



Results of Fiscal Year 2015 Research and Development

March 22, 2016

Fiscal Year 2016 Report to Congress



Homeland
Security

Science and Technology Directorate

Message from the Under Secretary for Science and Technology

March 22, 2016

I am pleased to submit the following report, “Results of Fiscal Year 2015 Research and Development,” which has been prepared by the Science and Technology Directorate (S&T). The report has been compiled pursuant to language in Senate Report 114-68 accompanying the *Fiscal Year (FY) 2016 Department of Homeland Security* (P.L. 114-113).



We are beginning to see results from our new Apex programs. In FY 2015, the Next-Generation First Responder Apex executed S&T’s first prize competition and launched S&T’s first accelerator program to take advantage of start-ups and small businesses.

In FY 2015, our Data Analytics Engine operationalized big data tools with U.S. Immigration and Customs Enforcement that are already creating new leads for investigators. They also continued support for data projects across DHS such as the Transportation Security Administration’s (TSA) ongoing rollout and expansion of the TSA Pre✓™ program. This reflects how valuable S&T’s new engine programs, which are crosscutting by design and reach across S&T’s and Department’s full range of missions, will be moving forward.

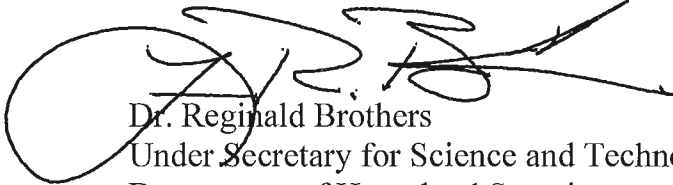
S&T programs connecting small businesses and universities to homeland security operational challenges continue to benefit the Department. For example, in FY 2015, S&T’s small business grants created operational software supporting law enforcement cyber forensics of cell phones. S&T’s university-based Centers of Excellence had numerous FY 2015 accomplishments ranging from tools to help the Coast Guard visualize and analyze geo-specific social media to now-operational tools helping the Federal Emergency Management Agency assess and maintain levees and dams to prevent failure during future storms.

First responders at all levels of government continue to benefit from S&T’s investments. In FY 2015, S&T commercialized a communications technology allowing the first responder community to save millions of dollars potentially by allowing agencies easily to upgrade and connect new and legacy systems at a low cost. FY 2015 also saw previous year projects like Finding Individuals for Disaster and Emergency Response (FINDER) become fully operational, and, in the case of FINDER, saving multiple lives during the international response to the Nepal earthquakes.

Finally, in addition to numerous multi-year projects reaching fruition, FY 2015 results reflect S&T's valuable subject matter expertise and technical triage during crises or major events. S&T provided essential support to the Department's Ebola response that included filling technical knowledge gaps that better informed response and kept responders, doctors, and patients safe. S&T also supported the United States Secret Service and City of New York during Pope Francis's three-city visit.

Inquiries related to this report may be directed to me at (202) 254-6033 or to the Department's Deputy Under Secretary for Management and Chief Financial Officer, Chip Fulghum, at (202) 447-5751.

Sincerely,



Dr. Reginald Brothers
Under Secretary for Science and Technology
Department of Homeland Security



Results of Fiscal Year 2015 Research and Development

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I. Legislative Requirement

This report was prepared pursuant to language in Senate Report 114-68 accompanying the *Fiscal Year (FY) 2016 Department of Homeland Security (DHS) Appropriations Act* (P.L. 114-113).

Senate Report 114-68 states:

In conjunction with the President's fiscal year 2017 budget request, S&T is to report on results of its R&D for the prior fiscal year to include all technologies, technology improvements, or capabilities delivered to frontline users.

II. FY 2015 Science and Technology Directorate Research and Development Results

Pursuant to language in Senate Report 114-68 accompanying the *FY 2016 DHS Appropriations Act* (P.L. 114-113), this report was prepared to provide information concerning the results of research and development for the DHS Science and Technology Directorate (S&T) that occurred in the prior fiscal year.

The following are the results for FY 2015 organized by S&T budget thrust areas.

III. Apex

Project: Next Generation First Responder (NGFR) Apex program

End Users: Federal, state, local, territorial, and tribal first responder agencies

Result: In FY 2015, S&T conducted its inaugural prize competition under the *America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Reauthorization Act of 2010* (P.L. 111-358), awarding a total of \$25,000 to two innovative small businesses that developed solutions to locate and track first responders indoors, increasing the likelihood that responders make it out of an emergency safely. The NGFR Apex program seeks to develop a scalable and modular ensemble that includes an enhanced duty uniform, personal protective equipment, wearable computing and sensing technology, and robust voice and data communication networks. NGFR helped launch the EMERGE! Accelerator Program for Wearable Technology for First Responders, working with established accelerators to speed up the time to market for cutting-edge technologies, ultimately supporting 18 start-ups and connecting them with investors. NGFR facilitated direct engagement between the first responder community and industry, including reaching more than 900 stakeholders at in-person events and leading the Responder of the Future dialogue as part of the S&T National Conversation.

Group/Division: First Responders Group (FRG)

Project: Apex Engines: Data Analytics Engine (DA-E)

End Users: U.S. Immigration and Customs Enforcement (ICE)

Result: ICE operationalized its Big Data network architecture and tools, built by DA-E and delivered to ICE as part of the Border Enforcement Analytics Program Apex, for agents in three major cities. These capabilities look across multiple data sets and increase the probability of detecting illicit activity. They led to new insights and investigations and raised ICE's profile within the counter-proliferation community, creating collaboration opportunities with other agencies and partner countries. As part of DA-E's work, a geo-coding evaluation report for more than 30 tools was produced that enables ICE agents and analysts to visualize and project shipment data onto maps and better understand flows and concentrations of shipments with national security sensitive material. The evaluation was also shared with other DHS Components with a geo-coding requirement.

Group/Division: Homeland Security Advanced Research Projects Agency (HSARPA) Innovation and Technology Resources

Project: Apex Engines: Data Analytics Engine (DA-E)

End Users: Transportation Security Administration (TSA)

Result: DA-E completed an analysis of third party TSA Pre✓™ enrollment vendors in partnership with TSA to examine commercial options for expanding TSA Pre✓™

participation. Reports to TSA helped to define parameters for the commercial service and evaluation procedures for use during the acquisition program.

Group/Division: HSARPA Innovation and Technology Resources

Project: Apex Air Entry/Exit Re-Engineering (AEER)

End Users: U.S. Customs and Border Protection (CBP) Office of Field Operations

Result: In FY 2015, AEER completed a Rapid Usability Evaluation of mobile tools (for traveler inspections) that, prior to a purchase and planned deployment by CBP, revealed the poor performance of tablet devices for mobile travel document scanning and identification of passengers who have completed processing. The purchase was subsequently canceled, and CBP is planning a new, more robust approach based on weaknesses identified by S&T.

Group/Division: HSARPA Borders and Maritime Security Division

Project: Apex Engines: Modeling and Simulation Engine (MS-E)

End Users: United States Secret Service (USSS)

Result: MS-E provided USSS with technical oversight for crowd ingress, egress, and emergency evacuation during the Pope's September visit to the United States, specifically during the September 23 outdoor mass at the Basilica of the National Shrine of the Immaculate Conception and surrounding areas. The value of the MS-E work has already led USSS to express interest in using S&T capabilities to support future missions at the 2016 Republican National Convention in Cleveland, Ohio, and the Democratic National Convention in Philadelphia, Pennsylvania.

Group/Division: HSARPA Innovation and Technology Resources

IV. Small Business Innovation Research

Project: Cybersecurity for Law Enforcement: Enhancements to NowSecure Forensics Software

End Users: Montgomery County Police Department, Loudoun County Sheriff's Office, USSS, and DHS Office of the Chief Security Officer (OCSO)

Result: In FY 2015, S&T provided NowSecure Forensics licenses to the Montgomery County Police Department, Loudoun County Sheriff's Office, USSS, and the DHS OCSO. The S&T-funded software became commercially available and transitioned to use with numerous law enforcement agencies internationally. NowSecure helps law enforcement analyze information from negative-AND flash memory chips used widely in cell phones. S&T's investment significantly enhanced the company's commercial offering and added a free version of the software for law enforcement.

Group/Division: HSARPA Cyber Security Division

Project: Small Business Innovation Research (SBIR) 6.1-004 Phase III: Signal Processing for a Southern Border Surveillance System

End Users: CBP Office of Border Patrol

Result: The prime contractor for the CBP Integrated Fixed Towers program acquired video enhancement software previously developed under the SBIR project Signal Processing for a Southern Border Surveillance System. This new software improves video system utility, functionality, and user friendliness for Border Patrol agents.

Group/Division: HSARPA Borders and Maritime Security Division

Project: Aviation Scanner

End Users: CBP Office of Field Operations

Result: S&T transitioned a small, mobile scanning system designed to examine interior voids of light aircraft without needing to inspect visually the spaces, which are typically difficult to access physically. Successful trials conducted at Fort Lauderdale-Hollywood International Airport resulted in adaptation of the system by CBP for operational use in Laredo, Texas.

Group/Division: HSARPA Borders and Maritime Security Division

Project: First Responder Technologies: Virtual Shooter

End Users: Federal, state, local, territorial, and tribal law enforcement agencies

Result: In FY 2015, Virtual Shooter was transitioned to ICE Office of Firearms and Tactical Programs' Armory Operations Branch to take on firing load and minimize repetitive motion injuries to ICE officers from recoil, ejection cycles, and other movements of more than 200,000 test firings each year. Virtual Shooter is a robotic solution that mimics the movements and reactions of a human firing a gun to mechanically test a wide range of firearms and ammunition to ICE's specifications.

Group/Division: FRG First Responder Technology Clearinghouse

V. Border Security

Project: Land Sea Cargo Screening: Brownsville, Texas, Rail Scanner Relocation

End Users: CBP Office of Field Operations

Result: S&T created and transitioned the first-ever data-link for sharing U.S. and Mexico rail scanning data, providing CBP and its Mexican partners real-time X-ray data. The data-link technology is operational and transmitting rail data at the new Brownsville and Matamoros International Bridge connecting Texas and Mexico railways. The project overcame aggressive timelines and resulted in the first shared U.S.-Mexico streaming data resource for combatting trafficking between the two countries' border.

Group/Division: HSARPA Borders and Maritime Security Division

Project: Cargo Container Security: Electronic Federal Protective Service (eFPS)

End Users: Federal Protective Service (FPS)

Result: S&T successfully automated all manual data collection and reporting tasks at FPS's Remote Delivery Screening Facility. FPS uses the facility to evaluate drivers, vehicles, and cargo before allowing them to continue with deliveries to various federal facilities in the National Capital Region, including the White House. eFPS is in full-time operational use by FPS. S&T also piloted the use of GPS tracking devices to secure and monitor these deliveries.

Group/Division: HSARPA Borders and Maritime Security Division

Project: Port and Coastal Surveillance: Space-Based Technology Exploitation

End Users: CBP Air and Marine Operations

Result: S&T and Department of Defense (DOD) Coalition Tactical Awareness and Response (CTAR) demonstrated the ability to provide rapid access to task and receive unclassified, shareable, wide area, space-based commercial radar and electro-optical imagery over the maritime domain to support tactical operations. As a result, CBP is co-funding the creation of an initial operating capability based on CTAR for the CBP Air and Marine Operations Center in Riverside, California.

Group/Division: HSARPA Borders and Maritime Security Division

Project: Port and Coastal Surveillance: Integrated Maritime Domain Enterprise (IMDE)-Coastal Surveillance System (CSS) Program

End Users: United States Coast Guard (USCG) and CBP

Result: In FY 2015, IMDE-CSS achieved interim authority to operate for the nodes located at DHS Data Center Two (DC-2) and the Maryland Natural Resource Police (MNRP). The authority allows the CSS system to connect to and share data source feeds from coastal surveillance sensors such as the MNRP Maritime Law Enforcement Information Network system. IMDE-CSS Technical Demonstration One was conducted in August 2015 and demonstrated maritime domain awareness and secure information

sharing between federal, state, and local agencies. Chesapeake region data are now being shared with the IMDE-CSS node residing at the CBP Air and Marine Operations Center in Riverside, California.

Group/Division: HSARPA Borders and Maritime Security Division

Project: Ground Based Technology: Automated Scene Understanding (ASU), Canada U.S. Sensor Sharing Pilot (CUSSP)

End Users: CBP Office of Border Patrol

Result: In FY 2015, ASU/CUSSP used shared data from U.S. and Canada sensor towers to provide a correlated surveillance maritime picture simultaneously to CBP and Royal Canadian Mounted Police (RCMP) agents. S&T's Automated Scene Understanding technology provided an automated capability for alerting the operator to anomalous activity, relieving the watch stander from continuously monitoring sensor displays and allowing them to conduct other duties. S&T continued technology improvements for ASU/CUSSP based on agent feedback. S&T plans to conduct a demonstration of ASU/CUSSP for senior Canadian and U.S. leadership in the summer of 2016.

Group/Division: HSARPA Borders and Maritime Security Division

Project: Ground Based Technology: Slash CameraPole

End Users: CBP Office of Border Patrol

Result: In FY 2015, S&T piloted Slash CameraPoles on the northern border for day/night automated detections of border crossers in remote areas along the U.S.-Canadian border. Thermal imagers can monitor the border slash without false alarms caused by wind-blown clutter or nearby local activities outside the border zone. The slash is a 20-foot wide clearing along the entire northern border that demarcates the U.S.-Canada boundary. On the basis of CBP user feedback, upgrades were made to include collecting multiple snapshots per trigger, remotely capturing imagery and configure settings, and adjusting algorithms for natural events and gradual changes in the environment to minimize false and nuisance alarms. Communication protocols are being modified to streamline interactions between the CameraPole, end user networks, and other sensors for final installation of the three-pole system in FY 2016.

Group/Division: HSARPA Borders and Maritime Security Division

VI. Chemical, Biological, and Explosive Defense

Project: Advanced Imaging Displays

End User: TSA Office of Security Capabilities, Office of Training and Workforce Engagement, and Office of Human Capital

Result: In FY 2015, S&T transitioned five enhanced ScreenADAPT threat image databases and interfaces for workforce training to TSA. The systems accelerate visual search-and-detect skill acquisition, learning, and retention. S&T added dual-screen capability for visual search-and-detect skill training, which integrates eye tracking on two views of X-ray images (top-down and side views of scanned items).

Group/Division: FRG Resiliency Division

Project: Screening, Training, and Selection

End User: TSA Office of Security Capabilities and Office of Training and Workforce Engagement, TSA Training Academy at Federal Law Enforcement Training Center (FLETC)

Result: S&T transitioned an Exceptionally Performing Screener classroom-based training knowledge product to TSA end users. Training was developed based on analysis of performance data captured in the operational environment across different levels of performance, regions, airport categories, and brands of equipment to capture the most relevant, trainable aspects of the X-ray image analysis task. S&T's prototype training system uses force sensors integrated into clothing to enable objective assessment of hand placement and position as well as training of cross-gender empathy.

Group/Division: FRG Resiliency Division

Project: Standoff Trace Detection

End Users: U.S. General Services Administration (GSA), USSS, CBP

Result: S&T demonstrated standoff explosives detection technologies at the Johns Hopkins University Applied Physics Laboratory. The two systems were recent transitions from DOD programs for DHS implementation that measure the infrared signatures of explosive residues and provide operators with the capability to detect and identify threats in near real-time. The levels of materials detected are consistent with thumbprint quantities, indicative of terrorist activities.

Group/Division: HSARPA Explosives Division

Project: BioAssays

End Users: Centers for Disease Control and Prevention (CDC) Laboratory Response Network (LRN), state public health laboratories, DHS Office of Health Affairs (OHA)

Result: In FY 2015 S&T validated and transitioned assays to CDC LRN (163 laboratories across the Nation) that enable detection of all known Ebola viruses and all known Marburg viruses. The existing assay for the Ebola virus used by CDC detects

only a single, common strain of Ebola. The BioAssays project designs, tests, and validates assays to improve identification and characterization of biological threat agents, providing government officials with high confidence assay results upon which uniform and timely actions and decisions are enabled.

Group/Division: HSARPA Chemical and Biological Defense Division

Project Name: BioAssays

End Users: CDC, USSS, CBP, DHS Chief Readiness Support Officer, S&T FRG, United States Department of Agriculture (USDA), Federal Bureau of Investigation (FBI), state public health laboratories

Description/Result: In FY 2015, rapid, fieldable handheld assays for *Bacillus anthracis* (Anthrax), *Yersinia pestis* (Plague), and *Francisella tularensis* (Tularemia) were validated by S&T and became commercially available. These are low cost and available to all interested groups within government for use by first responders as tools for clearing suspected bio-incidents, white powder letters, etc. The BioAssays Project designs, tests and validates assays to improve identification and characterization of biological threat agents, providing government officials with high confidence assay results upon which uniform and timely actions and decisions are enabled.

Group/Division: HSARPA Chemical and Biological Defense Division

Project Name: Vehicle-Borne Improvised Explosive Device Countermeasures

End Users: FBI; New York City Police Department (NYPD); federal, state, and local bomb squad/explosive ordnance disposal organizations

Result: In FY 2015, S&T transitioned and completed operational test and evaluation of the Taurus system with FBI's Terrorist Explosives Device Analysis Center and the NYPD Bomb Squad. S&T developed Taurus to address challenges faced by military and domestic bomb squads when rendering safe explosive devices and removing hazardous materials. The Taurus system offers fine manipulation and motion-specific operations necessary to render explosives safe, and it is the only platform that can remotely perform delicate manipulation tasks beyond current ground Explosive Ordnance Disposal robotics systems. The lightweight, modular system design also allows users to customize Taurus to specific operational needs with minimal initial training.

Group/Division: HSARPA Explosives Division

Project Name: High Resolution Explosives Trace Detectors

End Users: TSA

Result: In FY 2015, S&T and the National Institute of Standards and Technology (NIST) transitioned pressure sensitive wands (PSW) to TSA that will help train transportation security officers (TSOs) on best practices for collecting explosives from surfaces. The current sampling of hands, interiors of baggage, etc. for trace amounts of explosive material indicating a potential threat is affected by how much pressure is used (e.g., too much pressure will not pick up as much material to sample). Training wands will help TSA maximize the benefit of its trace detectors and enhance operational

effectiveness. In FY 2016, TSA is planning to incorporate PSW training into nationwide TSO training curriculum.

Group/Division: HSARPA Explosives Division

VII. Counter Terrorist

Project: Bio threat Characterization: Ebola response

End Users: White House, public health responders, government agencies, hospitals, clinics, and health care workers involved in the Ebola response

Result: During the Ebola response in FY 2015, the Biological Threat Characterization program directed research at S&T's National Biodefense Analysis and Countermeasures Center (NBACC) laboratory to determine the stability of Ebola in blood and other body fluids under relevant environmental conditions and surfaces including personal protective equipment and airline carpet. This effort, along with previous research on Ebola virus, was adopted by the White House's Ebola Task Force and influenced the approach and procedures of public health organizations and multiple federal agencies during the response. USCG is also using the information to update its operational protocols for decontamination of Ebola-contaminated surfaces.

Group/Division: HSARPA Chemical and Biological Defense Division

Project: Integrated Terrorism Risk Assessment (ITRA)

End User: Department of Health and Human Services (HHS) Office of the Assistant Secretary for Preparedness and Response, National Institutes of Health, CDC, Food and Drug Administration (FDA), DOD, DHS, Department of Veterans Affairs, Department of Agriculture

Result: In April 2015, the interagency Public Health Emergency Medical Countermeasures Enterprise's Enterprise Executive Committee voted unanimously to use results of ITRA's Strategic National Stockpile formulary study as a formal criterion informing acquisition decisions alongside existing factors such as cost, efficacy, or shelf life among others. The study's recommendations for chemical, biological, and radiological countermeasures included, as one example, emphasizing countermeasures that could buy down more risk per countermeasure by being usable for multiple, rather than single, pathogens. As described in Homeland Security Presidential Directive 18, ITRA is directed to play a decision support role in medical countermeasure acquisition for the Strategic National Stockpile.

Group/Division: HSARPA Chemical and Biological Defense Division

Project Name: Aircraft Vulnerability: Commercial Aircraft Vulnerability and Mitigation (CAV&M)

End Users: TSA

Result: At the request of TSA's Explosive Operations Branch, in FY 2015 CAV&M completed live fire testing of TSA-developed Modified Least Risk Bomb Location procedures, which are in-flight emergency protocols for responding to a suicide bomber threat. CAV&M conducted seven tests in wide and narrow body commercial aircraft test assets for a range of explosive threat conditions. Cumulative results were presented to

TSA elements, and TSA's Explosive Operations Branch implemented training for Modified Least Risk Bomb Location procedures to TSA's Federal Air Marshals Service and solicited feedback from industry (e.g., airframe manufacturers, airlines) on further dissemination.

Group/Division: HSARPA Explosives Division

Project: Homemade Explosives Characterization: Incident Management Preparedness and Coordination Toolkit (IMPACT)

End User: State and local law enforcement, GSA, FPS

Result: In FY 2015, S&T delivered IMPACT to police departments in New York and New Jersey for evaluation in exercises simulating improvised explosive device (IED) and active shooter attacks by domestic ISIS-style adversaries. IMPACT is a geospatial tool to enhance situational awareness, communication, and collaboration during security events. It is the only geographic information system tool tailored for counter-improvised explosive device (CIED), counter-homemade explosives, and first responder use. This tool is used by more than 400 entities including local and state law enforcement, several units of the U.S. Army National Guard, as well as the CDC. S&T will make the tool Section 508 compliant for accessibility so that it may be used across the Federal Government.

Group/Division: HSARPA Explosives Division

Project: Homemade Explosives Characterization: Physical and Thermal Sensitivity of Technical Grade Ammonium Nitrate (TGAN) Based Improvised Explosives Project

End Users: TSA, DHS National Protection and Programs Directorate (NPPD), FBI

Result: S&T delivered the *Physical and Thermal Sensitivity of Technical Grade Ammonium Nitrate (TGAN) Based Improvised Explosives Report* to DHS to enable agency planning for countermeasures to specific explosive power, initiation sensitivity, and threat potential of TGAN. The report evaluated TGAN and ammonium nitrate based explosive mixtures (containing commonly available fuels) for critical diameter, physical sensitivity, and thermal stability. Terrorist groups are continually interested in producing these types of explosives; however, little data previously existed regarding their explosive behavior at various charge sizes.

Group/Division: HSARPA Explosives Division

Project: Homemade Explosives Characterization: Region of Responsibility Development

End Users: TSA

Result: In FY 2015, the Homemade Explosives Region of Responsibility Development program delivered 14 material assessment reports to TSA that advance airport security screening and strengthen explosives detection capabilities. These reports, which consist of precursors and homemade explosive threats, inform federal decision makers on chemical and explosive properties, threat intelligence, x-ray signatures, and a region of responsibility for each of these materials. They inform the 2016 TSA detection standards

for both checkpoint and checked baggage and influence vendor detection algorithm development.

Group/Division: HSARPA Explosives Division

Project: Actionable Indicators and Countermeasures

End User: DHS Office of Intelligence and Analysis (I&A); fusion centers; federal, state, local, territorial, and tribal law enforcement

Result: S&T demonstrated the Terrorist Extremist Violence United States database with I&A analysts and counterterrorism academics and transitioned two highly anticipated reports to end users on “Integrating Mental Health and Education Fields into CVE” and “Foreign Fighter Recruitment.”

Group/Division: FRG Resiliency Division

Project: Canine Explosives Detection

End User: DHS I&A; fusion centers; federal, state, local, territorial, and tribal law enforcement

Result: In FY 2015, Johns Hopkins University received a patent for the process of producing non-detonable training aid materials for training canines to detect explosives developed as part of S&T’s Canine Explosives Detection Program. S&T transitioned the process to TSA, which is targeting FY 2016 commercialization of the first training aid variant. Existing non-detonable commercially available training aids are not affordable, have shown poor performance metrics in independent testing, and are not widely used by the more than 3,000 explosive detection canine teams nationwide.

Group/Division: HSARPA Explosives Division

VIII. Cyber Security/Information Analytics

Project: Mobile Security: MobileIron

End Users: Federal Emergency Management Agency (FEMA)

Description/Result: In FY 2015, FEMA purchased 10,000 device license subscriptions for MobileIron, a mobile configuration manager that improves policy enforcement and assists enterprise users in keeping their mobile devices secure. S&T enhanced and delivered the product as part of an In-Q-Tel collaboration. Integration is ongoing, but after evaluating the mobile device management capabilities against the federal mobile security baseline from the Digital Government Strategy, FEMA adopted MobileIron as its solution of choice going forward.

Group/Division: HSARPA Cyber Security Division

Project Name: Software Assurance Marketplace (SWAMP)

End Users: Government, industry, Bowie State University

Result: In FY 2015, SWAMP more than doubled its output of assessments (from 650 to 1,500 per week) and expanded the initial offering of five open-source and commercial tools to 18. After piloting classroom use of SWAMP in FY 2014, Bowie State University integrated SWAMP into its computer science curriculum in FY 2015 and is using SWAMP in the classroom to reinforce sound software development and coding practices. SWAMP provides continuous assurance services to help narrow the gap that exists in the way software is tested and evaluated for security weaknesses and vulnerabilities, ultimately reducing the number of vulnerabilities deployed in software.

Group/Division: HSARPA Cyber Security Division

Project Name: SWAMP: CodeDx

End Users: S&T Office of the Chief Information Officer, DHS Domestic Nuclear Detection Office (DNDO), Commonwealth of Pennsylvania, National Security Agency

Result: In FY 2015, CodeDx was integrated into the SWAMP and transitioned to S&T Office of the Chief Information Officer, DNDO, and other federal agencies. CodeDx was also successfully piloted and transitioned to the Commonwealth of Pennsylvania.

CodeDx is a software tool that automatically consolidates, correlates, and normalizes software weaknesses detected by multiple static analysis tools to minimize time spent by users in software testing and reporting.

Group/Division: HSARPA Cyber Security Division

Project Name: Transition to Practice

End Users: United States Computer Emergency Readiness Team (US-CERT), Library of Congress, City of Tulsa, industry

Result: In FY 2015, S&T piloted and/or transitioned/licensed five key technologies to the marketplace:

- Hyperion, developed by Oak Ridge National Laboratory, is a malware forensics and software assurance technology that calculates the behavior of software—including malware—and provides a repeatable, cost-effective means to achieve software assurance. In FY 2015, S&T piloted Hyperion within US-CERT where it is being used to investigate quickly malware collected and to analyze and group this information. Hyperion was also licensed to R&K Software Solutions LLC, an application development and cyber solution company, in February 2015.
- Two technologies, CodeDNA and the Network Mapping System (NeMS), were piloted at the Library of Congress in 2015. CodeDNA, developed by Johns Hopkins University Applied Physics Laboratory, is being used by the Library of Congress to detect malware by identifying binaries and linking variants. NeMS, developed by the Lawrence Livermore National Laboratory, is a software-based network characterization and discovery tool that will help the Library of Congress discover what is connected to its network, what needs to be protected, and how to protect it. NeMS was also licensed to Cambridge Global Advisors, a strategic advisory firm, in July 2015.
- PathScan, a network anomaly detection tool developed by the Los Alamos National Laboratory, was licensed to Ernst and Young in 2015 to build service around this technology. PathScan quickly detects the movement of hackers once they breach the network, allowing operational teams to defend important network information quickly.
- In FY 2015, True Digital Security (a Tulsa-based firm) integrated the Pacific Northwest National Laboratory-developed Correlation Layers for Information Query and Exploration (CLIQUE) into the City of Tulsa's water management information technology infrastructure. This tool aided in discovery of nearly twice the network devices identified before the pilot began and spurred solution of previously years-long unresolved system issues. The technology was also implemented on the traffic control system within the City of Tulsa. As a result, Tulsa has committed to continue the pilot to other supervisory control and data acquisition systems in the city, making CLIQUE a permanent part of their operational network health monitoring.

S&T developed the Transition to Practice Program to transition federally funded cybersecurity technologies from labs to enterprise consumers and into broader utilization across the Homeland Security Enterprise.

Group/Division: HSARPA Cyber Security Division

Project: Cybersecurity for Law Enforcement: Provenance

End Users: New York State Police, Duke and University of North Carolina Medical Centers, Google Play

Result: In FY 2015, S&T completed development and delivered three provenance tools to law enforcement and private-sector users, including a capability for ensuring the integrity of computer incident evidence in criminal cases; methods to protect health records from illicit access or modification and quickly determine if they have been

altered; and a novel, easy-to-use tool for guaranteeing location provenance for mobile device security.

Group/Division: HSARPA Cyber Security Division

Project: Disrupting Cyber Threats and Inducing Change: Cyber Economics

End Users: Industry and private sector

Result: In FY 2015, S&T and the University of Maryland completed a comprehensive study of computer attacks on commercial firms and networks. Through surveys of more than 400 firms, in-depth case studies at 5 large companies, and quantitative analysis and modeling activities, the team determined the cost of damages resulting from computer attacks to industry, the amount of investment industry is making in computer security, and the relative return (or benefit) and optimal levels for such investment. This is the first industrywide database on the costs of computer attacks with up-to-date return on investment (?) figures and inclusion of investment models that include secondary damages.

Group/Division: HSARPA Cyber Security Division

Project Name: Improving Foundation Elements of Cybersecurity: Hybrid Analysis Mapping (HAM) Integration into ThreadFix

End Users: Financial sector

Result: In FY 2015, Denim Group developed HAM capabilities on the basis of an S&T Small Business Innovation Research software vulnerability analysis contract. The capability improves software analysis tool coverage and was integrated into the open-source ThreadFix platform. ThreadFix supports more than 2,000 open-source downloads; the commercial version of ThreadFix also has HAM technology and is used heavily in the financial sector.

Group/Division: HSARPA Cyber Security Division

Project: Internet Measurement and Attack Modeling: Stucco

End Users: US-CERT, DOD

Result: In FY 2015, S&T developed new methods of manipulating hand-tagged data for analysis in support of a data-mining capability. This methodology ultimately transforms unstructured data into searchable context data for cyber incidents. Stucco has been combined with other open-source tools to enhance situational awareness including with US-CERT and DOD agencies.

Group/Division: HSARPA Cyber Security Division

IX. First Responder/Disaster Resilience

Project: First Responder Technologies: Finding Individuals for Disaster and Emergency Response (FINDER)

End User: Urban search-and-rescue agencies and other federal, state, local, territorial, and tribal first responder agencies

Result: This project has been described in previous fiscal years. In FY 2015, the FINDER technology proved successful during its first real-world operational use supporting international search-and-rescue efforts in Nepal following the April 25, 2015, earthquake. Using FINDER, rescue workers were able to detect heartbeats of four victims trapped beneath two different collapsed structures, allowing the rescue workers to find and save the victims.

Group/Division: FRG First Responder Technology Clearinghouse

Project: First Responder Technologies: Radio Internet-Protocol Communications Module (RIC-M)

End User: Federal, state, local, territorial, and tribal first responder agencies

Result: In FY 2015, S&T's Technology Transition Office licensed RIC-M to two commercial partners to manufacture and sell in commercial markets. S&T was also awarded a patent for the RIC-M technology and received its first royalties from RIC-M sales (7 percent of each sale made). S&T developed RIC-M as a low-cost interoperability solution that could save the first responder community millions of dollars by allowing agencies to upgrade and reconfigure new and legacy systems easily at a low cost. RIC-M was field tested with state and federal response agencies including Montgomery County, Maryland; CBP; FPS; FBI; the U.S. Marshals Service; the Department of Justice (DOJ); and the Department of the Interior Office of Law Enforcement and Security.

Group/Division: FRG First Responder Technology Clearinghouse

Project: First Responder Technologies: Lost Person Locator

End User: Federal, state, local, territorial, and tribal law enforcement agencies

Result: In FY 2015, S&T's Lost Person Behavior App was released on Apple iTunes, Google Play, and Amazon.com. In 2013, the FBI's National Crime Information Center reported 627,911 individuals as missing. The app provides step-by-step search guidance, investigative questions, statistics, and behavioral profiles for more than 40 scenarios including lost hikers, children, and dementia patients.

Group/Division: FRG First Responder Technology Clearinghouse

Project: REDOPS: Micro Research and Development and Rapid Prototype for IED Defeat

End User: FBI and other federal, state, and local bomb squad/explosive ordnance disposal organizations

Result: In FY 2015, S&T transitioned systems including a locally manufactured shock-tube dispenser, a steel slug bullet, and a laminated window portal charge that were developed by individual bomb squads for use by the broader bomb squad community. This is a joint FBI and S&T investment in how Special Weapons and Tactics and bomb technicians attack and conduct render-safe activities for IEDs and people borne IEDs.

Group/Division: FRG First Responder Technology Clearinghouse

Project: First Responder Emergency Response and Management Tools: Next Generation Incident Command System (NICS)

End User: Federal, state, local, territorial, and tribal first responder agencies

Result: In FY 2015, the Massachusetts Institute of Technology Lincoln Laboratory, funded by the S&T FRG, released NICS as an open-source code and made it available on GitHub. The open-source code is now available for use by government, private, and international organizations involved in situational awareness for incident management. NICS is a collaborative, online incident map with a virtual whiteboard that allows first responders to collaborate, share situational awareness, manage resources, and plot strategies. NICS manages and distributes real-time feeds (e.g., vehicle locations, airborne images, video, weather, critical infrastructure, and terrain) to first responders and on-scene decision makers.

Group/Division: FRG Office for Interoperability and Compatibility

Project: First Responders Emergency Response and Management Tools (Virtual USA): Sensor Drone for Cell Phone Detection

End User: Federal, state, local, territorial, and tribal first responder agencies

Result: In FY 2015, S&T demonstrated new technology solutions for search-and-rescue operations. The 2-day field demonstration included an exterior drone that can detect cell phone signals through rubble or concrete and sensors that can detect and locate Bluetooth-enabled devices (e.g., cell phones). During the demonstration, a single drone was able to scan the area for cell phone signals in less than 20 minutes, providing real-time heat maps of cell phone activity. On the basis of the location of cell phone signals, canine and human teams were able to focus their searches on high probability locations of victims.

Group/Division: FRG Office for Interoperability and Compatibility

Project: Interoperability and Compatibility Standards: Project 25 Compliance Assessment Program (P25 CAP)

End User: Federal, state, local, territorial, and tribal first responder agencies

Result: In March 2015, S&T launched a new P25 CAP subsite on FirstResponder.gov. This Web site provides first responders with the latest information on P25 CAP compliant equipment as well as other critical program updates on P25 CAP testing and more. Project 25 is a suite of standards that enables interoperability among digital two-way land mobile radio communications products. P25 CAP provides public safety

agencies with evidence that the communications equipment they purchase is tested against and complies with standards for performance, conformance, and interoperability.

Group/Division: FRG Office for Interoperability and Compatibility

Project: Interoperability and Compatibility Standards: Voice Intelligibility Testing over Long-Term Evolution

End User: Federal, state, local, territorial, and tribal first responder agencies

Result: In FY 2015, S&T published and shared test results identifying the best commercially available codecs (software that encodes voice for digital transmission) for first responders, which will help public safety professionals choose the best software. First responders often work in difficult, high-noise environments and have very high standards for audio quality when they broadcast and receive information. Additionally, many jurisdictions are seeing broadband devices used for communications that were previously handled exclusively by land mobile radio. These two factors create the need for broadband audio quality that overcomes harsh noise environments.

Group/Division: FRG Office for Interoperability and Compatibility

Project: Wireless Communication: Chicago Long-Term Evolution (LTE)

End User: Chicago Police Department (PD), City of Chicago Office of Emergency Management & Communications (OEMC)

Result: In FY 2015, S&T piloted a video delivery system over an LTE network in Chicago's 7th District in collaboration with Chicago PD, Chicago OEMC, and the S&T Visual Analytics for Command, Control, and Interoperability Environments Center of Excellence at Purdue University. On the basis of the pilot, S&T published a lessons learned document with results, technical information, research design, and suggestions for future research. Chicago seeks to integrate video and data into daily operations and to optimize the transmission of video to officers in the field. This includes determining best practices for a large wireless network and similar technical environment to what many jurisdictions work through.

Group/Division: FRG Office for Interoperability and Compatibility

Project: Energy Sector Resiliency: Community Microgrids

End User: City of Boston, local communities, industry

Result: S&T demonstrated a microgrid controller testbed at Massachusetts Microgrid Controllers Symposium. The testbed enables industry and end users to evaluate their systems' microgrid performance under several simulated configurations. S&T also publicly released a Citywide Energy Study Report for the City of Boston, which is piloting an analytical framework for implementing community microgrids. Microgrids strengthen grid resilience by enabling response and recovery through continued operation even while the main grid is down (e.g., during severe weather).

Group/Division: FRG Resiliency Division

Project: Energy Sector Resiliency: Quick Release Connector

End User: Electric sector utilities

Result: S&T installed operational prototypes of the Quick Release Connector in Northeastern Rural Electric Membership Corporation's (an Indiana-based utility) distribution grid for pilot testing. The connectors allow powerlines to disconnect safely and automatically from poles under extreme loads (e.g., fallen trees) to avoid downed poles that create major safety hazards during storms and are costly to replace or repair during recovery. The Quick Release Connector patent was also released, which will enable future licensing to manufacturers for production.

Group/Division: FRG Resiliency Division

Project: Post Tracking System (PTS)

End User: FPS

Result: In FY 2015, S&T demonstrated the PTS through end-to-end Customer Acceptance Testing at FPS's contractor facility and verified the system's design and functionality. The PTS provides FPS the ability for contract personnel to record time and attendance and verify certifications necessary to stand post using three-factor authentication and an electronic system. The authentication (Personal Identity Verification card, personal identification number, and a biometric) means that the contractor personnel logging into the PTS is the correct person without depending on inefficient paper documentation, periodic inspections, and manual processes.

Group/Division: FRG Resiliency Division

Project: National Hurricane Technology: National Hurricane Program (NHP) Technology Modernization

End User: FEMA National Hurricane Program, FEMA Region I, II, III, IV, VI, & IX; Army Corps of Engineers; National Oceanic and Atmospheric Administration (NOAA) National Hurricane Center; federal, state, local, territorial, and tribal emergency managers

Result: S&T demonstrated next-generation hurricane evacuation planning platform capabilities at four NHP Technology Modernization Working Group meetings. Demonstrations included pilot products for emergency manager specific impact graphics, storm surge explorer, automated storm simulations, and serious gaming for decision makers. In 2013, FEMA identified a need for an upgraded hurricane decision support platform that integrates all phases of hurricane planning and evacuation decisions. S&T and FEMA are jointly enhancing the HURREVAC storm tracking and decision support platform, the computer-based tool commonly used throughout the emergency management community.

Group/Division: FRG Resiliency Division

Project: First Responder Technologies: Improved Structure Firefighting Glove

End User: Federal, state, local, territorial, and tribal fire/rescue departments

Result: In FY 2015, the glove received National Fire Protection Association certification and was made commercially available from Shelby Specialty Gloves. Mentioned in

previous years' reports, S&T developed the Improved Structure Firefighting Glove as a less bulky, updated glove that merges the needs of firefighters with available technology and improved materials. The new material and design allows firefighters to make more precise movements without having to remove their gloves as typically happens with current gloves.

Group/Division: FRG First Responder Technology Clearinghouse

X. Acquisition and Operations Support

Project: Capability Development Support: Large Crowd Evacuation Modeling and Simulation Support

End User: USSS

Result: S&T statistically modeled pedestrian traffic, large-scale crowd activities, and evacuation contingencies as part of Pope Francis's visit to the United States in September 2015. The model enabled informed adjustments to congestion and bottlenecks for evacuation planning and resource positioning for the event. S&T received certificates of appreciation from the USSS Director for its support.

Group/Division: Capability Development Support Group (CDS) Office of Operations and Requirements Analysis

Project: Capability Development Support: Support to DHS Joint Requirements Council and DHS Joint Task Forces (JTF)

End User: USCG, CBP, ICE, JTF-East, JTF-West, JTF-Investigations

Result: In FY 2015, S&T supported the three JTFs assembled by DHS: Joint Task Force-East (JTF-E), JTF-West (JTF-W), and JTF-Investigations (JTF-I). S&T identified and analyzed information-sharing requirements among three JTF-E Component organizations and assisted development of the initial JTF Common Operating Picture/Common Intelligence Picture system that displays all relevant operational information in one place. In July 2015, the system enabled the JTFs to meet full operational capability in support of the Southern Borders and Approaches Campaign Plan.

Group/Division: CDS Office of Operations and Requirements Analysis

Project: Capability Development Support: Cargo Time Release Study

End User: CBP

Result: S&T delivered analytical products based on operational data from CBP and other government agencies to measure the length and causes of delays at ports of entry. S&T's data analysis and findings help CBP reduce delays and increase the pace of trade. The efficient flow of lawful international commerce is immensely important to the U.S. economy, and S&T is supporting CBP's development of an electronic system to improve how imported cargo is moved by sea, rail, air, and truck.

Group/Division: CDS Office of Operations and Requirements Analysis

Project: Capability Development Support: Detection of Bio Threats and Hazards at Ports of Entry

End User: CBP, DHS Deputies Management Action Group, DHS Joint Requirements Council

Results: S&T delivered the final capabilities analysis report as directed by the Deputy's Management Action Group and the Joint Requirements Council as a result of the Ebola outbreak in 2015. S&T co-chaired a study of the detection of communicable diseases at U.S. ports of entry, and the capabilities analysis report will inform about FY 2016 and beyond Department-wide investment into communicable disease detection capabilities.

Group/Division: CDS Office of Operations and Requirements Analysis

Project: Chemical, Biological, Nuclear, and Explosives Standards

End User: TSA, FPS, USSS, CBP, U.S. Capitol Police; DOD, Department of State, federal, state, local, territorial, and tribal law enforcement.

Result: S&T delivered standards for measurement, calibration, and optimization of trace contraband detection systems. S&T partnered with the NIST to develop methodologies and test materials for direct insertion, dry transfer, standoff, fingerprint, background, documentary standards and procedures, round robin events, and training in the areas of trace contraband (explosives and drugs) sampling and detection. Protocols were created for pilot training courses with TSA. Upon request from the U.S. Capitol Police, test materials were prepared for screening units on Capitol grounds.

Group/Division: CDS Office of Standards

Project: Responder and Resiliency Standards

End User: CBP; federal, state, local, territorial, and tribal bomb squads and search-and-rescue teams; DOD

Result: S&T validated 30 standards and draft test methods for characterizing performance of CIED robots. This work supported four nationwide exercises with DHS, DOJ, and DOD through the Joint Program Office for Countering Improvised Explosive Devices. The exercises promote interoperability between U.S. public safety bomb squads and military Explosive Ordinance Disposal teams as well as facilitate training on tactics, techniques, procedures, and information sharing between U.S. and international bomb disposal groups.

Group/Division: CDS Office of Standards

Project: Standards Capability Development

End User: TSA, Transportation Security Laboratory (TSL), CBP, FPS, DHS DNDO

Result: S&T developed standards for radiation safety of x-ray and gamma-ray security screening systems. S&T partnered with NIST to inform technical grant and procurement guidance across DHS Components and to harmonize national and international x-ray security screening standards. This effort produced a number of knowledge products including standards for performance of portable transmission X-ray systems used in improvised explosive detection and hazardous device identification; for evaluating the imaging performance of security X-ray systems; for evaluating the image quality of X-ray computed tomography security screening systems; and for measuring the imaging performance of X-ray and gamma-ray systems for security screening of humans.

Group/Division: CDS Office of Standards

Project: First Responder Technologies (SAVER)

End Users: Federal, state, local, territorial, and tribal emergency responders

Result: As part of the System Assessment and Validation for Emergency Responders (SAVER) program, S&T published 18 technical reports on first responder technologies. These reports included technical notes, market survey reports, and an assessment report that can be found online at www.firstresponder.gov/SAVER and help first responders better select, procure, use, and maintain their equipment.

Group/Division: National Urban Security Technology Laboratory (NUSTL)

Project: Interagency Program: DHS Border Air Surveillance Systems and Wind Turbine Mitigation Solution

End User: CBP

Result: S&T delivered a radar mitigation technical solution and signed mitigation agreement in FY 2015 that allows installation of a proposed 130-turbine wind farm near a CBP air surveillance system on the southern border. In cooperation with CBP's Air and Marine Operations Long Range Radar Joint Program Office and experts from Javelina LLC (the wind farm developer), the agreement was necessary to move forward with construction near the critical system. S&T reviewed cost scenarios for software, hardware, new forms for radar, and timelines for implementation to help CBP determine the best solution without sacrificing situational awareness on the border.

Group/Division: Research and Development Partnerships Group (RDP) Interagency Office

Project: Operational Test and Evaluation

End User: CBP, DHS Management Directorate, U.S Citizenship and Immigration Services (USCIS), TSA, USCG

Result: In FY 2015, S&T conducted 10 independent analytical reviews supporting programs and acquisition decisions across the Department. S&T's assessments supported acquisition decisions for initial operational capability or low-rate production on TSA's Passenger Screening Program (Explosive Trace Detection systems); DHS Chief Information Officer's Homeland Security Information Network Releases 3.6 to 3.7; and USCIS Electronic Immigration System I-90 programs. S&T assessments informed final operational capability decisions for CBP's Land Border Initiative – Outbound License Plate Reader; TSA's Advanced Imaging Technology-2 (Automated Target Recognition); and USCG's National Security Cutter programs. S&T reports also provided four DHS programs with independent analysis documenting specific focus areas to improve.

Group/Division: CDS Office of Test and Evaluation

XI. Laboratory Facilities

Project: Radiological/Nuclear Response and Recovery Research and Development: Radiological Incident Awareness System and CONOPS Development

End User: State and local emergency management agencies, hazardous materials first responders

Result: In FY 2015, NUSTL completed physical installation of the Radiological Emergency Management System (REMS) in New York City's Grand Central Terminal. The sensors will continuously monitor radiation levels and alert emergency management officials to abnormally elevated radiation levels within the terminal. In addition to detecting high radiation levels, REMS also distinguishes real threats from innocent alarms, such as those caused by medical patients who have been treated with radioactive materials. The REMS concept was developed at NUSTL as a post-event radiation sensor network for response and recovery after an accidental or deliberate release of radiation in an urban area.

Group/Division: NUSTL

Project: Next Generation Passenger Checkpoint: Developmental Test and Evaluation of Explosives Detection Technologies for Screening People

End User: TSA, other DHS/federal agencies with personnel screening venues

Result: In FY 2015, TSL evaluated four prototype walkthrough portals (most based on millimeter wave technology), two handheld wands (one based on X-ray backscatter, the other on millimeter wave), two personal electronic device prototype screening systems, two bottled liquid scanners, and four cabinet X-ray carry-on bag screening systems. TSL also conducted 14 developmental assessments of upgrades to mature walkthrough portals in use at many airports. Results of assessments will inform future TSA procurement decisions.

Group/Division: TSL

Project: Integrated Passenger Screening Systems: Technology and Patent Development

End User: Screening Technology Solution Developers

Result: In FY 2015, S&T's TSL was awarded U.S. Patent 8,946,641 titled "Method for identifying materials using dielectric properties through active millimeter wave illumination." This innovation provides a way for millimeter wave systems to identify explosives and will help developers of screening systems increase accuracy of target detection.

Group/Division: TSL

Project: Chemical Security Analysis Center (CSAC): Hazard and Threat Analysis
End User: FEMA, DHS National Operations Center, DOD, HHS, DHS OHA, USSS
Result: In FY 2015, CSAC provided 59 reach-back responses to put actionable technical information into the hands of the operational community and policy and decision makers facing potential threats. CSAC also launched Chemical Agent Reactions Database version 2.0 in April 2015, which included new multiple structure and substructure search capabilities and specific tailored processes for the search and storage of data related to chemical forensics, explosives, emerging threat chemicals, and high-risk toxic industrial chemicals.
Group/Division: CSAC

Project: TSL Operations: Certification Testing of Explosives Detection Systems for Checked Baggage
End User: TSA
Result: S&T tested 13 different checked baggage explosives detection systems against new, more stringent performance requirements issued by TSA. Systems with acceptable performance moved on to operational testing by TSA. Most systems needing improvement worked on their detection algorithm performance with TSL's Developmental Test and Evaluation group, which conducted 19 certification readiness tests for explosives detection systems. Systems that pass the certification readiness test are available for TSA procurement.
Group/Division: TSL

Project: NUSTL: Performance Test and Evaluation (PTEN) Program
End User: Amtrak Police Department, state and local law enforcement, and first responders
Result: In support of the Pope's visit to New York City, S&T completed function testing and transferred personal radiation detectors and other radiation detection equipment to the Amtrak Police Department. NUSTL's PTEN program conducts functional tests of first responder radiological/nuclear detection equipment including personal radiation detectors, handheld isotope identifiers, backpack systems, radiation detection kits, and mobile detection systems. S&T also completed testing of 3,900 radiological/nuclear detection units in FY 2015, surpassing an overall milestone of 13,000 radiological/nuclear detection units tested for the DHS DNDO's Securing the Cities grant program partners.
Group/Division: NUSTL

Project: Bioforensics
End User: DHS Components and federal law enforcement
Result: In FY 2015, S&T conducted bioforensic casework in support of federal law enforcement attribution investigations, accessioned more than 200 bioforensic evidentiary samples and supported more than 30 traditional forensic examinations within biocontainment increasing the speed and ultimate prosecution of these investigations.

NBACC renewed and expanded the National Bioforensic Analysis Center's International Organization for Standardization (ISO) 17025 Scope of Accreditation, adding and accrediting new mission-driven bioforensic capabilities for the isolation and identification of viruses at biosafety level 4. NBACC achieved a world-first ISO 17025 accreditation for metagenomic analysis and "SNP-Based Genotyping" that greatly expands operational capabilities for investigating novel and genetically modified agents.

Group/Division: NBACC

XII. University Programs

Project: Coastal Hazards Center of Excellence (CHC): Innovative Component Design and Retrofit of Critical Civil Infrastructure

End User: U.S. Army Corps of Engineers (USACE), FEMA, dam safety officials

Result: S&T created computer-automated platform Risk Estimator for Embankment Structures to assess earthen dams and levees and specify the most cost-effective retrofit measures to minimize their potential for failure during severe storms. The method was incorporated into FEMA's Risk Prioritization Tool for Dams, which can also be used for levees, to improve the certification process of the thousands of miles of levees included in the National Flood Insurance Program.

Group/Division: RDP Office of University Programs

Project: CHC: Building Blocks for a National Resilience Scorecard

End User: USACE, FEMA, NIST, NOAA, non-governmental organizations

Result: S&T published a report that identifies and evaluates the building blocks needed to develop a national resilience assessment for analyzing the health and vulnerability of our Nation to natural and man-made hazards. The report addresses the ability to characterize resilience effectively and to exploit existing capabilities that could be used to create a national level resilience scorecard. The report is posted online at <http://civil.umd.edu/sites/default/files/documents/National-Resilience-Assessment.pdf>.

Group/Division: RDP Office of University Programs

Project: CHC: Review of the Methodologies Utilized to Determine Coastal Hazards and Damages along the Great Lakes for the National Flood Insurance Program

End User: FEMA

Result: S&T delivered study results to FEMA in April 2015 providing independent review of the methodology to determine Coastal Hazard Areas in the Great Lakes. To define, map, and mitigate risk in the Great Lakes region, FEMA needed to understand better the nature of coastal hazards associated with these bodies of water. Particular attention was focused on V-Zones, considered to be the most hazardous of the Special Flood Hazard Areas and which previously have not been mapped in the Great Lakes.

Group/Division: RDP Office of University Programs

Project: CHC: Infrastructure Modeling

End User: Local emergency managers, infrastructure managers, Sandia National Laboratories

Result: S&T transitioned the Multi-Network Interdependent Critical Infrastructure Program for the Analysis of Lifelines (MUNICIPAL) tool into the DHS Standard Unified Modeling, Mapping, and Integration Toolkit framework. MUNICIPAL, which is already in operational use in Wilmington, North Carolina, generates the optimal restoration plan for infrastructure recovery following a hurricane. It can be used to evaluate the

relationships between critical infrastructure sectors of a community, including power, water, and communication, or to study how the failure of one sector can affect other variables.

Group/Division: RDP Office of University Programs

Project: CHC: Identifying and Analyzing the Driving Forces of Hurricane Recovery for Disaster Stricken Areas to Improve Long-term Planning

End User: FEMA

Result: S&T developed a new method for collecting field data following severe storms such as hurricanes. The new method, deployed in Sandy recovery areas of New Jersey, combines hardware (e.g., iPad) and cloud-based computing to enable more accurate, mobile field data collection for emergency managers. Published results are in *ArcUser* “Benchmarking disaster recovery using collector for ArcGIS” (2015).

Group/Division: RDP Office of University Programs

Project: Center for Visualization and Data Analytics (CVADA): Social Media Analytics and Reporting Toolkit (SMART)

End User: USCG Ohio Valley Sector

Result: S&T delivered SMART to USCG Ohio Valley Sector to use in the Major League Baseball 2015 All-Star Game and related events. The toolkit was used to monitor the social media activity in the Cincinnati area throughout the heavily trafficked weekend as an extra safety measure. SMART is a highly interactive visual analysis system that allows the end user to extract valuable information quickly from the vast amounts of tweets, hashtags, and pictures posted every second on social media. Features such as the stream classifier and anomaly detection allow the user to see what topics are trending within a designated area and if those topics are of concern to public safety.

Group/Division: RDP Office of University Programs

Project: CVADA: Boat Allocation Module (BAM) Phase II

End User: USCG

Description: S&T delivered BAM II, the second phase of a sophisticated computer program, to help USCG further refine its boat allocation by sharing boats across stations. The BAM II project develops a tool for the practical implementation of boat sharing including “fractional” solutions for sharing boats between stations for potentially more efficient solutions.

Group/Division: RDP Office of University Programs

Project: CVADA: Gang Graffiti Automatic Recognition and Interpretation (GARI)

End User: Indianapolis Metropolitan Police, Indiana Intelligence Fusion Center Gang Task Force, INGangNetwork, Cook County Sheriff’s Department

Result: In FY 2015, S&T deployed GARI at the Cook County Sheriff’s Department in Chicago. Additionally, GARI won top honors at a nationwide tattoo recognition contest hosted by the FBI. The GARI system uses image analysis techniques to identify, interpret, and index gang tattoo images and provides a gang expert’s intelligence when it

comes to gang graffiti symbols and interpretation without having that expert on staff. Discussions are underway with the FBI for agency-wide use of the tool.

Group/Division: RDP Office of University Programs

Project: National Center for Risk and Economic Analysis of Terrorism Events (CREATE): Terrorist Recruitment and Countering Violent Extremism (CVE) in Minneapolis-St. Paul

End User: S&T, DHS Components

Result: S&T published a report on the foreign fighter study, “Terrorist Recruitment and Countering Violent Extremism (CVE) in Minneapolis-St. Paul,” in April 2015 and presented key findings to S&T and DHS Components, including the relationship between the Islamic State of Iraq and the Levant (ISIL) and al Shabaab, how the Minneapolis-St. Paul Somali community is distinct, and the effectiveness of programs in the Minneapolis-St. Paul community.

Group/Division: RDP Office of University Programs

Project: CREATE: Professional Education Course: Foundations of Decision Analysis for Homeland Security

End User: NPPD, USSS, DHS DNDO, FEMA, CBP

Result: S&T piloted a course, Foundations of Decision Analysis for Homeland Security, as part of a professional development program series. The 2.5-day course presented the basic foundations of decision making under uncertainty for homeland security applications, as well as illustrated the benefits of using a sound decision making system. Participants learned fundamental distinctions in decision-making including decisions versus outcomes and the implications of having a unity of effort decision culture.

Group/Division: RDP Office of University Programs

Project: National Center for Zoonotic and Animal Disease Defense (ZADD): AgConnect™ Certificate of Veterinary Inspection (iCVI) and Biosurveillance Field Entry System (BFES) Applications

End User: First responders, veterinarians

Result: S&T released the AgConnect™ mobile applications, iCVI and BFES, for free download to validated and accredited first responders through the Apple iTunes and Google Play stores. AgConnect™ is a suite of pluggable mobile and Web-based desktop applications for data aggregation and information sharing to support business continuity during animal disease incidents. The Colorado State Veterinarian’s Office used AgConnect™ during vesicular stomatitis outbreaks and to plan outbreak response for highly pathogenic avian influenza. AgConnect™ was also used to support an industry-sponsored evaluation exercise (simulated outbreak) of the Secure Pork Supply Plan, with AgConnect™ providing decision support to the National Assembly of State Animal Health Officials as part of the permit issuing process.

Group/Division: RDP Office of University Programs

Project: ZADD: Animal Disease Response Training

End User: FEMA, DHS OHA, and state and local first responders

Result: S&T transitioned the Animal Disease Response Training course for first responders, which FEMA's National Preparedness Directorate approved for inclusion in the National Training and Education Division course catalog. The course focuses on the best practices and safety issues associated with an agriculture emergency, including quarantine, biosecurity, euthanasia and disposal, use of personal protective equipment, and cleaning and disinfection.

Group/Division: RDP Office of University Programs

Project: ZADD: New Vaccine Development Method for Avian Flu

End User: U.S. Department of Agriculture and the poultry industry

Result: S&T developed a new vaccine method for avian flu. ZADD researchers published vaccine development work for an H7N9 vaccine in chickens, in which the disease originates, in a *Journal of Virology* article titled "Newcastle disease virus-vectorized H7 and H5 live vaccines protect chickens from challenge with H7N9 or H5N1 avian influenza viruses." The Newcastle Disease Virus-vector platform demonstrates a proof-of-concept for rapid generation (less than 1 month) of vaccine candidates against emerging pathogens.

Group/Division: RDP Office of University Programs

Project: Food Protection and Defense Institute: Emerging Threats

End User: S&T, FDA, USDA, CBP

Result: S&T delivered a report on the impact of the Ebola outbreak on the legal and illegal trade and distribution of food. The report assessment determined risk from three major West African food commodity exports (cocoa, palm oil, and cashew nuts), risk of human infection from legal imports of wildlife or illegally imported bush meat, and the vulnerability of cocoa (the only commodity imported from the region in a commercially meaningful quantity) to economically motivated adulteration.

Group/Division: RDP Office of University Programs

Project: National Consortium for the Study of Terrorism and Responses to Terrorism (START): Transnational Illicit Trafficking (TransIT) Geospatial Tool

End User: DHS I&A, ICE, CBP, DHS JTFs

Result: S&T patented the TransIT Geospatial tool, which identifies transnational criminal organizations (TCOs) and networks operating in the Central American Region capable of engaging in radiological/nuclear smuggling, as well as analyzes possible smuggling routes and methods that could be used by TCOs smuggling radiological/nuclear materials on behalf of terrorists. The model calculates optimized routes of TCOs on the basis of 13 modes of transportation. CBP, ICE, and DHS JTFs used modified models of this tool to support additional studies.

Group/Division: RDP Office of University Programs

Project: National Consortium for START: Innovation and CVE Course

End User: CVE policymakers and practitioners, Homeland Security Enterprise workforce

Result: S&T premiered the first known undergraduate course on CVE in the country, the Innovation and Countering Violent Extremism course at the University of Maryland. After learning the method of design thinking, students developed their own innovative ideas for CVE programs. Students presented their ideas to top CVE policymakers and practitioners.

Group/Division: RDP Office of University Programs

Project: National Consortium for START: Strategic Multilayer Assessment (SMA)

End User: DHS I&A, S&T

Result: S&T completed studies in several terrorism-related topics and disseminated results through a SMA Technical Lecture Series averaging 25 participants over 95 sessions in FY 2015, in addition to special panel discussions and white paper reports. Study topics included one related to ISIL with the Joint Staff for the Special Operations Command Central. Another focused on Boko Haram to identify their centers of gravity, potential vulnerabilities, and implications of policy options for African Command. A final study looked at implementation conditions for a two-state solution for Israel and the Palestinian Authority. START shared study results throughout government, academia, and industry, including DHS I&A and S&T.

Group/Division: RDP Office of University Programs

Project: National Consortium for START: Training in Risk and Crisis Communication (TRACC)

End User: DHS Headquarters and Components (public affairs), FEMA

Result: START copyrighted two modules for the TRACC curriculum. TRACC is a FEMA-accredited, social science-based curriculum designed to help organizations plan effective communication before, during, and after a crisis, including preparation, response, and recovery. START delivered the course to the Maryland Emergency Management Agency and has released it for general public and industry use.

Group/Division: RDP Office of University Programs

Project: Scientific Leadership Award Program: iLaw Enforcement App Assistance Program

End User: Public

Result: S&T developed a campus security smartphone app—iLaw Enforcement App Assistance Program for Students—that enables students, faculty, and staff to contact campus police quickly when faced with high-risk or immediate threat scenarios. The app also reports geospatial data to campus dispatch and police officers to enable a prompt response to the situation.

Group/Division: RDP Office of University Programs

Appendix—Abbreviations and Acronyms

BAM	Boat Allocation Module
BFES	Biosurveillance Field Entry System
CAV&M	Commercial Aircraft Vulnerability and Mitigation
CBP	U.S. Customs and Border Protection
CDC	Centers for Disease Control and Prevention
CDS	Capability Development Support Group
CHC	Coastal Hazards Center of Excellence
CIED	Counter-Improvised Explosive Device
CLIQUE	Correlation Layers for Information Query and Exploration
CREATE	Center for Risk and Economic Analysis of Terrorism Events
CSAC	Chemical Security Analysis Center
CVADA	Center for Visualization and Data Analytics
CVE	Countering Violent Extremism
DHS	Department of Homeland Security
DNDO	Domestic Nuclear Detection Office
DOD	Department of Defense
DOJ	Department of Justice
DOT	Department of Transportation
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FCC	Federal Communications Commission
FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FINDER	Finding Individuals for Disaster and Emergency Response
FLETC	Federal Law Enforcement Training Center
FPS	Federal Protective Service
FRG	First Responders Group
GARI	Gang Graffiti Automatic Recognition and Interpretation
GSA	General Services Administration
HAM	Hybrid Analysis Mapping
HHS	Department of Health and Human Services
HSARPA	Homeland Security Advanced Research Projects Agency
I&A	Office of Intelligence and Analysis
ICE	U.S. Immigration and Customs Enforcement
iCVI	Certificate of Veterinary Inspection
IED	Improvised Explosive Device
IMPACT	Incident Management Preparedness and Coordination Toolkit
ISIL	Islamic State of Iraq and the Levant

ISO	International Organization for Standardization
ITRA	Integrated Terrorism Risk Assessment
JTF	Joint Task Force
MUNICIPAL	Multi-Network Interdependent Critical Infrastructure Program for the Analysis of Lifelines
NBACC	National Biodefense Analysis and Countermeasures Center
NeMS	Network Mapping System
NPPD	National Protection and Programs Directorate
NICS	Next Generation Incident Command System
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NUSTL	National Urban Security Technology Laboratory
NYPD	New York City Police Department
OBIM	Office of Biometric Identity Management
OHA	Office of Health Affairs
OMB	Office of Management and Budget
PSW	Pressure Sensitive Wand
PTEN	Performance Test and Evaluation
PTS	Post Tracking System
RDP	Research and Development Partnerships Group
REMS	Radiological Emergency Management System
RIC-M	Radio Internet-Protocol Communications Module
S&T	Science and Technology Directorate
SAVER	System Assessment and Validation for Emergency Responders
SMA	Strategic Multilayer Assessment
SMART	Social Media Analytics and Reporting Toolkit
START	Study of Terrorism and Responses to Terrorism
SWAMP	Software Assurance Marketplace
TCO	Transnational Criminal Organization
TGAN	Technical Grade Ammonium Nitrate
TRACC	Training in Risk and Crisis Communication
TransIT	Transnational Illicit Trafficking
TSA	Transportation Security Administration
TSL	Transportation Security Laboratory
US-CERT	United States Computer Emergency Readiness Team
USACE	U.S. Army Corps of Engineers
USCIS	United States Citizenship and Immigration Services
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USSS	United States Secret Service
ZADD	National Center for Zoonotic and Animal Disease Defense