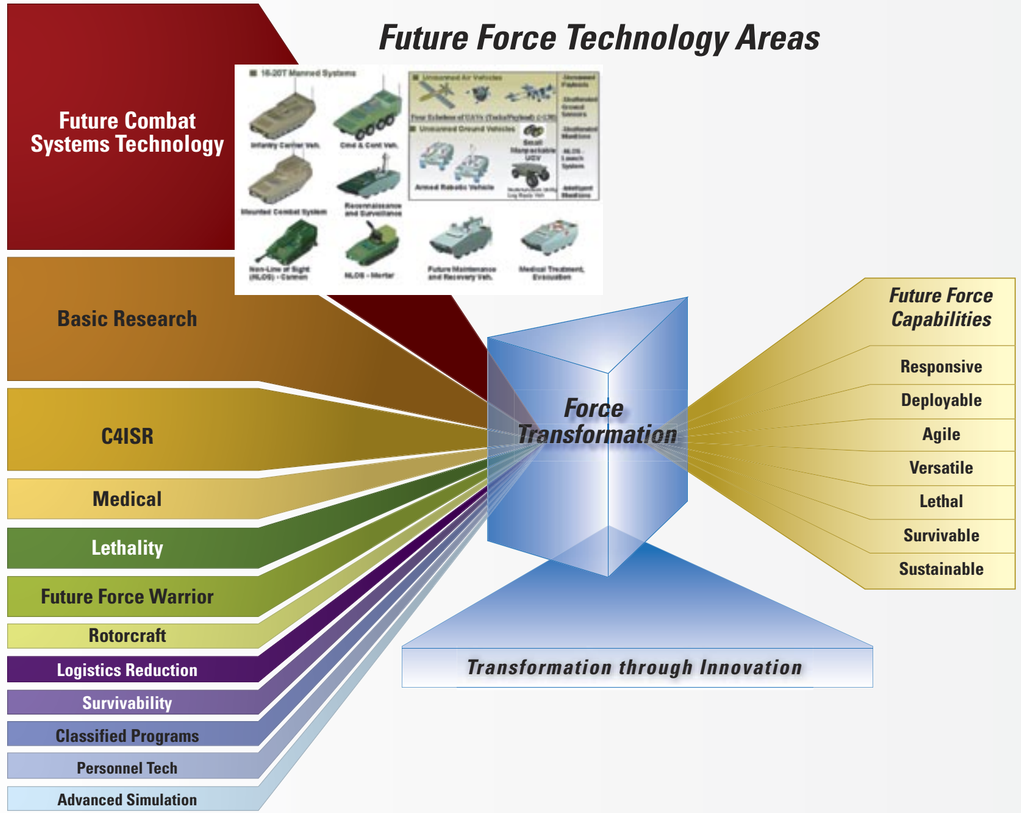


The Army Science and Technology (S&T) community is pursuing technologies to enable the Future Force and enhance the capabilities of the Current Force.

The most important S&T programs are designated by the Headquarters of the Department of the Army (HQDA) as Army Technology Objectives (ATOs). ATOs are co-sponsored by the warfighter's representative, Training and Doctrine Command (TRADOC). ATOs lead to the development of S&T products within the cost, schedule, and performance metrics assigned when they are approved.

Representative ATOs and some other key efforts are included here to relate S&T program opportunities to systems development and demonstration, and acquisition programs. The larger and more complex ATOs—those associated with significant warfighter payoff—may also be designated as Army Advanced Technology Demonstrations (ATDs) or Office of the Secretary of Defense (OSD)-approved Advanced Concept Technology Demonstrations (ACTDs). The ATDs and ACTDs are major systems and component-level demonstrations designed to "prove" the technical feasibility and military utility of advanced technology. The ACTDs also provide a limited leave-behind capability for continued evaluation and use while a determination is made regarding whether a formal acquisition program should be pursued. The Army's S&T investments have been articulated in terms of technology areas. The illustration at left depicts these technology areas in color bands that are relatively proportional to the Army investment in each area. The S&T section of this handbook is organized according to these technology areas, beginning with the Future Combat Systems (FCS) and ending with Advanced Simulation. Representative ATOs will be described within each area of technology. For FY05 there are 174 Army ATOs.

The Army Materiel Command (AMC), through the Research, Development and Engineering Command (RDECOM) centers and laboratories, executes nearly 70 percent of the Army's S&T program. Three other major commands (U.S. Army Medical Research and Materiel Command [USAMRMC], Corps of Engineers [COE], and Space and Missile Defense Command [SMDC]) and the Army Research Institute for Behavioral and Social Sciences execute the remainder of the Army S&T program.

Future Combat Systems (FCS)

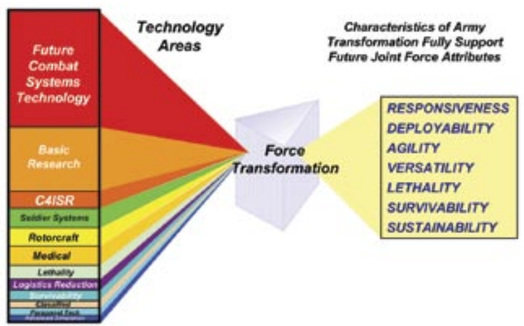
Since 2000, Future Combat Systems (FCS) has been the Army's top priority S&T program. In May 2003, FCS achieved acquisition Milestone B and transitioned from S&T to system development and demonstration (SDD). FCS will be a multi-functional, multi-mission, reconfigurable family of manned and unmanned systems designed to maximize:

- Joint interoperability
- Strategic and tactical transportability
- Integration of mission capabilities, including direct and indirect fire, reconnaissance, troop transport, counter-mobility, non-lethal effects, and secure, reliable communications

FCS will provide these advanced warfighting capabilities while significantly reducing logistics demands.

FCS is a system of systems, an ensemble of fighting capabilities that meets the weight and volume constraints for C-130 transportability. FCS will use mature Army technologies to provide revolutionary lethality through advanced direct and indirect weapon systems and increased agility using integrated advanced propulsion technologies such as electronic controlled suspension and hybrid electric propulsion.

The Boeing/SAIC lead systems integrator is identifying and integrating Army, Defense Advanced Research Projects Agency (DARPA), and industry technology programs to develop a system of systems that will satisfy the capabilities described in the Joint Requirements Oversight Council (JROC)-approved operational requirements document (ORD).



FCS objectives include the following:

- Provide revolutionary survivability for 20-ton class vehicles, using a combination of innovative lightweight armors, active protection systems, signature management, and new structural designs
- Reduce significantly logistic/sustainment demands compared to current systems by effectively integrating technologies to reduce fuel consumption and manning requirements
- Incorporate manned and unmanned air and ground platforms and effectively integrate these technology-enabled capabilities into the system-of-systems design

FCS will also feature embedded training and battle rehearsal capabilities to provide the commander with several new means to train the soldier.

FCS has adopted an "evolutionary" acquisition strategy that will enable the Army to increase its capabilities over time through spiral and incremental development processes. The initial version of FCS (Increment 1) will be designed to provide certain "threshold" capabilities, or basic capabilities of demonstrated effectiveness using current equipment or modified equipment in the Army's operational inventory. The subsequent versions will deliver increased functionality.

Army S&T continues to play an important part in the FCS program by providing certain critical technology solutions for FCS Increment 1, as well as capability-enhancing technologies for Increment 1 spirals and for Increment 2. Following are some of the other Army Technology Objectives (ATOs) that will enable FCS capabilities.

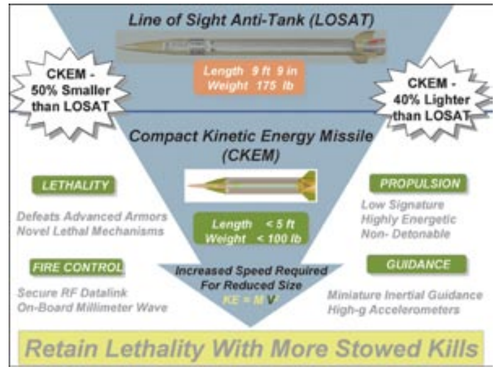
120mm Line-of-Sight and Beyond Line-of-Sight (LOS/BLOS) System ATD

The 120mm Line of Sight and Beyond Line of Sight (LOS/BLOS) ATD has as its objective the development and demonstration of a suite of 120mm LOS and BLOS armament system components and ammunition in support of the FCS Increment I Mounted Combat System (MCS), and the enhancement of the effectiveness of the Mid-Range Munition (MRM) through the addition of a second-seeker mode. The ATD will provide an integrated, lightweight MCS armament system components and ammunition suite that will defeat the operational requirements document (ORD) threat 0-12 kilometers.

Products of this ATD include the following:

- Lightweight, reduced-impulse cannon with electro-thermal igniter
- Advanced, novel penetrator kinetic energy and MRM munitions
- Fire control and ammunition handling system

These will be transitioned to Program Executive Office Ground Control Systems and Program Manager Ammunition in FY05-08. This effort provides a solution to one of the critical technology elements for FCS Increment I.



Compact Kinetic Energy Missile (CKEM) Technology ATD

The Compact Kinetic Energy Missile (CKEM) ATD will provide FCS and other Future Force systems with a revolutionary hypervelocity kinetic energy weapon. The CKEM weapon system is designed to provide overwhelming lethality against present and future threats at almost half the mass and size of the current kinetic energy (KE) missile. The result will be significantly improved versatility in the Future Force. CKEM will defeat explosive reactive armor (ERA) 1–3 and threat active protection systems by using a lighter, smaller, faster, KE missile that will significantly increase the number of KE stowed kills. CKEM's system-level performance goals include the following:

- Missile length: Fewer than five feet
- Missile weight: fewer than 100 pounds, threshold; 65 pounds, objective
- Range: Overwhelming lethality at 0.4–5.0 kilometers, with greater percentage kill than any current KE weapon at close engagements of fewer than 200 meters to ranges out to 8 kilometers
- Penetrator energy exceeding 10 megajoules at all ranges of interest

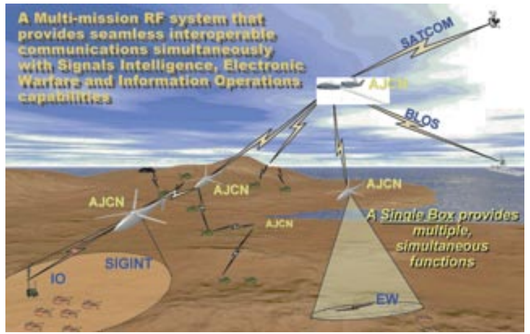
The following technologies are critical to successfully accomplishing the system performance goals and objectives:

- High-energy density
- Insensitive propulsion
- Enhanced lethality and hypervelocity guidance technology
- Advanced propulsion technology
- Miniaturization of guidance and control technologies
- Qualification of lethality damage mechanisms

Robotic Follower ATD

The Robotic Follower ATD will develop, integrate, and demonstrate control and perception technology required to achieve unmanned follower capabilities for future land combat vehicles. This technology supports a wide variety of FCS/ Future Force unmanned ground vehicles applications such as the Ruck Carrier, Supply Platoon, NLOS/ BLOS Fire, and Rear Security.

Key to the robustness and speed of the follower systems is the "assistance" of the manned leader (whether an individual soldier or a manned vehicle). This provides a high-level proofing of the follower's path, avoiding areas that would impede or confuse the unmanned followers, and operates with minimal user intervention. This cooperative effort between Tank Automotive Research and Development Center (TARDEC) and Army Research Laboratory (ARL) focuses on a series of demonstrations that successively increases the follower mobility performance and improves the maturity of the software algorithms, soldier/machine interface, and sensor technology for transition to FCS.



Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR)

Research and technology in the areas of command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) are designed to enable comprehensive situational awareness for network-centric operations. This technology area includes advanced sensors and sensor processing, intelligence and electronic warfare systems and techniques, militarized and special-purpose electronics, countermine technologies, and C4 system technologies. Following are some of the Army ATOs that will enable C4ISR capabilities.

Adaptive Joint C4ISR Node (AJCN) ACTD

The Adaptive Joint C4ISR Node (AJCN) ACTD demonstrates communications relay and signals intelligence/electronic warfare (SIGINT/EW) capability in a multi-functional, modular, scalable, and reconfigurable airborne payload. The ACTD will provide two Army payloads (fewer than 200 pounds) integrated into Hunter-class unmanned aerial vehicles and two payloads integrated into Air Force RC-135/KC-135 aircraft.

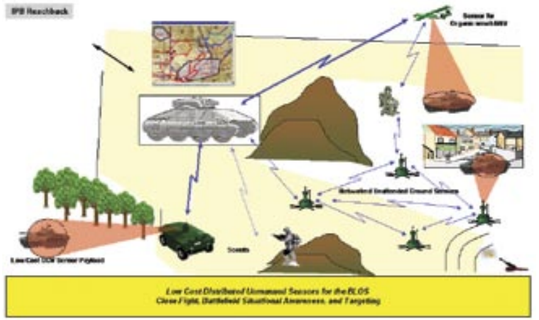
The mission payloads' primary functions are to relay multiple types of communications waveforms and to perform SIGINT, information warfare, and electronic attack missions simultaneously. The AJCN payloads are Joint Tactical Radio System (JTRS) compliant and will host JTRS software waveforms. An equally important product of the ACTD is the development of the concept of operations and tactics, techniques, and procedures for a multi-function payload and aerial communications relays.

The AJCN ACTD is a joint Army, Air Force, DARPA, and Joint Forces Command (JFCOM) technology program. The Army is the lead service; the Communications Electronics Research Development and Engineering Center is the technology manager. JFCOM is the operational manager. The ACTD program began in FY03 and will end with a military utility assessment in FY05. Funding for the four mission payloads' "residuals" support is provided through FY07 by the ACTD program.

Networked Sensors for the Future Force ATD

The objective of the Networked Sensors for the Future Force ATD is to develop and optimize sensor suites for small unmanned platforms, such as unmanned ground vehicles, small unmanned aerial vehicles, and unattended ground sensors. These sensor suites will incorporate robust (secure, jam-resistant, stealthy, self-organizing, self-healing) communications products.

A sensor hub links the networked sensors information to higher-echelon communications and provides reachback, command and control, sensor planning, and data management tools. The networked sensors will be developed to operate in complex terrain (including military operations in urban terrain) and demonstrate a system-of-systems capability.



This capability will provide commanders with organic unmanned networked sensors assets to provide beyond line-of-sight (BLOS) situational awareness (SA) picture and targeting information for direct and indirect fire weapons and threat avoidance. The networked sensors will:

- Provide remote monitoring out to approximately 10 kilometers without placing soldiers in harm's way
- Increase a unit's area of coverage
- Provide near-real-time BLOS SA data for early warning to speed decision making and reaction time

Low-cost sensor technology, such as uncooled infrared imaging, flash laser with short-wave infrared focal planes, and acoustic, seismic, and magnetic sensors, will be integrated on small unmanned platforms to demonstrate the day and night capability of these platforms to provide faster target identification and reaction time with reduced false alarms. The use of intelligence reachback and tools to aid in sensor deployment along with smart data management will also be developed.

Mounted and dismounted virtual simulations and live experiments with Training and Doctrine Command (TRADOC) Battlelabs in warfighter operational environments will be used to address hardware and operational integration issues; investigate new operational concepts, tactics, techniques, and procedures; and validate component and system technology readiness levels.

Battlespace Terrain Reasoning and Awareness

The Battlespace Terrain Reasoning and Awareness (BTRA) ATO seeks to develop a comprehensive suite of physical combat environment decision-support tools that generate the geospatial information necessary to support the decision and execution process across command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems of the Future Force.

The BATRA ATO will develop technology to improve the current static decision aids by providing dynamic tactical execution aids. These analytical tools will model the interrelationships of terrain, weather, force/threat behavior, and the influence of dynamic state environment changes. BTRA will ensure that the products of this analysis are "smart, interactive products" and have a content and structure capable of being imported and further evaluated by application-specific decision support tools of other C4ISR systems.

Geospatial Information Integration and Generation Tools

This ATO will deliver tools to integrate, manage, and exploit multi-source imagery, features, and elevation data to present only the best set of relevant terrain information. The generation and integration of high-resolution, accurate, timely, multi-source data into lightweight terrain networks are required to make the common relevant operational picture.

The capabilities developed will provide small-unit tactical operations with accurate, timely, up-to-date digital terrain information. Geospatial data mining tools will be developed to gather spatial data from traditional and non-traditional sources and automatically identify relationships and patterns that are not readily apparent to the warfighter. Additionally, software tools will be developed to generate terrain features and attributes from multi-source data in an autonomous or semi-autonomous mode to fill the gap between tactical geospatial information requirements and the strategic/operational information provided by the National Geospatial-Intelligence Agency (NGA, formerly the National Imagery and Mapping Agency [NIMA]).

Command, Control, and Communications On-the-Move (C3 OTM) ATD

The Command, Control, and Communications On-the-Move (C3 OTM) ATD is designed to provide effective employment of integrated C3 OTM systems, supported by intelligence, surveillance, and reconnaissance (ISR) assets and networked fires, and to provide early and continuing demonstrations of enhanced survivability and lethality of FCS platforms.This effort will leverage and integrate a variety of S&T, PM, and DARPA technology programs into a cohesive, integrated C3 system of systems.

In FY03, the initial demonstrations supported the FCS Milestone B decision by providing an understanding of the technology maturity and payoffs from C3 OTM technologies to enable FCS unit of action capabilities. These demonstrations integrated real, surrogate, and simulated sensors, along with surrogate FCS communications, and state-of-the-art command and control equipment to provide a baseline assessment of C3 technologies for the FCS and the lead systems integrator.

In FY04-05, the test bed demonstration assisted the FCS lead systems integrator and the Unit of Action Battle Lab to evaluate evolving FCS architectures. These demonstrations will continue in FY05, where 20 percent of the sensors/systems will continue to be simulated. Throughout the program, functionality and complexity of the command and control systems will be expanded to understand the limits of technology as capability is added. These demonstrations also provide operational testing information for tactics, techniques, and procedures.

Overwatch ACTD

The Overwatch ACTD's objective is to mature algorithms and integrate a staring sensor into a packaged system for mounting on a High Mobility Multipurpose Wheeled Vehicle (HMMWV) and an Unmanned Ground Vehicle (UGV) and to demonstrate the system's capability to detect, locate, and identify, by type, weapons being fired in real time. The ACTD will demonstrate the capability to detect, classify, and locate small arms, mortars, and rocket-propelled grenades in complex terrain at stand-off ranges to enable rapid, precision engagement of enemy shooters. The sensor package will consist of a fast-framing midwave infrared sensor, a longwave infrared imaging sensor, a laser ranger/designator, and an on-board processor. The HMMWV-mounted Battlefield Ordnance Awareness Sensor System will be modular in design to aid in migrating to other platforms.

In FY03 the program specified and acquired initial system hardware and developed and integrated the real-time system software. In FY04, the signature databases and classification algorithms were developed and integrated into a prototype sensor system on the HMMWV and the first initial full-scale test was performed.

In FY06, the sensor system will be integrated into the UGV and a major system demonstration will be performed. The final product will be a validated system mounted on an HMMWV and a UGV that supports dismounted forces by providing real-time detection, classification, location, and designation of small caliber weapons fire.

Joint Intelligence, Surveillance, and Reconnaissance (JISR) ACTD

The Joint Intelligence, Surveillance, and Reconnaissance (JISR) ACTD is designed to provide timely top-down/bottom-up ISR and operational information for enhanced battlespace visualization for the Central Command's (CENTCOM) early entry force commander. This includes sharing that picture with joint task force (JTF) and coalition partners. The program's goal is to implement a Web technology-based system of systems that integrates existing C4ISR sensors and processors to establish a joint tactical sensor grid. The JISR sensor grid has four major components:

- "Information agent" technology to enable smart data and product retrieval across disparate legacy sensors and databases
- Joint Technical Architecture (JTA) standard sensor link protocol (SLP) to plug additional tactical sensors into the grid
- Distributed geospatial metadatabase management system to organize, archive, and serve sensor data and other intelligence information to user friendly Web-based visualization tools
- Thin client Web browser technology allowing users remote access from any existing joint or combined command and control, intelligence (C2I) workstation

This sensor grid will seamlessly integrate with the existing theater C2I architecture to provide timely and relevant sensor data and other intelligence information to early entry forces and their supporting headquarters.

Counter Terrorism-Cave/Urban Assault ACTD

The Counter Terrorism-Cave/Urban Assault ACTD will demonstrate, with a Special Operations Forces (SOF) sponsor, an optimized suite of prototype lightweight, soldier-borne sensors that provides decisive overmatch for dismounted assault in restricted/covered environments – caves, tunnels, and urban environments. Current sensors are too large, too heavy (not man-portable), lack the range needed for identification, and the sensitivity for operations in "true dark" (interior spaces) and restricted terrain.

The prototype sensor capabilities introduced in the ACTD use micro-uncooled, infrared, short-wave infrared imaging, urban unattended ground sensors, and through-the-wall sensing technologies. The ACTD program also provides tactics, techniques, and procedures to achieve decisive capabilities in difficult/restricted terrain, day or night. The ACTD is structured in two vignettes: Cave/Tunnel Surveillance and Assault (Operational Demo I) and Urban Assault (Operational Demo II).

In FY03 the ACTD program acquired a sensor suite consisting of approach sensors and cave assault sensors, then conducted component performance evaluations to develop initial tactics, techniques, and procedures. In FY06 the military utility assessment will be completed and field residuals will be provided to the U.S. Army Special Operations Command (USASOC) to equip two SOF "A Teams" and transition development to designated Special Operations Command (SOCOM) Program Executive Office/Program Manager (PEO/PM) for acquisition. The ACTD program will fund these residuals through FY08.

Joint Tactical Radio System (JTRS) Squad-Level Communications ATO

The Joint Tactical Radio System (JTRS) Squad Level Communications ATO will provide multi-band, multi-mode squad-level tactical radio communications as a JTRS Cluster 5 gap-filler for the FCS Block I first-unit-equipped, limited user test in FY07. Through technical collaboration with the Future Force Warrior ATD, this ATO will ensure that user size, weight, power consumption, and unit cost objectives are met, and critical soldier radio wideband networking waveform (WNW) technologies are optimized for transition to the Land Warrior and JTRS Cluster 5 acquisition programs.

Wideband networking waveform and radio technologies emerging from the DARPA Small Unit Operations Situation Awareness System (SUO SAS) Phase 3 program will be matured to support network-centric operations for the dismounted soldier while mitigating risk for JTRS Cluster 5. This ATO will provide squad-level voice and data communications with connectivity to upper echelon C2/maneuver and unattended networks.

In FY00-02, DARPA developed and demonstrated SUO SAS prototype tactical radio communications in laboratory and field environments, supported by networking modeling and simulation analysis. In FY03, the Army conducted SUO SAS prototype tactical radio communications performance trade-off and affordability analyses to provide a shared wireless access protocol (SWAP)-reduced design and develop communications reference architecture to support hardware and software portability to JTRS. The SUO SAS prototypes were included in the C3 OTM demonstration in FY03 to evaluate heterogeneous quality of service in mobile ad hoc networks.

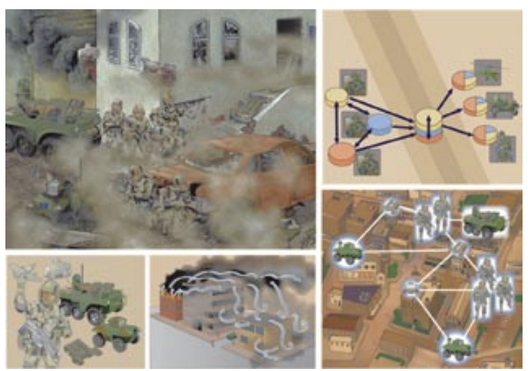
In FY04-05 the ATO program has developed SWAP-reduced, scalable (multi-band, multi-channel) radio frequency (RF) front-end and programmable radio modem and link-layer intranet processor WNW hardware and software components with JTRS-compliant application programming interfaces and begin laboratory integration and technical demonstrations of a squad-level tactical radio. In FY05-07, the ATO program will:

- Integrate wideband networking waveform with the JTRS platform to demonstrate portability
- Complete ruggedized Future Force Warrior soldier tactical radio mechanical packaging design
- Integrate with Future Force Warrior system for wearable application

Functional prototypes will be provided for the Future Force Warrior ATD operational user demonstrations and to support the FCS Block I first unit equipped limited user test.

Command and Control (C2) in Complex and Urban Terrain

The purpose of the Command and Control (C2) ATO is to develop a suite of C2 tools for Future Force dismounted and mounted commanders, leaders, and soldiers to employ during close combat in complex and urban terrain. These tools will be used to identify and fuse critical decision information day and night in any combat situation. Objectives will include experiments with an ensemble of tactical decision aids, unattended ground sensor clusters, air vehicles, ground robots, and human platforms, including their organic sensor assets.



The results will be enhanced survivability and increased combat effectiveness enabled by enhanced collaboration, reachback, autonomous asset management, and seamless situational understanding capabilities.

A modeling and experimentation effort will identify critical information filters for the commander. The Army Research Laboratory (ARL) will develop human performance models to quantify the effects of uncertainty on dynamic decision-making. The work will be a collaborative effort with the Mounted Maneuver Battle Lab, Ft. Knox, KY; the Dismounted Battlespace Battle Lab, Ft. Benning, GA; the Battle Command Battle Labs, Ft. Leavenworth, KS and Ft. Huachuca, AZ; and the Depth and Simultaneous Attack Battle Lab, Ft. Sill, OK. A suite of C2 system tools to provide decision aids to manage cognitive load and uncertainty in complex/urban terrains will also be demonstrated at these installations.

Command and Control of Robotic Entities (C2 ORE) ATO

This Command and Control of Robotic Entities (C2 ORE) ATO will develop innovative products to provide coordinated, dynamic, battle-command, tactical control of unmanned systems and synthesis of information from robotic air and ground systems to enable optimal interaction, coordination, and collaboration among unmanned systems. Candidate areas will be initially vetted in a modeling and simulation environment and subsequently tested in a series of three field experiments. Example air-ground information synthesis areas include:

- Air-ground information management aiding navigation, situation awareness, and mission payloads (e.g., reconnaissance, surveillance, and target acquisition; countermine; effects)
- Complementary multi-perspective imaging
- Optimization of air-ground communications relay placement

To accomplish this objective, C2 ORE will conduct system-of-systems integration and field experimentation with best-of-breed unmanned air and ground systems technologies from participating Army Research, Development, and Engineering Command ATOs/ATDs to support system of systems evaluation across multiple tactical application scenarios in relevant environments.

This will be augmented by a modeling and simulation environment that leverages current robotic and communication models to support communications, effects characterization, information management analysis, payload evaluation, and scalability testing. Live/virtual experimentation will be conducted utilizing TRADOC scenarios at locations including the Ft. Dix C4ISR on-the-move testbed and Ft. Knox Unit of Action Maneuver Battle Lab. Air-ground information systems products will be developed as an integral service for the FCS system of systems common operating environment. Yearly experimentation/analysis reports will capture relationships regarding air-ground information management and network utilization; this, in turn, will drive the design of services.

Soldier System Technologies

Soldier system technologies enable a paradigm shift in future infantry soldier capabilities, including enhanced ballistic protection, clothing and equipment, dismounted warrior C4, compact power and power management, nutritional enhancements, soldier weapons, and warrior technology integration, all at reduced weight.

Future Force Warrior (FFW) ATD

The Future Force Warrior (FFW) ATD will demonstrate revolutionary lethality, survivability, and agility for the dismounted soldier and small teams through an integrated system-of-systems approach. The goal is to provide the dismounted soldier with the same combat overmatch, skip-a-generation capability that the FCS brings to the maneuver portion of the Future Force.

FFW will employ open-system architectures and high risk/high payoff technologies to yield a lightweight, multi-threat, protective combat suite integrated with multi-function sensors, weapons, and medical capabilities. The soldier system-of-systems will enable the soldier to operate for extended periods under arduous conditions, with minimal loss in physical capabilities from fatigue, stress, and hardship.

A network-centric communications, sensor, and power suite will provide connectivity with other dismounted personnel, unmanned air/ground platforms, and FCS to form adaptive, distributed sensor networks for better situational understanding of local environments and threats. FFW connectivity will enable the soldier and small teams to network and mass fires, and generally access the power of the Future Force.

Key performance goals include the following:

- Fifty-pound maximum fighting load per warfighter
- Twenty-four-hour individual and 72-hour autonomous team operations
- Full networked communications
- Compatibility with Warfighter Information Network-Tactical (WIN-T)/Joint Tactical Radio System (JTRS)

A competitive concept exploration phase will be followed by design and demonstration phases to provide integrated, system-of-systems soldier demonstrators for FY07 field experiments and demos. Concurrent maturation of technologies will be performed to ensure system-of-system affordability, with reduced sustainment costs.

Flexible Display Technology for Soldiers and Vehicles ATO

This ATO will develop technologies for the affordable production of lightweight, rugged flexible displays. Technology advances will be exploited in three critical areas:

- Barrier coatings and structures
- Backplane electronics to drive individual pixels
- Electro-optic materials and devices for imaging

The development of displays on flexible substrates will enable novel applications that cannot be achieved by glass-based technologies. For example: wearable and conformal soldier applications, conformal, rugged cockpit displays, and compact displays that roll out for multi-user applications. For traditional imaging applications, flexible substrates will reduce the display component weight by more than 60 percent.

Weight reduction will be realized by lowering the ruggedization packaging for the electronic system, for those applications where the display glass limits the system ruggedness. This ATO will enable displays based on reflective, bi-stable electro-optic (EO) imaging devices and high-efficiency emissive devices that have lower power consumption as compared to traditional liquid crystal displays.

The reduction in power consumption is 30 percent to more than 90 percent as compared to conventional liquid crystal displays (LCDs) depending on the application. These EO devices are compatible with flexible substrates so that the power savings will be realized for all flexible display applications. The Army's Flexible Display Center will be executed through Arizona State University and in combination with the Army's ManTech flexible display program, as well as significant participation from the display industry.

Close-In Active Protection System (CIAPS) ATO

The Close-In Active Protection System ATO will demonstrate a prototype hard-kill active protection technology—Close-In Active Protection System (CIAPS)—to protect light armored vehicles (Phase 1) and tactical-wheeled vehicles (Phase 2) from rocket-propelled grenades and man-portable anti-tank guided missiles fired from ambush without warning at very close range.

In FY04, the ATO demonstrated a CIAPS prototype on a light armored vehicle and completed a tradeoff analysis for the CIAPS concept for tactical wheeled vehicles. In FY05, the ATO will demonstrate active protection system (APS) interceptor sensors and warhead with directional fragment pattern optimized for precise engagement with limited coverage. The goal by FY06 is to demonstrate a prototype CIAPS mounted on a HMMWV that defeats rocket-propelled grenades fired from short range, with multiple threats and on-the-move testing.

Waste to Energy Converter (WEC) ATO

The onsite Waste to Energy Converter (WEC) will reduce waste to nonhazardous byproducts while producing useful energy. Military field-feeding produces tons of packaging and food waste that must be buried, burned, or backhauled to disposal sites at great expense. A typical maneuver battalion or force provider base camp produces over a ton of solid waste per day. For overseas operations, reliance upon a host nation's often inadequate waste disposal infrastructure presents human health and environmental concerns, force protection challenges, and potential future liabilities.

The program objective is to convert 250 pounds of mixed plastic to 2 million BTUs of energy (equivalent to 16 gallons of jet-propulsion fuel 8 [JP8]) in a 24-hour period. The Army objective is to convert 1,500 pounds of organic mixed waste to 7.5 million BTUs (60 gallons of JP8) (technology readiness level [TRL] 6). The WEC will thereby reduce two logistical burdens, waste and fuel, while enhancing force protection and reducing signature and environmental impacts.

Rotorcraft

Rotorcraft research and technology is designed to enhance the performance and effectiveness of future rotorcraft, including rotors and structures, propulsion and drive systems, avionics and weapons, and human systems integration (e.g., crew station) technologies. The Army has reoriented the aviation S&T strategy to focus on unmanned aerial vehicles (UAV) to support the FCS goal of dominant situational awareness.

The strategy seeks creative and innovative approaches to integrate technological advances in aeronautics as well as mission equipment for UAVs. This strategy focuses on advances that are achievable by designing the UAV systems from the ground up, without the limitations that a manned platform imposes, and which take advantage of the warfighting synergy gained when manned and unmanned systems combine to accomplish a common objective.

The strategy also avoids the "man in the cockpit" and leverages the unique ability of the UAV to accomplish "dull, dirty, and dangerous" missions. The Army strategy aims to conduct research to mature technologies that result in UAV products that represent leap-ahead capability for the warfighter and are technically ready to transition to production. Following are some of the ATOs that will enable rotorcraft capabilities.

Hunter Standoff Killer Team (HSKT) ACTD

The Hunter Standoff Killer Team (HSKT) ACTD (FY01-FY06) will demonstrate advanced precision targeting, manned and unmanned vehicle teaming, and battlefield cognitive decision-aiding. These advanced warfighting capabilities will be integrated from mature technologies. The elements will be linked with other service assets as part of a joint maneuver task force to show the utility of teamed airborne reconnaissance, surveillance, targeting, and attack operations in a joint environment. The HSKT ACTD will also demonstrate tactics, techniques, and procedures and a concept of operations (CONOPS) while conducting a joint military utility assessment. The combatant commander sponsor for this ACTD is Pacific Command/U.S. Forces Korea.

The HSKT will:

- Improve the ability to mass fires and effects
- Increase force effectiveness in lethality, survivability, and operational tempo
- Improve intelligence and battle command situational awareness

This ACTD enables Future Force lethality capabilities by integrating and demonstrating the following technologies and tools:

- Cognitive Decision Aiding (CDA)
- Teaming UAVs with AH-64D Longbow Apaches and the Army Airborne Command and Control UH-60 Black Hawk (manned/unmanned teaming will allow the AH-64D Longbow Apache to use UAVs as wingmen, extend shooter eyes-on-target, increase situational awareness within current cockpit workload, and produce a more lethal, survivable, and responsive manned platform)
- Precision targeting sensor on UAVs
- Upgraded accuracy of Joint Standoff Weapons engagements from Navy F/A-18
- Exploitation of overhead theater surveillance assets

A-160 Hummingbird

The A-160 Hummingbird, a DARPA/ARMY ATO, is a rotary-wing UAV. Performance goals include:

- A 2500-nautical mile range
- 40 hours endurance
- 30,000-foot ceiling
- Out-of-ground-effect (OGE) hover performance of 15,000 feet

The vehicle is designed as either an extended range, multi-purpose UAV or medium altitude, long endurance UAV to support the Future Force units in primarily a C4ISR role. Other roles include tactical deployment of unattended ground sensors (UGSs), UGVs, and micro air vehicles (MAVs).

The A-160 relies on numerous advances in technologies to achieve these unprecedented characteristics. First is a patented optimum speed rotor (OSR) control that allows the rotor to operate over a wide range of operating speeds. The OSR enables the A-160 to operate at an optimum lift-over-drag (L/D) point for the specific flight conditions using high L/D airfoils. The rotor must be very stiff and light to operate over this wide range. The rotor blades are composed of graphite fiber composites that satisfy both requirements. Second, the hingeless, rigid, main rotor system allows the vehicle to be very responsive. Combined with high-speed electrical actuators, the system enables precision control, higher harmonic control, and improved performance in gusty conditions. Third, the A-160 has a high fuel fraction and an efficient power plant.

Designed payload weight will be a minimum of 300 pounds, which can be significantly increased by sacrificing range and endurance. Current maximum payload is 1,000 pounds. Projected aircraft-integrated payloads include the following:

- Electro-optic/infrared (EO/IR) surveillance systems
- Laser rangefinder/designators
- Synthetic aperture radar
- Ground moving target indicator radar
- Foliage penetration radar
- Electronic intelligence (ELINT) systems
- Communications network relays
- Net-centric communication nodes
- Satellite communication links
- Electronic countermeasures payloads

Many payloads will provide a maneuver commander with added situational awareness and increased situational understanding. There are also numerous payloads for remote delivery to include unmanned sensors and tactical resupply. The A-160 Hummingbird is being developed by Frontier Systems, Inc., of Irvine, CA.

Medical

Biomedical research and technology provide new opportunities to reduce casualties and loss of life, protect and treat warfighters to ensure worldwide deployability, and increase warfighter availability. Research efforts are managed by the U.S. Army Medical Research and Materiel Command (USAMRMC), and include Army and Department of Defense (DOD)-funded programs for which the Army is executive or DOD lead agent. Health hazards addressed include endemic infectious diseases (i.e., diseases naturally common to a specific geographic area), chemical and biological warfare agents, environmental injuries, operational stress, and trauma resulting from enemy weapons. The major goals of the Army biomedical S&T program are to provide technologies in the following three investment areas:

- Combat casualty care (prevent and treat casualties under field conditions)

- Infectious diseases (prevent or treat illness and injury)
- Military operational medicine (sustain optimum military effectiveness)

The primary goal of medical, chemical, and biological defense S&T development research is to identify and characterize medical countermeasures that have the potential to protect and sustain the joint service warfighter force in a chemical and/or biological warfare environment.

Following are some of the Army ATOs and other efforts that will enable new force health protection and combat health support technologies.

Combat Casualty Care

Field Medical Monitoring and Therapeutic Devices for Casualty Care ATO

The Army is developing smaller and lighter diagnostic life support and surgical systems that are compatible with far-forward field operations, in which factors such as high noise, vibration, dirt, moisture, and electromagnetic interference can render many medical devices unusable. These systems will fill a current gap in far-forward treatment capability and enable effective casualty care to be provided in the logistically constrained, highly mobile battlefield of the Future Force. Systems being developed include a two-person portable stretcher system for medical evacuation that integrates improved technologies in power, patient monitoring, and delivery of medication and oxygen.

Other efforts will exploit micro-impulse radar patient-monitoring for medic use, and will use ceramic oxygen-generator technology to provide medical-grade oxygen and eliminate logistically burdensome compressed gas cylinders. Other efforts focus on enhancing the current military field anesthesia delivery system to provide reproducible drug delivery and greater patient safety and achieve U.S. Food and Drug Administration (FDA) approval of the system. The latter will enable peacetime training and use of the device. Together, these systems will enhance the capability of medics and far-forward surgeons to initiate and sustain essential critical care at the front lines and during evacuation.

Fibron Dressing

Chitosan Dressing

Hemorrhage Control ATO

Army medical researchers are working on a variety of products that can save lives by quickly stopping blood loss from severe battlefield wounds. Excessive bleeding is the most common cause of death for wounded soldiers. Even in hospitals, the major causes of early death among the wounded are central nervous system injury and uncontrolled bleeding. The Army is pursuing drugs, devices, and techniques that slow or control bleeding and are usable far forward on the battlefield, since these have the greatest potential to save lives.

Two varieties of hemostatic bandages are currently under investigation. Designed to stem blood flow at the point of wounding, these bandages can be applied immediately and can stop the bleeding faster.

Army researchers have worked in coordination with Israeli investigators to explore the use of recombinant-activated human clotting factor VII (rFVIIa) in stopping internal bleeding. The protein rFVIIa binds to injured tissue and stimulates blood clot formation in the vicinity of the injury. The protein has been used successfully to treat bleeding episodes in hemophiliacs.

Army medical researchers are also developing expandable foams derived from fibrinogen, a protein involved in human blood clotting that is converted into fibrin, the major constituent of clots. These foams could be injected as a liquid into an inaccessible deep-cavity wound of a casualty (e.g., chest, abdomen), where they would be activated and expand to contact injured internal organs and control bleeding. High-intensity focused ultrasound (HIFU) is the third method being explored to stop internal bleeding. It uses ultrasound to locate the point of bleeding and then focuses a high-energy ultrasound beam on that point to cauterize the bleeding vessel.

Soft Tissue Trauma Care ATO

The Army is evaluating methods to effectively treat soft-tissue (flesh) injuries on the battlefield. New spray-on, flexible wound dressings provide pain relief, anti-infective protection, and auto-cleaning of wounds, as well as provide protection from further battlefield contamination. These dressings will preclude further and secondary tissue injury or damage, and may allow wounded soldiers to either continue operating, or at least minimize their care requirements pending evacuation. Other devices include a new, servo-controlled tourniquet for potential incorporation into advanced combat uniforms, and a lightweight system for wound cleaning and removal of dead tissue from the wound.

Battlefield Treatment of Fractures ATO

The Army is evaluating methods of effectively treating bone fractures that occur on the battlefield. New lightweight splint materials that can be effectively applied by the combat medic may, for upper extremity fractures, permit limited or full battlefield functionality of injured warfighters. For lower extremity fractures, these materials may permit sufficient mobility to reduce the number of unit personnel required to move the casualty pending battlefield evacuation. Other devices include new pins for surgical stabilization of fractures that incorporate anti-infectives to prevent subsequent bone infection, and new bone replacement material for surgical repair of bone injuries that incorporates anti-infectives to prevent subsequent infection complications.

Blood Products ATO

The Army seeks to develop freeze-dried plasma for use in treating bleeding in combat casualties. Current supplies of plasma must be refrigerated and delivery for use on the battlefield is logistically demanding. Successful development and licensing of freeze-dried plasma will make plasma available as a lightweight powder that can be reconstituted when needed. No special storage will be required and shelf-life will be much longer. This ATO also seeks a new method to rapidly sterilize blood products. This will allow medical treatment facilities to remove blood from one soldier, sterilize it, and transfer it immediately into another soldier without the worry of spreading infections such as HIV.

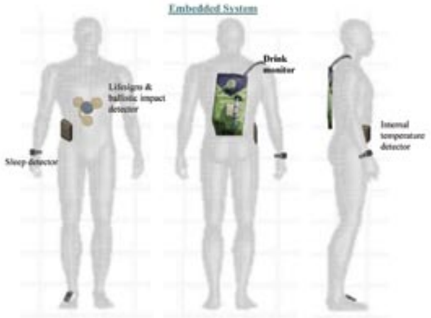
Warfighter Physiological Status Monitor (WPSM)

The proposed Warfighter Physiological Status Monitor (WPSM) will provide remote situational awareness information to warfighters and warrior medics. The WPSM will monitor soldier hydration status, internal temperature, and sleep status. It will also detect ballistic impacts on the soldier and the presence of a pulse and respiration. The final deliverable will be an integrated warfighter-worn prototype, compatible with the Land Warrior and Future Force Warrior battlefield ensembles. The information provided from each soldier will enable medical and tactical decision-making at a distance. This will allow the warfighter to maintain readiness through preventive health interventions (e.g., warning that a certain soldier is close to becoming a heat casualty or so tired that his thinking is impaired), and the warrior medic to direct his resources (time, equipment, supplies) to the casualties that will most benefit (triage).

Military Operational Medicine Research Program

The Military Operational Medicine Research program provides biomedical "skin-in" solutions that protect soldiers and enhance their performance in the face of multiple stressors in operational and training environments. It is a unique biomedical research program with relevant core capabilities, a problem-solving orientation, and a human physiology research focus. The program's biomedical research products have diverse applications that transition to Army planners, doctrine and materiel developers, and the Army medical community. These products also find service-specific applications elsewhere in DOD. The program's research products include the following:

- Physiological response and injury prediction tools



Warfighter Physiological Status Monitor

- Biomedically-based equipment design guidelines, behavioral models, and mental status assessment measurement techniques
- Weapon system health hazard assessment methods

Head-Supported Mass (HSM) - Warfighter Health and Performance ATO

Head-supported devices (HSDs), such as protective helmets and weapon sighting and communication systems, are critical components of combat systems; however, HSDs increase the weight supported by the head and neck and may place soldiers at risk of degraded performance or neck injury. System developers and health hazard assessors lack biomedically-based design guidelines and health hazard assessment methods to support the development of effective HSDs that will not degrade performance or injure soldiers. This research effort will use epidemiological studies, biomechanics and injury studies with human cadavers and mannequins, and advanced biofidelic neck models to develop and validate neck injury criteria. HSM research products will include biomedically-based HSD design guidelines for system developers and a health hazard assessment method for HSDs.

Body Armor Blunt Trauma Assessment ATO

Soldiers need effective and lightweight body armor, but future body armor systems made with effective, lightweight ballistic materials are likely to fail the current, overly conservative body armor performance standard for blunt trauma protection. This research effort employs novel force characterization

techniques, advanced human and animal finite element models, and animal injury validation studies to correlate measured forces behind body armor to blunt trauma injury. The research product will be a biomedically valid, user-friendly, and cost-effective body armor blunt trauma performance standard and testing method for body armor developers.

Medical Countermeasures for Laser Eye Injury ATO
The human eye is extremely vulnerable to the directed energy from military lasers. In an instant, and without warning, temporary or permanent visual impairment can be produced at tactical ranges and beyond. In the absence of proven medical countermeasures, the threat of visual impairment can seriously degrade force effectiveness. The Army needs effective diagnostic tools and treatments to rapidly evaluate and treat laser eye injuries on the battlefield to mitigate long-term damage, and laser eye exposure limits to guide the development of advanced laser systems that pose reduced risks of injury to soldiers who use them. This research will produce exposure limits for a new generation of frequency-agile laser systems. It will also produce a laser eye injury field therapy kit containing comprehensive laser eye injury diagnostic tools and advanced genomic and proteomic derived treatment strategies. These will enable combat medics to rapidly diagnose and treat laser eye injuries on the battlefield.

High-Altitude Warfighter Readiness Strategies (HWRS) ATO
The High-Altitude Warfighters Readiness Strategies (HWRS) ATO will address the need of Future Force to rapidly deploy and effectively fight in any environment, including high-altitude environments. Rapid deployment of unacclimatized troops to high altitudes can cause debilitating effects on performance and health. Current acclimatization techniques can take 6-14 days of continuous exposure to high altitude. Available medications that reduce acute mountain sickness (AMS) also impair work performance and have other adverse effects. This research will use advances in the understanding of altitude acclimatization and AMS pathophysiology to develop strategies to protect and sustain soldier performance and decrease AMS susceptibility during rapid deployments to altitude. The research products will include specifications for performance-enhancing nutritional supplements for high-altitude rations; procedures to induce and time-compress altitude acclimatization prior to deployment; prediction models of military work performance and altitude illness; and a decision aid to plan and manage unit task performance, altitude illness, and logistical needs.

Infectious Disease Research
The Military Infectious Diseases Research program is an Army-funded and –directed program that involves Army and Navy scientists deployed in an Army-Navy network of laboratories and field sites in the U.S. and overseas. The program focuses on developing drugs, vaccines, and vector-control products to prevent the operational impact of endemic infectious diseases in the battle area, the most common cause of military casualties during combat deployments. Recent emphasis is on developing diagnostic devices to assist the field medic in evaluation, management, and other decision-making relative to infected warfighters.

An Intravenous Drug to Treat Severe and Complicated Malaria Caused by Multi-Drug-Resistant Malaria
This ATO addresses a need for a new intravenous drug to treat severe and complicated malaria caused by multi-drug-resistant malaria parasites. The ATO will demonstrate efficacy and safety sufficient to obtain FDA approval for human studies and warrant transition of the candidate drug to advanced development.

Anti-Malarial Drug Discovery
This ATO will explore the feasibility of using genomic approaches, such as DNA microarray technology, to identify a new malarial parasite targets. Targets will be used to develop assays for drug discovery. The goal is to identify two new unknown targets and two drugs for each target to carry on to development for either treatment and/or prophylaxis of malaria.

Congressionally Directed Medical Research Programs (CDMRP)
The U.S. Army Medical Research and Materiel Command (USAMRMC) Office of Congressionally Directed Medical Research Programs (CDMRP) manages targeted biomedical research programs mandated by Congress. The mission of the CDMRP is to promote innovative research, recognize untapped opportunities, create partnerships, and guard the public trust in these target areas. Although not all of these programs have direct war-zone relevance, the potential benefits of the research realized by the civilian population will extend to warfighters and their dependents. Since its inception in FY92, the CDMRP has managed approximately $2.3 billion to support peer-reviewed research, spanning 26 programs. The five core programs managed by the CDMRP focus on breast, prostate, and ovarian cancer, neurofibromatosis, and military health. More than 4,180 contracts and grants have been awarded and are managed by the CDMRP. The USAMRMC will continue to manage peer-reviewed research programs in its five core programs and other areas as specified by Congress.

Lethality
FCS and the Future Force will require a complementary mix of weapon systems to accomplish the flexible, layered lethality necessary for the full range of missions. Weapon systems development programs focus on providing overwhelming lethality for line-of-sight (LOS), non-line-of-sight (NLOS), and beyond-line-of-sight (BLOS) with enhanced precision. These systems will not only contribute to survivability of the FCS forces but will also reduce the sustainment requirements associated with delivering vast quantities of ammunition, missiles, or mortars to the battlefield. The following programs are key technologies in this area and the associated area of target detection/identification/designation.

Objective NLOS-M Cannon Technology
This is a breech-loading mortar armament system that provides improved maximum rate of fire and improved sustained rate of fire in a lightweight 120mm mortar system. The program will demonstrate a breech-loaded mortar system able to receive digital threat information and engage targets out to eight kilometers.

Micro Electro-Mechanical Systems (MEMS), Inertial Measurement Unit (IMU) ATO
The Army is using Micro Electro-Mechanical Systems (MEMS) technology to develop affordable, precision guidance systems for missiles and munitions. The low-cost, high-gravity (high-G), MEMS Inertial Measurement Unit (IMU) program is developing small, reliable MEMS-based IMUs and inertial navigation systems to address the Army's concern over the high cost of traditional IMU systems, such as spinning mass, ring laser, and fiber-optic gyroscope-based systems. Army/Navy guided munitions and missiles require improvements in fire support (FS) capabilities for both close range and over-the-horizon missions. All extended range munitions require an inertial navigation system to achieve the required delivery accuracy.

A critical component of this system is the IMU. Today the IMU is costly and cannot survive the high-G setback acceleration experienced by projectiles; it cannot provide tactical accuracies; and it cannot be produced in quantity. Accordingly, the Army is focusing on development of a common MEMS-configured IMU product. Although the specific application requirement varies among munitions (which need high-G capability) and missiles (which need high accuracy), the same processing and manufacturing technologies are necessary for high-yield, low-cost MEMS devices for both weapon systems.

These MEMS-based guidance systems will enable the development of faster, smaller, lighter, lower cost, and more precise munitions and missiles. MEMS technology also provides inherent cost savings and size reduction, making it ideal for application to navigation and control systems for small missiles and munitions and other applications. In addition to the size and weight savings, the new MEMS IMUs are being designed to meet the requirements for more than 90 percent of the DOD tactical weapons; therefore, economies of scale in production will also result in major cost savings for DOD.

Logistics Reduction
Logistics reduction technologies enhance deployability and reduce logistics demand. Examples include the following:

- Precision roll-on and roll-off air delivery
- Technologies for airfields and pavements to support force projection
- Twenty-first century trucks and robotics to support resupply and demand for food, fuel, and water

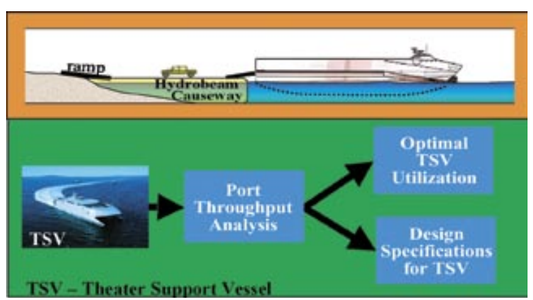
For convenience, environmental programs managed by the U.S. Army Corps of Engineers are also included in this section. Following are some of the Army programs and ATOs that will enable logistics reduction and environmental technologies.

Joint Rapid Airfield Construction (JRAC) ATO

The Joint Rapid Airfield Construction (JRAC) ATO will produce engineering tools that will vastly improve the military's capability to rapidly construct contingency airfields in the theater of operations. The primary objectives of this program are to:

- Integrate advanced terrain analysis technologies and performance prediction modeling to optimize contingency airfield site selection
- Exploit advanced construction technologies to enhance airfield construction productivity
- Utilize emerging commercial soil stabilization technologies to rapidly provide contingency airfield surfaces capable of sustaining mission operations

Rapid deployment of the Future Force will require airfields in-theater to sustain intense aircraft traffic associated with stability and support operations and small-scale conflict scenarios. In many force projection operations, in-theater airfields are either nonexistent or severely deteriorated. Currently, light and medium military engineer units do not have the capability to rapidly upgrade existing airfields or to construct contingency airfields to support Future Force mission requirements.



The objectives of this ATO is to bring together technologies that will assist the Interim and Future Forces in achieving optimal force projection throughput. This effort will create a rapid and effective site-selection process, enhance
construction productivity by 30 percent using computer assisted methods, and develop innovative stabilization techniques that will reduce required additive amounts by 50 percent and improve material cure times by as much as 96 percent.

Rapid Port Enhancement for the Theater Support Vessel (TSV) ATO

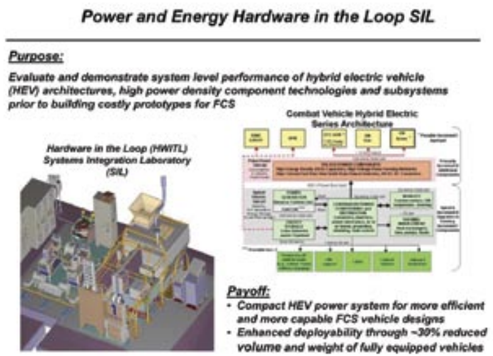
The Rapid Port Enhancement for the Theater Support Vessel (TSV) ATO will develop rapidly installed causeways for offloading TSVs at small ports, utilizing high strength fabric technologies. The program also will develop objective tools for evaluating existing port throughput capacity, port upgrade potential, and potential power projection throughput.

The product of this ATO will be a TSV-transportable causeway system that will build upon technologies produced by the Enhanced Coastal Mobility and Sea-State Mitigation ATD. This work will lead to a dramatic increase in the ability of the TSVs to accomplish required discharge rates, even in locations where the port infrastructure is extremely limited. Analytical tools will also be developed for identifying potential bottlenecks and predicting TSV throughput at small ports.

In FY04, an analytical modeling capability to predict causeway motions/responses was developed and technologies for continued development and demonstration of the causeway system will be evaluated and down-selected. By FY06, modeling and simulation tools for bottleneck identification and prediction of TSV throughput capabilities at small ports will be completed and validated and a rapidly installed lightweight causeway system will be transitioned to system development and demonstration.

Power and Energy Hardware-in-the-Loop Systems Integration Laboratory (P&E SIL)

The Power and Energy Hardware-in-the-Loop Systems Integration Laboratory (P&E SIL) provides a cost-effective, enhanced development environment for evaluating and demonstrating the performance of enhanced technologies for a compact, reduced weight hybrid electric (HE) power system for FCS-class ground vehicles. The program utilizes, leverages, and enhances the SIL developed under the Combat Hybrid Power Systems (CHPS) program to develop, characterize, and demonstrate advanced architectures, system controls, power and energy generation, intelligent management and compact components, and subsystems through Technology Readiness Level 5 (TRL 5).



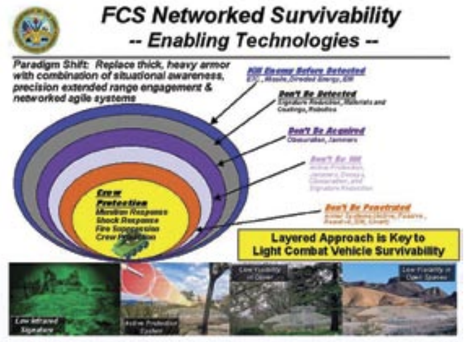
The P&E SIL environment provides system reconfiguration capability to evaluate variable bus voltages, component upgrades, and multiple controls in a highly instrumented laboratory. The P&E SIL will be used to iteratively evolve the vehicle design and configuration of FCS Increment I and II HE propulsion systems.

Compact, lightweight HE continuous and pulse-power subsystems will be matured for FCS ground vehicles. CHPS set modules and ARL power budget tools will be utilized in development of a real-time power and energy system-of-systems modeling and simulation tool.

Survivability

In FCS, the traditional notion that survivability equates to heavily armored vehicles is no longer valid. Survivability of the force and of individual platforms will be achieved with many layers of protection. The basic notion behind this concept is to "See First, Understand First, Act First, and Finish Decisively."

For FCS to be significantly more deployable and sustainable than current heavy forces, much lighter ground platforms will be needed. While survivability in FCS will be enhanced significantly through superior situational awareness and remote fires, the challenge for S&T is to provide sufficient platform protection for soldiers to perform their missions with confidence while keeping the systems light and agile. Following are some of the Army ATOs that will enable survivability technologies.



Integrated Survivability (IS) ATD

The FCS Ground Combat Vehicle Integrated Survivability (IS) ATD matures, integrates, and demonstrates selected survivability technologies from several different research, development, and engineering centers (RDECs) and the Army Research Laboratory (ARL) to address FCS platform threats.

Technologies include the following:

- Passive/active threat sensors
- Electronic warfare (EW) countermeasures
- Chemical energy/kinetic energy (CE/KE) active protection
- Advanced armors
- Signature management (SM) (testing of treated SM armor panels only)
- Decision control hardware and software
- Vehicle interface provisions
- Soldier/machine interface provisions

This program identifies and addresses the integration issues associated with upgrading FCS baseline survivability capabilities to meet FCS objective system survivability requirements, while maturing individual technologies for direct transition to the FCS SDD program. This ATD will also address the responsiveness, repairability and durability of armor modules, and the maintainability and transportability of the survivability suite.

Sensors for Explosive Detection ATO
All standoff sensors for detecting Improvised explosive devices (IEDs) must overcome significant higher-clutter sources, particularly from manmade objects in urban environments. Standoff sensors that rely on physical characteristics such as size, shape, depth, or concealment and casing material will inevitably encounter natural or manmade objects that closely resemble their targets. Short-range standoff sensors that detect explosives, on the other hand, are looking for a characteristic that is unique to their targets. These sensors could be deployed on autonomous and/or robotic platforms. Together, physical and chemical sensors could drastically reduce the occurrence of false alarms.

To date, there are no known explosives-detection sensors sensitive and mature enough to be transitioned to the field, though some are approaching this goal. The objective of this ATO will be to continue to develop short-range explosive-detection standoff sensors and evaluate their viability for IED and weapon cache detection and confirmation in urban tactical deployment and IED/mines in route clearance scenarios. In addition to sensor development, significant research will be conducted in the field for target explosive signatures. Collaboration with Edgewood, Transportation Security Administration, Department of Homeland Security, Army Research Laboratory, Army Research Office, and other Department of Energy (DOE) laboratories, such as Sandia and Oak Ridge, will be an important aspect of the signature/modeling research component.

Explosives/detection sensors are applicable for reduction of high-clutter areas such as those found in urban (IED/weapon cache) and route-clearance (IED) areas, and for mines in on/off-route scenarios. Currently, one explosives-detection technique (amplified fluorescence quenching polymer-based) is being studied for these applications, while others (spectroscopic) are in basic/applied research stages. In parallel with other sensors, explosives-detection sensors can move close to a suspected area and provide data, once integrated, that will reduce false alarm rates.

Future Force Power ATO
This ATO delivers critical power to the battlefield for essential C4ISR equipment required by the Future Force to win the information war and direct precision fire upon its opponents. Power technologies in this ATO span both mobile and soldier applications and allow seamless battlefield energy availability. This ATO will develop, demonstrate, and transition component-power technologies leading to higher energy, lighter weight, quieter, fuel-efficient and cost-efficient power sources, battery chargers, and power management systems.

This effort will provide technology advancements leading to new silent watch capability with quiet, lightweight mobile power generation. The ATO delivers 50 percent fuel savings with co-generation of cooling and power for shelter/tent systems. It bridges the gap between vehicles and soldiers with standalone self-powered man-portable field chargers/remote power sources, that reduce logistics costs by 80 percent by allowing the tactical use of rechargeable batteries.

Applied power management through the ATO effort greatly reduces required power and energy demands for both mobile and soldier applications. Specific power solutions and goals will include the following:

- 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
- Implementation and integration of power management for TOC and soldier systems
- Development of modular plug-in vehicle power sources for mission electronics

Personnel
Personnel technologies include advanced training tools and methods to enhance warfighter and commander abilities and performance; advanced human engineering concepts to ensure human system physical compatibility; and cognitive engineering concepts to avoid information overload and optimize task allocation to enhance warfighting effectiveness. Following are some of the Army ATOs that will enable personnel technologies.

Methods and Measures of Commander-Centric Training ATO
This ATO will develop and assess training methods for Future Force commanders and operators and formulate principles of effective training and measurement in the Army's future environment. This ATO will provide changes in unit behavior associated with digitization, identify key skills for digital system operators, identify key commander and operator skills, and develop measures of performance with defined levels of proficiency.

It will also describe requirements for automated measurement tools in realistic, simulated environments, employ controlled research environments for assessing training method, and formulate and assess training principles for key command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) skills to provide to materiel, training, doctrine, and training device developers.

Selection, Classification, and Performance Metrics for the Future Force ATO
This ATO will develop and test methods for identifying knowledge, skills, and attributes needed for effective future performance and for validating predictor measures needed for selecting and classifying soldiers in 2008 and beyond.

This ATO will identify common demands for future Army initial-entry jobs, identify selected future demands for two job groups, and identify the knowledge, skills, and attributes needed to effectively perform future jobs in these groups. The knowledge, skills, and attributes will include those linked to Army-wide demands as well as those unique to these groupings. The ATO will develop predictors and measures of future performance, then link predictors and performance measures to provide recommendations for future enlisted selection and classification.

Embedded Combined Arms Team Training and Mission Rehearsal
The goal of embedded training research is to develop simulation technology that will be embedded within Future Force systems to provide training and mission rehearsal capabilities that are available anytime, anywhere. Research is being conducted to support embedded training for both mounted and dismounted warfighters. Embedded training will provide individuals, crews, and leaders with realistic training, skill development, and mission rehearsal capabilities that will be an integral part of their FCS and Future Force Warrior systems. When fielded, it will permit soldiers to train with their "go to war equipment" anytime, anywhere.

Embedded training will integrate constructive and virtual simulations with actual warfighter machine interfaces, creating an "on-board" environment that will allow individuals and crews to use sensors, displays, and controls to interact with virtual terrain and computer-generated forces. The research will also explore the feasibility of using tactical C4ISR network and communications systems for net-based embedded training.

Advanced Simulation
Advanced Simulation tools provide increasingly realistic environments and systems to support acquisition, requirements, and training. This includes technologies for networked simulations, embedded training, constructive simulations, virtual environments, and range systems for live use. Following is one of the Army ATOs that will enable Advanced Simulation leading to immersive virtual training.

Modeling Architecture for Technology, Research and Experimentation (MATREX) ATO
The Modeling Architecture for Technology, Research and Experimentation (MATREX) ATO will evolve a component-based architecture to address fundamental deficiencies in the integration of current simulation systems. Currently, the Army's ability to examine the questions related to Army transformation is limited by:

- The lack of interoperability between key DOD simulations
- Inconsistent data and algorithm representations in Army simulations
- Modeling and simulation (M&S) expertise that is geographically distributed, thus difficult and costly to bring together for simulation needs throughout the acquisition process

This ATO will also develop new techniques to support high fidelity, distributed, and secure wide-area networked simulation that includes the Army, other services, and industry.

Enhanced Learning Environment with Creative Technologies ATO
The Army needs the capability to rapidly deploy effective, engaging training solutions using modern training technology to address not only the operational problems of lessons learned in the COE, but also the procedural issues that impede effective deployment (e.g., lack of onsite mentors and coaches). The objective of this ATO is to develop the academic design, methods, tools, and metrics for the use of interactive simulation technology as the means to deliver effective training. Interactive simulation technology is expected to increase the soldier's engagement in the training experience, thereby increasing retention and decreasing the burden of retraining.