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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE February 2005	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, R-1 # 49				
COST (In Millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Total Program Element (PE) Cost	80.961	62.546	139.100	66.900	62.500	63.000	66.000	68.000
Rapid Strike Force Technology LNW-01	14.154	0.721	36.400	46.400	47.630	60.120	66.000	68.000
Small Unit Operations LNW-02	12.757	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Future Combat Systems LNW-03	54.050	61.825	102.700	20.500	14.870	2.880	0.000	0.000

(U) Mission Description:

(U) This program element is budgeted in the Advanced Technology Development Budget Activity because it is developing and demonstrating the concepts and technologies that will address the mission requirements of the 21st Century land warrior.

(U) The emerging U.S. vision of future land warfare places strong emphasis on technology supporting early entry of light, efficient land forces. This project is developing technologies that enable mobile and survivable systems for efficient command and control, mobility, surveillance, targeting and reconnaissance as well as effective and adaptive weaponry, which are important aspects of an early-entry capability. The project consists of: Mach 5/50 Technology Development; Boomerang; Multi-Modal Missile; Non-Lethal Alternatives for Urban Operations; and the Tactical Urban Operations program. These programs are closely coordinated with the U.S. Army, Navy and Marine Corps.

(U) The U.S. Military requires flexible, effective and efficient multi-mission forces capable of projecting overwhelming military power worldwide. This force must ultimately provide our national leaders with increased options when responding to potential crises and conflicts. To satisfy this requirement, the joint Army/DARPA Future Combat Systems (FCS) program is being developed to provide enhancements in land force lethality, protection, mobility, deployability, sustainability, and command and control capabilities.

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(U) <u>Program Change Summary:</u> <i>(In Millions)</i>	<u>FY 2004</u>	<u>FY 2005</u>	<u>FY2006</u>	<u>FY2007</u>
Previous President's Budget	81.513	63.121	102.700	55.000
Current Budget	80.961	62.546	139.100	66.900
Total Adjustments	-0.552	-0.575	36.400	11.900
 Congressional program reductions	 0.000	 -0.575		
Congressional increases	0.000	0.000		
Reprogrammings	0.900	0.000		
SBIR/STTR transfer	-1.452	0.000		

(U) <u>Change Summary Explanation:</u>	
FY 2004	Decrease reflects SBIR/STTR transfer and a below threshold reprogramming.
FY 2005	Decrease reflects congressional undistributed reductions.
FY 2006 - 2007	Increase reflects additional funds in project LNW-01 to fund new non-lethal technologies and tactical urban operations efforts.

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COST (In Millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Rapid Strike Force Technology LNW-01	14.154	0.721	36.400	46.400	47.630	60.120	66.000	68.000

(U) Mission Description:

(U) The emerging U.S. vision of future land warfare places strong emphasis on technology supporting early entry of light, efficient land forces, particularly in urban areas where both combatants and civilians are present. This project is developing technologies that serve as force multipliers, enabling safe and effective operations in hostile environments. Revival of this project stems from the need to support the development of effective and adaptive weaponry, both lethal and non-lethal, for a variety of target suppression effects. Other technologies to be explored will include tele-operated systems, novel targeting and firing techniques, and advanced situational awareness and response systems.

(U) Program Accomplishments/Planned Programs:

	FY 2004	FY 2005	FY 2006	FY 2007
Mach 5/50 Technology Development	1.219	0.000	0.000	0.000

(U) Previously completed tasks in this project demonstrated revolutionary weapon concepts for firing small caliber projectiles at very high rates without the need for internal moving parts. The continuing Mach 5/50 tasks extend the concepts and technologies for leap-ahead performance in tactically relevant, lightweight, medium caliber direct fire weapons. The medium caliber projectiles (50-60 millimeter, 728 grams) will have a minimum muzzle velocity of 1,600 meters per second (~ Mach 5) at 600 rounds per minute or greater. Mach 5/50 technology development will provide multiple Services with a low-cost, reliable enabling technology to support a wide range of current and future applications including extended range combat vehicle firepower and lethality, full-spectrum future combat vehicle lethality for active protection systems, high engagement rate naval air defense, critical fixed site defense and improved aircraft self-defense. Portions of the technology development are conducted under an agreement with the Australian Defence Science and Technology Office.

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(U) Program Plans:

- Develop medium caliber concepts, detailed performance simulations and technical analyses.
- Fabricate and test critical technology subsystems.
- Complete integration of pre-prototype components and evaluate against simulation-based interim performance parameters.
- Critical design review and complete fabrication of full-function prototype.
- Complete system test and evaluation of full function prototype and validate simulations.
- Conduct Phase 1 firing demonstration and deliver final report.
- Conduct Phase 1 Rate of Fire demonstration.
- Transition hardware and data packages to DoD laboratories for Service-specific engineering and platform integration.

	FY 2004	FY 2005	FY 2006	FY 2007
Boomerang	5.483	0.721	0.000	0.000

(U) This program continued work previously reported under PE 0602702E, Tactical Technology to rapidly develop and demonstrate affordable and reliable acoustic gun shot detection and localization techniques. This program focused on enhancing the safety of vehicle convoys and increasing situational awareness. Based on previous acoustic shot detection work, this program developed system hardware design and packaging, vehicle integration concepts, user interfaces and signal processing algorithms and software for prototype systems, as well as continued refinement of algorithms, hardware and software to improve system performance and accuracy. Acoustic sensors, mounted in an array at the top of a mast, are used to detect both supersonic shock and sound waves from muzzle blast and then identify the location of the shooter. Users receive simultaneous visual and auditory information about the point of fire from an LED display and speaker. Boomerang systems are being tested by warfighters serving in Operation Iraqi Freedom (OIF) and are providing force protection capabilities for moving vehicles and stationary sites. The systems were designed for ease of use, installation and field upgradeability. Shot data collected from a series of CONUS firing tests and from systems deployed to OIF demonstrated that Boomerang provides troops the ability to detect and locate supersonic shots for both stationary and moving targets. Comments from deployed troops continue to be collected and analyzed. As a result, an improved version of the Boomerang system with significantly smaller acoustic arrays (designed to reduce visual footprint) is being developed with enhanced crew display, increased detection range, ability to provide shooter's elevation, and improved electro-magnetic interference thresholds so as not to interfere with tactical combat radios used by Marine and Army units.

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(U) Program Plans:

- Improve performance based on data from deployed systems, user feedback and evolving concepts of operations.
- Conduct extensive testing on the enhanced system to validate improved system performance, reliability, and robustness.
- Fabricate and deliver updated systems to deployed warfighters for field testing.

	FY 2004	FY 2005	FY 2006	FY 2007
Multi-Modal Missile	0.000	0.000	12.400	16.400

(U) The Multi Modal Missile program will explore the development of an integrated, man-portable weapon system capable of performing surface-to-surface, anti-armor, and surface-to-air-anti-aircraft missions with an emphasis on extreme precision. The program will focus on delivering precision targeting accuracy to 1) enable light-weight munitions and thus deeper magazine and/or longer engagement ranges, 2) tailor categories of kill through subsystem targeting, and 3) the potential for lethal effects against targets otherwise beyond the reach of man-portable weapons. The objective M3 capability will integrate a variety of existing weapons-systems functions and provide the dismounted soldier with a compact system to engage vehicles, rotorcraft, and close air support aircraft. The effort will also explore additional mission concepts to include anti-personnel and breaching applications and will consider beyond-line-of-sight functionality. Critical characteristics of this weapon system concept include light weight, simple operation, and affordability. Technologies under consideration will include advanced imaging seekers and/or operator terminal guidance; low-cost, high-performance, solid-rocket engines; sensor-based fusing; and novel warhead concepts to support a wide range of engagement geometries with desired lethality effects against a range of targets.

(U) Program Plans:

- Perform initial system design analyses and trade off studies.
- Initiate critical technology, maturation efforts for seeker, propulsion, guidance and warhead.
- Develop, analyze and assess initial multi-modal missile system preliminary designs.

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	FY 2004	FY 2005	FY 2006	FY 2007
Non-Lethal Alternatives for Urban Operations	0.000	0.000	12.000	15.000

(U) The Non-Lethal Alternatives for Urban Operations effort will explore system concepts and enabling technologies for non-lethal weapons in challenging urban and semi-urban environments. This effort will assess effects, targeting systems, delivery systems, and counter effects, and will develop integrated less-lethal system options for application to urban warfighting. Effects to be investigated will include less-lethal projectiles, malodorants, counter mobility agents, entanglers, and marking agents. The effort will address both systems designed to counter individual personnel and systems designed to provide area effects against vehicles, crowds and groups of combatants. This effort will explore both direct fire and indirect fire delivery options. Systems concepts to be explored will include force protection for fixed sites, force protection for mobile forces, individual soldier weapon options, systems for border protection, systems for protection of extended infrastructure and systems to support application on autonomous and teleoperated unmanned ground robotic vehicles in urban environments.

(U) Program Plans:

- Perform initial concept development and effects assessment.
- Develop initial urban less-lethal system design.
- Begin focused less-than-lethal technology maturation efforts to address and reduce system risk.

	FY 2004	FY 2005	FY 2006	FY 2007
Tactical Urban Operations (TURBO) program	0.000	0.000	12.000	15.000

(U) The Tactical Urban Operations (TURBO) program is an outgrowth of the Precision Urban Combat System (PUCS) program funded from PE 0603766E, Project NET-01. TURBO will develop and validate advanced precision and area weapon capabilities for use by joint dismounted forces in urban combat operations. Example technologies include: precision munitions with greatly improved accuracies, individual area effect munitions with greater range and flexibility, sensors with the capability to detect hidden human targets, improved weapon sights and weapon enhancements to provide greater accuracy and identification of friend or foe, multi spectral designation / marking systems for improved flexibility and covertness, and robotic applications. These systems will be developed within the framework of both legacy forces and expected future forces.

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The result will be to provide dismounted soldiers with increased capability and flexibility, and to move precision munitions accuracies from meters to centimeters thus allowing very small weapons to be effectively employed. The program will be a multi-phase program with frequent user reviews to ensure that the resulting products are meaningful and affordable. The program will culminate with a series of prototype demonstrations of the capabilities in a surrogate urban combat environment.

(U) Program Plans:

- Define system architecture and constraints in conjunction with user group.
- Develop and demonstrate technologies and evaluate to determine system effectiveness.
- Initiate second phase to improve selected technologies and integrate them into the overall PUCS system.

	FY 2004	FY 2005	FY 2006	FY 2007
Reconnaissance, Surveillance and Targeting Vehicle (RST-V)	7.452	0.000	0.000	0.000

(U) The Reconnaissance, Surveillance and Targeting Vehicle (RST-V) program, conducted by the Marine Corps and DARPA, designed, developed, and demonstrated a prototype hybrid electric drive, lightweight, highly maneuverable advanced technology demonstrator vehicle capable of V-22 internal transport. The vehicle incorporated technological advancements in the areas of integrated survivability techniques and advanced suspension. The vehicle also hosts integrated precision geolocation, communication and Reconnaissance, Surveillance and Targeting sensor subsystems. The RST-V platform provides a mobile quick deployment and deep insertion capable, multi-sensor, battlespace awareness asset for small unit tactical reconnaissance teams, fire support coordinators and special reconnaissance forces. Continuing efforts were funded to accelerate the prototype into Technology Readiness Level (TRL) 6 with hardening of components prior to the system development phase and full transition to the Marine Corps. DARPA established an MOA with the Marine Corps for final transition of this program in September 2004.

(U) Program Plans:

- Funded component upgrades to reach TRL 6 and transition to Marine Corps.

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(U) **Other Program Funding Summary Cost:**

- Not Applicable.

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COST (In Millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Future Combat Systems LNW-03	54.050	61.825	102.700	20.500	14.870	2.880	0.000	0.000

(U) Mission Description:

(U) The Army's Future Combat Systems (FCS) is envisioned to be a System of Systems (SoS), which will provide capabilities that strike an optimum balance between critical performance factors (e.g., operational and tactical mobility, lethality, survivability, and sustainability) and strategic responsiveness. The FCS program embraces an evolutionary acquisition, spiral development process. The first FCS SoS Unit of Action (UA), equipped with the eighteen (18) FCS Systems, plus the Network, will be initially fielded in 2014. The program allows for continuous capability upgrades through the introduction of new, enabling technologies throughout the development phase. This Joint DARPA/Army activity supports the FCS spiral process through the development of critical technology improvements for FCS platform variants and the Network. The resulting network-centric SoS will continue to provide the Unit of Action overwhelming lethality, strategic deployability, self-sustainment, and high survivability over other conventional ground forces.

(U) Program Accomplishments/Planned Programs:

	FY 2004	FY 2005	FY 2006	FY 2007
FCS Supporting Technologies	54.050	61.825	102.700	20.500

(U) DARPA and the Army identified key areas where technology development is needed for potential pre-planned product improvements via the planned FCS Spirals: Class I, II and III unmanned air vehicles, robotic unmanned ground vehicles, UA and above command, control and communications, advanced radar sensor and EW systems, and advanced armament and missile systems.

(U) The Perception for Off-road Robotics (PerceptOR) program identified and developed revolutionary unmanned vehicle perception prototypes. These perception systems were flexible enough to operate in off-road environments and provided extensive experimental test data in a variety of operationally relevant terrain and weather conditions. The resulting technology is applicable to a variety of combat roles and will enable

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greater confidence in postulating the conditions under which unmanned off-road robotics should be used. The FCS PerceptOR technology was integrated into the UGCV-PerceptOR Integration (UPI) program.

(U) The Unmanned Ground Combat Vehicle (UGV) program developed vehicle prototypes exhibiting advanced performance in endurance, obstacle negotiation, and transportability (small size) based on novel designs unrestrained by the need to accommodate human crews. These prototypes included unique mobility configurations, exceptional drivetrains, advanced structures/composites, terrain/soil analysis, sensory exploitation and interaction with robotic control architectures. The FCS UGSV technology was integrated into the UGCV-PerceptOR Integration (UPI) program.

(U) The UGCV-PerceptOR Integration (UPI) program will integrate autonomous navigation algorithms with the Spinner platform to yield an unmanned ground vehicle (UGV) that operates reliably in obstacle-rich terrain. Spinners will be used as platforms to port and test methods for perception techniques to optimize autonomous performance. This natural mating of the best-of-class sensors and algorithms on a vehicle of Spinner's class represents a leap forward in UGV capability. Autonomous mobility will be further enhanced by the use of terrain data for path planning. The program's technologies will transfer to the FCS Armed Robotic Vehicle (ARV) and Autonomous Navigation System (ANS) programs through PM-UA, anticipated to occur in FY 2008.

(U) The Future Combat Systems MultiCell and Dismounted Command and Control program enables experimentation with advanced command and control information technology. MultiCell emulates the functionality of an entire tactical combined arms force. The program incorporates both unmanned air and ground robotic platforms, headquarters working at the operational level, and human dismounts. MultiCell also provides commanders with recommended interface functions and workload allocations. MultiCell validates the understanding of the dynamics of complex warfighting organizations thus defining commander interface layouts, functions and displays for maximum flexibility and effectiveness. This program recommends capability enhancements supporting technology for the nomination of information sources and supports visualization of current and future operational states. MultiCell enables commanders to successfully prosecute future command and control operations with significantly reduced staff. DARPA established an MOA with the Army for this program in August 2003. The Multi Cell Command and Control technology is planned for transition to the Army at the conclusion of Phase II, anticipated to be completed by FY 2006.

(U) The Maneuver C³ program will develop robust, assured and potentially high data rate connectivity for the Future Combat Systems (FCS) elements along with a command and control architecture to reduce the number of forward deployed Command and Control (C²) operators. The

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communications component will develop an integrated architecture that provides for a seamless transition from line-of-sight to non-line-of-sight communications. To enable this functionality, development of new secure waveforms, directional antennas and mobile ad hoc networks will be initiated. The C² component will directly leverage the Army's investment in the automation of the Battlefield Functional Areas within the Army Battle Command System (ABCS). Because of the multitude of single aspect systems that feed information in ABCS, large amounts of data are made available to the commander, thus requiring a much larger staff of operators and workstation analysts to complete the fusion function of battlefield data into information for the commander to make decisions. Future operations involving FCS technologies and operational capabilities cannot be restricted by a less responsive C² architecture and large support staffs. DARPA established an MOA with the Army for this program in July 2004.

(U) Under the Maneuver C³ program, the Mobile Networked Multiple-Input/Multiple-Output (MIMO) (MNM) project will pursue MIMO communication systems, which have the potential to increase data rates by 10-20 times above current systems. MIMO will use multipath to create parallel channels in the same frequency band thereby increasing spectral efficiency. This effort will demonstrate the MNM capability under dynamic urban Non-Line-of-Sight multipath channel conditions where conventional techniques are degraded. This effort will undertake advanced MIMO technology development and perform field demonstrations of mobile ad hoc networks (MANETs). This effort will culminate in the development of a wideband form-factor (Joint Tactical Radio System (JTRS) cluster 1 size PC card) system. The MNM technology is planned for transition to the Army, FCS Program at the conclusion of Phase II that is anticipated to be completed by FY 2007.

(U) The Netfires program developed and tested a containerized, platform-independent multi-mission weapon concept as an enabling technology element for FCS. NetFires provides rapid response and lethality in packages requiring significantly fewer personnel, decreased logistical support and lower life-cycle costs, while increasing survivability compared to current direct fire gun and missile artillery. NetFires will allow FCS to defeat all known threats, will be air deployable in C-130 (and smaller) aircraft, and will enhance the situation awareness and survivability of FCS by providing standoff target acquisition and extended-range, non-line-of-sight engagements. The program developed and demonstrated a highly flexible modular, multimission precision missile and a loitering attack missile that can be remotely commanded. Both missile types have a self-locating launcher and a command and control system compatible with FCS. This program transitioned to the Army in March 2004.

(U) Two autonomous air vehicle programs will provide reconnaissance and surveillance, and targetin g information for small unit FCS direct and indirect fire weapons. The approach is to develop autonomous vehicles for operation at two levels; a company level vertical take off and

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landing unmanned air vehicle (VTOL UAV) program will develop a vehicle for carrying out airborne surveillance and targeting against ground targets; and a platoon level VTOL UAV for providing small units with an organic reconnaissance and surveillance capability. The company level UAV will be developed under the OAV-II program and the platoon level UAV will be developed under the Micro Air Vehicle (MAV) program.

(U) The Organic Air Vehicle – II program consists of 2 primary elements: development of lift augmented ducted fan vertical flight vehicles together with their associated flight controls; and evaluation and integration of supporting technologies including non-line-of-sight communications, heavy fuel engines, improved navigation and obstacle avoidance, and acoustic noise reduction. Once the basic flight vehicle is proven, these technologies will be integrated into the flight vehicle and demonstrated in a simulated mission. The OAV-II program will leverage several programs in DARPA and the services including advanced communications, sensor developments, the MAV ACTD, and UAV command and control programs. The dry system weight (no fuel) of the OAV II to be developed in FY 2005 will be no greater than 112 lbs. DARPA established an MOA with the Army for this program in December 2004. The program will transition to the Army at the end of Phase III, which is anticipated to be in FY 2009.

(U) The primary goal of the Micro Air Vehicle (MAV) Advanced Concept Technology Demonstration (ACTD) program is to further develop and integrate MAV technologies into militarily useful and affordable backpackable systems suitable for dismounted soldier, Marine, and Special Forces missions. It will focus on the development of lift augmented ducted fan MAVs to accomplish unique military missions, particularly the hover and stare capability in restricted environments. The objective of the MAV ACTD is to demonstrate a backpackable, affordable, easy-to-operate, and responsive reconnaissance and surveillance system. The system will provide the small unit with militarily useful real-time combat information of difficult to observe and/or distant areas or objects. The system will also be employable in a variety of warfighting environments (for example: in complex topologies such as mountainous terrain; urban areas; confined spaces; and high concentrations of civilians). The initial MAV technology development program focused on the technologies and components required to enable flight at small scales, including flight control, power and propulsion, navigation and communications. The MAV ACTD program is intended to get DARPA-developed small, VTOL UAVs rapidly into the hands of the users for evaluation and evolution of the technologies; development of tactics, techniques and procedures; and to provide a residual operational capability to active duty forces. The FCS MAV technology is planned for transition to the Army during FY 2007.

(U) The FCS LADAR Support (JIGSAW Phase III) program develops advanced laser radar (LADAR) sensor systems and technologies. Jigsaw enables warfighters to accomplish day/night target identification and verification in stressing environments. Environments of interest include targets hidden by foliage and camouflage, and targets in urban settings, such as alleyways. Jigsaw technologies are designed to provide

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warfighters with reliable combat identification; the LADAR sensor will deliver a visual picture of the target scene. DARPA established an MOA with the Night Vision and Electronic Sensors Directorate for this program in October 2004. The JIGSAW technology is planned for transition to the Army at the conclusion of Phase III that is anticipated to be completed by FY 2007.

(U) The Foliage Penetration (FOPEN) Reconnaissance, Surveillance, Tracking and Engagement Radar (FORESTER) initiative supports the Future Combat Systems (FCS) and the U.S. Army Objective Force. The program is developing FOPEN Ground Moving Target Indication (GMTI) radar. This radar promises persistent, long-term detection and tracking of enemy combat vehicles and dismounted troops moving in open and forested areas of the battlefield. The technology allows Objective Force commanders to operate with confidence in forested areas. It also detects low-flying aircraft such as helicopters and ultra-lights. Its synthetic aperture radar images support terrain delimitation, road identification, and target tracking in wooded areas. FORESTER is a UHF-band FOPEN GMTI radar for deployment on rotary wing platforms such as the A160 unmanned helicopter. The radar, operating from a hovering platform under calm wind conditions, can achieve calm-weather detection ranges in excess of 30 kilometers against dismounted troops moving in forested areas. The program employs adaptive antenna processing and innovative radar waveforms to overcome radio frequency interference and electronic countermeasures in hostile electromagnetic environments. The FORESTER technology is planned for transition to the Army at the conclusion of Phase III anticipated to be completed by FY 2008.

(U) The Affordable Adaptive Conformal Electronically Steerable Array Radar (AACER) program develops components and technologies for a helicopter-borne surveillance, targeting, and communications capability and integrates them into an airborne system suitable for use on the next generation Unmanned Airborne Vehicles such as A-160. The technologies being developed include: (1) Ka band Electronically Scanned Antenna Arrays (ESA) which lend themselves to affordable manufacturing techniques; (2) underlying ESA devices such as phase shifting elements and power amplifiers/combiners which operate at Ka band and are affordable yet support the requirements of a high performance radar system; (3) miniature receiver exciter modules capable of generating waveforms for high performance MTI and SAR radar, for communications functions including combat identification, and for growth to higher performance and additional functions in radar and electronic warfare; (4) very high performance, small size and low cost signal processors to support high resolution radar surveillance and tracking functions, target imaging and geolocation, and communications functions; (5) signal processing algorithms to optimally exploit the inherent capability of the ESA to support multiple functions simultaneously, each with state-of-the-art operational performance; and (6) integration of all technical elements into a functional system that meets UAV platform constraints, is suitable for flight demonstration on manned and unmanned vehicles, and provides a concrete basis for demonstrating the affordability of production units. If successful, this program will provide a vastly improved intelligence and targeting capability for local commanders by providing a dedicated, rapidly taskable asset with the capability to maintain surveillance of a large

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region of their battlespace, including areas inaccessible or obscured to larger airborne assets. DARPA established an MOA with the Army for this program in January 2005. The AACER technology is planned for transition to the PEO-IEW at the conclusion of Phase III, anticipated to be completed by FY 2008.

(U) The Affordable Weapon System Long Gun program will evaluate and develop a re-useable, long endurance, low cost, joint, unmanned/armed missile system combined with a tri-mode long wave infrared/near infrared/visible (LWIR/NIR/VIS) sensor with laser spot targeting. Ducted fan propulsion will provide efficient thrust for long endurance. The missile will be launched from a canister carried on a sea or ground vehicle, will fly to a specified target area, and use a tri-mode sensor operating at visible, long, and near-infrared wavelengths to search for targets. If a qualified target is found, the missile will attack the target with a self-contained munition. If no targets are found, the missile could be commanded to return to base. The missile will include a data link back to a human controller/operator to confirm target characteristics, approve engagement, and perform battle damage assessment. Beginning in FY 2005, the program is funded under PE 0603286E, Project AIR-01.

(U) The electro-magnetic (EM) Mortar program will design and demonstrate EM guns (coilgun and railgun) capable of firing modified 120 mm mortar rounds to 420 m/s. The second goal is to evaluate significant system “trade space issues” for implementation including: 1) ammunition integration and compatibility; 2) vehicle integration concerns; 3) system reliability metrics (barrel life, EM interference); 4) lethality change due to modification; and 5) system supportability metrics. Transition of operational capability will be accomplished through the Army FCS program, and is anticipated to occur in FY 2007.

(U) The DP-5X program will provide a flight-ready, tactically transportable, vertical take-off and landing unmanned air vehicle (VTOL UAV) to integrate with a gimbaled payload for technology demonstration of the JIGSAW sensor package. The UAV will be employable by a two person team and deployable in a single HMMWV. It will provide lift for a 75 lb payload with 6 hours endurance, 100 kts cruising speed, with nap of the earth agility. Multi-mission capability and modularity will allow the DP-5X to rapidly integrate additional payloads for sensing, communications, and target effects. The DP-5X program is planned for transition to the Army in FY 2007.

(U) The Future Combat Systems Studies, Analysis and Experimentation Project enables the continued Joint analysis and integration of enabling future land warfare concepts and technologies into the U.S. Army Future Combat System program. It enables the rapid analysis of opportunistic concepts and technologies, and provides support for Joint Force effectiveness modeling of DARPA enabling technologies by the

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TRADOC “Future’s Center.” The project has three initial focus areas: Air Assault Expeditionary Forces (AAEF), USMA Systems Engineering, and Directed Studies.

(U) The objective of the FCS International Cooperation program is to establish a Science and Technology Project Agreement with Singapore as well as supporting the conduct of FY 2004 Coalition Interoperability wargaming analysis with Singapore and the UK using the DARPA developed Joint Semi Automated Forces (JSAF) Simulation. The program is in collaboration with the Army. The Singapore Project agreement will initially support the Mechanized Air Assault, Unmanned Air Vehicles, Coalition Command and Control, and Multispectral Goggles for Dismounted Infantrymen and Scouts. This program investigates the development of novel quantum dot detector technology and applications to multi-spectral systems, concentrating on the visible to near infrared. The initial assessment of detector technology will include the spectral sensitivity, quantum yield and temperature-dependant material parameters. These parameters will be related to the sensor requirements, including new design concepts for unique micro-sensors and goggle applications. DARPA established an MOA with the Army for this program in April 2004. The FCS International Cooperation technology is planned for transition to the Army by FY 2007.

(U) The Sensor DART program will produce and demonstrate unattended ground sensors into an aerodynamic glider capable of covert delivery from a stand-off at least 45 km with a 50 m or less circular error probability (CEP). Sensor DART will leverage and integrate capabilities derived from the Hawkeye small UAV demonstrator and Steel Rattler (hand emplaced) and Steel Eagle (F-15 air emplaced) projects. The basis for the Sensor Dart is a platform/sensor system that transitions from winged flight to earth-penetrating dart. The integration of glider and precision delivered sensor will provide a well-coupled seismic and acoustic sensing capability in support of the Unit of Action (UA). The transition customer will be UA Product Manager Robotic and Unmanned Sensors (PM RUS) out of Fort Monmouth. Transition will occur following program conclusion, after FY 2007.

(U) The WolfPack program will further develop the initial capability for close approach electronic warfare. The overall effectiveness and efficiency of FCS will be improved by this effort through the development of an advanced, collaborative electronic warfare sensing and attack system. This will lead to improved situational awareness of the battlespace for other FCS platforms and will improve their survivability in a wide range of potential conflicts. The improved WolfPack system will be able to suppress enemy air defenses, RF communication systems, and networks either through sensing and passing back targeting information to other FCS weapon platforms for kinetic fire or by collaboratively jamming those systems and networks on its own. The WolfPack technology is planned for transition to the Army by FY 2006.

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- (U) Program Plans:
- PerceptOR
 - Conducted perception system prototype development testing in both laboratory and field.
 - Conducted evaluation experiments on early perception system prototypes in variety of terrain and environmental conditions.
 - Conducted algorithm development for advanced perception behavior.
 - Continued algorithm and supporting technology developments for unmanned maneuver.
 - Updated prototype algorithms and hardware based on supporting experimentation.
 - Explored system implications of degraded component performance (communications constraints, sensor and other faults).
 - Unmanned Ground Combat Vehicle (UGCV)
 - Conducted UGCV surrogate tests.
 - Conducted testing of prototypes against mobility, endurance, and payload fraction metrics.
 - Conducted resilience testing on prototypes and make reliability measurements.
 - Updated prototype hardware with late development technology and prepare for extreme testing conditions.
 - UGCV – PerceptOR Integration (UPI)
 - Integrate perception on original Spinner.
 - Redesign and construct (2) Spinner vehicles.
 - Integrate Spinner payloads.
 - Commence testing of ported Learning Applied Ground Robots (LAGR) hardware on Spinner.
 - Conduct operational UPI testing of Spinners + Perception.
 - Complete testing of ported LAGR hardware on Spinner.
 - MultiCell and Dismounted Command and Control
 - Develop prototype command and control interfaces for higher commanders, cell commanders and dismount commanders.
 - Conduct human-in-the-loop experiments with dismounts and higher headquarters, including joint feeds.
 - Develop supporting operational and systems architectural framework products.
 - Develop a supporting C4ISR simulation test-bed to assess the performance of the C2 prototype.

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- Maneuver C³
 - Validate organic, self-contained approaches versus approaches that “reachback” to other systems for C².
 - Select wireless communications network architecture(s) for implementation.
 - Demonstrate sub-system components for assured communications in a hostile environment using novel waveforms and beam steering antennas for low probability of detection and anti-jam.
 - Refine Commander’s Support Environment (CSE); expand CSE knowledge base and collective intelligence module.
 - Continue to refine and expand supporting simulation.
 - Collect and assess the insights of human-machine interface requirements for training prototypes with the assistance of Army Research Institute.
 - Conduct experiments in support of selected command and control functions for operations with manned/unmanned systems.
 - Complete the development of an initial C² experimental demonstrator.
 - Continue experiments of Unit Cell C² incorporating limited activities of the dismounted soldier.
 - Extend C² architecture to handle inter-unit cell operations, and operations between unit cell and next higher level.
 - Demonstrate an integrated architecture that provides seamless transition from line-of-sight to non-line-of-sight communications via unmanned aerial vehicles and satellite communications.
 - Demonstrate new secure communication waveforms and mobile ad hoc networks using directional antennas.
- Multiple Networked Multiple -Input/Multiple Output (MIMO) (MNM)
 - Validate the MNM concept with field demonstrations of the MIMO-based Mobile Ad Hoc Network (MANET) and custom wideband RF/signal processing designs.
 - Design and demonstrate wideband antenna/RF hardware and the MIMO signal processing.
 - Design and develop a frequency agile MNM showing dynamic spectral efficiency and agility in an operational form factor for use in an urban and rural setting with applications for military and military operations other than war scenarios.
- Netfires
 - Program transitioned to Army in FY 2004.

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- Organic Air Vehicle - II
 - Initiate competitive contracts for system preliminary design.
 - Evaluate preliminary designs and downselect to best design(s).
 - Perform detailed designs of flight vehicles.
 - Perform risk reduction testing on critical vehicle subsystems.
 - Develop ~ 112 lb (dry weight) flight vehicle and demonstrate robust flight stability.
 - Integrate RSTA payload sensors and non-line-of-sight communications with the flight vehicle.
 - Demonstrate RSTA and target designation missions with the integrated system.

- Micro Air Vehicle
 - Demonstrate transition T-MAV (gasoline engine) in military operations in urban terrain exercises and conduct experiments with troops in field trials.
 - Develop small heavy fuel engines.
 - Demonstrate diesel D-MAV (diesel engine) in military operations in urban terrain exercises and conduct experiments with troops in field trials.
 - Provide Army unit from 25th Infantry Division, 25 D-MAV systems (50 air Vehicles) as a residual operational capability.

- Jigsaw Phase III
 - Establish a Joint DARPA-NVESD (U. S. Army Night Vision and Electronic Sensors Directorate) JIGSAW Program.
 - Develop a form, fit, & function Jigsaw Sensor for integration onto the DP-5X.
 - Develop real-time on-board registration and processing capability.
 - Advance the technologies to a Technical Readiness Level 6.

- Foliage Penetration (FOPEN) Reconnaissance, Surveillance, Tracking and Engagement Radar (FORESTER)
 - Demonstrate detection of slowly moving ground targets in foliage by rotorcraft-mounted Ground Moving Target Indication (GMTI) radars through measurements, simulations and analyses.
 - Design, assess, and evaluate a brassboard FORESTER hardware system.
 - Design, assess, and evaluate a form-fit-and-function FORESTER hardware system for rotorcraft installation.

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- Conduct end-to-end system performance tests that include aircraft effects under static and dynamic conditions.
- Conduct airborne flight-testing and demonstrate performance with the fully integrated FORESTER/aircraft system.
- Affordable Adaptive Conformal Electronically Steerable Array Radar (AACER)
 - Initiate competitive contracts for system preliminary design.
 - Evaluate preliminary system designs, production cost estimates, and results from critical antenna technology demonstrations and down select to best design(s).
 - Develop prototype modules and perform subsystem tests, system integration, and rooftop testing.
 - Perform flight tests, system characterization, and simulated military missions in manned aircraft, and finalize production cost estimates.
 - Modify designs/software based on flight test results, and integrate to unmanned air vehicle.
 - Train military operators and perform simulated military mission tests and evaluation.
- Long Gun System
 - Modify existing Affordable Weapon System (AWS) airframe as basis for missile design.
 - Replace engine with ducted fan with rotary engine operated with heavy fuel.
- EM Mortar
 - Conduct modeling and simulation to design the launcher, power supply, and projectile modifications for coupling to the launcher.
 - Design launcher for mortar launch application and develop specifications for the power system coil and rail guns.
 - Fabricate coil and rail gun launchers.
 - Conduct laboratory testing of the launchers with capacitor-based power systems.
 - Assess large-scale manufacturing issues for capacitors and demonstrate operation in a full-size module.
 - Conduct ammunition and weapon system testing.
- DP-5X
 - Design and fabricate airframe.

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- Test DP-5X rotor.
- Integrate airframe with automatic controls.
- Conduct airframe thermal and vibration testing.
- Integrate sensor package with airframe.
- Conduct flight tests of airframe with sensor package.

- Studies/Analysis/Experiments
 - Conduct systems engineering studies.
 - Conduct experiments with Air Assault Expeditionary Force.
 - Conduct FCS related directed studies and analysis.

- International Cooperation
 - Jointly explore and develop innovative mechanized air assault force concepts of operations through enabling technologies.
 - Evaluate the operational performance of the DARPA Organic and Micro Air Vehicles in complex terrain environments, e.g. urban and jungle.
 - Implement Command Post of the Future (CPoF) to exchange information and concepts on command and control and explore interoperable architecture demonstrating plug and operate capabilities.
 - Assess the operational utility of the CPoF Battleboard as the basis for defining future collaboration between Singapore and the U.S.
 - Conduct interoperability wargaming.
 - Conduct perception system prototype development testing in both laboratory and field.
 - Initiate development of novel quantum dot detector technology for new design concepts for micro-sensors.

- Sensor Dart
 - Develop initial design concept that addresses separate Sensor Dart versions for a Unit of Action deployment.
 - Conduct detailed trade studies and systems analysis that will be performed to maximize system capabilities.
 - Generate designs detailing the glider, dart, sensor, electronics, and communications subsystems.
 - Integrate Sensor Dart subsystems for flight testing.

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- Develop and flight test prototype glider and dart system.
- Demonstrate network sensor architecture for detecting heavy armor.
- WolfPack
 - Reduce form factor size of initial WolfPack capability hardware to suit multiple delivery options under the FCS architecture.
 - Expand initial WolfPack sensing capabilities to cover additional enemy military systems waveforms.
 - Optimize initial WolfPack power generation and management systems for longer endurance.

(U) Other Program Funding Summary Cost:

	FY 2004	FY 2005	FY 2006	FY 2007
PE 0603005A Army	105.020	104.800	40.000	25.000