Science & Technology

The Army's Science and Technology (S&T) strategy is to develop the technology options that will enable the Future Force while seeking opportunities to enhance the Current Force. This strategy is achieved by simultaneously investing in the three components of Science and Technology:

1 Research to create new understanding for paradigm shifting capabilities in the far-term,
2 Translating research into militarily useful technology applications in the mid-term, and
3 Demonstrating maturing technology in relevant operational environments and facilitating transfer of that technology during the near-term.

Technology demonstrations "prove" the concept, inform the combat developments process, and provide the acquisition workforce with evidence of technology's readiness to satisfy system requirements. The diverse S&T investment portfolio exploits the dynamic nature of opportunities presented through scientific discovery and the "game-changing" potential of innovative technology applications in response to adaptive threat capabilities.

These investments are planned to achieve the capabilities outlined in the Quadrennial Defense Review (QDR) and the needs identified in the Training and Doctrine Command's (TRADOC) capability needs assessment. The Army program is synchronized with the DoD-wide S&T program through the director, Defense Research and Engineering Reliance 21 process.

S&T INVESTMENT—FUTURE FORCE TECHNOLOGY AREAS

The diverse Army S&T portfolio is characterized in terms of Future Force Technology Areas. The investments in these areas are shown opposite in a color depiction (Figure x-1) that approximates their proportionate dollar value in FY07 by Technology Area. The TRADOC documents depicted on the right describe the Army Capstone Concept, Future Capabilities Needs, and TRADOC Concept and Capabilities Development Plan (AC2DP). TRADOC conducts Capability Gap analyses annually to identify gaps and shortfalls to the S&T community that are used to shape Army Technology Objectives (ATOs) to satisfy specific needs within the gaps. The ATOs are the highest priority Army S&T efforts designated by the Headquarters of the Department of the Army (HQDA) funded within the Technology Area investments.

The S&T section of Weapon Systems 2007–2008 is organized by Future Force Technology Area. Selected ATOs are described within most of the Technology Areas. ATOs are not designated within the Basic Research area because these investments fund sciences (discovery and understanding), not technology.

The ATOs are cosponsored by the S&T developer and the warfighter's representative, TRADOC. Capabilities derived from joint and Army concepts are used to identify and prioritize capabilities for the Future Force. TRADOC validates that the ATOs will provide enablers for needed capabilities. The ATOs are focused efforts that develop specific S&T products within the cost, schedule, and performance metrics assigned when they are approved. The goal is to mature technology within ATOs to transition to program managers for system development and demonstration and subsequently to acquisition. The complete portfolio of 86 ATOs is described in the 2007 Army Science and Technology Master Plan (distribution is limited to government and current government contractors).

Short descriptions of technologies or capabilities pursued within the Future Force Technology Area investments are provided below:

Force Protection technologies enable organizations, platforms, and Soldiers to avoid detection, acquisition, hit, penetration, and kill, including advanced armor, countermine and counter improvised explosive devices (IEDs) detection and neutralization, aircraft survivability, active protection systems, and installations.

Intelligence, Surveillance, and Reconnaissance (ISR) technologies enable persistent and integrated situational awareness and understanding to provide intelligence specific to the needs of the Soldier requirements, across the range of military operations.

Command, Control, Communications, and Computers (C4) technologies provide capabilities for superior decision-making, including intelligent network decision agents and antennas to link Soldiers, leaders, and organizations into a seamless battlefield network.

Lethality technologies enhance Soldiers and platforms to provide overmatch against threat capabilities and include non-lethal technologies enabling tailorable lethality options.

Medical research and technology protects and treats Soldiers to sustain combat strength, reduce casualties, and save lives.

Unmanned Systems technologies enhance the effectiveness of unmanned air and ground systems through improved perception, cooperative behaviors, and increased autonomy.

Figure x-1: The Technology Area color bands shown on the left are approximately proportional to the Army's financial investment in FY07. The specific technologies funded in these investment areas are aligned to achieve the Force Operating Capabilities defined by U.S. Army Training and Doctrine Command (TRADOC). The documents on the right identify the capability needs used in the TRADOC Capability Needs Analysis, which determine the Future Force Capability Gaps.

Soldier Systems technologies provide materiel solutions that protect, sustain, and equip Soldiers and non-materiel solutions that enhance human performance. Together these solutions enable Soldiers to adapt and excel against any threat.

Logistics technologies enhance strategic response and reduce logistics demand.

Military Engineering and Environment technologies enhance deployability, sustainability, and battlespace awareness. They also enable sustainment of training and testing range activities.

Advanced Simulation technologies provide increasingly realistic training and mission rehearsal environments to support battlefield operations, system acquisition, and requirements development.

Rotorcraft technologies enhance the performance and effectiveness of future rotorcraft.

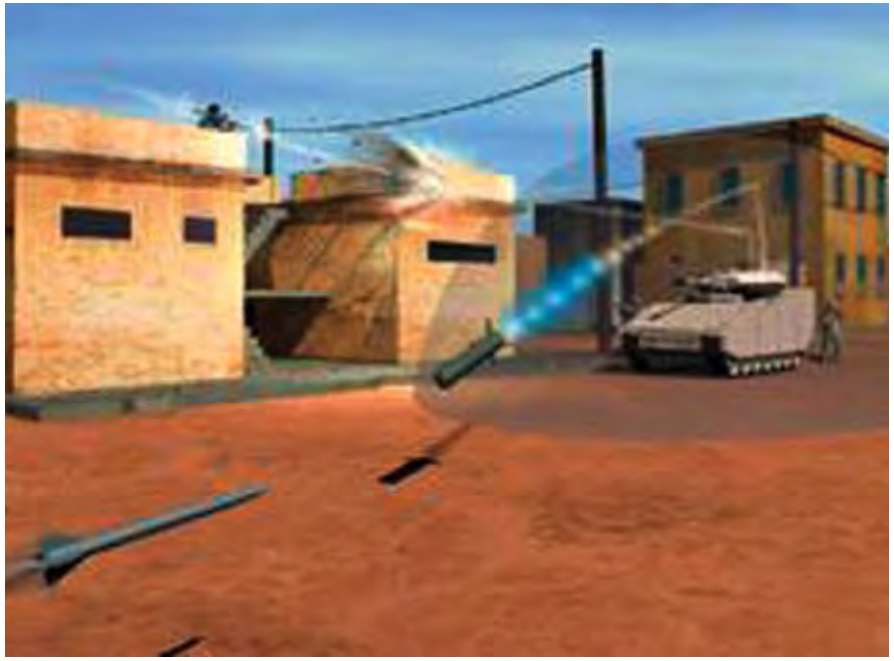
Basic Research investments seek to develop new understanding to enable revolutionary advances or paradigm shifts in future operational capabilities.

The Army S&T program pursues technologies to enable a fully capable Future Combat Systems (FCS) Brigade Combat Team within the joint land force and to spin out technologies as they are available for the Current Force. The FCS related S&T investments are included within the Future Force Technology Area investments already described.

FORCE PROTECTION

Kinetic Energy Active Protection System (KEAPS)

The Kinetic Energy Active Protection System (KEAPS) ATO provides added capability to defeat tank-fired Kinetic Energy (KE) rounds to the Chemical Energy (CE) system that currently defines the FCS Point of Departure APS. This ATO develops warhead and interceptor chassis designs and will conduct robust component testing. These components support the FCS Hit Avoidance Suite designed to enhance the protection of FCS against tank-fired threats.



Mine and Improvised Explosive Device (IED) Detection

The Mine and IED Detection ATO addresses near-term technology advancements to defeat Current and Future Force mine/IED threats. This ATO demonstrates an increase in on-road speed for mounted forces' detection of anti-tank (AT) mines with low false alarm rates and capabilities for off-road detection of mines and roadside IEDs. It also demonstrates an autonomous, high-performance, standoff anti-personnel (AP) mine detection capability on a small unmanned ground vehicle (UGV) for increased survivability during dismounted mine/IED detection missions. This ATO develops new airborne sensor modalities to assist with mine/IED detection. This ATO also develops new techniques to automate change detection and speed up the image analysis process for IED detection. This effort completes development and integration of vehicular Ground Penetrating Radar (GPR); conducts a series of on-road and off-road vehicular GPR demonstrations in a variety of operational scenarios; fully integrates the cueing and confirmation sensor suite for roadside IED detection; and demonstrates a convoy escort capability.

Network Electronic Warfare/IED Countermeasures

This ATO delivers technology upgrades along with improved operational capabilities at the end of each FY, starting in FY06 to PM Counter RCIED Electronic Warfare (CREW). Each year will then see a progression of upgraded operational capabilities, by coupling previous efforts with enhancements and culminating with yearly system demonstrations.

Network Electronic Warfare will demonstrate UAV and ground-based electronic support measures systems in an operational environment. Information Operations algorithm development will focus on a broad range of target transmission parameters. This integrated capability may become the baseline for Spiral 4 of the Counter RCIED Electronic Warfare (CREW) program and spiral integration into FCS at TRL 6.

Countermine/IED Neutralization

The Countermine/IED Neutralization ATO enhances the operational tempo of the Future Force's mounted operations in maneuver areas, including urban operations, which have a high likelihood of surface and buried anti-tank mines and roadside IEDs.

INTELLIGENCE, SURVEILLANCE, RECONNAISSANCE

Soft Target Exploitation and Fusion (STEF)

The Soft Target Exploitation and Fusion (STEF) ATO develops and demonstrates automated tools to solve the fusion, exploitation, and sensor management/cross-cueing issues associated with prosecuting and tracking individuals, recognizing their patterns of association, and tracking the organizations they form. This effort allows the commander to target significant individuals and to understand the organizations exerting influence in his area of operation sufficiently to disrupt or attack the organizational infrastructure. STEF will develop a service-oriented architecture compliant framework and evaluate/develop basic fusion tools for relationship exploitation, sensor management, and cross-cueing. As the automated tools are matured, they will be spiraled into the DCGS-A program.

Human Infrastructure Detection and Exploitation (HIDE)

This effort focuses on the development of algorithms for the detection of human infrastructure presence, such as machinery, currents in wires, computer emanations, industrial compounds, and humans themselves in confined spaces, using a variety of low-cost sensors including acoustic, seismic, magnetic, electric-field, passive infrared (IR), chemical, Radio Frequency (RF), and optical imagers. Algorithms will be structured to be adaptable to varying combinations of sensor modalities, environmental conditions, and varying missions. The algorithms and sensors will be integrated on a small mobile Unmanned Ground Vehicle (UGV). Initial efforts will concentrate on a limited application for detection of man-made machinery and human activity in hidden/confined spaces. In the latter part of the ATO, coordination with CERDEC I2WD will tailor efforts for transition to meet program requirements. In addition, ARL is coordinating this ATO with other programs, such as Suite of Sense Through The Wall (STTW) Systems ATO, to ensure compatibility and avoid duplication of effort.

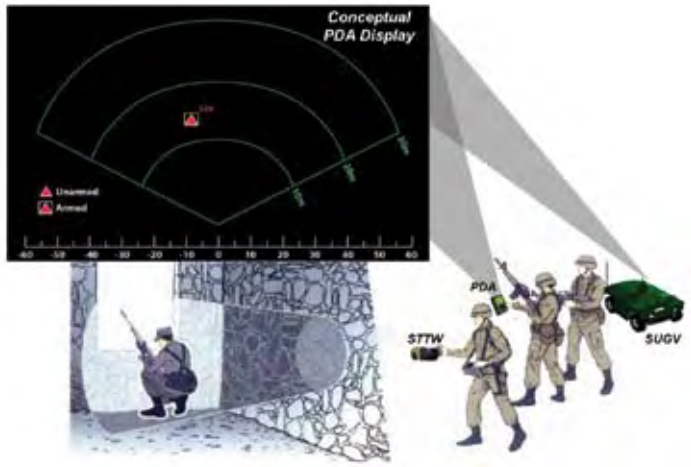
Multi-Mission Radar (MMR)

The Multi-Mission Radar (MMR) ATO develops a High Mobility Multipurpose Wheeled Vehicle/Brigade Combat Team-configured sensor for reconnaissance surveillance and target acquisition, situation awareness, alerting and cueing, and fire control quality information for air and missile defense (AMD) engagements.

MMR will enable the Army to rapidly deploy a single sensor to perform multiple missions (e.g., AMD engagements of rockets, artillery, mortars, UAVs, cruise missiles, and rotary-and fixed-wing aircraft). Counter-Fire Target Acquisition will enable precision attack munitions while simultaneously providing data to maneuver and maneuver sustainment units. MMR with a towed generator will be small and light enough for insertion via single CH-47 or C-130 sortie, but will still have long-range target acquisition capabilities. This system will improve light force lethality and heavy force mobility and deployability. In addition, MMR will track friendly UAVs and aircraft, providing airspace management support for deconfliction and air traffic control. The effort will culminate in demonstrations of an MMR system and prime item development specifications suitable for moving into a system development and demonstration phase.

Suite of Sense Through the Wall Systems (STTW)

The Suite of Sense Through the Wall (STTW) systems will explore several technologies to provide mounted/dismounted users the capability to detect, locate, and "see" personnel with concealed weapons and explosives hidden behind walls, doors, and other obstructions. One version will be Soldier borne, and will be modularly designed to facilitate integration into FCS small unmanned



ground vehicles (SUGVs). Another will be UGV mounted and will have increased standoff distance from the target area. STTW will conduct limited evaluation of concealed explosives detection/concealed weapons detection and begin development of next generation STTW systems with limited standoff, improved target geolocation, and detection of multiple targets through walls. The ATO will work closely with emerging FCS and Future Force Warrior (FFW) network communications architectures to demonstrate transmission of STTW data on a real-time basis, and conduct lab testing of STTW prototypes, and user testing at Ft. Benning's Military Operations on Urban Terrain (MOUT) facility. Through experiments, STTW will develop tactics, techniques, and procedures and will characterize urban and complex terrain phenomenology. STTW will participate in both the Air Assault Expeditionary Force demo and the FFW Advanced Technology Demonstration (ATD) with handheld/Soldier borne STTW technology demonstrators.

Class II UAV Electro-Optical Payloads

The Class II UAV Electro-Optical Payloads ATO develops, integrates, and demonstrates a mission equipment package (MEP) to satisfy the reconnaissance, surveillance, and target acquisition (RSTA) requirements for the Class II UAV. Parallel development of technologies is executed in this program. (1) Line of sight (LOS) RSTA+laser designator integrates advanced compact infrared imaging sensors and a lightweight laser designator in an inertially stabilized gimbal. (2) Non-imaging LOS/through foliage RSTA incorporates laser vibrometry, acoustic, and/or magnetic anomaly-based sensor payloads. (3) Active imaging LOS/through foliage RSTA uses 2-D and 3-D LADAR techniques based on scanned/staring high bandwidth focal plane arrays, next-generation laser sources, optical modulation/mixing, and Geiger-mode processing. (4) Lightweight, efficient laser designator concepts that include pumping with high brightness laser diode arrays, passive Q-switching for simplicity, and alternative host materials that provide compact 50-100 milli-Joule designators are investigated for their utility in small UAV/UGV and soldier systems. The MEP concept provides target ID by enabling the scout to quickly see and characterize potential targets and non-target objects that are in the open and in complex/urban terrain obscured by modest foliage, camouflage, or other man-made or natural materials.

All-Terrain Radar for Tactical Exploitation of MTI and Imaging Surveillance (ARTEMIS)

The ARTEMIS ATO provides an all-weather/all-terrain airborne ground moving target indication, tracking, and cueing system for Class IV unmanned air vehicles (UAVs). Unlike most tactical radars, ARTEMIS will be able to track both mounted and dismounted threats that employ cover to conceal their movements or move in open terrain. ARTEMIS will also incorporate a synthetic aperture radar (SAR) capability sufficient to image vehicle-sized threats in foliated/open terrain and smaller threats that are in the open or shallowly buried. The program emphasizes signal and data processing achieving a prototype system early enough in the program to ensure the availability of real data for development. Tower testing will support risk reduction and acquire data needed for the development of signal processing algorithms. A decision point will occur at the end of tower testing to determine readiness for engineering flight tests to begin. The system will be integrated onto a manned surrogate platform for flight testing. Tower and flight test data will be collected to support adaptive MTI processing, advanced motion compensation, and advanced exploitation evaluation and incremental improvement.

C4

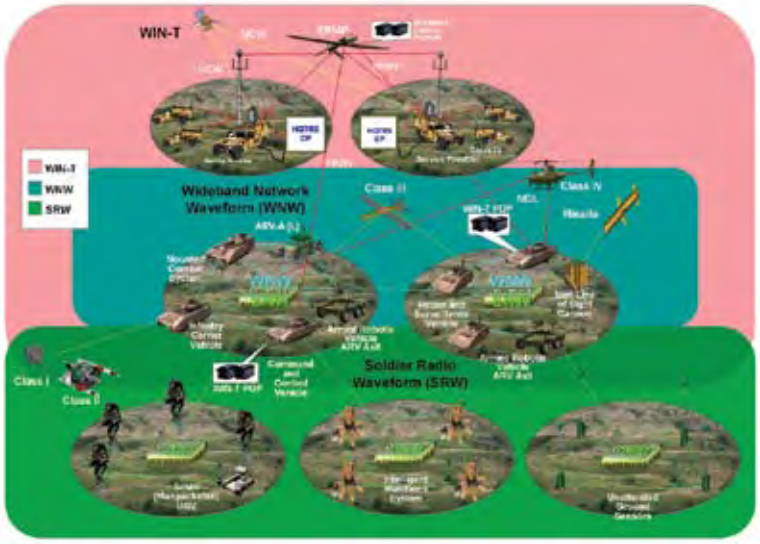
Networked Enabled C2 (NEC2)

The Network Enabled Command and Control (NEC2) ATO develops, integrates and transitions technologies, products, and services that provide network centric command and control (C2) capabilities to the Current and Future Force. Transition of these products and services are specifically focused on current, transitional (Battle Command Migration Plan), and future (FCS) Battle Command (BC) systems throughout all phases of operations and environments. NEC2 will develop advanced C2 software and algorithms that tailor and manage the flow of BC information and C2 services across Current and Future Force systems and enable the commander and his staff to effectively use vast amounts of information horizontally and vertically across the theater of operations for decision and information superiority. Technology efforts under NEC2 focus on applications in complex and urban terrain and battle command planning, execution, and re-planning products for unmanned systems and sensors, as well as decision making tools that account for political, religious, and cultural factors and expand the commander's reach to other government and non-government experts. The Unmanned Systems Capstone Experiment will evaluate unmanned software services v2.0 and air-ground systems performance across tactical application scenarios; collect and process communications characterization data; and deliver refined unmanned software services (v3.0, SRL 6) to PM FCS.

Tactical Mobile Networks (TMN)

The Tactical Mobile Networks (TMN) ATO develops, matures, and demonstrates communications and networking technologies that optimize bandwidth use, size, energy, and network prediction of tactical voice and data networks. TMN addresses emerging Future Force requirements through: (1) Proactive Diverse Link Selection (PAD-LS) algorithms to optimize use of available communications links; (2) multi-band, multi-mode tactical voice and data network communications services for dismounted Soldier Battle Command through the development of a Joint Tactical Radio System (JTRS) Software Communications Architecture (SCA) v2.2 Soldier Radio Waveform (SRW); and (3) software tools to dynamically predict and visualize on-the-move communications network performance.

TMN will conduct a modeling and simulation effort to develop and perform initial implementation and controlled environment demonstration of link selection algorithms. SRW will be implemented in prototype software defined radio (SDR) and will validate voice and data communications performance in operationally relevant field environment for dismounted Soldier and manned ground vehicle systems. Network management tools will be matured to include support for increased waveforms, entities, processing speed, full network topology, and a network visualizer to include network statistics and user priorities.



Tactical Network and Communications Antennas (TNCA)

The Tactical Network and Communications Antennas (TNCA) ATO develops, matures, and demonstrates affordable on-the-move (OTM) directional and omni-directional, low- profile antenna technologies and systems for the Current and Future Force. Efforts include affordable low-profile Ku/Ka and X band antenna systems and efficient Ku and Ka band power amplifiers for OTM tactical satellite communications (SATCOM). The antenna systems will be demonstrated in cooperation with PM WIN-T, JTRS JPEO, and FCS. Power amplifiers will leverage ARL's work with Gallium Nitride (GaN) and Metamorphic High Electron Mobility Transistor technologies. The effort will improve performance over current prototype multiband omni-directional antennas for OTM vehicular and dismounted Soldier platforms with ending TRLs of 6+. The omni antennas will provide higher gains to sustain Wideband Networking Waveform (WNW) link connectivity; reduce visual signatures; provide ballistic protection; host multiple waveforms on a single antenna; and provide for the integration of conformal, lightweight antennas within the Soldiers' protective combat gear, suppressing visual signatures and improving mobility. Body wearable antennas will be designed and developed to meet ground Soldier requirements.

Battle Space Terrain Reasoning and Awareness—Battle Command

This effort will provide integrated Battle Command capabilities to create and utilize actionable information from terrain, atmospheric, and weather effects and effects on units, systems, platforms, and Soldiers. This will enable agile, integrated ground and air operations in all operational environments. In FY10, an initial spiral of urban-based technologies from the Network Enabled Command and Control ATO will be incorporated. The resulting capability will result in Net Centric, n-Tier Terrain Reasoning Service(s) and embedded Battle Command applications.

This program will work with key transformational Battle Command programs and TRADOC Schools to: (1) conduct controlled demonstrations to gain insight into effectively integrating actionable terrain atmospheric and weather information into Battle Command SoS, staffs, processes and functions to enhance agile decision making and battle execution; (2) improve, extend, and mature terrain and weather-based information products and embedded applications within Battle Command SoS; (3) transition capabilities to DCGS-A, FCS, and CJMTK under forthcoming Technology Transition Agreements (TTA); and (4) support the development of a geo-Battle Management Language that extends the JC3IEDM to include representation of terrain, weather, and atmospheric actionable information.

LETHALITY

Non-Line of Sight-Launch System (NLOS-LS) Technology

The Non-Line of Sight-Launch System (NLOS-LS) Technology ATO is developing and maturing improved components and subsystem technologies for the NLOS-LS missile system. The ATO supports the NLOS-LS spiral development by transitioning affordable, mature components that enhance the NLOS-LS threshold performance through a subsystem maturation effort and continuing critical

component development efforts for future NLOS-LS performance enhancements. By the end of FY07, this effort will perform component/subsystem bench testing, tower testing, and static/dynamic testing of critical component prototype hardware/software and begin captive flight test series for performance validation of enhanced seekers for the Precision Attack Missile (PAM). Products include improved seekers for better resolution, IM controllable propulsion maturation, warhead subsystem integration and testing, and validated simulation models and performance studies. Modeling and simulation efforts include the implementation of the collaboration of information and simulation technologies through the linkage of physics based engineering models, hardware/software in the loop (HWIL/SWIL) designs, constructive analysis, and virtual prototype development and exercise. The ATO is developing an affordable NLOS-LS missile with advanced imagery to enhance target detections and battle damage assessment, and missile propulsion technologies that provide extended range.

ElectroMagnetic (EM) Gun Technology Maturation & Demonstration

The ElectroMagnetic (EM) Gun Technology Maturation & Demonstration ATO focuses on developing and demonstrating key EM gun subsystems at or near full-scale to support future armament system developments. Future armored combat systems require more lethal yet compact main armament systems capable of defeating threat armor providing protection levels greatly in excess of current systems. The goal is to reduce technical risk associated with EM Gun technology by demonstrating meaningful technical progress at subsystem level; gain an understanding of EM technology issues; identify technology trends; conduct return on investment analyses; and craft a technology development strategy. By FY08, this effort will build a lightweight cantilevered high-fidelity railgun with integrated breech and muzzle shunt and demonstrate performance at hypervelocity and multi-round launch capability. It will integrate compact, twin counter-rotating pulsed alternator power supplies, conduct subsystem functional tests, and accomplish high fidelity PPS demonstrations that will establish requisite performance criteria to transition into the follow-on ATD. EM armaments offer the potential to field a leap-ahead capability by providing adjustable velocities, including hypervelocity, greatly above the ability of the conventional cannon. EM armaments could greatly reduce the sustainment requirements and vulnerabilities of conventional cannon systems and potentially can be fully integrated with electric propulsion and electromagnetic armor systems to provide an efficient, highly mobile, and deployable armored force. If successful, the payoff of EM gun technology will be increased lethality and lethality growth potential and enhanced platform survivability by reducing launch signature, and carrying less explosive energy on board.

Common Smart Submunition (CSS)

The Common Smart Submunition (CSS) ATO will develop and demonstrate the next generation target discriminating submunition. CSS will provide the warfighter with an affordable, smaller, one shot and more than one kill capability for gun and missile/UAV launch environments. The enhanced capabilities will be obtained through the integration of CSS's long standoff Explosively Formed Penetrator (EFP) warhead, laser radar (LADAR), and imaging infrared (IIR) sensor technologies into a small (120mm diameter) and lightweight submunition that can be deployed from multiple platforms (e.g., GMLRS, 155mm projectiles, 120mm mortars, UAVs). LADAR and IIR sensors will provide significant improved aimpoint correlation and discrimination capabilities. Substantial cost and logistics savings will be achieved through reduced munition size, multiple platform applications, and cross service use (Army, Air Force, Navy/USMC). In FY08, a full function submunition will undergo a captive carry test (CCT) to determine sensor performance against dynamic targets in a simulated tactical environment. Prototype submunitions demonstrating full form capability will be developed and drop tested. M&S system/analytical tools are being developed for platform evaluations and carrier integration analyses. The increased performance of CSS over the current submunition will result in a reduced logistics footprint and a significant decrease in unexploded submunitions.

Missile Seeker Technology

The Missile Seeker Technology ATO is developing advanced technologies for low-cost seekers and counter-measures for tactical missiles and future sensor applications. The ATO consolidates state-of-the-art research and development of advanced technologies in the areas of uncooled infrared (UCIR) technology for missile seekers and unmanned sensors, IR seeker counter-counter measures (CCM) for laser threats, and phased arrays for tactical seekers (PATS). This ATO will design, develop, and test advanced optics and signal processing techniques used in UCIR seeker and sensor packages; develop IR seeker CCM technologies to defeat near-term, Level II (Dazing) laser IR countermeasure (IRCM) threats and far-term, Level III (Damaging) laser IRCM threats; and develop Micro Electro-Mechanical Systems (MEMS)-based or alternative low-cost phased arrays to provide rapid beam steering for sensors, optical and RF

missile seekers, and RF data links. This effort will conduct laboratory and field evaluation of lock-on-before-launch (LOBL) and lock-on-after-launch (LOAL) UCIR concepts, demonstrate prototype configurations, and transfer UCIR technology to appropriate aviation and missile systems. It will fabricate a passive phased sub-array with phase shifters, bench test, and initiate transition of PATS. The ATO will lead to lower cost, lighter weight, smaller weapons with increased lethality and reliability and enable the weapon systems to maintain lethality in the laser CM environment of the future battlefield.

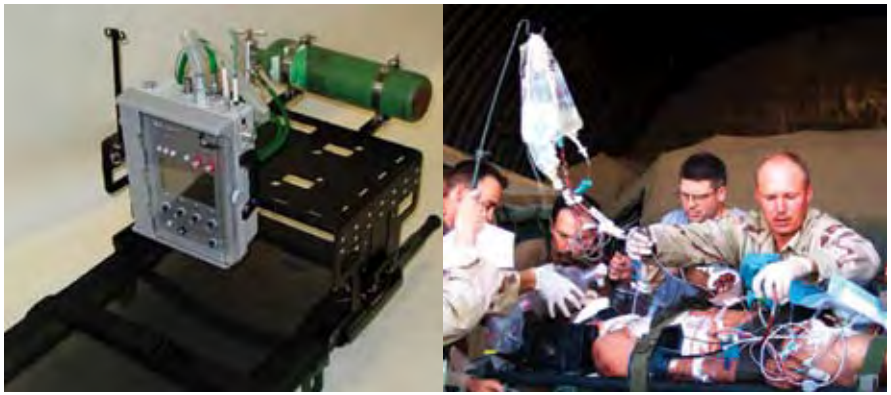
Insensitive Munitions (IM) Technology

The Insensitive Munitions (IM) technology ATO is exploring ways to increase safety of items containing energetic materials. Increasing insensitivity of energetic materials will enhance survivability and sustainment of warfighting ability, while providing life-cycle cost savings for Army systems. Increased performance requirements (range and lethality) combined with lightening the force make reduced sensitivity munitions critical to the warfighter. Currently available technology does not enable IM-compliant munitions to be developed and fielded in timeframes consistent with requirements. New technologies, both energetics and system level mitigation, will provide solutions for designing munitions to maintain/improve survivability at reduced/constant platform and packaging weight, and obtain cost and logistics benefits through reduced hazard class and improved safety. This will provide a capability to PMs and PEOs to improve munitions response to IM threats for new or existing munitions. The ATO will explore new energetic-formulation and venting technologies for IM design, demonstrate integrated technologies for improved IM behavior in guns, missiles, and warheads, and develop predictive methodologies for IM tests. The payoff is improved tactical and combat system survivability leading to reduced transportation and storage burden.

MEDICAL

Automated Critical Care Life Support System (ACCLS)

The Automated Critical Care Life Support System (ACCLS) provides critically injured battlefield casualties with a self-contained life support system for far forward stabilization and transport in air and ground vehicles. This ATO will conduct research to support the discovery, adaptation, and development of algorithms and sensors for integration into a lightweight, semi-autonomous



(Phase 1) and fully autonomous (Phase 2) critical care life support system, capable of monitoring and delivering closed-loop life support to combat casualties during treatment and within air and ground evacuation environments, including the UH60 and FCS Medical Treatment Vehicle variant. This ATO will produce clinically validated software algorithms for closed loop control of IV fluid and oxygen and will develop the system requirements and specification documents to generate a Request for Proposal (RFP) for the required hardware. The payoff of this approach is that treatment will be automatically titrated (i.e., adding small amounts until you reach desired medical effect) optimizing the casualty's condition while conserving fluid, oxygen, and power resources.

Fluid Resuscitation Tech to Reduce Injury and Loss of Life on the Battlefield

This ATO addresses noncompressible (i.e., any place a tourniquet or pressure cannot be applied) hemorrhage, which is the leading cause of death in casualties with potentially survivable injuries. Care of these patients requires control of bleeding and metabolic resuscitation. The solutions currently used for resuscitation, including blood products, dilute coagulation factors, and increase the tendency for more bleeding and metabolic imbalance. By integrating products formulated in other efforts and techniques to stop bleeding, metabolic resuscitation will be optimized and evaluated in relevant animal models. Clinical guidelines for the care of the combat casualty consisting of a mix of blood components, fluids, and drugs for the control of bleeding, and immunological stability of casualties, will be developed and evaluated.

Vaccines and Drugs to Prevent and Treat Malaria

This ATO aims to develop safe, effective vaccines to protect Soldiers against malaria and to develop drugs for the treatment of life-threatening malaria. Historically malaria is the disease that has caused the most disrupton in military operations in tropical regions of the world. There is no vaccine available for prevention, and the malaria parasite continues to develop resistance to new drugs used for treatment or prevention. Products from this ATO include vaccines for Plasmodium falciparum and Plasmodium vivax malaria, and a new FDA-approved drug for treating life-threatening severe and complicated malaria. This will result in improved protection against acquiring malaria and more effective and safer treatments if malaria is contracted.

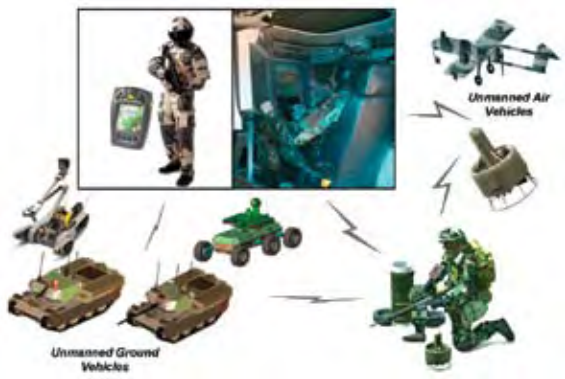
Biomedical Enablers of Operational Health and Performance

This ATO provides multi-focused, biomedical solutions to protect Soldier health and enhance Soldier performance in extreme environments and during continuous operations. It will produce an altitude readiness management system that will enable unit commanders and mission planners to minimize the risk of altitude related injuries among Soldiers operating in high altitudes. The system will include strategies for rapid altitude acclimatization, and guidelines for determining medical and other logistical requirements in high-altitude operations. This ATO will lead to the development of new water doctrine for cold and mountain missions, as well as a mission planning tool that predicts average individual performance across a 0–48-hour period of sleep loss. Additionally, performance enhancing nutritional supplements for rations and predictive models based on high-altitude operations will be developed. This ATO will lead to the development of an enhanced fluid and nutrient delivery system to sustain hydration in Soldiers. This system will produce prediction models of warfighter water requirements; develop strategies, countermeasures, and doctrine to reduce hydration related injury; and sustain Soldier performance. Finally, the ATO will develop a mission planning tool for the prediction of individual performance during deployments. The payoff of this research will be improved health and performance in hot environments, high operational tempo, and at high altitudes.

UNMANNED SYSTEMS

Robotics Collaboration (RC)

The Robotics Collaboration (RC) ATO will develop advanced models, metrics, and design guidelines for optimal mounted and dismounted Soldier-robotic performance, and employ this information to demonstrate the technology required for effective interaction with both air and ground unmanned systems. This ATO will mature and demonstrate scaleable user interfaces for multi-screen mounted crew-stations, single screen workstations, or Soldier-portable PDA-sized devices. The interface design will also provide for graceful degradation of the display system by reconfiguring controls and displays in the event of hardware failure and provide associated functionality upon discovery of available services. RC will also develop an Intelligent Systems Behavior Simulator (ISBS) to mature and refine mounted crew and dismounted Soldier task models and associated metrics. Results from iterative ISBS experimentation will drive development of intelligent agents that decrease Soldier workload and reduce and/or automate controlling tasks across mounted and dismounted systems. It will develop 3-D models and algorithms using colorized ranging with LADAR and visual sensors for safe operations of unmanned systems around Soldiers and pedestrians. Models will be tested in both man-in-the-loop simulation and field experimentation using FCS-relevant scenarios. Hardware and software will be integrated onto existing manned and unmanned platforms. Additionally, this ATO will develop and demonstrate militarily-relevant autonomous collaborative behaviors for multiple unmanned vehicles (UVs), simultaneously supporting both mounted/dismounted ground and airborne warfighters.



Near Autonomous Unmanned Systems

This effort will develop, integrate, and demonstrate robotic technologies required for Future Force unmanned systems.

This ATO will advance the state of the art in perception and control technologies to enable the unmanned platform to conduct missions autonomously in populated, dynamic, and complex environments while adapting to changing conditions. It will develop initial tactical/mission behavior technologies to provide the unmanned ground vehicle (UGV) the capability to maneuver tactically in conjunction with manned systems and provide the Soldier-machine interface technology that will permit Soldiers to control multiple types of air and ground unmanned systems. A UGV self-security system will be developed and integrated to allow the detection of human threats at varying distances from the vehicle and calculate the appropriate response to deter the threat. Modeling and simulation will be used to develop, test, and evaluate the unmanned systems technologies (i.e., tactical behaviors, UGV self-security, perception algorithms). A test bed platform and appropriate mission modules will be integrated with the software and associated hardware developed to support warfighter experiments in a militarily significant environment.

Manned-Unmanned Rotorcraft Enhanced Survivability (MURES)

Current threat warning receivers (radar, missile, laser) and situational awareness systems, such as Integrated Situational Awareness & Targeting (ISAT), provide threat identification and sector/geolocation only. Existing decision aiding systems, such as Rotorcraft Pilot's Associate (RPA), provide line-of-sight masking to threat sensors only. These systems lack the intelligence to provide the critical information own force assets really need. Technology exists to assemble threat lethality footprints in real time by assessing own ship signatures, clutter environment, threat sensitivity, and jammer effectiveness. This information is a critical element to effective team decision aiding and management of manned and unmanned aircraft operating in threat environments, and directly enhances team survivability and mission effectiveness.

This ATO will develop real-time Survivability Planner Associate Rerouter (SPAR) software tailored to small unit manned-unmanned team operations. It will also develop interfaces to existing unmanned and manned mission management/ decision aiding architectures to allow team cooperative/collaborative responses to tactical threats and enhance team survivability. Specific demonstration goals are rapid (<1 sec) and accurate (>90%) situational understanding of threat lethality to own force assets through Future Army mission simulations.

SOLDIER SYSTEMS

Leader Adaptability

This ATO provides the strategies and methods for rapidly developing the skills that leaders will need to perform adaptively in current mission scenarios and in future net-enabled environments. Army leaders already face new and rapidly changing challenges in the operational environment. In the future they will be challenged with a more widely distributed battlefield. Future technologies will provide increasing amounts of information from a variety of sources. They will have to employ network systems and decision aids not currently available. Leaders at the tactical level must learn to adapt more quickly to unanticipated operational situations and to fully advantage new capabilities as they are fielded. Prior research demonstrated interactive leader training tools to develop agility, adaptability, and selected critical thinking skills. This research will be leveraged to develop and assess training and leader development methods to improve how the Army develops leadership and battle command skills, including procedures for near real-time performance assessment and feedback. The methods will support faster skill acquisition and longer retention of cognitive and interpersonal skills required for adaptable performance. In FY08, this ATO will demonstrate technologies to train leadership skills in junior leaders through synthetic experience and develop prototype training programs to improve learning of complex cognitive skills necessary for adaptive battle command performance in net-enabled environments.

Future Force Warrior

The Future Force Warrior (FFW) Advanced Technology Demonstration (ATD) is developing and demonstrating an integrated Soldier and Small Team System of Systems (SoS). The FFW ATD is achieving revolutionary advances for the dismounted warfighter by developing Networked Communications/Collaborative Situational Awareness (NC/CSA), an integrated modular combat ensemble, netted lethality, man-portable power sources, Soldier mobility/sustainability, and human performance monitoring for the Future Force. This FFW SoS will be network

compatible with the FCS, other Future Force platforms, and robotic air/ground platforms to form adaptive, distributed sensor networks for better warfighter situational awareness and the capability to leverage combat power from higher echelons. Key performance goals for the ATD include developing and integrating a networked Soldier system that weighs less than 70 lbs in the fighting load (rifleman configuration, night attack, respiratory CB threat), supports 24-hour individual and 72-hour autonomous team operations, supports full NC/CSA with networked fires, and has connectivity with the network through leveraging the SLICE Warrior System Radio Terminal (WSRT) hosting the Soldier Radio Waveform (SRW). The goal is to demonstrate 2X increased combat effectiveness of Soldiers in small combat units (SCU) and improve affordability of the ensemble in preparation for transition to Ground Soldier System (GSS) system development and demonstration. In addition the ATD will identify/transition mature technologies for insertion into Land Warrior and analyze the other variants (core, mounted, air) to identify common requirements and gaps to enable expansion of the FFW/GSS architecture and system design concept for the other variants. The FFW ATO is developing and integrating component hardware and software and building a limited number of prototype systems to conduct limited user evaluations. The FFW architecture, design, hardware and software prototypes, and user evaluations will support the GSS Milestone B decision.

Mounted/Dismounted Soldier Power

The Mounted/Dismounted Soldier Power ATO delivers critical power to the battlefield for essential C4ISR equipment required by the Future Force. This ATO will develop, demonstrate, and transition component power technologies leading to higher-energy, lighter-weight, quieter, fuel- and cost-efficient power sources, battery chargers, and cooling systems. It includes the development of Micro Electro-Mechanical Systems (MEMS) technology to further increase power system efficiency and reduce size and weight. This effort will provide technology advancements leading to new silent watch capability with quiet, lightweight mobile power generation. The ATO delivers 50% fuel savings with co-generation of cooling and power for shelter/tent systems. It bridges the gap between vehicles and Soldiers with stand-alone self-powered man-portable field chargers/remote power sources, which reduce logistics costs 80% by allowing the tactical use of rechargeable batteries. Specific power solutions and goals will include component level development of burner technologies; component development and integration of heat driven cooling system technologies combined with waste heat recovery systems; improved energy density and recharge rate in rechargeable batteries; component integration of meso-machine, stirling, and fuel cell systems; and MEMS coolers for advanced passive and active cooling at the device and module level for high-power electronics.

Soldier Protection Technologies

This ATO focuses on the development of innovative materials for lightweight ballistic/blast and predictive tools for the development of improved individual armor systems. This effort will research and develop novel fiber technologies to reduce the weight of ballistic protection for the individual warfighter, while maintaining or increasing ballistic protection from conventional and emerging threats. The effect of novel blast weapons on currently fielded protective clothing and its interaction with the human body will be researched to obtain a better understanding of the energy transfer mechanisms inherent in protective materials and within the body. This information, coupled with data on the interaction of blast waves with textile materials, will allow the development of physics-based models and analytical tools for the design of clothing systems that optimally attenuate the effects of blast overpressure, and an experimental test device for evaluating the designs. A product of the ATO is a software tool capable of identifying promising extremity armor configurations. This will guide the design

of new extremity armor configurations that will provide individual Soldiers with ballistic protection that offers maximum flexibility, agility, and mobility and minimizes the energy expended during movement in dismounted operations.

LOGISTICS

Advanced Lightweight Track

The Advanced Lightweight Track program will develop a new, field supportable, robust track system with lightweight, low-vibration, and low-acoustic emissions as well as reduced crew maintenance. The advanced hybrid steel track concept will offer greater robustness with a nominal weight increase over the continuous segmented band track.

The development of a lightweight track system presents some challenges. For example, traditional lightweight track is less durable and more vulnerable to mine blast damage. To overcome these challenges, a new design approach and new elastomer components will be incorporated into the development of two new track families, (i.e., the segmented band track and the hybrid steel track). These approaches will yield a new generation of track systems with both the lightweight and robust capabilities for future tracked combat vehicles.

Precision Airdrop–Medium

The Precision Airdrop–Medium ATO is developing technologies for medium payload weight precision airdrop, a capability the Army currently lacks. This is part of the Joint Precision Airdrop System, a family of guided airdrop systems. This ATO is expanding upon the current precision airdrop weight capability of 10,000 lbs to a 30,000 lbs capacity, potentially providing high-volume resupply of fuel and ammo, along with other sustainment cargo. In addition, it will enhance the potential strategic deployment airdrop capability to augment air/land and mitigate the maximum on ground (MOG) limitations (high-volume supplies and combat equipment). The ATO is developing a decelerator/ parachute system and guidance and navigational capabilities to deploy a 30,000 lbs payload from 25,000 ft., with an airdrop accuracy of 100m CEP. The payload weight aligns with the medium block for Precision, Extended Glide Airdrop System (PEGASYS) and the corresponding payload capacity of the Palletized Load System/Load Handling System (PLS/LHS) and the related, emerging technology program Smart Distribution-Modular Intermodal Platform (MIP). A medium weight precision offset airdrop capability will enable immediate tactical deployability, as well as reduced drop zone detectability and vulnerability. The ATO is developing the technology to provide the required never-too-late supply and distribution capability the widely dispersed combat teams of the Future Force will require in the first days of a conflict, increasing their operational agility.

Hybrid Electric FCS

The Hybrid Electric drive program matures and characterizes technologies for FCS ground vehicles to enable silent operation/mobility, enhanced dash speed, battlefield robustness, and reduced signatures (acoustic, thermal, visual, electromagnetic interference.) This ATO focuses on reducing weight/volume by increasing operating frequencies of the power electronic switching devices (inverters and dc-dc converters). It also focuses on reducing the thermal management size, weight, and power requirements by increasing the operating temperatures of the individual system components (batteries, converters/inverters, motors/generators). This program advances the Hybrid Electric Vehicle (HEV) System Architecture, allowing for intelligent power and energy generation and management and includes the development of a hybrid electric test cycle baseline to measure the variables of hybrid vehicles against standard vehicles. The fuel economy tests will evaluate Future Tactical Truck System (FTTS) variants and other existing HEV assets against standard baseline vehicles.

Products of this ATO will be integrated into the power and energy hardware in the Loop Systems Integration Laboratory (SIL) for further evaluation to determine their impact on hybrid electric power system performance. Development and validation efforts are coordinated closely with the FCS LSI and Manned Ground Vehicle (MGV) integrators.

Prognostics and Diagnostics for Operational Readiness and Condition Based Maintenance

This ATO develops prognostics algorithms and application-specific sensors. The Common Logistical Operating Environment-compatible core sensors-processing module will interface these algorithms and application-sensors with low/no-power THVS (temperature, humidity, vibration, and true g-shock) sensors and processor via secure wireless link for remote interrogation. Near-term and FCS commodity readiness and maintainability rely on the ability to detect health status and performance and environmental conditions/metrics that limit asset lifetime. Diagnostic sensors will enable health assessment. Predicting remaining lifetime requires interpretation of the information on both the asset and quality of sensor data. Commanders and logisticians must be able to access the data expeditiously with a minimum of effort. This project will develop a core “tag” with embedded sensors and processing that can be wirelessly interrogated. The asset’s sensor history data will be analyzed by both on-board and post-processed prognostics algorithms to assess immediate readiness and remaining time to maintenance or lifetime. Resultant data will yield actionable information for both commander and logistician leading to increased readiness, enhanced awareness of materiel condition, increased confidence of mission completion, and smaller logistics footprint through condition-based maintenance.

ADVANCED SIMULATION

Learning with Adaptive Simulation and Training (LAST)

Army trainers lack the ability to rapidly create effective, Common Operating Environment (COE)-relevant, virtual training simulations that incorporate political/cultural effects of the environment and behaviors of an adaptive, asymmetrical enemy. LAST focuses on developing the pedagogical design and enhanced tools/methods for rapidly creating/modifying COE-relevant scenarios in virtual simulations. Additionally, the research develops enhanced virtual entities and political/cultural effects in integrated virtual simulations. These efforts will produce improvements in instruction, decision-making, and learning retention. The research leverages the abilities of the RDECOM STTC, ARI, ARL-HRED, and ICT. We have developed a scenario task list based on cognitive task assessment, a pedagogical design for the user environment, and a concept for the single user module practice environment for bilateral engagements. We have identified an initial set of tools/methods and behavioral models and are integrating these tools/

methods with a single-user module providing training in bilateral negotiation. The effort will conclude by conducting warfighter experiments and assessing the effectiveness of prototypes.

Scaleable Embedded Training and Mission Rehearsal (SET-MR)

Embedded training (ET) is a key performance parameter for FCS and GSS, and is required by Abrams, Bradley, and Stryker platforms, but it has been slow to evolve. FCS is developing live, virtual, and constructive (LVC) ET but has no significant ET spinout to the Current Force until FY12 and Current Force ET fielding plans are limited to gunnery training. This ATO will support a common implementation strategy and address known technology shortfalls in ET across Current Force combat and GSS. It aims to accelerate ET and mission rehearsal (MR) implementation in Current Force combat vehicles and Soldier systems up to platoon level. It will also develop tactical engagement simulation (TES) sensors for dismounted Soldier live training, size, power, and accuracy requirements. Additionally this ATO will provide ET risk mitigation for FCS, GSS, Heavy Brigade Combat Team (HBCT), and Stryker Brigade Combat Team (SBCT). The ATO will end in FY09 with field demonstrations of mission rehearsal and LVC ET using Current Force combat vehicles and dismounted Soldiers as the experimental force.

S&T ROLE IN FORMAL ACQUISITION MILESTONES

The Army S&T community role in acquisition involves not only technology development and transition but also formal participation in Milestone Decisions for acquisition programs of record. At Milestone A, the DASA (R&T) needs to ensure that the Technology Development Strategy for a program is synchronized with the Army S&T program and that the Technology Transition plan is realistic and funded. As the component S&T Executive, the DASA (R&T) is responsible for conducting a Technology Readiness Assessment (TRA) at all Milestone B and Milestone C decisions for Major Defense Acquisition Programs (MDAP). This assessment has become even more important with recent statutory requirements for the Milestone Decision Authority (MDA) to certify to Congress that the technologies of an MDAP have been demonstrated in a relevant environment–prior to approving a Milestone B. The TRA serves as the gauge of this readiness for the MDA's certification at both Army and Office of the Secretary of Defense (OSD) levels. The TRA process is a collaborative effort carried out among the Program Office, the S&T community, and (for ACAT 1D programs) the Under Secretary of Defense for Acquisition, Technology, and Logistics.

SUMMARY

The Army Science and Technology Investments seek to enable capabilities described in the Quadrennial Defense Review and the needs established in the TRADOC Capability Gap/Technology Shortfalls process. The S&T investments are characterized in Future Force technology areas. The highest priority S&T investments in Future Force technology areas are designated as ATOs. The ATOs are developed and approved for execution through a rigorous process that engages the S&T, acquisition, and combat development communities. Each ATO has defined products, milestones, designated resources, and projected warfighter payoff. The ATO products are shaped to provide technologies that are relevant to satisfying capabilities needs. The acquisition program managers partner with the S&T materiel developers to enhance opportunities for rapid transition of technology described in Technology Transition Agreements.