Terrorists around the world continue to evolve tactics and procedures that threaten the safety of the homeland and personnel serving in U.S. missions abroad. The Combating Terrorism Technical Support Office (CTTSO) remains agile to respond to the Department of Defense’s (DoD’s) needs for cutting edge technology to address capability gaps that are often shared by the interagency and our international allies.

In 2018, CTTSO continued to develop anti-tunnel technologies in order to strengthen our border security posture. These technologies address joint requirements with Israel as directed by the National Defense Authorization Act to establish anti-tunnel capabilities to detect, map, and neutralize underground tunnels that threaten the United States or Israel. Defeating the threat of small unmanned aerial systems (sUAS) continue to be a challenge. We worked closely with Defense agencies to provide near-terms solutions and continue to coordinate development of novel capabilities to counter sUAS.

This review book highlights technologies that were delivered to end users in the DoD, interagency, and our international allies in the areas of — increased lethal capability, novel body armor, and expeditionary chemical detection to name a few; and also highlights continuing projects that will come to fruition in the next year.
# TABLE OF CONTENTS

**Combating Terrorism Technical Support Office**  
Mission ................................................................. 2  
History and Organization ................................................ 2  
CTTSO and Other Agencies .............................................. 2  
Technology Transition .................................................. 3  
Innovation .................................................................. 3  
International Partners .................................................. 4  

**Technical Support Working Group**  
Mission .................................................................... 6  
History and Organization .............................................. 6  
TSWG Fiscal Year 2018 Project Funding ......................... 7  

**Subgroups**  
Advanced Analytic Capabilities .................................... 8  
Chemical, Biological, Radiological, Nuclear, and Explosives ......................................................... 13  
Improvised Device Defeat/Explosives Countermeasures ................................................................. 19  
Investigative and Forensic Science ................................ 25  
Irregular Warfare and Evolving Threats ....................... 30  
Personnel Protection .................................................... 35  
Physical Security ....................................................... 42  
Surveillance, Collection, and Operations Support .......... 48  
Tactical Operations Support ......................................... 51  
Training Technology Development ............................ 59  

**Appendix**  
2018 Performers .......................................................... 64
MISSION

The mission of the Combating Terrorism Technical Support Office (CTTSO) is to identify and develop capabilities to combat terrorism and irregular adversaries and to deliver these capabilities to Department of Defense (DoD) components and interagency partners through rapid research and development, advanced studies and technical innovation, and provision of support to U.S. military operations.

History and Organization

The Assistant Secretary of Defense for Special Operations/Low-Intensity Conflict (ASD SO/LIC) established CTTSO in 1999 to consolidate its research and development programs previously administered by the Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence). The research and development effort that supports the interagency, Technical Support Working Group (TSWG), was the first program to transition to CTTSO.

The Explosive Ordnance Disposal/Low-Intensity Conflict (EOD/LIC) Program, which developed advanced technologies for Joint Service EOD and Special Operations Forces (SOF) missions, transitioned in 2001. In 2007, the Irregular Warfare Support (IWS) Program was initiated to satisfy a growing need to improve the capacity of the United States to counter insurgencies and fight an irregular war. In FY16, portions of the EOD/LIC and IWS Programs that support the CTTSO mission were transitioned to TSWG under the Improvised Device Defeat/Explosives Countermeasures and Irregular Warfare and Evolving Threats Subgroups, respectively.

CTTSO and Other Agencies

CTTSO is charged with providing a forum for interagency and international users to discuss mission requirements to combat terrorism, prioritize these requirements, fund and manage solutions, and deliver capabilities. CTTSO accomplishes these objectives through rapid prototyping of novel solutions developed
and field tested before the traditional acquisition systems are fully engaged. This low-risk approach encourages interdepartmental and interagency collaboration, thereby reducing duplication, eliminating capability gaps, and stretching development dollars.

**Technology Transition**

Technology transition is deeply embedded within CTTSO’s project management principles to ensure technologies developed are seamlessly transitioned to low-volume production or mass manufacturing where applicable. Transition is successful when research and development projects evolves into the commercial market and/or is inserted into government acquisition programs. This ensures the capabilities developed by CTTSO are accessible for deployment by CTTSO’s diverse end user community.

CTTSO program managers work with external government agencies, end users, and industry to overcome barriers that may prohibit the successful transition of CTTSO technologies.

Transition planning is incorporated into each milestone of our projects, including a Technology Transition Plan that is developed by the vendor. Technology Transition Plans are used to provide a framework for how the technology will transition to the commercial market and/or government acquisition. Topics discussed in the Technology Transition Plan include:

- The capability gap addressed by the development of the technology;
- Identifying customers and defining the market size;
- Understanding and managing intellectual property and data rights;
- Production strategies including partnering, investment capital, and licensing;
- Commercialization and affordability;
- Environment, safety, and regulatory issues;
- Security and export control provisions;
- Test and evaluation planning and independent operational testing; and
- Operational suitability and operational support planning.

The keys to accelerating the complicated process of moving prototypes to production include having a disciplined process, providing assistance, and teamwork among program managers and developers. Additional information is available at the Technology Transition section of the CTTSO website, www.cttso.gov.

**Innovation**

In the current budget environment of focusing on doing more with less, the need for innovation increases as we look for new ways to combat terrorism. Novel solutions come from individual entrepreneurs and tinkerers, and in order to leverage those solutions, CTTSO must constantly look for ways to actively engage them. The Innovation program at CTTSO has, at its core, the following objectives:

- Identify new ways to obtain success, rather than uncertain development, through prizes, challenges, and other rewards;
- Provide additional tools and resources to fulfill operational capability gaps;
- Increase the number and diversity of solution providers; and
- Provide rapid and agile ways of doing business that lower both cost and risk.

Innovation is a model that enables Government research and development programs to identify the best solutions in the shortest amount of time possible at a lower cost. The following initiatives are underway at CTTSO to support the Innovation program.
International Partners

International cooperation allows CTTSO to leverage foreign experience, expertise, resources, and infrastructure in a unified approach against terrorism for the benefit of all. Therefore, in addition to its domestic interagency efforts, CTTSO directly manages bilateral agreements with five partner countries: Australia, Canada, Israel, Singapore, and the United Kingdom.

We have decades long histories of mutual support, technical cooperation, and information sharing. The rise of international terrorism began hundreds of years ago but reached new depths in the 1960s and 70s. Its subsequent proliferation in the 21st century spurred U.S. efforts to broaden the scope of cooperative activities to combat this threat to international peace and security.

From modest beginnings in the early 1990s, CTTSO’s international relationships have matured and grown into wide-ranging and multifaceted programs that address a variety of technically sophisticated threat capabilities employed by terrorist groups and their state sponsors. Tactics, techniques, procedures, countermeasures, and associated equipment identified, developed, and tested under terms our expanding cooperative arrangements found their way into the inventories of U.S. and partner operators where they enhanced our respective national capabilities and permitted all partner nations to respond more effectively to the threats.

The partnerships provide insights into regional affairs, access to a broader technology base, and allows for the use of unique facilities offered by each country. Each of the agreements are 50/50 cost shared, comprised of financial and non-financial contributions, to address joint requirements, reducing duplication of efforts and scientific trial and error. Bilateral meetings are held on a regular basis to review ongoing projects and to discuss new areas of collaboration.

In addition to CTTSO’s bilateral partners, CTTSO cooperates with other countries when appropriate. Dozens of operational capabilities developed with CTTSO partners are currently in service with a variety of personnel both throughout the United States and around the world.

Our international partnerships continue today and will for the foreseeable future as we strive to blunt the efforts of those who would seek to destroy our freedoms and compromise our way of life.
TECHNICAL SUPPORT WORKING GROUP
MISSION

The mission of the Technical Support Working Group (TSWG) is to identify, prioritize, and coordinate interagency and international research and development (R&D) requirements for combating terrorism. Through the Department of Defense’s Combating Terrorism Technical Support Office and funding provided by other agencies, the TSWG rapidly develops technologies and equipment to meet the high-priority needs of the combating terrorism community, and addresses joint international operational requirements through cooperative R&D with major allies.

History and Organization

In April 1982, the National Security Decision Directive 30 assigned responsibility for the development of an overall United States policy on terrorism to the Interdepartmental Group on Terrorism (IG/T), chaired by the Department of State. TSWG was an original subgroup of the IG/T, which later became the Interagency Working Group on Counterterrorism (IWG/CT). In its February 1986 report, a Cabinet-level Task Force on Counterterrorism, led by then Vice President Bush, cited TSWG as assuring, “the development of appropriate counterterrorism technological efforts.”

TSWG operates under the management and technical oversight of the Department of Defense (DoD) Assistant Secretary of Defense for Special Operations/Low-Intensity Conflict (ASD SO/LIC) and the policy oversight of the Department of State’s Bureau of Counterterrorism and Countering Violent Extremism.

TSWG’s 10 subgroups are chaired by senior representatives from DoD, other federal agencies, and national organizations with special expertise in those functional areas. Chairmanship of subgroups is as indicated in the organizational chart below.
Core funding includes $47.5 congressionally directed for cooperative anti-tunnel work with the Government of Israel.
ADVANCED ANALYTIC CAPABILITIES
FOCUS AREAS

Advanced Computing
Develop, apply, and integrate advanced computing systems and methodologies to the operational environment.

Anticipatory Analytics and Foresight
Apply, develop, and integrate new anticipatory analytic tools to the full spectrum of the operational environment. Apply, develop, and integrate strategic foresight analytical methods, systems, capabilities, and tools to strategic planning.

Big Data, Algorithms, and Decisions
Integrate big data, algorithms, and decision making tools to enhance tactical-to-strategic decision making.

Decision, Planning, and Analytical Tools
Develop stand-alone tools, models, and enabling technologies that provide new capabilities for improved military and interagency sense making. Successful technologies may be transitioned as an independent capability and/or integrated into larger systems.

COMPLETED PROJECT

Argument Mapper for Structured Reasoning
Argument Mapper, developed by Uncharted Software, Inc. is designed to enhance critical thinking in intelligence analysis. It is an easy-to-use, web based interactive software tool that supports the application of evidence based reasoning to analytic questions. Designed in collaboration with analysts and analytic methodologists, this tool applies structured argument mapping methodology and visualization techniques to help analysts make sense of complex problems and overcome cognitive biases. Analysts can work both top down from hypotheses to evidence (i.e., deductive reasoning), and bottom up from evidence to hypotheses (i.e., inductive reasoning), and a mixture of both at the same time. Analysts can share and collaborate on reasoning by allowing colleagues, managers, and reviewers to place comments directly on the subject in the argument map through the web-based application. Argument Mapper is accredited on the Joint Worldwide Intelligence Communications System and has a training course available from the vendor.
Special Operations Requirements Tool – Operational Environment

Special Operations Requirements Tool – Operational Environment (SORT-OE) by System of Systems Analytics, Inc. (SoSACorp) is a prototype software tool within the Enhanced Model Enabled Analysis, Design, and Execution (eMEADE) tool suite and is being developed to support the visualization of multiple OEs from a return on investment (RoI) perspective. This capability will enable decision makers to quickly see investments from the performance, stability, and/or resource view. SORT-OE presents the tradeoff between portfolio risk (potential for success) and portfolio return. The more risk a Commander is willing to accept, the higher the expected RoI. Therefore, within a prescribed OE, for a given amount of risk, SORT-OE strives to present an optimal portfolio of actions that could produce the highest possible return, allowing decision makers and analysts to factor in and weigh the impacts of policies on investment decisions.

Virtual Anticipation Network

Virtual Anticipation Network (VANE) is a project with NuWave Solutions to use big data and machine learning to identify indicators and warnings of difficult to detect “gray zone” attacks. VANE encompasses a number of tools that use machine learning to process unstructured data and highlight anomalies to make predictive forecasts on gray zone (e.g., hybrid or irregular warfare) activity. VANE’s core uses are: activity forecasting, anomaly and weak signal detection, what if/hypothesis analysis, scenario back-casting and likelihood assessment, and data exploration and visualization. VANE applies machine learning to model the environment, identifying phenomena through anomaly detection, and then assesses/monitors phenomena through scenario modeling. Analysts can leverage VANE to reduce surprise, increase sensitivity to weak signals, improve objectivity, and scale analysis to more sensors.
Custom Analytics Tools for Law Enforcement Organizations

Custom Analytics Tools for Law Enforcement Organizations (LEOs) by the Common Operational Research Environment (CORE) Lab allows LEOs to understand the dynamic nature of social networks relationally, spatially, and temporally. All too often, practitioners have to rely on analytic software that was not designed with them in mind. Though useful in some cases, existing analytic software does not account for practitioner workflows, their time constraints, and their need to remain analytically flexible as new network-related challenges arise. The CORE Lab, under the sponsorship of CTTSO, initiated the Custom Analytics Tools for LEOs project to address these analytic challenges. This project harnesses the power and flexibility of R and R packages (https://cran.r-project.org) such as R Shiny (https://shiny.rstudio.com), to develop custom analytic tools with user-friendly interfaces on top of back end code that automates key steps in processing, exploitation, and dissemination of network analysis-based products. This ongoing project is engaging with local, federal, and DoD organizations to continue to design and iteratively develop tools that address the needs of counter-network professionals.

Advanced Analytic Demonstrator (SOFWERX Sandbox)

The Advanced Analytic Demonstrator by SOFWERX is a “sandbox” environment that will showcase government owned, open source analytic platforms, tools, and models to end users and enable them, with some developer assistance, to explore their use to address new and emerging SOF requirements. The Advanced Analytic Demonstrator provides a means of modifying, enhancing, improving, or adapting CTTSO-developed tools to new applications, allowing end users to benefit from faster employment of existing capabilities “off the shelf.” Initial CTTSO-developed platforms to be supported at SOFWERX include the MEADE/SORT-OE platform, Argument Mapper, and others.
<table>
<thead>
<tr>
<th><strong>MEMBERSHIP</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intelligence Community</strong></td>
</tr>
<tr>
<td>• Office of the Director of National Intelligence</td>
</tr>
<tr>
<td><strong>U.S. Department of Defense</strong></td>
</tr>
<tr>
<td>• Defense Intelligence Agency</td>
</tr>
<tr>
<td>• Joint Improvised-Threat Defeat Organization</td>
</tr>
<tr>
<td>• National Geospatial-Intelligence Agency</td>
</tr>
<tr>
<td>• National Reconnaissance Office</td>
</tr>
<tr>
<td>• Naval Postgraduate School</td>
</tr>
<tr>
<td>• Office of the Secretary of Defense (Rapid Fielding Office)</td>
</tr>
<tr>
<td>• Office of the Secretary of Defense, Homeland Defense and Americas’ Security Affairs</td>
</tr>
<tr>
<td>• Office of the Secretary of Defense for Special Operations and Low-Intensity Conflict</td>
</tr>
<tr>
<td>• U.S. Army G-2</td>
</tr>
<tr>
<td>• U.S. Army G-3/5/7</td>
</tr>
<tr>
<td>• U.S. Marine Corps Intelligence Department</td>
</tr>
<tr>
<td>• U.S. Special Operations Command</td>
</tr>
<tr>
<td>• Army Special Operations Command</td>
</tr>
<tr>
<td>• Special Operations Command Central</td>
</tr>
<tr>
<td><strong>U.S. Department of Homeland Security</strong></td>
</tr>
<tr>
<td>• Customs and Border Protection</td>
</tr>
<tr>
<td>• Border Patrol</td>
</tr>
<tr>
<td>• Office of Intelligence and Analysis</td>
</tr>
<tr>
<td><strong>U.S. Department of Justice</strong></td>
</tr>
<tr>
<td>• Federal Bureau of Investigation</td>
</tr>
</tbody>
</table>
CHEMICAL, BIOLOGICAL, RADIOLOGICAL, NUCLEAR, AND EXPLOSIVES
FOCUS AREAS

CBRNE Characterization and Attribution
Systematically investigate and identify the unique physical and chemical characteristics of CBRNE materials; develop tools to determine the origin of CBRNE agents and materials; and evaluate clandestine methods of chemical and biological agent and homemade explosives production.

Consequence Management
Develop CBRN decontamination solutions, tools, and techniques; develop decision support tools which analyze, aggregate, and integrate multi-source data to provide enhanced on-scene situational awareness and risk assessment capabilities for CBRNE response; and develop training solutions to enhance the operational effectiveness of CBRNE operators.

Protection
Develop respiratory and dermal protective equipment to minimize exposure to CBRN materials while operationally enhancing individual performance; enhance shelter-in-place capabilities; and develop materials, tools, and techniques for hydration systems in compromised environments.

Detection and Identification
Develop equipment, tools, and techniques to sample, detect, and identify trace (gases, vapors, and non-visible amounts of solid and liquid) and bulk (microgram and higher amounts of solid and liquid) amounts of CBRNE threat materials at point, proximity (inches), and standoff (meters to kilometers) distances in both fixed and on-the-move configurations.

Personal Cooling Systems Evaluation
First responders require protection from chemical, biological, radiological, nuclear, and explosive (CBRNE) threats; however, personal protective ensembles (PPEs) pose their own dangers. The physical barrier when wearing PPE prevents operators from naturally cooling, creating the risk of heat strain and related illnesses when working in warm environments and/or on extended missions. Commercial personal cooling systems (PCSs) potentially provide relief, but little reliable information exists for operators to understand their impact or decide which products are most appropriate for their mission.

Queensland University of Technology in Australia evaluated representative PCS products combined with different classes of CBRNE PPE, including explosives ordnance disposal bomb suits. Testing examined human physiology and performance at rest with PCS (pre-operational) and on a treadmill with PCS and PPE (operational).

Evaluation results demonstrated that the appropriate PCS was ensemble dependent. Results indicate the ideal PCS/PPE combinations could increase work tolerance time by 21% to 60% compared with operating in PPE without PCS. This suggests an ideal PCS/PPE combination may increase mission durations, a critical advantage in CBRNE operations, while reducing heat-related casualties.
Ebola Stability Assessment in Drying Human Blood

The reasons for the difference in magnitude between the 2013–2016 Ebola virus (EBOV) outbreak and those seen historically remain unknown. Previous CTTSO efforts evaluating EBOV decontamination methods suggested the root cause might derive from a phenotypic change — a variation in the virus’ genes leading to new characteristics. Specifically, the 2013–2016 EBOV appeared more stable in dried blood than previous EBOV outbreaks. If correct, it means dried blood poses a greater infectious hazard than anticipated. Identifying whether or not EBOV genetics played a role in the magnitude of the outbreak offers potential pathways towards improved countermeasures and mitigation strategies.

CTTSO and Defense Threat Reduction Agency funded this effort to assess EBOV isolates from the 2013–2016 and historical outbreaks, along with related filovirus isolates. The Department of Homeland Security (DHS) National Biodefense Analysis and Countermeasures Center (NBACC) performed the evaluation. Testing entailed spiking samples of human blood with virus, then incubating the infected blood at temperature and humidity levels representing West African environmental conditions. At set times over 72 hours, the amount of viable virus remaining for each isolate was determined, indicating the virus stability. NBACC found that EBOV isolate stability did not differ significantly, suggesting that genes did not affect persistence. DHS released a report detailing this work and their conclusions. These negative results provide helpful information by allowing researchers to focus on other root causes and mitigation strategies such as evaluating cultural behaviors or response factors.

High Volume Sampler/Analyzer Test Bed for Explosive Detection

Screening for explosives inside of large containers, such as conex containers, presents challenges impeding accurate readings: low vapor pressure of explosives, the presence of interferents or materials that may adsorb vapor, and the large space in which the sample may be present. Recently, highly sensitive instruments have been developed that work in conjunction with high volume samplers to collect air from these containers and then analyze the sample for trace explosives. In order to explore this possible route to explosive screening, CTTSO and DHS S&T have funded the Transportation Security Laboratory to build a high volume test bed. Assessments were performed in collaboration with Canada Border Services Agency, Transport Canada, the United Kingdom’s Defence Science and Technology Laboratory, the Transportation Security Administration, and Israel’s Prime Minister’s Office.

Test bed objectives included characterizing the air samples obtainable from cargo containers to define the detection requirements, evaluating the state-of-the-art applicable technologies, and providing feedback to the participating vendors to help further their system’s development. The first phase of testing conducted in August 2016 used conex containers and wrapped pallets that were empty or contained a bulk explosive threat. The second phase in August 2017 used more realistic scenarios by adding more boxes and other packing materials. The final test in late 2018
evaluated the system in colder weather to diversify environmental conditions tested. The experiments yielded valuable information regarding vapor concentrations and saturation times that were incorporated in the development of the European Civil Aviation Conference (ECAC) explosive vapor detection standard. Participating vendors received valuable feedback from their system evaluations, and the information garnered by this project advanced understanding of the scenario and the detection requirements necessary to implement fieldable systems.

“Black Canary” – Individual Chemical Detector

Military personnel and first responders face challenges detecting vapors from toxic industrial chemicals (TICs) and chemical warfare agents (CWAs). Personnel in the field need timely threat warnings to avoid harmful exposure. This requires sensitive and accurate chemical detection equipment. In collaboration with Australia’s Defence Science and Technology (DST) Group, the Black Canary project developed a robust and portable detector that provides users the early warning needed to react to the presence of toxic gas.

Black Canary is based on color change chemistry paired with an opto-electronic design. The device uses small, swappable cartridges, each detecting a specific toxic vapor at or below the permissible exposure limits defined by the United States Occupational Safety and Health Administration. Cartridges are miniaturized, single-wavelength spectrometers, comprising of a reactive chemical sample casing and electronics package. Each device holds up to eight cartridges that are interchangeable for anticipated threat vapors. Black Canary is a user-friendly solution that offers sophistication often associated with larger handheld devices.

Non-Encapsulating National Fire Protection Association (NFPA) Class 1 Ensemble

For decades, fully encapsulating chemical protective suits constituted the principal form of personal protective ensembles (PPEs) when facing the most dangerous hazardous chemical incidents. In this PPE design, the operator and all their equipment reside inside the suit, including their self-contained breathing apparatus (SCBA). While this configuration offers protection from harsh chemical hazards, encapsulation limits functionality by impeding movement, dexterity, and vision. Until recently, NFPA standards prevented assessing any non-encapsulating design. However, recent revisions to the standards (NFPA 1994) now permit non-encapsulating PPE designs.

International Personnel Protection will develop a garment to be certified at NFPA 1994’s highest protection level, Class 1 (gas-tight integrity), using a non-encapsulating design with the SCBA on the outside of the garment. The product will provide the same vapor and liquid protection, but in a more operationally relevant configuration which facilitates operator mobility and functionality.
Pharmaceutical Based Agent Decontamination

Increasing law enforcement encounters with fentanyl-related deaths in the United States, Australia, and Europe pose a growing public health and national security crisis. While collaborative efforts address the risk to first responders and the protocols needed to safely destroy other pharmaceutical based agents (PBAs), little information exists on field destruction of recovered fentanyl and mixtures.

Working with Australia’s Defence Science and Technology (DST) Group, this project will design and recommend a field deployable technique to detect and neutralize bulk fentanyl. The approach will cover safety, materials, instructions for application, and confirming successful decontamination, along with proper disposal procedures. Based on knowledge of different PBA molecular structures, this effort will produce a predictive tool for destruction of new analogs as they surface.

High Sensitivity and Homemade Explosive Trace Detector

The High Sensitivity and Homemade Explosive (HME) Trace Detector will greatly expand current fielded detection capabilities. The project focuses on two main trace detection challenges: detecting lower levels of conventional threat residue and enabling trace HME detection in the hundreds of nanogram range.

L-3 Technologies under a CTTSO contract, in collaboration with the United Kingdom, is developing a man portable, high sensitivity and HME trace benchtop detector. The technology aims to address both challenges by implementing a "direct inject" thermal desorption approach into ion mobility spectrometry (IMS), by creating a small desorption volume directly integrated in the ionization module. The system will also make improvements with ionization efficiency and transport, along with a new sample trap material with improved desorption properties that is capable of reaching higher temperatures needed for HME salt desorption.

MEMBERSHIP

- Environmental Protection Agency
- Federal Reserve Board
- Intelligence Community
- InterAgency Board
- International Association of Fire Chiefs
- State and Local Agencies
  - Alexandria (VA) Fire Department
  - Arlington County (VA) Fire Department
  - Baltimore County (MD) Fire Department
  - Boston (MA) Fire Department
  - City of Orlando (FL) Police Department
  - District of Columbia Fire Department
  - District of Columbia Metropolitan Police Department
  - Douglas County (GA) Emergency Management Agency
  - Douglas County Fire Department
  - Fairfax City (VA) Fire Department
  - Fairfax County (VA) Fire and Rescue Department
  - Fairfax County Police Department
  - Fort Dodge (IA) Fire Department
  - Houston (TX) Police Department
  - Los Angeles (CA) Police Department
  - Metropolitan Nashville (TN) Police Department
  - Miami-Dade (FL) Fire Rescue Department
  - Nashville (TN) Fire Department
  - New York City (NY) Fire Department
  - New York City Office of Chief Medical Examiner
  - New York City Police Department
  - Northern Illinois Police Alarm System
  - Palm Beach (FL) Fire Rescue
- Raleigh (NC) Fire Department
- San Francisco (CA) Fire Department
- Texas Department of Public Safety
- Virginia Beach Fire and Rescue
- Virginia Department of Emergency Management
- Virginia Department of Transportation
- U.S. Capitol Police
- U.S. Department of Agriculture
  - Animal and Plant Health Inspection Service
  - Food Safety and Inspection Service
- U.S. Department of Commerce
  - National Institute of Standards and Technology
- U.S. Department of Defense
  - Defense Advanced Research Projects Agency
- Defense Intelligence Agency
- Defense Threat Reduction Agency
  - Joint Improvised-Threat Defeat Organization
- Joint Chiefs of Staff
- Joint Program Executive Office for Chemical and Biological Defense
- National Guard Bureau
- Office of the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense
- Pentagon Force Protection Agency
- U.S. Air Force Air Combat Command
- U.S. Army
  - 20th Support Command, CBRNE
  - 22nd Chemical Battalion
  - Armament Research, Development, and Engineering Center
  - Chemical, Biological, Radiological, and Nuclear School
  - Defense CBRN Response Force
  - Medical Department
  - Medical Research Institute of Infectious Diseases
  - National Ground Intelligence Center
  - Research, Development, and Engineering Command, Edgewood Chemical Biological Center
  - Research Institute of Environmental Medicine
  - U.S. Marine Corps
  - Chemical Biological Incident Response Force
- U.S. Navy
  - Bureau of Medicine
  - Naval Air Warfare Center
  - Naval Explosive Ordnance Disposal Technology Division
  - Naval Forces Central Command
  - Naval Research Laboratory
  - Naval Surface Warfare Center
  - U.S. Special Operations Command
- U.S. Department of the Interior
  - National Park Service, United States Park Police
- U.S. Department of Justice
  - Bureau of Alcohol, Tobacco, Firearms and Explosives
  - Federal Bureau of Investigation
  - National Institute of Justice
  - U.S. Marshals Service
- U.S. Department of Labor
  - Occupational Safety and Health Administration
- U.S. Department of State
  - Bureau of Arms Control, Verification and Compliance
  - Bureau of Counterterrorism and Countering Violent Extremism
  - Bureau of Diplomatic Security
  - Bureau of Overseas Buildings Operations
- U.S. Department of Transportation
  - Research and Innovative Technology Administration (Volpe Center)
- U.S. Senate Sergeant at Arms White House
  - Homeland Security Council
  - Office of Science and Technology Policy
FOCUS AREAS

Improvised Device Defeat
Improve or develop operational capabilities to neutralize, render-safe, and contain blast and fragmentation during improvised terrorist device, and explosives response operations.

Device Diagnostics and Threat Characterization
Provide advanced technologies and technical solutions that improve identification, analysis, and technical characterization of explosives, improvised explosive devices (IEDs) and their components, and potential weapons of mass destruction in support of response operations.

Robotics and Remote Means
Develop or enhance platforms, systems, and technologies to remotely conduct activities related to the neutralization or rendering safe of IEDs, unexploded ordnance (UXO), homemade/improvised explosives and their precursors, and enhanced hazard devices containing chemical, biological, or radiological materials.

COMPLETED PROJECTS

Multi-Fit Inflatable Bomb Suit Helmet Liner
Bomb suits are hot, heavy, and bulky, adding an extra layer of difficulty for bomb technicians conducting bomb disposal operations. To alleviate some of the discomfort and to ensure a properly fitted helmet, Med-Eng was contracted to manufacture a Multi-Fit Inflatable Bomb Suit Helmet Liner. Med-Eng assessed a variety of designs, settling on one inspired by technology used in professional football, lacrosse, cycling, and hockey helmets. The Multi-Fit Inflatable Bomb Suit Helmet Liner optimizes fit, comfort, and ease of wear. By reducing discomfort and operator stress, bomb technician concentration and effectiveness is significantly improved. Operators are able to incorporate the inflatable liners into a variety of Med-Eng helmets, which are widely deployed in bomb squads across the U.S. military and law enforcement communities. With minimum helmet modification, a single solution accommodates a wide range of head sizes. Fit adjustments can be made through a bladder system, inflated by an external pump while the helmet is being worn, allowing for immediate comfort feedback.

Bomb Suit Heads-Up Display
The bomb disposal community identified the need for a bomb suit heads-up display (HUD) to enhance situational awareness for bomb technicians while wearing the bomb suit. Med-Eng was contracted to develop a system that provides critical visual information to a bomb technician while they are performing bomb disposal operations. To find the most viable technology, Med-Eng evaluated numerous commercially available HUD systems, selecting the best for use with a variety of EOD tools and sensors, and for best integration with different EOD helmet ensembles. The HUD system
was designed to fit or retrofit to most EOD helmets currently used by the U.S. bomb disposal community. The HUD connects to the bomb suit wrist-controller, which provides voice recognition and collects data from all subsystems, such as low-light/IR cameras, threat sensors, and suit controls. Additionally, the modular architecture accommodates a wide variety of commercial-off-the-shelf peripherals, allowing data feeds to be rapidly integrated into the system with minimal system alteration. Now technicians can receive visual images and feedback from items such as a high definition search camera that can capture pictures or transmit video of hard-to-reach places, laser rangefinder for distance estimation, and different chemical and radiological detection systems. Bomb technicians can also customize their HUD to personal preferences and specific mission needs.

---

### ONGOING PROJECTS

#### Automated Recognition of Bomb/IED Components

Currently, X-ray images are the primary tool used by bomb technicians to analyze the internal components and circuitry of a potential improvised explosive device (IED). The technician relies on experience and images taken from multiple angles to identify key components. This information is then used to formulate the technician's next steps or render-safe strategy. Sandia National Laboratories was tasked with developing image analytics algorithms using machine learning to assist in this process. Sandia’s algorithms, called the Automated Recognition of Bomb/IED Component System, will automatically identify and categorize components in an X-ray image. The system works in two modes, with the first allowing the operator to select a component in the image and query the system for identification of that specific component. The system then returns information on the type of component and a percentage confidence-level that the identified component is correct based on matches in the component library. In the second mode, the system searches the entire image and attempts to recognize any components that would constitute a firing circuit for an IED. The system has been integrated into Sandia’s X-ray Toolkit (XTK) which is an accepted standard for the U.S. bomb disposal community. Sandia is continuing to improve the system’s deep learning algorithms.

#### NASA Robotics Challenge

CTTSo and NASA are conducting a series of workshops that challenge teams to rapidly develop and deploy inexpensive unmanned solutions for real-world improvised explosive device (IED) problems. Teams are made up of military and public safety bomb technicians, NASA engineers, and NASA high school interns, who work collaboratively to design and build new robots that provide a solution to the challenge task, and then compete under timed, real-world conditions. The teams are graded on overall mission success, ease of deployment, and innovation. For example, a previous challenge tasked teams with using robot platforms to cut through the roof of a box truck and describe the contents of a potential vehicle-borne IED (VBIED), all
within 15 minutes of leaving the safe area. In another challenge, teams used only modified small drones with team-created attachments to cut through the roof of a potential VBIED, examine the contents, and drop a mock explosive counter-charge inside. In 2018, teams were confronted with the difficulties of working in underground spaces. They had to overcome maneuvering robotic platforms within extremely confined spaces, working within low- or no-light conditions, and deal with communications issues found while operating in tunnels. Overall, the workshops promote the development of creative solution-sets for identified technology gaps experienced by technicians, while conducting remote operations during bomb disposal operations. The workshops also reveal future challenges that EOD technicians may face and familiarize the bomb technician community with commercially available robotics and peripheral technologies. Finally, the workshops function as a platform for EOD technicians to learn and share broader knowledge about new tactics and techniques, as well as emerging technologies.

Humanoid Robot

CTTSO and NASA are developing a humanoid robot to conduct bomb disposal operations. Building on a humanoid robot design originally envisioned for the mission to Mars, NASA is creating a next-generation robot that can be used to address a variety of hazards that bomb disposal technicians face when dealing with suspect packages and improvised explosive devices (IEDs). The development of a humanoid robot for bomb disposal will dramatically reduce the need for dangerous manual approaches by bomb disposal technicians, and will be especially beneficial in addressing the challenges identified in dealing with vehicle-borne IEDs. Prior work in dexterous humanoid design, robot mobility, manipulation, and remote supervisory control will be further advanced to address the difficult problems of bomb disposal. These technological advancements will be integrated to conduct operations such as hazard area reconnaissance using automated object detection; maneuvering through complex terrain environments using 3-D mapping; and remote interrogation of suspect packages, backpacks, and vehicles. Manipulation of EOD-specific tools for rendering safe explosive hazards will also be part of this effort.

Bomb Squad 3-D Printing Kit

The ability to 3-D print existing render-safe tools will provide a quick, low-cost option for making EOD-specific tools, and provides added flexibility in selecting tools for render-safe options. AMP Research, Inc. is developing a file library of one thousand 3-D printable tools for the bomb disposal community. The 3-D CAD designed tools will be compatible with and comparable to existing render-safe tools, and match performance characteristics of existing tools, while minimizing the time required for 3-D printing. This library can be accessed online by bomb technicians, and printable tools can be built using common, commercially available 3-D printers. The project will also identify and rank 3-D printers by “good, better, best” for each tool.
Multi-Language Incident Notification System

Considering the increased number of significant improvised explosive device (IED) incidents, and the use of a variety of technically sophisticated devices, it is critical that bomb technicians across the globe have immediate access to technical information on device characteristics, so if faced with the same type of device, they are better able to resolve the incident. Technical information about a device needs to be quickly, securely, and efficiently communicated to bomb technicians locally, regionally, nationally, and even internationally. The instant notification system (INS), which is being developed as a smartphone-based application, provides bomb technicians responding to an incident with the ability to send immediate notifications to fellow technicians when an incident is called in, while the incident is in progress, when an update is given, and when the incident is resolved. Information about an IED or suspect device can be entered into the INS in under 30 seconds using a graphic interface and drop-down menus, with responding bomb technicians and those receiving the notifications able to enter and read data in English, French, or Spanish; other languages may be added in the future depending on end user needs. End users can also customize which type of notifications to receive, and from what geographic area of interest. Real-time mapping of previous suspect package incidents, hoax devices, and IED incidents will be visible to responding technicians using the INS app, which will provide rapid identification of device trends and common incident characteristics for any given geographic area.

Portable Camera for Bomb Suit Operations

Despite the proliferation of robotic platforms that allow bomb technicians to conduct many operations remotely, bomb technicians sometimes need to make a manual approach on a suspect package, or improvised explosive device (IED). Suspect packages and IEDs are often concealed in a manner that prevents identification of components from a single viewing angle because they may be under a car, in a wheel-well, or secreted under stairs or furniture. The bulkiness of a bomb suit impedes the bomb technician's ability to access these tight spaces, resulting in the need for a portable camera capable of capturing high-definition still images and video, combined with the ability to be easily used while wearing a bomb suit. This development effort will result in a small, high-definition, live-streaming portable camera that will have a wearable touch screen display, include a gimballed extendable boom with a body mounting kit for ease of carrying and rapid accessibility. The portable camera system will allow the user to change camera angles and control pan and tilt of the camera using a joystick and extendable boom. The portable camera system will be ruggedized to resist damage and will provide bomb technicians an additional tool to enhance mission effectiveness.
### MEMBERSHIP

<table>
<thead>
<tr>
<th>Intelligence Community</th>
<th>United States Bomb Technician Association (USBTA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Association of Bomb Technicians and Investigators (IABTI)</td>
<td>U.S. Capitol Police</td>
</tr>
<tr>
<td>Joint Program Office for Countering Improvised Explosives Devices</td>
<td>U.S. Department of Defense</td>
</tr>
<tr>
<td>National Aeronautics and Space Administration</td>
<td>• Pentagon Force Protection Agency Bomb Squad</td>
</tr>
<tr>
<td>National Bomb Squad Commanders Advisory Board</td>
<td>• U.S. Air Force</td>
</tr>
<tr>
<td>State and Local Law Enforcement</td>
<td>• Air Combat Command</td>
</tr>
<tr>
<td></td>
<td>• Explosive Ordnance Disposal Technical Detachment (AFCEC/CXE)</td>
</tr>
<tr>
<td></td>
<td>• U.S. Army</td>
</tr>
<tr>
<td></td>
<td>• 52nd Ordnance Group</td>
</tr>
<tr>
<td></td>
<td>• Explosive Ordnance Disposal Technical Detachment</td>
</tr>
<tr>
<td></td>
<td>• U.S. Marine Corps</td>
</tr>
<tr>
<td></td>
<td>• Chemical Biological Incident Response Force</td>
</tr>
<tr>
<td></td>
<td>• Explosive Ordnance Disposal Detachment</td>
</tr>
<tr>
<td></td>
<td>• U.S. Navy</td>
</tr>
<tr>
<td></td>
<td>• Explosive Ordnance Disposal Fleet Liaison Office</td>
</tr>
<tr>
<td></td>
<td>• Explosive Ordnance Disposal Technology Division</td>
</tr>
<tr>
<td></td>
<td>• National C-IED Knowledge Network</td>
</tr>
<tr>
<td></td>
<td>• Training and Evaluation Unit ONE</td>
</tr>
<tr>
<td></td>
<td>• Training and Evaluation Unit TWO</td>
</tr>
<tr>
<td></td>
<td><strong>U.S. Department of Homeland Security</strong></td>
</tr>
<tr>
<td></td>
<td>• National Protection and Programs Directorate</td>
</tr>
<tr>
<td></td>
<td>• Office for Bombing Prevention</td>
</tr>
<tr>
<td></td>
<td>• Science and Technology Directorate</td>
</tr>
<tr>
<td></td>
<td>• Homeland Security Advanced Research Projects Agency</td>
</tr>
<tr>
<td></td>
<td>• Transportation Security Administration</td>
</tr>
<tr>
<td></td>
<td>• U.S. Coast Guard</td>
</tr>
<tr>
<td></td>
<td>• U.S. Secret Service</td>
</tr>
<tr>
<td></td>
<td><strong>U.S. Department of Justice</strong></td>
</tr>
<tr>
<td></td>
<td>• Bureau of Alcohol, Tobacco, Firearms and Explosives</td>
</tr>
<tr>
<td></td>
<td>• Federal Bureau of Investigation</td>
</tr>
<tr>
<td></td>
<td>• National Institute of Justice</td>
</tr>
</tbody>
</table>

- Arizona Department of Public Safety
- Charleston County (SC) Sheriff’s Office
- Delaware State Police
- Fairfax County (VA) Police Department
- Houston (TX) Police Department
- Maryland State Police
- Michigan State Police
- Pittsburgh (PA) Bureau of Police
- Santa Clara County (CA) Sheriff’s Department
- South Carolina Law Enforcement Division
- St. Paul (MN) Police Department
INVESTIGATIVE AND FORENSIC SCIENCE
FOCUS AREAS

Credibility Assessment (Detection of Deception and Intent)

Develop improved interviewing and interrogation equipment, methods, and techniques through behavioral/operational psychology advancements, including psycholinguistics, cognitive methods, and motivational techniques.

Crime Scene Response

Improve the quality of recognition, collection, documentation, analysis, and preservation of evidence and actionable information from incident scenes for future prosecution and targeting. Create standardized field tests, collection sets, kits, and other crime scene equipment. Develop capabilities to rapidly and visually document a scene in any environment. Increase the safety and security of law enforcement first responders at a terrorism scene.

Criminalistics

Create advanced capabilities in the traditional forensic science disciplines to identify individuals and improve the recovery, identification, evaluation, and analysis of material and traces. Develop benchtop and handheld instrumentation that decreases throughput time and automates interpretation.

Digital and Multimedia Forensics

Develop computer forensic hardware, software, decryption tools, and digital methods to investigate terrorism. Develop advanced methods to extract, decrypt, analyze, and enhance audio recordings, video images, and other forensic information from analog and digital sources.

Forensic Exploitation

Develop a lexicon, common operating procedures, and advanced techniques for material and personnel exploitation of sensitive sites, caches, targeted objectives, and incident scenes. Advance the portable and packable expeditionary and “reach back” exploitation analysis capabilities for level I, II, and III forensic analysis. Improve law enforcement-related technical surveillance methods.

COMPLETED PROJECT

Forensic Acquisition Tool for Cloud-Based Data

Applied Research Associates, Inc. in Littleton, Colorado has developed a forensically validated software tool to allow for the collection of large volumes of data to be stored in a cloud-based environment. The software tool allows users to collect digital evidence from cloud-based storage containers in a fashion similar to how digital evidence is collected from physical storage media. Additionally, Applied Research Associates, Inc. has developed related procedures on the collection and storage of digital data, information, and evidence in cloud-based containers and services. The files collected as evidence can be either logical or physical acquisitions, depending on level of access to the cloud-based service. The collected information can be stored in a format compatible with existing digital forensics image formats and contain the information collection metadata consistent with digital forensics case documentation best practices. The tool is compatible with commonly used computer hardware.
Next Generation Vampire (Collaborative Forensic Exploitation Platform)

Booz Allen Hamilton of McLean, Virginia, is developing a rugged device weighing less than 2.5 pounds that will provide fast, efficient, and accurate collection and analysis of information, evidence, and biometrics from sensitive sites and crime scenes. The device will support multiple capabilities and requires minimal training time to employ. Specific features include a 12-megapixel camera that can capture images of latent prints and full crime scene photos. It will illuminate the scene with white light and two ultraviolet wavelengths. It also has a laser-based image rescaling system. The device will also capture live fingerprints from persons of interest. The units will include customized software that performs some analysis on fingerprint images and connects to databases such as the FBI Next Generation Identification system. It is able to form an ad hoc mobile network and share data with other Vampire units. Some facial recognition and document exploitation capabilities will also be available.

Five Eyes Forensic and Technical Exploitation Handbook

The National Forensic Science Technology Center of Largo, Florida, is developing a Five Eyes Forensic and Technical Exploitation Handbook that will provide guidance and information on all aspects of forensic and technical exploitation of tactical sensitive sites. It will support military and law enforcement operations, missions, and tasks relating to forensic and technical exploitation. The handbook will address the following topics: training, equipment, personnel, doctrine and concepts, organizations, infrastructure, logistics, and interoperability. It will include exploitation definitions and objectives; operating concepts across the range of military operations; exploitation disciplines, capabilities, levels, organizations, and outcomes; and integration with intelligence processes.
Miniature/Body Worn Audio Video Transmitters

AMP Research, Inc. of Naples, Florida, is developing a standalone, miniature radio frequency transmitter that will provide high performance and low power consumption video for surveillance operations. The device will transmit live video for difficult concealment applications. The device will be body-worn, remotely configurable, and allow for plug-in devices such as antennas, cameras, microphones, batteries, and switches. The design of the device will be such that it can be worn and operated without injury to the wearer and provide high performance video and audio. It will operate in the S-band or C-band, be one inch by one inch by 3/8 inch or less in size, and have a range of at least 500 meters line-of-sight.

Unconstrained Scalable Facial Recognition

Noblis, Inc. of Reston, Virginia, is developing an unconstrained scalable facial recognition application program interface suite and graphical user interface environment (i.e., Face Recognition Environment [FRE]) that builds upon a government-provided face recognition algorithm into a flexible and customizable tool. This tool will be capable of scalable unconstrained face detection, clustering, and recognition for a variety of operational missions. The software will allow for broader case use and will adapt to large-scale streaming applications. They will develop an operationally focused FRE and integrate algorithms into the overall application. The software will be made ready to install on CentOS Linux or Windows.

Forensic Speaker Recognition Applications

SRI International of Menlo Park, California, is developing, testing, and evaluating protocols, procedures, and best practices for forensic speaker recognition and comparison examiners to accomplish their analyses and examinations. The research and development will advance and improve validated forensic capabilities in the areas of: listener accuracy, measurement and examiner training protocols, pilot collection of speech in high emotion settings, and compliance with privacy, legal, and ethics regulations. This project focuses on the type of speech heard and the associated recordings found in typical law enforcement and forensic casework. The protocols, procedures, and capabilities that are developed will have specifications and performance parameters that work with a broad variety of listener types and compare listener accuracy alone and in conjunction with automated systems.
Credibility Assessment Algorithm Development

Lockheed Martin Advanced Technology Laboratories of Arlington, Virginia, is developing, testing, and producing several credibility assessment algorithms and related software that will be used in credibility assessment systems employed or being developed by the National Center for Credibility Assessment (NCCA). The algorithms will be incorporated into the NCCA Avatar and a thermal imager system. The algorithms will analyze the input signals from different physiological processes to determine the credibility and intent of the interviewee at a level of accuracy of 80% or higher.

MEMBERSHIP

Environmental Protection Agency
- National Enforcement Investigations Center

Intelligence Community

National Forensic Science Technology Center

National Transportation Safety Board

Office of the Director of National Intelligence

U.S. Department of Commerce
- National Institute of Standards and Technology
- Office of Law Enforcement Standards

U.S. Department of Defense
- Component Commands
- Defense Advanced Research Projects Agency
- Defense Computer Forensics Laboratory
- Defense Criminal Investigative Service
- Defense Cyber Crime Institute
- Defense Forensic Enterprise, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
- Defense Forensic Science Center
- Defense Forensics and Biometrics Agency
- Defense Intelligence Agency
- Defense Threat Reduction Agency
- Joint Improvised-Threat Defeat Organization
- Headquarters, U.S. Marine Corps
- Intelligence Systems Support Office
- National Center for Credibility Assessment
- National Geospatial Intelligence Agency
- National Media Exploitation Center
- Office of the Provost Marshal General
- Pentagon Force Protection Agency
- Rapid Reaction Technology Office
- U.S. Air Force Office of Special Investigations
- U.S. Army Criminal Investigation Command
- U.S. Navy
  - Naval Criminal Investigative Service
  - Naval Research Laboratory
- U.S. Special Operations Command

U.S. Department of Energy
- Office of Security Technology and Assistance

U.S. Department of Homeland Security
- Customs and Border Protection
- Border Patrol

U.S. Department of Justice
- Bureau of Alcohol, Tobacco, Firearms and Explosives
- Drug Enforcement Administration
- Federal Bureau of Investigation
- National Institute of Justice
- U.S. Marshals Service

U.S. Department of State
- Bureau of Counterterrorism and Countering Violent Extremism

U.S. Department of Transportation
- Federal Aviation Administration

U.S. Postal Inspection Service
IRREGULAR WARFARE AND EVOLVING THREATS
FOCUS AREAS

Advanced Influence and Information Capabilities
Conduct research, operational analysis, capability design, and implementation support to develop new tools, techniques, and activities that enable our forces to influence, disrupt, corrupt, or usurp the decision making of adversaries and potential adversaries within the physical, information, or cognitive domains of the information environment.

Counter-Network Concepts and Capabilities
Conduct research, analysis, and development of new concepts and capabilities that integrate unique skill sets of combined, multi-agency and multi-national domains to identify and interdict threat networks and enterprises.

Partnership Capacity Development
Conduct research, operational analysis, capability design, and implementation support in order to more effectively assist, train, advise, and influence foreign partners, foreign competitors, adversary leaders, and relevant populations in support of expeditionary, low-cost, small-footprint operations in the air, land, maritime, and cyber domains.

COMPLETED PROJECTS

Nightingale
The Digital Outreach Team (DOT) at the Department of State’s Global Engagement Center actively counters extremist messaging online. The Nightingale application has helped DOT operators to better engage extremists through virtual means by supporting efficient approval workflows and improving response times. Nightingale made the online engagement process more efficient for DOT by allowing near real time engagement with extremist messaging. It accomplishes this by 1) providing dynamic workflows for action tracking, team discussion, and supervisor approval; 2) streamlining analytics for social network situational awareness; 3) logging all data associated with DOT messages and operator interactions for recordkeeping and metrics. Nightingale has managed all outgoing DOT messaging since the summer of 2015.

Foreign Criminal Law Analytical Capability
The Foreign Criminal Law Analytical Capability (FClaw) project helped operationalize law as a non-kinetic tool for removing key leadership from violent extremist organizations. FClaw has allowed government agency legal teams to review a nation’s local laws, along with their propensity to enforce those laws. This information supports working with other nations by linking key extremist leaders to specific crimes. U.S. legal teams can then work with the U.S. Department of State and the nation most willing to arrest, prosecute, and incarcerate violent extremist leaders when they enter the partner nation’s sovereign territory.

Credit: Photo by Joe Gratz
Vocalis

Violent extremist organizations influence local populace through a multifaceted campaign combining sophisticated propaganda/media products, financial and economic incentives, physical intimidation, and religious appeals to effectively counter legitimate governments. Project Vocalis created an information dissemination and influence training program designed for improving our foreign partner’s capability in countering violent extremist narratives and increasing the government’s ability to communicate with their local populace. Vocalis has emphasized the need for the partner nations to engage their population at the local level, which better identifies narratives and tactics that resonate positively with the population. Partner nations using this capability have seen an immediate improvement on amplifying operational successes and improved interaction with the populace it serves.

Information Environment Common Operating Picture

The Information Environment Common Operating Picture (iCOP) and accompanying analyst workspace have enabled the Department of Defense (DoD) to better understand the informational effects of DoD activities and how adversaries, near-peer competitors, and violent extremist organizations operate in the information environment. iCOP has informed mission management of DoD contributions to Phase 0 of Military Operations (Shape the Environment) and U.S. Government shaping efforts. The capability has led to the DoD developing and supporting more effective operations to counter adversarial activities.

The Behavioral Influence Assessment

The Behavioral Influence Assessment (BIA) model project supported further BIA system-level development to determine the utility of using the BIA model within the terrorist network analysis space. During the project, Sandia National Laboratories ran data about the Al-Shabaab terrorist network through the BIA model, forecasting the potential outcome of actions taken against the terrorist group. Defence Science and Technology Laboratory (Dstl) and CTTSO convened a Military Judgment Panel (MJP) to determine if first, the forecasted outcomes were better than what can be determined without BIA model support and second, the benefit BIA could add to decision makers. The BIA model proved successful, demonstrating that the BIA model would work against terrorist networks. The MJP also verified that the BIA model supported better decision making and identified from its users that there are no other tools that provide this capability.
Countering Adversarial Disinformation

The Department of Defense’s (DoD) Military Information Support Operations (MISO) Force is adept at developing and disseminating paper, leaflet, and broadcast products with a focus on pushing messages to the largest offline audience it can reach. As the global online population grows the DoD’s MISO community is exploring new and more efficient ways to reach specific target audiences with rapid and precise messaging. Drawing on the latest in technology and methods developed in the advertising industry, this effort evaluates the applicability and usefulness of such techniques. It focuses on conducting target audience analysis and more precisely coordinating online and offline communication efforts.

Fixed Focus

Whether actively recruiting or seeking a more sympathetic audience, adversaries generate an unprecedented amount of publicly available information and digital content. The U.S. and its allies need a better means to gather, store, utilize, and share digital information to more effectively counter adversarial messaging. Fixed Focus works to fill this requirement through a secure, access-controlled, unclassified data platform and repository for interagency and international use and collaboration. Fixed Focus enhances the ability of information communicators to collect, search, retrieve, view, and analyze photos, audio, and video, providing more timely access and improving cross-government(s) coordination of key messaging and counter messaging content.

Remote Advise and Assist Full Spectrum Virtual Accompany Kit

In environments where advisors have limited contact with partner forces, quickly building capacity is severely restricted. Often, after receiving formal training, trainees are on their own to maintain and improve their individual skill sets without advisors and in a force that lacks institutional knowledge. This project addresses new capabilities that could lead to successful Remote Advise and Assist (RAA) operations across the military disciplines, beyond purely kinetic operations and into other skill sets. The project is developing and fielding advanced RAA prototypes to see if these prototypes meaningfully improve the advisor’s ability to mentor partners from a distance, regardless of military mission. Observations will help advance virtual communications between advisors and partners during both kinetic and non-kinetic operations. If successful, advisors will significantly enhance time with their students when physical access is severely restricted.
MEMBERSHIP

Intelligence Community
National Defense University
United Kingdom
- Defence Science and Technology Laboratory
- Strategic Analysis Group – Policy and Capability Studies
U.S. Agency for International Development
U.S. Department of Defense
- Coalition Joint Forces Land Component Command
- Combined Joint Task Force – Operation Inherent Resolve
- Defense Institute of Security Assistance Management
- Defense Threat Reduction Agency
- Peacekeeping and Stability Operations Institute
- Strategic Capabilities Office
- U.S. Air Force
- U.S. Africa Command
- U.S. Army War College
- U.S. Central Command
- U.S. European Command
- U.S. Marine Corps
- U.S. Navy
- U.S. Pacific Command
- U.S. Southern Command
- U.S. Special Operations Command
U.S. Department of Homeland Security
- Immigration and Customs Enforcement
- Homeland Security Investigations
- Office of Community Partnership
- Office of International Affairs
U.S. Department of Justice
- International Criminal Investigation Training Assistance Program
- Federal Bureau of Investigation
- Global Training Unit
- Instructional Systems
- Terrorist Explosive Device Analytic Center
- Office of Overseas Prosecutorial Development Assistance and Training
U.S. Department of State
- Bureau of African Affairs, Office of Regional Security Affairs
- Bureau of Counterterrorism and Countering Violent Extremism
- Bureau of Educational and Cultural Affairs
- Bureau of Political-Military Affairs
- Global Engagement Center
U.S. Department of the Treasury
- Office of Terrorism and Financial Intelligence
U.S. Patent and Trademark Office
- Africa Program
Wilson Center
- Africa Program
FOCUS AREAS

Communications and Situational Awareness
Develop situational awareness and communication capabilities that aid in identifying threat indicators, conducting risk assessments and providing early warning to personnel providing protective services for VIPs. Develop tools to facilitate situational awareness, reporting, and communications for incident response personnel.

Individual Protection and Survivability
Develop advanced personnel protection systems that mitigate ballistic, blast, and emerging operational threats. Personal protective equipment focuses on novel materials and designs to provide maximum protection.

Personnel Tracking and Recovery
Develop inconspicuous systems to geolocate and track high risk personnel, signal situations of duress, and facilitate recovery of missing or captured personnel.

Ballistic and Blast Threat Assessment
Research ballistic and blast effects on the human body and develop guidelines, tools, and techniques to mitigate the effects.

COMPLETED PROJECTS

Special Operations Tactical Standalone Plate
Special operations tactical operators face adversaries with weapons that are proving to be increasingly effective against current body armor. The proliferation of high velocity armor piercing (AP) and armor piercing incendiary (API) projectiles throughout special operations’ areas of operation are of particular concern. Today’s body armor systems can provide protection against these threats but at the expense of bulk and weight, degrading operators’ mobility. Southwest Research Institute in San Antonio, TX and Karagozian and Case, Inc. in Glendale, CA, have independently developed advanced ceramic/composite armor systems to defeat modern AP and API projectiles at reduced thickness and weight to allow operators to have ballistic protection from advanced threats without sacrificing mobility. Each vendor has developed armor systems composed of optimized thicknesses of silicon carbide and ultra-high molecular weight polyethylene.

Helmet for 7.62 × 39 mm Mild Steel Core Protection
Modern ballistic helmets used by U.S. military and law enforcement personnel typically provide protection from handgun and low velocity rifle threats. Today’s high threat operational environments often include advanced adversaries wielding the prolific AK-47 with mild steel core projectiles. There is an urgent need to provide head protection capable of defeating the 7.62 × 39 mm mild steel core projectile. XTEK, LTD in
Adelaide, South Australia has developed a lightweight helmet system to protect against this threat. To enhance the ballistic performance of the helmet, XTEK used advanced ultra-high molecular weight polyethylene material in unique ply geometry combined with deep draw preforming and a proprietary consolidation process. The helmet system uses commercial-off-the-shelf suspension and retention components. The helmet defeats one strike from the objective threat without perforation and limits the back face deformation to 25.4 millimeters. The helmet also provides impact attenuation in accordance with the Department of Transportation Federal Motor Vehicle Safety Standard 218.

**Wireless Health Monitor**

Attacks on government facilities place quick reaction forces and personnel recovery teams in harm’s way. Firefights, severe injuries, and the need to maintain radio silence can leave operators unable to communicate their status to the command post. In order to provide timely support, there is an urgent need to remotely monitor the health of incident responders. MRIGlobal in Kansas City, MO has developed a wearable sensor that measures vital signs — pulse, body temperature, respiratory rate, and blood oxygen level. The system encrypts the data with the GPS location and wirelessly transmits this information to an operations center. The sensor was designed for placement without the need to remove clothing. It will operate for a minimum of twenty-four hours without operator intervention and is compatible with the Android Tactical Assault Kit (ATAK). The communications device provides multiple communications links with the primary link being the Iridium satellite network and cellular providing a secondary communications path. The system includes a momentary switch that enables the operator to send an emergency alert.

**Mobile Gunshot Detection**

Security forces transporting high risk personnel or executing vehicle operations in high risk environments are targets for small arms fire. If subjected to small arms fire, security forces can gain an advantage when provided the firing source (bearing, elevation, range) which leads to improved tactics for returning fire, and/or apprehending the shooter(s). Current mast-mounted acoustic gunshot detection systems are generally not practical for law enforcement/civilian vehicle operations due to the system size and construction. Hyperion Technology Group in Tupelo, MS has developed a system that automatically detects suppressed supersonic and some subsonic gunshots. The system reports source location information for the incoming threat(s), it is discrete and works effectively in challenging radio frequency environments and in urban and rural environments at speeds of 40 miles per hour. Installation and removal of the system requires minimal tooling with no permanent modifications to the vehicle. The system incorporates GPS location to provide a moving map display inside the sensing vehicle, it can communicate and display the gunshot detection data to other nearby vehicles, and it can be setup for temporary fixed site/free standing operation. The detection system operates in all weather conditions that vehicles are driven in.
Three Dimensional Backface Deformation

To date, there is no mechanism to dynamically measure body armor backface deformation (BFD), particularly with regard to armor designed for the female form. This leaves a great deal of uncertainty in the understanding of the relationship between injury and BFD in clay, making it difficult for manufacturers to improve designs, specifically in relation to armor system protection levels and coverage area. The Netherlands Organisation for Applied Scientific Research (TNO), based in The Hague, Netherlands developed an instrumented ballistic clay box test device outfitted with sensors that can capture data related to ballistic impacts in clay to include pressure, acceleration, and clay deformation, over time. TNO delivered two instrumented ballistic clay box test devices with setup and operational instructions, one each to the United States and United Kingdom, for further evaluation. The systems provide a key step to measuring trauma related to BFD in female armor and in general, will lead to a better understanding of the injury mechanism for behind armor blunt force trauma. The integrated test device uses repeatable procedures and produces consistent test results to provide accurate measurements in clay, from initial impact to rest, of the dynamic backface signature, acceleration, and pressure results. These dynamic measurements provide a more realistic representation of the complete impact profile when compared to measuring the static (resting) backface deformation as the only metric for predicting trauma to persons wearing body armor. The collection of complete impact profiles of ballistic impacts on clay may lead to improved performance requirements and armor designs for females.

ONGOING PROJECTS

Concealable Plates for Rifle Protection

Special operations forces and high value personnel are often in situations where body armor is desired, but for numerous reasons the situation would be less confrontational if the body armor was not evident to the casual observer. Body armor that is easily noticed may identify high risk personnel as a target or signal a special operator’s lack of trust or intent to resolve a situation kinetically. There is a need for low-visibility body armor capable of protecting personnel from rifle threats. The Naval Postgraduate School (NPS) in Monterey, California is developing a set of ballistic plates to be integrated with a previously developed low-visibility carrier and concealment system. The concealment system consists of a carrier, a compression layer, and a biofidelic concealment layer. NPS will apply superplastic forming and surface hardening techniques to titanium plates to achieve the concealable geometry and ballistic performance needed for the panels. A tough strike face will be achieved by applying a titanium nitride surface layer to the strong titanium substrate.
Air-launched Fast Autonomous Reconnaissance System (AFARS)

Special operations assault teams transported by the V-22 tilt rotor aircraft often deploy so quickly that they are unable to coordinate traditional intelligence, surveillance, and reconnaissance (ISR) assets to clear the objective or landing zone prior to their arrival. Assault teams need an organic, fast moving, lead ahead ISR capability to provide real-time surveillance of the landing zone as they approach. AeroTargets International in Monrovia, MD is developing an air-launched fast autonomous reconnaissance system to provide this crucial capability. The system will include a turbojet powered, variable geometry air frame which will dash ahead of the V-22. The system will dash in a low aspect ratio, swept wing configuration and then reconfigure to a high aspect ratio, low speed loitering configuration which will orbit the landing zone. The system will provide a minimum of 8.5 minutes of ISR prior the assault team’s arrival. The system will be air-launched via a standard 14-inch bomb rack or roll off from the V-22 cargo ramp at 10,000 to 20,000 feet at speeds up to 275 knots. The ISR payload will provide National Imagery Interpretability Rating Scale (NIIRS) 8 imagery or better. The autonomous waypoint navigation system will be capable of inflight changes and adjustments.

Electromyography Sensors

Wearable robotic systems are a means to augment human locomotion and can assist in carrying heavy armor, improve human endurance over long missions, and provide a means for increasing armor protection while limiting the added burden to the user due to the load carrying exoskeleton. In order to coordinate robotic motion with human motion, there needs to be an interface that allows for both human and robotic motion to synchronize. Current electromyography (EMG) technology used to measure human muscle activity in the context of controlling robotic/human augmentation platforms generally provides noisy signals due to motion artifacts, cross-talk, external electromagnetic interference, etc. This project seeks to develop and demonstrate an electromyography interface that will allow for timely, accurate, and reliable prediction of intended human motion, essential for highly dynamic human augmentation systems. Johns Hopkins University Applied Physics Laboratory is developing a solution that consists of a robust EMG sensor system comprised of electrodes, and sampling and processing electronics. Instead of using traditional adhesive sensors, the electrodes and sampling electronics will be embedded into a wearable compression fabric and predict intended human motion with enough fidelity for high-level control. The processing and required electronics will be capable of integration into a robotic/human augmentation platform for augmented physical human performance.

Armored Passenger Vehicle Handbook Update

The current Armored Passenger Vehicle (APV) Handbook, developed in 2009 by SURVICE Engineering, covers applicable guidelines and regulation areas for government agencies responsible for APV procurement and life cycle management. It is a comprehensive handbook containing guidelines for the procurement, testing, and management of commercial APV program information to include APV protection levels, program funding,
schedules, and plans for replacement vehicles and vehicle maintenance, normal road usage, standards for vehicle disposal and more. Since the release of the first edition handbook, updates have been made to vehicles, procurement procedures, maintenance, and other related APV information rendering the current handbook outdated. SURVICE Engineering is developing an updated APV handbook to reflect the current APV standards. The updated APV Handbook will be available as a hardcopy or a viewable copy on a mobile application accessible through iOS and Android operating systems.

**CUAS On The Move**

Unmanned aerial systems (UASs) or “drones” have entered the commercial market and are readily available for consumers to purchase. The ease of use and accessibility to this powerful technology has drawn attention to the potential harmful use of UASs against U.S. interests both within the U.S. and overseas. CACI International in Sterling, VA is developing a mobile platform to detect, identify, and mitigate UAS threats. The system will be capable of operating on a moving vehicle or marine vessel at speeds up to 60 miles per hour. The system will detect, identify, and counter remote control model aircraft threats at a minimum range of 5 km. The external components of the system will operate from 0 °C to 60 °C in adverse weather conditions, including rain, salt spray, fog, snow, and dust. The system will be powered via a vehicle or mobile battery, or shore power. The system will be capable of being installed and set up in less than 1 hour with no permanent modifications to the vehicle/vessel. This will provide convoys the ability to monitor the airspace in real time and the ability to protect the convoy while on the move.

**Biomarkers**

Military and law enforcement personnel may be exposed to many types of physically or psychologically traumatic events over their terms of service. High level blast exposure, repeated low level blast exposure, head injuries, and psychological trauma each have the ability to cause long lasting, debilitating conditions in personnel returning from service. Increasing numbers of service members are being diagnosed with traumatic brain injury (TBI), mild traumatic brain injury (mTBI), blast injury (BI) or post-traumatic stress disorder (PTSD) upon return from deployments.

Currently, the medical community hypothesizes that these chronic neurological conditions create neurodegenerative changes in brain chemistry, ultimately resulting in a progressive decline of memory and executive functioning, depression, anger, and irritability.
Historically, these conditions were diagnosed using clinical cognitive tests and evaluations. The Translational Research Institute (TRI) Australia in Woolloongabba, Queensland is collaborating with major magnetic resonance spectroscopy equipment manufacturers to develop protocols to identify neurochemical deregulation specific to mTBI, TBI, BI and PTSD. TRI employs magnetic resonance imaging (MRI), functional magnetic resonance imaging (fMRI), diffusion tensor imaging (DTI), magnetic resonance spectroscopy (MRS), and specifically localized correlated spectroscopy (LCOS-Y) to identify and monitor the neurochemical deregulation for each specific condition and correlating the results with cognitive diagnoses. The MRS protocols developed under this program will enable earlier, more accurate diagnoses and treatment of these conditions. Results of this effort are scheduled for release during the second quarter of 2020.

MEMBERSHIP

Intelligence Community
U.S. Capitol Police
U.S. Department of Commerce
  • National Institute of Standards and Technology
  • Office of Law Enforcement Standards
U.S. Department of Defense
  • Defense Threat Reduction Agency
  • Joint Personnel Recovery Agency
  • Pentagon Force Protection Agency
  • Rapid Reaction Technology Office
  • U.S. Air Force
    • Office of Special Investigations
  • U.S. Army
    • Criminal Investigation Command
  • U.S. Navy
    • Naval Air Systems Command
    • Naval Criminal Investigative Service
    • Office of Naval Research
    • Program Executive Office, Ships
    • Marine Corps Warfighting Lab
  • Joint Trauma Analysis and Prevention of Injury in Combat
  • Medical Research and Material Command
  • Natick Soldier Systems Center
  • Program Executive Office Soldier
    • Soldier Protection and Individual Equipment
  • Research, Development, and Engineering Command
  • Research Laboratory
  • Tank Automotive Research, Development, and Engineering Center
  • U.S. Navy
    • Naval Air Systems Command
    • Naval Criminal Investigative Service
    • Office of Naval Research
    • Program Executive Office, Ships
    • Marine Corps Warfighting Lab
  • U.S. Special Operations Command
  • Army Special Operations Command
  • Marine Corps Forces Special Operations Command
  • Naval Special Warfare Command
U.S. Department of Energy
U.S. Department of Homeland Security
  • Customs and Border Protection
  • Federal Law Enforcement Training Center
  • U.S. Secret Service
    • Special Services Division, Technical Security Division
U.S. Department of Justice
  • Federal Bureau of Investigation
  • National Institute of Justice
U.S. Department of State

Credit: Courtesy of DST Group
PHYSICAL SECURITY
FOCUS AREAS

Blast Effects and Mitigation
Evaluate blast threats and develop anomaly detection and mitigation approaches to protect groups of personnel, facilities, installations, and venues. Develop decision support tools and technical solutions related to blast effects.

Screening, Observation, Detection, and Protection
Develop technologies and techniques to protect personnel in facilities, and infrastructure, by improving situational awareness; detecting, identifying, and locating threats; and, controlling access to critical assets. Emphasize automatic threat detection/alerting.

Maritime Security
Develop technologies to protect ships, ports, shore and offshore facilities. Develop sensors and devices for detection and tracking; physical barriers; and stopping devices.

Subterranean Activities
Develop capabilities to detect, locate, map, monitor, survey, and disrupt subterranean infrastructure and activities in permissive and non-permissive environments.

COMPLETED PROJECTS

Enhanced Security Observation Set (eSOS)
U.S. Special Operations Forces (SOF) have an ongoing operational need to enhance their situational awareness and scan for potential threats at outposts in remote and potentially vulnerable locations. The U.S. Secret Service (USSS) requires a small, modular, portable security system for protecting government officials, dignitaries, and VIPs. The eSOS effort updated the technology and enhanced the capabilities of the previously developed Security Observation Set force protection kit to meet current SOF and USSS requirements. The eSOS kit extends the range of the sensor alarm system to greater than 50 yards in a non-line-of-sight indoor environment during short-duration stays. It also incorporates internet protocol and megapixel video capabilities to provide wider coverage of the outpost perimeter and high-resolution image assessment. Other eSOS improvements include an integrated power management system and a wireless mesh communications infrastructure that allows rapid set up and provides automated detection capabilities. CTTSO delivered prototype eSOS systems to U.S. Army SOF and USSS. The U.S. Army Rapid Equipping Force is sponsoring Army Test and Evaluation Center certification of eSOS components that will be available for procurement on the GSA schedule.
Ammonium Nitrate Fertilizer Threat

CTTSO worked with the Department of Homeland Security (DHS) Office of Infrastructure Protection and the Federal Bureau of Investigation to sponsor comprehensive modeling and simulation, and follow-on blast testing to assess the vulnerabilities and risks associated with transporting fertilizer grade ammonium nitrate. The U.S. agriculture industry uses ammonium nitrate fertilizer all over the country, and routinely ships large quantities of ammonium nitrate by road or rail. The results of this effort will provide DHS and other U.S. Government policymakers with baseline data to inform potential policy changes governing the safe transportation of ammonium nitrate fertilizer in the United States.

Forced Entry Resistant Roller Door

Personnel entry and exit ways for embassies and secure facilities are protected by side-hinged, forced entry (FE) and ballistic resistant doors designed to delay an attacker for up to 60 minutes in accordance with Department of State (DOS) Standard SD-STD-01.01. Conversely, these facilities use roller doors that open and close vertically on a track at logistics entry points (e.g., cargo bays, loading docks, vehicle garages), leaving these areas susceptible to forced entry attacks. To address this vulnerability, CTTSO and the DOS Bureau of Diplomatic Security teamed up to sponsor the development and testing of a roller door capable of meeting the DOS 15-minute performance criteria of resistance to an attempted forced entry. The door operates as a normal roller door would, and is capable of being both electrically and manually driven. The FE Resistant Roller Door is a more secure and durable logistics-area door for use in U.S. Government and commercial facilities.

Certification for Blast Protection Professionals

Government buildings and infrastructure are designed to minimize injury and damage in the event of a bomb attack. Engineers, architects, and building designers all contribute toward meeting defined blast protection requirements, but no third-party certification existed to help identify people with experience and competency in blast protection analysis and design. The Certified Blast Protection Professional (CBPP) certification guidelines consist of best-practice knowledge, skills, and abilities for professionals engaged in characterizing or mitigating the hazardous effects of explosives. The certification guidelines are written in compliance with ISO/IEC 17024, the internationally accepted benchmark for personnel certification programs across numerous vocations. The guidelines are the basis of a subsequent CBPP certification that will enable U.S. Government and industry interested in procuring engineering services related to blast protection to identify competent professionals with the requisite training and experience to engineer and design future facilities and infrastructure.
Enhanced Urban Canyon

CTTSO, in collaboration with Singapore’s Ministry of Defence and the Defence Science and Technology Agency, has conducted a comprehensive series of explosives tests to determine how blast propagates in a complex urban environment. City buildings constructed with metal, glass, wooden, or other facades will bend and break up during explosive events. These localized responses affect how blast pressures can vent, diffract, refract, and propagate through an urban environment. Understanding these factors is important to estimate the effect and range a particular explosive device will have in an urban environment, and will drive the enhancement of High Fidelity Predictive Blast Modeling (HFPBM) and Fast Running Models (FRM) software. Improved prediction of the urban blast environment will benefit security forces, first responders, and emergency planners that rely on these tools to plan for and respond to an explosive attack in high-density urban centers.

Tunnel Collapse Response Guide

Underground operations can place personnel in difficult environments and situations — little or no ambient light, claustrophobic spaces, restricted movement, poor communications, and limited tracking capabilities. Operations become even more challenging by potential environmental risks such as flooding, cave-ins, suffocation, and harmful air quality resulting from smoke, airborne debris, or hazardous gases. The Tunnel Collapse Response Guide effort was two-fold: conduct a comprehensive study delineating measures for rescuing victims inside collapsed tunnels, and produce an in-depth guide of best practices for subterranean scenarios typically encountered by operators, primarily U.S. Customs and Border Protection (CBP) and rescue personnel. The study took into account the varying size, depth, configuration, and geologies of earthen tunnels and underground municipal infrastructure encountered along the U.S. Southwest border. The guide lists existing technologies that support tactics, techniques, and procedures for rescue personnel responding to a subterranean structure collapse. It also describes the advantages and disadvantages of current technologies and identifies capability gaps. Finally, the guide provides a menu of specialized equipment and training recommended for post-collapse personnel recovery and operationally achievable recommendations to aid in enhancing safety while executing a counter tunnel mission or rescue operation. Copies of the guide will be available through the Government Printing Office.
Next Generation In-Tunnel Surveillance System (NGITSS)

Significant challenges exist when conducting operations within subterranean and other enclosed or constrained environments. Subterranean environments include tunnel systems beneath cities for walkways, rail transit, and utilities; simple dirt tunnels with minimal infrastructure used for illegal or illicit operations along a border region; and, the complex chimney, flue, boiler, pipe and ductwork associated with heavy industries such as mining, and power generation. These subterranean environments can be extremely difficult to access and navigate, and pose significant danger to operational personnel. Military, law enforcement, border patrol, first responder, and disaster response personnel will all benefit from an affordable means to virtually explore, image, analyze, map, and conduct surveillance of subterranean environments on-demand and in near real time. The NGITSS effort is developing a small unmanned aerial system to safely conduct inspections of tunnels, and for routine inspections of underground municipal infrastructure. It will have the ability to enter horizontal or vertical tunnel openings and navigate within structures with a diameter as small as 20 inches. The NGITSS will be self-propelled, self-contained, and capable of line-of-sight and non-line-of-sight flight while avoiding collisions with walls or objects, both in autonomous and user-controlled flight modes. The NGITSS will also provide an imagery and mapping capability from the point of insertion to 1,000 feet round trip.

Technology Development for Subterranean Operations

Terrorist and criminal organizations are using underground tunnels to launch rockets, cache weapons, smuggle goods and personnel, and conduct other illicit and hostile activities that threaten our borders, and our security forces and military operating domestically and overseas. Israel has significant experience with tunnel detection and remediation owing to the enduring tunneling activities along their borders. During their conflict with Hamas in the summer of 2014, the Israel Defense Forces discovered and destroyed 32 tunnels, and Hamas has spent considerable time and resources since then to attempt to rebuild its tunnel network.

Beginning in 2016, the United States National Defense Authorization Act directed the U.S. Department of Defense to carry out research, development, testing, and evaluation of anti-tunnel technologies with Israel. The development and fielding of effective capabilities in support of subterranean operations will help protect both Israel and the United States from potential threats stemming from illicit tunnel activities.

Aviv

Current less-than-lethal weapons (LLW) used for crowd control and single target situations have a maximum effective range of less than 50 meters. At this range, the forces employing LLW are inside the hit zone of various improvised weapons, such as slingshots. There is an ongoing requirement to increase the range of LLW to enable forces to engage adversaries from a safe distance. CTTSO, in partnership with the Government of Israel, is developing an LLW prototype that fires pepper projectiles with improved accuracy at extended ranges. The LLW will be a handheld airsoft gun resembling the M4/M16 rifle with improved accuracy at longer ranges, with the goal of achieving an effective range of up to 100 meters.
MEMBERSHIP

American Society for Testing and Materials
Environmental Protection Agency
Federal Reserve Board
General Services Administration
Intelligence Community
State and Local Agencies
- DC Metropolitan Police Department
- DC Protective Services Police Department
- New York City (NY) Police Department
- Port Authority of New York and New Jersey
- Virginia Department of Transportation
U.S. Capitol Police
U.S. Department of Commerce
- National Institute of Standards and Technology
U.S. Department of Defense
- Defense Advanced Research Projects Agency
- Defense Intelligence Agency
- Defense Threat Reduction Agency
  - Joint Improvised-Threat Defeat Organization
- Explosives Safety Board
- Joint Chiefs of Staff
- Joint Non-Lethal Weapons Directorate
- Joint Task Force North (USNORTHCOM)
- Joint Warfare Analysis Center (USJFCOM)
- National Ground Intelligence Center
- National Reconnaissance Office
- Office of the Secretary of Defense
- Physical Security Enterprise and Analysis Group
- Unified Combatant Commands
- U.S. Air Force
  - Research Laboratory
- U.S. Army
  - Armament Research, Development, and Engineering Center
  - Research Laboratory
  - Asymmetric Warfare Group
  - Communications-Electronics Research, Development, and Engineering Center
- Corps of Engineers
- Engineer Research and Development Center
- Office of the Provost Marshal General
- Night Vision and Electronic Sensors Directorate
- Rapid Equipping Force
- Research, Development, and Engineering Command
- Training and Doctrine Command
- U.S. Marine Corps
- Central Command
- Systems Command
- Warfighting Laboratory
- U.S. Navy
  - Chief of Naval Operations
  - Commander Navy Installations Command
  - Expeditionary Combat Command
  - Naval Criminal Investigative Service
  - Naval Explosive Ordnance Disposal Technology Division
- Naval Facilities Engineering Command
- Naval Facilities Engineering Service Center
- Naval Sea Systems Command
- Naval Undersea Warfare Center
- Office of Naval Research
- Strategic Systems Programs
- U.S. Special Operations Command
- Army Special Operations Command
  - Army Special Forces Command (Airborne)
- Joint Special Operations Command
- Marine Corps Forces Special Operations Command
- Naval Special Warfare Command
  - Naval Special Warfare Development Group
U.S. Department of Energy
- Federal Energy Regulatory Commission
- National Nuclear Security Administration
- Nuclear Regulatory Commission
U.S. Department of Homeland Security
- Customs and Border Protection
- Immigration and Customs Enforcement
- National Protection and Programs Directorate
- Federal Protective Services
- Science and Technology Directorate
- Transportation Security Laboratory
- Transportation Security Administration
- U.S. Coast Guard
- U.S. Secret Service
U.S. Department of the Interior
- Bureau of Reclamation
U.S. Department of Justice
- Bureau of Alcohol, Tobacco, Firearms and Explosives
- Drug Enforcement Administration
- Federal Bureau of Investigation
- Federal Bureau of Prisons
- U.S. Marshals Service
U.S. Department of State
- Bureau of Counterterrorism and Countering Violent Extremism
- Bureau of Diplomatic Security
U.S. Department of Transportation
- Volpe National Transportation Systems Center
SURVEILLANCE, COLLECTION, AND OPERATIONS SUPPORT
FOCUS AREAS

Biometrics, Recognition, Identity Intelligence, Tracking, and Exploitation (BRITE)

Improve technologies to identify and/or mask entities of interest using or countering biometrics, pattern recognition, database technologies, and exploitation methodologies.

Cyber and Convergence Technologies

Support or improve technologies for cyber and signals collection as these technologies increasingly converge with other systems and technologies to include, but not limited to the “Internet of Things.”

Human Language Technology (HLT) and Media Exploitation

Develop and employ HLT where these technologies can best assist humans – operators and analysts – to make sense of volume and the variety of media sources; apply timely and actionable information in theater; and enhance communication skills and cultural understanding.

Surveillance/Counter-Surveillance

Develop audio, video, and advanced surveillance technologies, as well as automated tools and techniques to defeat adversarial tactics, techniques, and procedures, and methodologies.

Technical Collection/Special Communications

Improve ISR by developing and enhancing multi-INT sensors, SIGINT collection, and tagging tracking, locating technologies for intelligence operations. Develop and enhance special communications and canine advanced technologies in support of Special Operations and intelligence collection activities.

COMPLETED PROJECTS

Red Sonja

This project supported a USSOCOM requirement to add functionality to identify and correlate captured voice identifiers through a common operating picture (COP) and analysis tool. Red Sonja, incorporated in the COP and analysis tool, successfully provided refined geolocation based on the correlated voice data identifiers. The project is completed and Red Sonja transitioned as part of the ongoing COP/analysis tool community.

Jetson

This project supported the development of a device to capture cardiac signatures to aid in the positive identification of an individual at a distance up to 200 meters. Existing long range biometric methods that rely on facial recognition suffer from acquiring enough pixels to use face matching algorithms and require high performance optics to acquire visual signatures at significant distances. Additionally, movement, environmental conditions, changes in facial appearance (i.e., beards, sunglasses, headwear) can obfuscate the face and result in considerable inaccuracies. Being able to measure unique cardiac signatures obtained from an individual at a distance provides additional biometric identification when environmental conditions and changes in facial appearance hinder the use of more common facial recognition systems.
Beetlejuice

This Rapid Innovation Fund (RIF) effort is to develop and deliver novel and high-performance speech-based noise reduction and speaker tagging, tracking, and locating (TTL) technology. The effort supports the delivery of TTL technology to support law enforcement and military operations in order to enhance identification and tracking capabilities. The technologies will provide near real-time situational awareness of incoming signals, filtering speakers, messages, languages, and location.

Hastings

The Hastings effort is to design, develop, integrate, and test a compact, gimbaled next generation hyperspectral imaging (HSI) aerial sensor that integrates both short-wavelength infrared (SWIR) and long-wavelength infrared (LWIR) bands. Many of the most important applications of airborne HSI sensors operate in the SWIR wavelength regions. SWIR requires illumination for passive use (such as solar illumination), which generally restricts operation to day time. While LWIR HSI sensors offset the capability gap by utilizing passive thermal emissions to support full day/night operations, it is widely recognized that the SWIR and LWIR are complementary sensors each offering benefits and supporting the other. Bringing the sensors together to support both spectral ranges in a compact manner would be beneficial for generating a broad range of ISR capabilities. In particular, a single sensor package offering both SWIR and LWIR HSI capabilities will leverage their separately demonstrated ability to detect solid, liquid, and vapor chemicals of interest.

Sling Blade

The Sling Blade effort is to develop an electronically steerable array (ESA) antenna. The ESA antenna radio is a small antenna that works in conjunction with newer band commercial satellite constellations, such as INMARSAT 5 and O3b, to provide communications capabilities for sensitive operations. Many operations today take place in hostile, denied, or sensitive environments where it is critical for operators to maintain a low profile to avoid detection by foreign adversaries. Easily identifiable and bulky military equipment is not only burdensome from a size, weight, and power perspective but it can be detrimental to mission effectiveness.

Membership

| Intelligence Community | Special Operations Forces |
TACTICAL OPERATIONS SUPPORT
FOCUS AREAS

Offensive Systems
Develop advanced equipment and capabilities that enhance the effectiveness of small tactical units engaged in direct action operations. Develop specialized weapons, munitions, detonators, distraction/diversion devices, and other unique tactical equipment.

Unconventional Warfare and Counter-Insurgency Support
Develop advanced tools and equipment specifically for small tactical units conducting a broad spectrum of military, paramilitary, special warfare, and digital operations focused on force protection, assisted and unassisted recovery, and operational preparation of the environment.

Tactical Communications
Develop flexible, enhanced, full spectrum communications capabilities specifically designed for tactical forces, with emphasis on reducing operational load while improving operator mobility and efficiency. Develop assured tactical communications connectivity in challenging environments such as complex urban, subterranean, and maritime.

Tactical Reconnaissance, Surveillance, and Target Acquisition Systems
Develop technologies to assist small tactical teams in conducting organic reconnaissance, surveillance, and target acquisition missions. Develop systems that enhance the visual perception or other imaging capabilities of tactical operators in all conditions and environments.

Specialized Infiltration, Access, and Exfiltration Systems
Develop technologies that assist tactical assault forces in gaining rapid insertion, access and egress to and from objectives. Improve evaluation of tactical options, and support efficiency and stealth, including remote operations. Develop enhanced target analysis, manual and dynamic breaching technologies for small tactical assault teams.

Survivability Systems
Develop man portable tools and equipment to enhance operator survivability during the conduct of tactical missions.

COMPLETED PROJECTS

7.62 × 51 mm NATO Subsonic Ammunition Optimization – Position Insensitive Subsonic Round
United States and United Kingdom tactical operators required an advanced round for precision subsonic 7.62 × 51 mm NATO ammunition due to inconsistencies in the performance of current subsonic cartridges. The 7.62 × 51 mm NATO subsonic round designed by MAC, LLC negates powder position sensitivity issues and increases the maximum effective range of the subsonic projectile. The increase in performance is accomplished through a new and advanced case design that compacts the powder load and ensures consistent ignition and burn characteristics while firing. The result is an optimized subsonic round that has greater range and accuracy, allowing tactical operators to more effectively engage targets in situations where a subsonic projectile is required.
Multi-Ability Reconfigurable SUAS (MARSUAS)

SOF tactical teams are currently constrained to singular design small unmanned aerial systems (sUAS) which cannot adapt to multiple mission roles or rapidly changing situations on the ground. Units are challenged with maintaining training currency, training standardization, interoperability between platforms, sustainment of the systems, and an increase in operational load when deploying these different sUAS.

The MARSUAS, developed by UAV Solutions, provides SOF with a single sUAS platform that can be configured in the field to support missions requiring a Quad Rotor sUAS, Tilt Rotor/Vertical Take Off & Landing (VTOL) sUAS, and Fixed Wing Long Endurance sUAS with one common tablet controller. SOF units now have a cost effective, rapidly reconfigurable sUAS that has the potential to replace all existing Group One (1) sUAS for small team tactical operations.

Maritime Canister-Launched Small Unmanned Aerial System (MCLSUAS)

The Maritime Canister-Launched Small Unmanned Aerial System gives SOF maritime forces a capability to launch, operate, and recover a collapsible-wing sUAS while remaining underwater in Sea State Three (3) conditions. The MCLSUAS consists of the Vector Hawk sUAS, Canister Launch Unit, and a Maritime Ground Control Station. The MCLSUAS, developed by Lockheed Martin, has a minimum operating time of 40 minutes with a dash speed of 50 knots, and will stay afloat for a minimum of 30 minutes for recovery and reuse after a water landing.

Sonitus Tooth Acoustic Communicator

The Sonitus Technologies Tooth Acoustic Communicator (TAC) provides tactical operators with a method of voice communications without the need for in-ear or over-the-ear solutions. The TAC utilizes a single, molded mouthpiece with a bone conduction speaker to send audio to the inner ear. The device also has an embedded, waterproof microphone that enables the user to transmit sound through normal speech without the need for an external microphone. Because of the unique design, the TAC shields both incoming and outgoing auditory signals from external noise and provides the operator with crisp, clear audio during high noise tactical operation environments such as live fire, breaching, military free fall, and diving. CTTSO has provided multiple prototypes and training for units to operationally test and evaluate to inform follow-on development requirements.
Suprakor-60 Single Stage Reinforced Wall Breaching

The Suprakor-60 is an end user loaded explosive charge frame that claims to be able to create a man-sized hole in all types of reinforced masonry walls — inclusive of double rebar reinforced concrete walls — up to 200 mm thick in one shot. CTTSO is working with the USMC Methods of Entry School to live fire test the effectiveness of the charge amongst a number of targets as a potential solution to unfulfilled breaching requirements across the tactical operator community.

120 mm Enhanced Mortar Targeting System – FMTV Mobile (120 mm EMTAS-Mobile)

Current deployments for SOF require agility and mobility for all combat resources due to the constantly changing battlespaces. The 120 mm EMTAS Mobile provides SOF with an organic, highly accurate and rapid 120 mm mortar capability that can be used on mounted patrols or for protection of operating bases. The FMTV Mobile uses the common Army 120 mm mortar and mortar rounds. Coupled with precise laying accuracy provided by EMTAS’ 360-degree electrically driven targeting system, it is capable of delivering up to 10 rounds a minute from the short halt out to 7.2 kilometers with only a two-man crew. The system, designed by Elbit Systems of America, is roll-on roll-off for use with the common Army M1083 Family of Medium Tactical Vehicles (FMTVs) and can also be used in a mounted or dismounted configuration depending on tactical unit requirements.

Ammunition Initiatives Meeting Workshop

The individual tactical operator armed with small arms and ammunition is the most employed weapon system in the fight against terrorism in U.S. and allied arsenals. In response to tactical operations community requests to bring together both government and select industry representatives, CTTSO conducts a DoD, interagency, and select international partner subject matter expert workshop called Ammunition Initiatives Meeting (AIM). AIM is a wide ranging forum that enables collaboration on threats, capability gaps, and discussions on new and promising initiatives related to small caliber ammunition, relevant weapons, and accessory development. This workshop is conducted annually and includes the following focus areas:

- CT, Irregular Adversary, and Peer Threat Weapon and Ammunition Developments
- Joint U.S. and International Lessons Learned/Capability Gap Session
- U.S. DoD and NATO Ammunition and Small Arms Systems Initiatives
- Select Industry Ammunition and Small Arms Initiatives
- Exterior and Wound Ballistics Overview and Testing
- Lightweight Ammunition Technology
- Projectile Aerodynamic Design, Interior Ballistics, Exterior Ballistics, and Terminal Effects
- Modern Ammunition Production and Testing
- Leap-Ahead Ammunition, Projectile, Propellant and Case Technology
- Intermediate Caliber Cartridge Developments
- The Law Enforcement Perspective
- Geopolitical Influences on Small Arms Ammunition Development and Employment
- Fire Control Systems
- Improved Suppression Technologies
Now in its tenth year, the AIM workshop has continually been the incubator for rapid interagency development of various novel and advanced ammunition technologies including: lightweight polymer combat ammunition with enhanced terminal performance; intermediate caliber rifle and machine gun cartridges to improve standoff range for allied tactical personnel; advanced next-generation sighting devices; forward flowing signature suppression; as well as a vast assortment of new CT-related technologies and enhanced training initiatives. CTTSO AIM government-only sessions are held at the SECRET level. AIM is the only classified meeting of its type dedicated to these focus areas and has attracted more than 80 agencies, and over 100 government personnel from five countries to include Australia, Canada, Israel, New Zealand, the United Kingdom, and the United States. AIM also includes a live-fire demonstration of advanced technologies from both government and industry developers.

.300 Blackout Optimization and Supercavitating Ammunition

Tactical operators currently use a variety of different personal defense weapons for specialized mission profiles where the kinetic energy and range of a rifle is required, but the concealability of a pistol is needed. The CTTSO .300 Blackout optimization effort with Naval Surface Warfare Center Crane focuses on determining the optimal barrel length, twist rate, and cartridge for the Sig Sauer MCX .300 Blackout chambered rifle platform for these specific mission profiles. The project will conduct the necessary developmental testing required to find the optimal weapon system configuration, followed by operational testing by tactical operators. Phase two of the effort will acquire, test, validate, and operationally test the DSG Technology .300 Blackout caliber supercavitating ammunition for use in maritime environments. The supercavitating properties of this projectile make it optimal for target engagement from air to water, water to water, and water to air, providing maritime tactical operators with maximum flexibility in their mission profiles.

Extreme Sniper Strike Operations (ESSO)

The Extreme Sniper Strike Operations with Applied Ballistics is a two-phase project focused on the enhancement of ballistic algorithms and the development of a sniper platform capable of a high probability of first round hit at extremely long range. Phase one of the project tests current and experimental projectiles for exterior ballistic profiles from supersonic through transonic to end of flight. The data is gathered and analyzed to enhance current ballistic algorithms with known data for spin drift, spin rate decay, and transonic turbulence as well as determine the optimal projectile design for engaging targets at ranges well beyond current sniper platforms. Phase two is the development of a new cartridge and weapon system, inclusive of tactical operator training and operational evaluation that will give tactical operators a twofold benefit through an improved ballistic firing solution, and a new sniper system to engage targets well beyond currently fielded capabilities.
.338 Norma Magnum Lightweight Medium Machine Gun and Polymer Ammunition

United States and United Kingdom tactical operators currently have a choice between 7.62 mm or .50 caliber machine guns for long-range combat engagements. The 7.62 mm M240 machine gun variants provide dismounted troops with maneuverability, but are limited in range. Current inventory .50 caliber machine guns are too heavy and cumbersome for dismounted use. Due to this limitation they are almost exclusively used at fixed sites and on mounted patrols. The 23-pound .338 Norma Magnum Lightweight Medium Machine Gun made by General Dynamics Ordnance and Tactical Systems, in conjunction with the polymer ammunition made by MAC, LLC, fills the capability gap between the light, but limited range 7.62 mm weapons, and the longer range, but heavy and cumbersome .50 caliber weapon systems. With an effective range out to 2,000 meters, linked ammunition that is 15 percent lighter than conventional .338 Norma Magnum linked ammunition, and nearly 65 percent lighter than .50 caliber linked ammunition, the .338 Norma Magnum Lightweight Medium Machine Gun and its polymer ammunition provides tactical operators with an optimal capability for long-range direct fire combat engagements.

Enhanced Direct View Optic

Machine gunners are utilizing optical systems that are not optimized for the unique requirements of a machine gun. Long range optics tend to have a tiny exit pupil diameter, which limits the observation capabilities of the gunner while engaging targets at long range. The Enhanced Direct View Optic effort with Sandia National Laboratories is exploring novel analog optical pathways to increase the diameter of the exit pupil for long range scopes. The increase in exit pupil gives the gunner a greater ability to keep his targets in view during machine gun fire. This will result in increased performance of machine gunner teams, reduce ammunition requirements for lethal target engagement, and raise the situational awareness of the machine gunner during target engagement for force protection.

United States/United Kingdom Stabilized Weapon Mount

Tactical operators are required to deliver accurate fires from land, sea, and air platforms. All host platforms impart motion on the weapon system that must be mitigated. The majority of host platforms have constraints (such as size, weight, and power) that result in a crew-served solution. Crew-served systems tend to be poor at motion mitigation; however, recent trials in the United Kingdom and United States have indicated the potential of stabilized crew-served technology. This project will allow the United Kingdom and United States to live-fire test new technologies and enable informed decisions on interoperability and future procurements of stabilized weapon mounts.

CTTSo Advanced Communications Workshop

The annual CTTSO Advanced Communications Workshop will bring tactical operations communicators together to discuss the next generation of tactical communications equipment, as well as identify current capability gaps and shortfalls to help drive innovation and increased capability. Additionally, there will be presentations from select industry representatives to showcase advanced and emerging technologies. The workshop briefings and discussions will identify potential government and industry solutions which already exist or are in development, or may initiate new rapid development of advanced tactical communications capabilities by government agencies and military research and development organizations.
Silicone Membrane Amplified Lightweight Speaker (SMALS)

Currently fielded military communication device speakers are antiquated, large, and conspicuous to support critical missions. The Silicone Membrane Amplified Lightweight Speaker project is developing a state-of-the-art amplified speaker-transceiver unit to work with a number of military and commercial radio devices. SMALS, made by industry partner GromaTech, leverages commercial-off-the-shelf technologies to provide an advanced system that enhances current communications packages. SMALS will provide extended frequency response and improved audio output in comparison to the performance of legacy sub-miniature cone type speakers currently used. Ongoing development has coupled high performance audio drivers with a specially tuned acoustic chamber that provides superior performance for today's warfighters at one-fifth the weight and less than half the size of the currently fielded radio speaker.

Micro Weather Sensor – Air to Surface Employment Kit (MWS-A2SEEK)

Currently fielded Micro Weather Sensor (MWS) devices are critical to collecting meteorological data that provide commanders, mission planners, SOF operators, and support personnel with necessary environmental fidelity to plan and execute missions. In order to gather weather data, small tactical units hand deliver the MWS in hostile environments, leading to potential losses in personnel. To reduce the risk to personnel, SOF requires a method to deliver the MWS by air using fixed or rotary wing aircraft.

To meet this requirement, STARA Technologies Corporation is developing an Air to Surface Employment Kit (A2SEEK) for the MWS. The MWS-A2SEEK will be hand-launched from military aircraft, descend, land at a predetermined location, automatically attain a stable position, and begin autonomous weather reporting operations for up to 150 days.
• Explosive Ordnance Disposal
• Global Strike Command
• U.S. Army
  • 20th Support Command, CBRNE
  • Armament Research, Development, and Engineering Center
  • Asymmetric Warfare Group
  • Maneuver Center of Excellence
  • Night Vision and Electronic Sensors Directorate
  • Office of the Army G-3/5/7 (Operations/Plans)
  • Office of the Army G-8 (Financial Management)
  • Program Executive Office Soldier
  • Program Manager Unmanned Aircraft Systems (PMUAS)
  • Rapid Equipping Force
  • Soldier Systems Center
• U.S. Marine Corps
  • Explosive Ordnance Disposal
  • 2nd Marine Aircraft
  • Marine Corps Forces Cyber Command
• U.S. Navy
  • Naval Academy
  • Naval Air Weapons Station, China Lake
  • Naval Postgraduate School
  • Naval Surface Warfare Center, Carderock Division
  • Naval Surface Warfare Center, Crane Division
  • Naval Surface Warfare Center, Dahlgren Division
  • Navy Explosive Ordnance Disposal Group 2
• U.S. Special Operations Command
  • Air Force Special Operations Command
  • Army Special Operations Command
    • 1st Special Forces Command (Airborne)
    • 75th Ranger Regiment
  • Army Special Operations Aviation Command
  • Civil Affairs
  • Military Information Support Operations Command
  • U.S. Army John F. Kennedy Special Warfare Center and School
  • Joint Special Operations Command
  • Marine Corps Forces Special Operations Command
  • Naval Special Warfare Command
    • Naval Special Warfare Groups
    • Special Boat Teams
    • Theater Special Operations Commands
• U.S. Department of Energy
  • National Nuclear Security Administration
• U.S. Department of Homeland Security
  • Customs and Border Protection
    • Border Patrol Tactical Unit
    • Border Search, Trauma, and Rescue
    • Rio Grande Valley Sector
    • Special Operations Group
• U.S. Special Operations Command
  • Air Force Special Operations Command
  • Army Special Operations Command
    • 1st Special Forces Command (Airborne)
    • 75th Ranger Regiment
  • Army Special Operations Aviation Command
  • Civil Affairs
  • Military Information Support Operations Command
  • U.S. Army John F. Kennedy Special Warfare Center and School
  • Joint Special Operations Command
  • Marine Corps Forces Special Operations Command
  • Naval Special Warfare Command
    • Naval Special Warfare Groups
    • Special Boat Teams
    • Theater Special Operations Commands
• U.S. Department of Justice
  • Bureau of Alcohol, Tobacco, Firearms and Explosives
    • Special Response Teams
  • Drug Enforcement Administration
    • Special Operations Division
  • Federal Bureau of Investigation
    • Ballistic Research Facility
    • Critical Incident Response Group
    • Hostage Rescue Team
    • Joint Terrorism Task Force – National
    • Joint Terrorism Task Force – Local
    • Washington Field Office
  • U.S. Marshals Service
• U.S. Department of State
  • Bureau of Diplomatic Security
TRAINING TECHNOLOGY DEVELOPMENT
FOCUS AREAS

Innovative Training and Educational Concepts
Research, develop, and evaluate training and educational programs that employ novel instructional design and/or delivery methods for accelerating and enhancing the acquisition of advanced knowledge and skills.

Human Performance Technology
Analyze the full range of performance gaps and select interventions to improve and sustain human performance. Develop, test, and evaluate performance improvement technologies and programs based on cognitive and physiological principles to optimize operator training and ultimately mission performance.

Mobile Learning
Design and develop intuitive, interactive learning solutions for anywhere, anytime access from mobile devices. Develop mobile applications and technology that supports learning through ubiquitous and just-in-time access to educational resources, collaborative learning environments, and user-generated content.

Immersive Learning Technology
Research and develop technology that allows a learner to seamlessly interact with, and become immersed in, a learning environment. Develop tools, technologies, and techniques for improving the design, development, and validation of interactive and immersive learning technology.

••• COMPLETED PROJECTS •••

Virtual Reality Part Task Trainer (vrPTT)
The Air Force Special Operations Command (AFSOC) is leveraging advanced technology for warfighting readiness. Special operations aircraft are in high demand in multiple theaters, limiting the availability of training aircraft at home station. Additionally, many training readiness capabilities and methodologies currently in use were developed over 40 years ago. As a result, they are limited in terms of fidelity, immersion and portability, cannot be easily modified based on changes to real world systems, and are often not affordable. To support AFSOC in overcoming these limitations, CTTSO sponsored the development of a Virtual Reality Part Task Trainer (vrPTT) designed for training AC-130 checklist procedures. The vrPTT, developed by Vertex Solutions, consists of an untethered, wearable, and lightweight visual display linked to a high capacity computer. Students are immersed in a 3-D, high definition virtual reality AC-130 cockpit integrated with an automated intelligent virtual tutor. They are able to view, manipulate, and operate virtual images of aircraft mission systems.
and components through bare-handed interactive functions that provide real-time feedback (e.g., touch, move, operate, and access selectable exploded views of components). The automated and interactive intelligent tutoring program adjusts in complexity based on graduated skill development and includes task performance evaluation and remediation. Four fully functional vrPTT systems were delivered to AFSOC, which is planning to develop the system further to include additional crew positions.

City Life: Illusion of Life in a City Environment

City Life improved the quality of simulation-based training by providing a more realistic virtual reality (VR) environment typical of a real city. The VR environment immerses students into scenarios for training skills such as surveillance, security, and personnel protection. City Life features realistic indoor and outdoor structures and spaces for one generic North American city and one generic foreign city. Up to 10,000 unique, non-player characters move and interact inside and outside the structures and exhibit realistic, unpredictable human behaviors over a 24-hour cycle. The student-controlled avatars can observe the non-player character behaviors and, in some instances, engage in purposeful interaction. City Life represents a significant improvement in the realism of patterns of life within a virtual city space from other simulation technologies. City Life was delivered to the United States Department of Defense, Department of State, Secret Service, and Customs and Border Protection as well as Public Safety Canada and the Royal Canadian Mounted Police.

Avatar Based Interactive Instruction (ABII)

Current training videos on explosive ordnance disposal (EOD) procedures use live instructors to demonstrate the learning objectives from a single visual perspective. The U.S. Navy identified a need to improve learning through interactive, avatar-based instructional videos for demonstrating EOD tactics, techniques, and procedures from different perspectives to increase the level of student interactivity with the instructional content and to make training accessible away from the campuses at government sites. The Avatar Based Interactive Instruction project, developed by Ordnance Holdings, Inc., will leverage the latest in gaming
technology to develop interactive training videos featuring human-like avatars for demonstrating applied skills from different perspectives (e.g., viewing angles, multiple levels of zoom). The videos will take an active learning approach to increase student knowledge and improve decision-making abilities, both inside and outside of the classroom. Students not only see the procedures demonstrated, but also interact with the videos through decision-making actions and then receive real-time feedback about those decisions. The final deliverable will consist of five interactive videos.

**SPEAR Cognitive Performance**

Optimal human performance depends on a complex array of physical and cognitive factors that make collecting and understanding data on human performance indicators a significant challenge. Historically, due to technological limitations, the collection, analysis, and representation of cognitive performance data has been irregular and accomplished through disparate systems of varying levels of automation, rather than an ongoing, unified, and automated process. Titus Human Performance Solutions’ SPEAR Cognitive Performance effort will enhance their current SPEAR platform to incorporate metrics from cognitive performance correlates, such as stress, motivation, and fatigue, into the existing USSOCOM sponsored SPEAR application. The enhanced application will provide a common language for instructors, psychologists, and human performance coaches to more wholly evaluate personnel readiness, more accurately target precision training and intervention methods, and ultimately, improve mission success rates.

**Synthetic Intelligence, Surveillance, and Reconnaissance (Syn-ISR)**

High cost and real-world operational tempo make accessing live full motion video (FMV) ISR for training unfeasible, preventing forces from “training as they fight.” While virtual solutions exist, these ISR simulations do not integrate live, dynamic actions on the ground with high-definition ISR simulation. The best of breed technologies pre-script avatar actions and assume role players will do exactly what actions have been anticipated. Therefore, a more realistic and dynamic training capability is needed. More than an ISR simulator, Cubic’s Syn-ISR integrates live role player activities and replicates those role player’s actions in the form of realistic avatars overlaid onto the simulated ISR feed. The simulated feeds, coupled with real-time role player activity, creates replicated FMV ISR that is nearly indistinguishable from real-world FMV ISR. Additionally, Syn-ISR is responsive to immediate tasking and quickly adjusts to changing environmental conditions (e.g., weather, sea state, traffic), providing geographic combatant commanders and their special operations forces with a highly realistic tool that ensures their forces are prepared for every aspect of combat operations.
Recent events and emerging threats have demonstrated a need for more realistic active shooter event training that incorporates stress factors. The Pentagon Force Protection Agency and the Royal Canadian Mounted Police will evaluate a high-intensity, one-week, live-fire training course through the application of human performance technology. Students’ physiological data, indicating key factors such as stress level, will be gathered during the course and cross-referenced with their shooting performance scores. This objective information is essential for determining whether the course is effective in approximating real-world reactive shooter scenarios. The resulting report will influence decisions about course design for law enforcement and the military to manage stress levels, enhance realism, and optimize human performance.

**MEMBERSHIP**

**Intelligence Community**
- InterAgency Board
- National Bomb Squad Commanders Advisory Board
- National Tactical Officers Association

**U.S. Department of Defense**
- Advanced Distributed Learning Initiative
- Defense Intelligence Agency
- Joint Improvised-Threat Defeat Organization
- Joint Staff
  - Joint Information Operations Warfare Center
- Office of the Under Secretary of Defense for Personnel and Readiness
- Pentagon Force Protection Agency
- U.S. Army
  - Asymmetric Warfare Group
  - Joint Readiness Training Center
- U.S. Marine Corps
  - Training and Education Command
  - Weapons Training Battalion
- U.S. Navy
  - Naval Diving and Salvage Training Center
  - Naval School Explosive Ordnance Disposal
- U.S. Special Operations Command
  - Joint Special Operations Command
  - Air Force Special Operations Command
  - Army Special Operations Command
  - 75th Ranger Regiment
  - U.S. Army John F. Kennedy Special Warfare Center and School
- Naval Special Warfare Command

**U.S. Department of Homeland Security**
- Customs and Border Protection
- Federal Law Enforcement Training Center
- Immigration and Customs Enforcement
- Homeland Security Investigations
- Protection and Programs Directorate
  - Office for Bombing Prevention
- Science and Technology Directorate
  - Transportation Security Administration
- U.S. Coast Guard
- U.S. Secret Service

**U.S. Department of Justice**
- Bureau of Alcohol, Tobacco, Firearms and Explosives
- Federal Bureau of Investigation
- Office of the Attorney General
- U.S. Marshals Service

**U.S. Department of State**
- Bureau of Counterterrorism and Countering Violent Extremism
- Bureau of Diplomatic Security

**U.S. Department of the Treasury**
- Financial Crimes Enforcement Network
Arizona
Impact Research and Technology, LLC, Phoenix
STARA Technologies Corporation, Gilbert

California
Decision Sciences International Corporation, Poway
Karagozian & Case, Inc., Glendale
Lawrence Livermore National Laboratory, Livermore
Naval Postgraduate School, Monterey
Spectral Labs, Inc., San Diego
SRI International, Menlo Park
Tek84 Engineering Group, San Diego
University of Southern California, Los Angeles
XR Sciences, Carlsbad

Colorado
RadiantBlue Technologies, Inc., Colorado Springs
Rank One Computing Corporation, Denver

District of Columbia
Department of Homeland Security, Science and Technology Directorate
Naval Research Laboratory
SDS Advisors, LLC
Transportation Security Administration

**Florida**
AMP Research, Inc., Naples
Carley Corporation, Orlando
Harris, Melbourne
National Forensic Science Technology Center, Largo
Naval Surface Warfare Center, Panama City
Quantum Improvements Consulting, Orlando
Titus Human Performance Solutions, Tallahassee

**Georgia**
Georgia State University, Atlanta
Georgia Tech Research Institute, Atlanta
VersaTOL, LLC, McDonough

**Hawaii**
Spectrum Photonics, Honolulu

**Idaho**
Idaho National Laboratory, Idaho Falls

**Illinois**
Float, LLC, Morton
Motorola Solutions, Inc., Schaumburg
Vertex Solutions Group, Urbana

**Indiana**
Naval Surface Warfare Center, Crane

**Maine**
Sensor Research Development Corporation, Orono

**Maryland**
AeroTargets International, Monrovia
Airboss Defense, Inc., Landover
Army Research Laboratory, Adelphi
Army Test and Evaluation Command, Aberdeen Proving Ground
Avon Protection Systems, Inc., Belcamp
Chesapeake Testing Services, Inc., Belcamp
Edgewood Chemical Biological Center, Aberdeen Proving Ground
ELTA North America, Fulton
GromaTech, LLC, Laurel
Harris Next Gen, Columbia
HP White Laboratory, Inc., Street
Intelligent Automation, Inc., Rockville
Israel Military Industries Services, Bethesda
Johns Hopkins University Applied Physics Laboratory, Laurel
Mistral, Inc., Bethesda
N5 Sensors, Inc., Rockville
National Biodefense Analysis and Countermeasures Center, Frederick
Naval Surface Warfare Center, Carderock Division, Potomac
Naval Surface Warfare Center, Explosive Ordnance Disposal Technology Division, Indian Head
Ordnance Holdings, Inc., Reisterstown
SURVICE Engineering, Belcamp
UAV Solutions, Inc., Jessup
W.L. Gore & Associates, Inc., Elkton

**Massachusetts**
908 Devices, Inc., Boston
Blauer Manufacturing Company, Boston
D4H Technologies, Boston
Infoscitex Corporation, Littleton
InnoCentive, Waltham
L-3 Technologies, Inc., Wilmington
Navy Clothing and Textile Research Facility, Natick
Rapiscan, Andover

**Michigan**
Applied Ballistics, LLC, Cedar Springs
Avon Protection Services, Cadillac

**Mississippi**
Army Engineer Research and Development Center, Vicksburg
Hyperion Technology Group, Inc., Tupelo
Kopis Mobile, LLC, Flowood
MAC, LLC, Bay Saint Louis

**Missouri**
MRIGlobal, Kansas City

**Nevada**
Remote Sensing Laboratory, Nye County

**New Hampshire**
Kollsman, Inc. / Elbit Systems of America, Merrimack
L-3 Warrior Sensor Systems, Insight Technology, Londonderry

**New Jersey**
Army Armament Research, Development and Engineering Center, Picatinny Arsenal
Signature Science, LLC, Egg Harbor
SRI International, Princeton
Transportation Security Laboratory, Egg Harbor

**New Mexico**
Energetic Materials Research and Testing Center, Socorro
Sandia National Laboratories, Albuquerque

**New York**
Brookhaven National Laboratory, Upton
Cornell University, Ithaca
Entropix, LLC, Victor
Intertek Testing Services, Cortland
Lockheed Martin Mission Systems and Training, Owego
Mastodon Design, LLC, Rochester
Med-Eng, LLC, Ogdensburg
PAR Government Systems Corporation, Rome

**North Carolina**

**Ohio**
Battelle Memorial Institute, Columbus

**Pennsylvania**
Cornell Cookson, Mountain Top
Gentex Corporation, Simpson
University of Pennsylvania, Philadelphia

**Rhode Island**
Naval Undersea Warfare Center, Newport

**Texas**
Baker Engineering and Risk Consultants, Inc., San Antonio
Cubic Defense Applications, Inc. – Intific, Austin
Elbit Systems of America, Fort Worth
International Personnel Protection, Inc., Austin
National Aeronautical Space Administration (NASA), Houston
Southwest Research Institute, San Antonio
Utah
Dugway Proving Ground, Dugway
Orbital ATK, Clearfield

Vermont
Deep Analytics, LLC, Montpelier
General Dynamics Ordnance and Tactical Systems, Williston

Virginia
Applications Technology (AppTek), LLC, McLean
Battelle Memorial Institute, Arlington
BCF Solutions, Sterling
Blackbird Technologies, Inc., Herndon
Bode Cellmark Forensics, Inc., Lorton
Booz Allen Hamilton, Inc., McLean
CACI International, Inc., Sterling
CONTROP USA, Inc., Manassas
ECS Federal, LLC, Fairfax
Equinix, Inc., Reston
First Line Technologies, LLC, Chantilly
Ideal Innovations, Inc., Arlington
Information Systems Worldwide, Arlington
L-3 Technologies, Inc., Leesburg
Lockheed Martin Advanced Technology Laboratories, Arlington
Lunarline, Arlington
ManTech International Corporation, Chantilly
Microbac Laboratories, Sterling
Naval Special Warfare Development Group, Virginia Beach
Naval Surface Warfare Center, Carderock
Naval Surface Warfare Center, Dahlgren
Night Vision and Electronic Sensors Directorate, Ft. Belvoir
Noblis, Inc., Reston, VA
NuWave Solutions, McLean, VA
Osen-Hunter Innovative Technologies, Virginia Beach
Progeny Systems Corporation, Manassas
Raytheon Blackbird Technologies, Inc., Herndon
Resonate Learning Consultants, LLC, Reston
System of Systems Analytics, Inc., Fairfax
White Canvas Group, LLC, Alexandria
ZTI Solutions, Annandale

Wisconsin
BBI Detection, LLC, Madison

Australia
Defence Science and Technology Group, Canberra, Australian Capital Territory
Defence Science and Technology Group, Fisherman's Bend, Melbourne, Victoria
Flinders University, Adelaide, South Australia
Queensland Fire and Rescue Service, Brisbane, Queensland
Queensland University of Technology, Brisbane, Queensland
Translational Research Institute Australia, Woolloongabba, Queensland
University of Adelaide, Adelaide, South Australia
University of Melbourne, Parkville, Victoria
XTEC Limited, Adelaide, South Australia

Canada
AirBoss Defense, Acton Vale, Quebec
Public Health Agency Canada, Winnipeg
Public Safety Canada, Ottawa, Ontario
Royal Canadian Mounted Police, Regina, Saskatchewan
Uncharted Software, Inc., Toronto, Ontario

Democratic Republic of the Congo
Institut National de Recherche Biomédicale, Kinshasa
Israel
CS3 Composite Solutions, Inc., Holon
Elbit Systems, Ltd., Yokneam
Genosmart, Modi’in Makabim-Re’Ut
Israel Atomic Energy Commission, Tel Aviv
Israel Defense Forces
Israel Ministry of Defense, Tel Aviv
Israel Security Agency, Tel Aviv
Pearls of Wisdom Advanced Technologies, Ltd., Kefar Netter
Prime Minister’s Office
Rafael Advanced Defense Systems, Ltd., Haifa
Tamar Explosives, Ltd., Tel Aviv

Netherlands
Netherlands Organisation for Applied Scientific Research, The Hague

Singapore
Defence Science and Technology Agency
Ministry of Defence

Spain
SEADM, Valladolid
SEDET, Valladolid

United Kingdom
Avon Protection Systems, Inc., Melksham
BBI Detection, Porton Down
Cardiff University, Cardiff
Centre for the Protection of National Infrastructure, London
Defence Science and Technology Laboratory, Fort Halstead
Defence Science and Technology Laboratory, Porton Down
Defence Science and Technology Laboratory, Portsdown West
Department for Transport, London
Smiths Detection Watford Limited, Hertfordshire
University of Bristol, Bristol