduct technical assessments on proposed and established Department acquisition programs. A technical assessment is a combined system engineering review of an acquisition program and an assessment of the technologies that are necessary to realize the capability that the acquisition program intends to deliver. S&T will conduct technical assessments of ongoing acquisition programs in FY16 and will conduct additional assessments in FY17 and beyond. In the future, where an assessment determines that major technical risk and/or overall program risk is high, follow-on technical assessments may be conducted during the acquisition cycle to monitor these risks.

Systems engineering technical assessments provide greater understanding of the technical maturity of solutions that DHS intends to acquire. The results of these assessments provide information on:

- The ability of an acquisition program to deliver the needed capability on schedule;
- Potential opportunities to augment the program with new or additional capabilities; and
- Potential new gaps and associated R&D efforts that could be addressed through proposed and existing acquisition programs.

VI. The IPTs in Summary: Current and Next Generation

In August 2015, the Secretary issued a memorandum directing the establishment of IPTs to identify DHS technological capability gaps and coordinate R&D efforts to close those gaps across the mission areas of the Department. Consistent with the Secretary's guidance, S&T developed an initial IPT process that delivered results in FY16 and provides a solid blueprint for future evolution. The initial IPT level of effort established an IPT governance structure, guidance, data collection templates, and an outreach platform available across the Department. DHS components implemented the process through three main bodies—sub-IPTs, IPTs, and the SRC—and incorporated feedback from additional DHS HQ organizations through the Technical Advisory Board (TAB). The process supports Departmental unity of effort by facilitating cross-component collaboration and traceability of R&D efforts.

The Secretary outlined the following primary objectives for the IPTs:

- Identify and prioritize technological capability gaps and corresponding efforts to develop solutions to close those gaps;
- Identify R&D being performed across DHS, both in traditional R&D funding lines and in component acquisition programs;
- Ensure that technology being acquired meets DHS and component mission needs;
- Identify and de-conflict duplicative R&D efforts; and
- Develop and report metrics for the transition of technological solutions to close gaps.

The two documents delivered to the Secretary address the first two objectives. The IPT process established for the FY16 cycle provides the foundation to achieve the remaining three objectives in future cycles. In so doing, the IPT process will address the GAO recommendations to improve R&D tracking and coordination across the Department.

S&T established five chartered IPTs in FY16, all of which had active sub-IPTs that met and identified mission-focused capability gaps. Four of the five IPTs completed the process by providing priority gaps to the SRC.

During the FY16 IPT process, DHS conducted an additional analysis focused specifically on identifying cross-cutting, resilience-oriented efforts. Because resilience influences R&D activities across multiple mission areas, DHS evaluated the IPT-identified priority gaps and corresponding R&D efforts for their contributions toward enhancing resilience.

Building on the process established to date, the IPTs will continue to evolve as the central mechanism by which the Department identifies and coordinates its R&D efforts to DHS priority missions. To ensure a sustainable and defensible process for future years, S&T initiated an annual, independent AAR of the IPT process. The initial AAR will assess the effectiveness and transparency of the methodology and results from the FY16 process and identify lessons learned to support recommendations for improvement in future cycles.

Acronym List

AAR	After Action Review	**USCG**	U.S. Coast Guard
CBP	U.S. Customs and Border Protection	**USCIS**	U.S. Citizenship and Immigration Services
CIO	DHS Chief Information Officer	**USSS**	U.S. Secret Service
CRCL	DHS Office of Civil Rights and Civil Liberties	**USST**	Under Secretary for Science and Technology
CT	Counterterrorism		
DHS	U.S. Department of Homeland Security		
DNDO	DHS Domestic Nuclear Detection Office		
FEMA	Federal Emergency Management Agency		
FRRG	First Responder Resource Group		
FY	Fiscal Year		
GAO	Government Accountability Office		
HSE	Homeland Security Enterprise		
I&A	DHS Office of Intelligence and Analysis		
ICE	U.S. Immigration and Customs Enforcement		
IED	Improvised Explosive Device		
IPT	Integrated Product Team		
JRC	DHS Joint Requirements Council		
JRIMS	Joint Requirements Integration and Management System		
MGMT	DHS Directorate for Management		
NPPD	DHS National Protection and Programs Directorate		
OHA	DHS Office of Health Affairs		
PLCY	DHS Office of Policy		
PPE	Personal Protective Equipment		
R&D	Research and Development		
S1	Secretary of Homeland Security		
S2	Deputy Secretary of Homeland Security		
S&T	DHS Science and Technology Directorate		
SRC	Science and Technology Research Council		
TAB	Technical Advisory Board		
TSA	Transportation Security Administration		

Appendices

This section contains appendices that provide supporting information on topics referenced in the report, as follows:

- **Appendix A: Integrated Product Team Structure and Functions** – Describes the IPT governance structure and functional process established in FY16.
- **Appendix B: Development and Transition of Solutions to Address Priority Gaps** – Outlines the process by which DHS will assess high-priority gaps to support decisions to develop and transition solutions to address those gaps; and describes DHS activities that support solution development and transition.

Appendix A - Integrated Product Team Structure and Functions

In response to the Secretary's August 2015 memorandum, S&T established an operational framework and process for FY16 to support the stand-up, governance, and ongoing operations of the IPTs. Composed of three main implementing bodies—sub-IPTs, IPTs, and the S&T Research Council (SRC)—plus an advisory board, the FY16 IPT process engaged executives and staff from across DHS to identify technological capability gaps and priority R&D efforts to close those gaps.

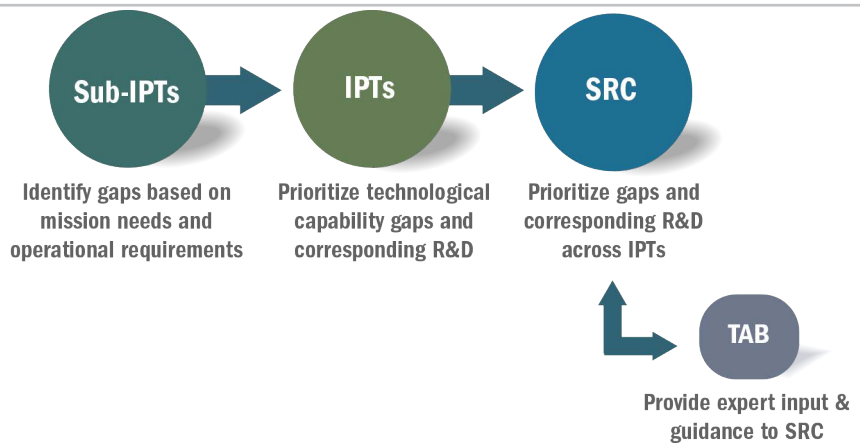

Figure 1. IPT Governance Structure

Sub-IPTs

The sub-IPTs included component and S&T staff with expertise in a specified topic within the larger mission area of their respective IPT.

The bulk of work performed as part of the IPT process was accomplished at the sub-IPT level. A representative from the JRC participated on each sub-IPT to ensure alignment with the JRC process and consideration of the requirements identified through that process. In FY16, the sub-IPTs performed some or all of the following activities:

- Identifying high-priority technological capability gaps based on mission needs and operational requirements;
- Documenting ongoing DHS R&D activities within their area of focus; and
- Identifying R&D efforts that address high-priority gaps.

Integrated Product Teams

The IPTs were composed of senior-level staff and executives from across DHS who are empowered to act on behalf of their components. IPT members worked collaboratively to conduct some or all of the following activities in FY16:

- Considering the technological capability gaps identified by the sub-IPTs and developing a list of high-priority gaps across the IPT mission space;
- Validating any ongoing DHS R&D activities identified by the sub-IPTs; and

- Reviewing R&D activities identified by the sub-IPTs and generating a list of R&D efforts that address high-priority gaps across the mission space.

In addition to inputs from the sub-IPTs, the IPTs considered additional component needs that fell within the scope of the IPT mission, as well as any new or emerging priorities identified by Department leadership or dictated by real-world events.

The IPTs worked closely with legal, policy, civil liberties, and privacy advisors to ensure that appropriate protections were built into planned outcomes and issues were addressed through review and adjudication cycles.

S&T Research Council

For FY16, the SRC included the component senior executives who chair the IPTs, a chair from S&T, and a senior representative of the JRC. Each IPT provided the SRC with a list of high-priority mission-focused gaps and corresponding R&D efforts. The SRC reviewed the consolidated inputs from the IPTs and generated a list of high-priority technological capability gaps and corresponding R&D efforts across the IPTs.

A senior representative of the FRRG also participated in the SRC, to ensure alignment and awareness of top-priority needs of responders in the field. The FRRG identified priority capability gaps and R&D efforts for the State and local responder community and submitted this information to the SRC. The FRRG provided input to SRC deliberations as appropriate, but did not vote on the DHS component-driven priorities identified by the IPTs.

To ensure a broad view across the full spectrum of DHS R&D, the SRC required input from many stakeholders within DHS, beyond the information provided by the IPTs. This report reflects that additional input, gleaned primarily from two sources:

1) A data call to all DHS components to identify ongoing research and/or development activities across the Department; and

2) A Technical Advisory Board (TAB) that reviewed and advised on SRC recommendations and draft products.

Technical Advisory Board

The TAB included senior representatives from DHS HQ components and offices that did not participate in the IPTs. Chaired by the DHS Office of Policy, the TAB provided advice on key milestones and recommendations, as requested by the SRC.

In FY16 and going forward, the TAB may conduct or support the following activities:

- Reviewing and commenting on draft SRC products;
- Responding to queries related to the technical content or execution of the IPT process;
- Providing input to a consensus-based process for ranking gaps and corresponding DHS R&D activities in accordance with SRC guidance.

Appendix B - Development and Transition of Solutions To Address Priority Gaps

The Secretary identified several objectives for the IPT process, including developing and reporting metrics for the transition of technological solutions to close capability gaps. To this end, DHS developed a process to assess the high-priority gaps identified by the SRC to inform decisions on how best to move forward in addressing the gaps. This process, illustrated in the figure below, requires coordination across DHS to ensure that all component equities are represented and that appropriate programs are leveraged to support process objectives.

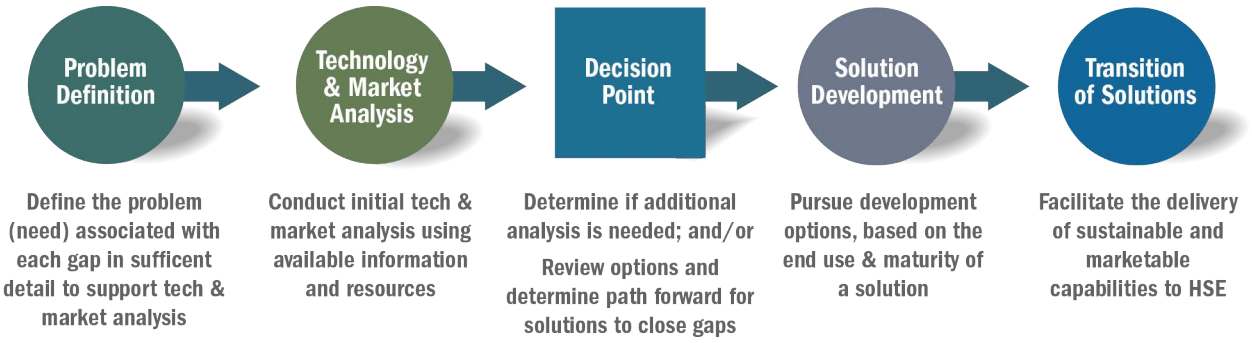

Figure 1. Assessing Priority Gaps to Support Solution Development and Transition

The first step ensures an understanding of the mission need associated with a priority gap to support further analysis. Analysts then identify existing technology opportunities and market information that may support a gap. A decision point occurs between the 2nd and 3rd steps, when sufficient information exists to support decisions on solution development or refinement. If more information is needed, additional analysis may be pursued.

To implement the process effectively, a dedicated team will be formed to focus on each gap. These teams should include component and S&T program managers and other subject matter experts with working knowledge of the gap, as well as representatives of DHS activities that support the development and transition of solutions to address the gap. The technology scouting and technology transition activities play a role throughout the process, as described below.

Technology Scouting and Market Analysis

Technology scouting and market analysis provide critical information about technologies that are or have been developed, deployed, and utilized in a given market sector. This information enables DHS to make better decisions about how it invests in R&D. This information can:

- Identify existing technologies that could be adopted or modified;
- Determine what technologies are being used and/or acquired in a given market;
- Provide information on legacy systems, buying patterns, lifecycle and maintenance costs, and regulatory and policy issues; and
- Isolate early adopters of new technologies.

Technology Transition

DHS provides mechanisms and services that support the conversion of technologies, standards, and knowledge products to the operational environment. This process includes leveraging the technology scouting and market analysis activities described above; designing formal transfer agreements, employing tools such as Partnership Intermediary Agreements (PIA) and Cooperative R&D Agreements (CRADA); assisting with patent applications; and tracking and managing intellectual property for DHS and its partners.

Brief descriptions of other programs and activities that support solution development and transition are presented below, in alphabetical order.

Center of Innovation. S&T manages the United States Air Force Academy (USAFA) Center of Innovation (CoI), which is designed to create novel capabilities from emerging industry research technologies that will eventually enable commercial off-the-shelf (COTS) products. The CoI enables the Federal Government to conduct cooperative research with leading private industry technology companies. The CoI is in the process of integrating several industry technologies to examine alternatives for better communication and collaboration among Federal Government organizations.

In-Q-Tel. In-Q-Tel (IQT) is an independent, not-for-profit organization that invests in venture capital startup companies that support intelligence and homeland security needs. IQT provides a conduit through which DHS can anticipate and leverage technology trends to support near-term development and piloting activities that address prioritized capability gaps.

Interagency Programs. DHS develops trusted partnerships with other Federal Government agencies to leverage combined investments and resources in support of R&D programs and initiatives. The Homeland Security Act of 2002 gives S&T the responsibility to coordinate with other appropriate executive agencies in developing and carrying out the science and technology agenda of the Department to reduce duplication and identify unmet needs.

International Programs. DHS develops partnerships with foreign governments and international organizations to enhance scientific and technical knowledge for the homeland security enterprise (HSE). These partnerships will provide HSE stakeholders with access to innovative R&D knowledge, funding, and other unique capabilities and resources. S&T currently manages partnerships with Australia, Canada, France, Germany, Israel, Mexico, the Netherlands, New Zealand, Singapore, Spain, Sweden, the United Kingdom, and the European Commission.

National Laboratories. DHS maintains critical laboratory assets and coordinates related activities to support technological innovations, scientific breakthroughs, rapid response capabilities, and solution deployment. S&T oversees a network of five DHS laboratories and coordinates with 13 Department of Energy (DOE) National Laboratories in support of DHS priorities and missions. The DOE Labs can support the gap assessment process by helping to validate capability gap analyses and improve requirements generation.

Operational Experimentation. Operational Experimentation (OpEx) is a method of operational analysis designed to generate end-user feedback on operational requirements and technologies to support a broad range of homeland security stakeholders. This process demonstrates technologies in real-world scenarios to determine operational constraints and the efficacy of a sponsored technology in a given mission space. Ideally, there will be

OpEx events centered on specific capability gaps identified by each of the IPTs. The results of these events will be coordinated with the Joint Requirements Council to inform DHS acquisitions that address priority needs.

PIONEER. The goal of the Partnering for Innovation and Operational Needs through Embedding for Effective Relationships (PIONEER) program is to develop better relationships and enhance interaction between S&T and DHS components to increase understanding of research and development processes. This program embeds S&T scientists into the operational environments of DHS components, enabling current-state awareness of the components' most critical needs. Concurrently, DHS component personnel are embedded into the S&T research, development, test, and evaluation processes.

Prize Competitions. DHS prize competitions engage a broad range of talent through public crowdsourcing to produce ideas and solve tough homeland security challenges. Prizes are most effective when there is a well-defined problem and the results of a competition can produce change. DHS announces a problem or question to the public (usually through publication in the Federal Register), along with specific criteria for evaluating entries. A diverse group of judges then assesses the submissions against stated criteria and ensures that desired results are achievable.

Research & Development Accelerators. The DHS Accelerator program is designed to attract innovators, while keeping pace with the speed of technological advancement. Accelerators provide DHS with visibility and allow for engagement with startup companies that are developing cutting-edge technologies. Accelerators and their private sector networks provide a cost-effective way to engage a multitude of high-quality companies and influence their development to align with DHS priority needs.

SAFETY Act Implementation. DHS has an office devoted to implementing the SAFETY Act, a law that may limit the legal liability of companies that manufacture or sell technologies and services that have anti-terrorism capabilities. The "Support Anti-Terrorism by Fostering Effective Technologies" (SAFETY) Act was enacted by Congress as a direct result of 9/11 and as part of the Homeland Security Act of 2002 (Title VII, Subtitle G). By capping liability, the law promotes the creation, deployment, and use of anti-terrorism technologies to protect the homeland and save lives.

Small Business Innovation Research (SBIR). The DHS SBIR Program provides early-stage funding, based on scientific merit, to U.S. small businesses to develop new technologies and innovations that have the potential to meet DHS R&D needs. DHS S&T's SBIR program is focused on near-term commercialization and delivery of operational prototypes to Federal, State, and local emergency responders and managers, as well as internal DHS entities. In addition, technology solutions resulting from SBIR funding provided by other Federal agencies can be leveraged through the S&T SBIR Program's Other Agency Technology Solutions (OATS) pilot program, helping to reduce the time from proof-of-concept feasibility to demonstration.

University Centers of Excellence. DHS manages 10 university Centers of Excellence (COE) that conduct research and education in support of DHS major mission areas. DHS components can use the COEs to answer research questions, access advanced capabilities and technical solutions, and find highly skilled future workers. COEs are broadly based in DHS mission areas and have the flexibility to address new problems or unexpected challenges, including those identified through the IPT process.

Research priorities for the COEs originate with the DHS components, which staff the Federal Coordinating Committees (FCCs) for each COE and select the most mission-relevant projects. The FCC process is focused on long-term challenges with uncertain outcomes, compared to the shorter term, better defined priorities addressed by the IPTs. Technological capability gaps prioritized through the IPT process will inform new research questions for the COEs. These questions will be considered annually and biennially in COE reviews, during which some research projects are discontinued and replaced by new ones.

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