RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE June 2001		
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research					R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E , R-1 #18					
COST *(In Millions)*	FY 2000	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	Cost To Complete	Total Cost
Total Program Element (PE) Cost	144.194	215.896	173.885	153.348	163.600	171.300	184.300	184.300	Continuing	Continuing
Naval Warfare Technology TT-03	13.499	4.965	15.000	15.000	20.000	26.200	36.200	36.200	Continuing	Continuing
Advanced Land Systems Technology TT-04	26.034	15.137	24.425	27.348	29.162	35.144	35.144	35.144	Continuing	Continuing
Advanced Tactical Technology TT-06	37.483	26.207	57.062	52.313	48.230	41.371	41.371	41.371	Continuing	Continuing
Aeronautics Technology TT-07	43.854	32.835	43.941	34.887	42.450	44.291	47.291	47.291	Continuing	Continuing
Advanced Logistics Technology TT-10	14.958	27.596	23.564	23.800	23.758	24.294	24.294	24.294	Continuing	Continuing
Joint Logistics ACTDs TT-11	8.366	9.856	9.893	0.000	0.000	0.000	0.000	0.000	0.000	N/A
Unmanned Systems TT-12	0.000	99.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	N/A

(U) Mission Description:

(U) This program element is budgeted in the Applied Research Budget Activity because it supports the advancement of concepts and technologies to enhance the next generation of tactical systems. The Tactical Technology program element funds a number of projects in the areas of Naval Warfare, Advanced Land Systems, Aeronautics, and Logistics technologies. FY 2001 includes congressionally added funding for Unmanned Systems initiatives (Project TT-12).

(U) The Naval Warfare Technology project is focusing on enabling technologies for a broad range of naval requirements. Programs include Friction Drag Reduction, High Energy Density Materials, and Submarine Payloads and Sensors. The Friction Drag Reduction program will develop friction drag reduction technologies for surface ships and submersibles. The High Energy Density Materials program explored high risk/high pay-

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E

off breakthroughs in missile propellants and explosives technologies. The Submarine Payloads and Sensors effort explored submersible platforms designed to maximize payload capacity. This project also includes funding for the Center of Excellence for Research in Ocean Sciences.

(U) The Advanced Land Systems Technology project is developing technologies for enhancing the U.S. military's effectiveness and survivability in operations ranging from force-on-force conflict to military Operations-Other-Than-War. The NetFires program (formerly Advanced Fire Support Systems) will provide rapid response and lethality associated with gun and missile artillery, thereby increasing survivability, yet requiring fewer personnel and less logistical support. The Alternatives to Antipersonnel Landmines program will explore technologies to obviate the need for mines. The Close-In Sensing program will emphasize new approaches to detect traditionally low signal-to-signal noise or concealed targets. The Low Cost Guided Medium Caliber Projectiles program will develop affordable guidance and control technologies for 25-60mm gun launched projectiles. The Counter-artillery Force Protection program explored advanced sensors, munitions and deployment concepts to counter evolving threats. The Dog's Nose/Unexploded Ordnance Detection program developed sensors for the chemically specific detection of explosives or other chemicals, comparable to the effectiveness of canine olfaction detection.

(U) The Advanced Tactical Technology project is exploring the application of compact and solid state lasers; high performance computational algorithms to enhance performance of radars, sensors, communications, and electronic warfare and target recognition and tracking systems; precision optics components for critical DoD applications; new tactical systems for enhanced air vehicle survivability, advanced airbreathing weapons, enabling technologies for advanced space systems; emerging payload delivery concepts; and miniature air-launched decoy systems.

(U) The Aeronautics Technology project will explore technologies to reduce costs associated with advanced aeronautical systems and provide revolutionary new capabilities for current and projected military mission requirements. This project funds development of a new family of micro-air vehicles; micro adaptive flow control technologies; small-scale propulsion system concepts; innovative vertical take-off and landing concepts; ceramics for propulsion systems; quiet supersonic aircraft platforms; long endurance unmanned air vehicle concepts; and a hypersonic flight demonstration.

(U) The Advanced Logistics project is investigating and demonstrating technologies that will make a fundamental difference in transportation and logistics. The program will define, develop and demonstrate fundamental enabling technologies that will permit forces and sustainment materiel to be deployed, tracked, refurbished, sustained and redeployed more effectively and efficiently. The project will also develop and demonstrate advanced military-grade measures for security, robustness and scalability to enable the wide-scale application of large-scale agent technology to U.S. military logistics and command and control domains operating in high-tempo conventional and information warfare environments.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E

(U) The Joint Logistics project, composed of two Advanced Concept Technology Demonstrations (ACTDs), will develop and migrate interoperable web-based joint logistics decision support tools (JDSTs) to the Service logistics communities.

(U) The Unmanned Systems project will pursue the development of unmanned advanced capability aircraft and ground combat vehicles consistent with Public Laws 106-259 and 106-398. Systems to be developed under this project include the Air Force and Naval Unmanned Combat Air Vehicles (UCAV) and Army Future Combat Systems (FCS).

(U) Program Change Summary: (*In Millions*)

	FY2000	FY 2001	FY 2002
Previous President's Budget	142.501	121.051	126.679
Current Budget	144.194	215.896	173.885

(U) Change Summary Explanation:

FY 2000	Increase reflects minor reprogrammings.
FY 2001	Increase reflects net effect of congressional reductions for Advanced Rotorcraft Technology and Compact Lasers; congressional adds for the Unmanned Systems Initiative (Project TT-12) and the Center of Excellence for Research in Ocean Sciences (TT-03); the Section 8086 reduction; and the government-wide rescission.
FY 2002	Increases reflect continuation of the Naval Warfare project (TT-03) to develop Friction Drag Reduction technologies; increase in the Advanced Tactical Technology project (TT-06) for new solid state laser work; and increase in the Aeronautics Technology project (TT-07) for the Hypersonics program.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE June 2001					
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research					R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-03					
COST *(In Millions)*	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Naval Warfare Technology TT-03	13.499	4.965	15.000	15.000	20.000	26.200	36.200	36.200	Continuing	Continuing

(U) Mission Description:

(U) The Naval Warfare Technology project develops advanced technologies for application to a broad range of naval requirements. The principal enabling technologies include investigation into High Energy Density Materials (HEDM) for advanced explosives and propellants and innovative payload and platform concepts for expanding the envelope of operational capabilities for surface and submersible platforms.

(U) The Friction Drag Reduction program, beginning in FY 2002, will further develop friction drag reduction technologies, investigated under PE 0601101E, Project MS-01 in FY 2000/2001, for surface ships and submersibles that can be practically implemented in the operational environment. The goal is the development of radical skin friction drag reduction sustained over time periods that are operationally relevant. The primary focus of this program is on two methods known to reduce friction drag: injection of polymers or microbubbles into the flow boundary layer. The program will address, by means of computation and small-scale laboratory experiments, the practical barriers to the implementation of polymer additives and microbubbles. Other drag reduction techniques that are discovered by these investigations will also be explored.

(U) The High Energy Density Materials (HEDM) program fostered high-risk/high payoff efforts in missile propellant and explosives technologies applicable to a wide variety of tactical and strategic military systems. The HEDM project investigated the synthesis of new molecules capable of providing orders of magnitude increases in explosive and/or propulsive energy per unit weight. The potential benefits included: thermodynamic properties which could result in their having two-to-six times as much propulsive/explosive energy as current state-of-the-art operational materials, the "greening" of production and use, and reduction of detectability.

(U) The Submarine Payloads and Sensors Program explored the possibilities that emerge when a unified set of payload and sensor concepts, operational implications, and supporting platform concepts are formulated in a balanced manner. Technology and programmatic roadmaps for the interlocking payload, sensor, combat system and platform concepts that evolve were defined as part of this effort. Mature efforts identified for further development in FY 2001 and beyond are budgeted in Program Element 0603763E, Project MRN-02, Marine Technology. Core program transitioned to Navy in mid FY 2001.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-03

(U) The Center of Excellence for Research in Ocean Sciences (CEROS) objectives are to support the Department of Defense by encouraging leading edge research and development in ocean sciences, exploiting exceptional Hawaiian ocean research facilities, involving highly specialized small businesses with recognized expertise in ocean related research, and providing access to the ocean sciences expertise of the University of Hawaii. Major research areas of interest include shallow water surveillance technologies, ocean environmental preservation, new ocean platform and ship concepts, ocean measurement instrumentation, and unique properties of the deep ocean environment.

(U) Program Accomplishments and Plans:

(U) FY 2000 Accomplishments:

- High Energy Density Materials (HEDM). ($ 4.146 Million)
  - Initiated techniques to scale up synthesis of High Energy Density Materials (HEDM) to gram quantities and experimentally verified physical properties.
  - Conducted preliminary experiments related to synthesis of novel nitrogen molecules ($N_5^+ N_3^-$).
  - Explored other synthesis methods.

- Submarine Payloads and Sensors. ($ 2.353 Million)
  - Completed concept development phase, refined and finalized multiple payload and sensor concepts and associated mission concepts.
  - Defined and matured two flexible platform concepts capable of supporting multiple payload and sensor concepts.
  - Identified development roadmaps and technology risks and opportunities associated with the final system and platform concepts.

- Center of Excellence for Research in Ocean Sciences (CEROS). ($ 7.000 Million)
  - Selected projects for funding, both new efforts and follow-on development to projects selected in previous years.
  - Contracted selected projects and monitored progress of ocean related technologies of high interest to the DoD.
  - Transitioned appropriate products to military use.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-03

(U) FY 2001 Plans:

- CEROS. ($ 4.965 Million)
  - Select projects for funding, both new efforts and follow-on development to projects selected in previous years.
  - Contract selected projects and monitor progress of ocean related technologies of high interest to the DoD.
  - Transition appropriate products to military use.

(U) FY 2002 Plans:

- Friction Drag Reduction. ($ 15.000 Million)
  - Develop methodology for scaling drag reduction results previously demonstrated in Budget Activity 6.1 funded concept evaluations to larger scale models appropriate for predicting the drag reduction in operationally relevant systems.
  - Validate initial modeling efforts through small scale laboratory experiments.
  - Calculate drag reduction in operationally relevant systems.
  - Commence optimization and engineering of polymer and/or microbubble properties in operationally relevant configurations.
  - Commence development of larger scale models.

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

Submarine Payloads and Sensors:

Source	FY 2000	FY 2001	FY 2002
Navy, PE 0603561N, Advanced Submarine Development	2.500	9.600	16.900

(U) Schedule Profile:

- Not Applicable.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE June 2001					
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research					R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-04					
COST *(In Millions)*	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Advanced Land Systems Technology TT-04	26.034	15.137	24.425	27.348	29.162	35.144	35.144	35.144	Continuing	Continuing

(U) Mission Description:

(U) This project is developing technologies for enhancing the U.S. military effectiveness and survivability in operations ranging from force-on-force conflict to military Operations-Other-Than-War (OOTW). This emphasis is on developing affordable technologies that will enhance the military's effectiveness while decreasing the exposure of U.S. or allied forces to enemy fire. This project consists of the following main efforts: NetFires; Antipersonnel Landmines Alternatives; Close-In Sensing; Low Cost Guided Medium Caliber Projectiles; Dog's Nose/Unexploded Ordnance Detection and Counter-artillery Force Protection (CFP).

(U) The NetFires program (formerly Advanced Fire Support System) is developing and testing a containerized, platform-independent multi-mission weapon concept as a supporting element of the Future Combat System (FCS). NetFires will provide rapid response and lethality in packages requiring significantly fewer personnel, decreased logistical support, and lower life cycle costs, while increasing survivability compared to current gun and missile artillery. NetFires will allow FCS to defeat all known threats in a system compatible with air deployability in C-130 (and smaller) aircraft and enhance the situation awareness and survivability of FCS by providing extended-range, non-line-of-sight engagements. Beginning in FY 2001, NetFires is funded from PE 0603764E, Project LNW-03, Future Combat Systems.

(U) The Antipersonnel Landmine Alternative (APLA) program is developing technologies that provide our warfighter with enhanced capabilities that obviate the need for antipersonnel landmines (APLs). Technologies under investigation include self-healing minefields that achieve protection of antitank mines from both dismounted and mounted breaches without the use of APLs, and tags with minimally guided munitions to detect, locate and rapidly engage dismounted infantry permitting the compression of critical timelines and distance constraints that limit the effectiveness of conventional indirect and direct fires.

(U) The Close-in Sensing program will develop technologies and platforms to complement our national remote sensing assets. The close-in sensors will exploit various phenomenologies to make robust detection, classification, and identification of time-critical targets, hardened, hidden and highly protected targets and characterization of the local radio frequency (RF) environment. The technologies developed will emphasize new

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-04

hardware and approaches to detect traditionally low signal-to-noise or concealed targets without placing people in harm's way and will emphasize infiltration and exfiltration technologies.

(U) The Low Cost Guided Medium Caliber Projectiles program is focused on developing affordable guidance and control (G&C) technologies for 25-60mm gun launched projectiles. Today, missiles, rockets, some mortars, and some large caliber weapon systems have G&C components that make them precision munitions. Medium caliber guns are used primarily for line-of-sight engagements in situations where effectiveness is based on delivering high rates of fire, using a large number of rounds, to defeat a variety of targets from ground and air platforms. Potential advantages of low cost G&C systems for improving accuracy (i.e. probability of hit and probability of kill) of medium caliber gun launched projectiles include: 1) significantly reduced logistics burden associated with ammunition re-supply, 2) extended range and area of influence of medium caliber weapons, and 3) option of employing inexpensive medium caliber rounds to accomplish some missions that currently require expensive material (large caliber rounds and missiles.) The focus of this effort is on overcoming technical challenges associated with miniaturization of guidance and maneuver components, while keeping the cost per round low enough to be accepted as an affordable option. Primary program goals are to: 1) demonstrate an order of magnitude decrease in the number of rounds that must be fired to achieve the same effectiveness as current medium caliber systems, and 2) demonstrate significantly enhanced performance and effectiveness of medium guns against stationary and moving targets by enhancing accuracy and precision at range. Technical challenges include: 1) designing low cost, small guidance systems that can withstand very high G loading and projectile spin; 2) designing low cost, small, effective maneuver mechanisms to divert or correct course of the bullet in flight; and 3) devising inexpensive methods for testing and evaluating performance of smart bullets, since current test methods are destructive to the on-board components and gun ranges typically are not instrumented to record the bullet's behavior in flight.

(U) The Dog's Nose/Unexploded Ordnance (UXO) Detection program developed sensors for the chemically specific detection of explosives or other chemicals characteristic of land mines and/or shallowly buried UXOs. The sensors developed under this program provide soldiers with the effectiveness of canine olfaction detection without the logistics and other constraints imposed by the use of live animals. These chemically specific sensors can work either singly or in conjunction with other technologies such as the hyperspectral mine detector.

(U) The Counter-artillery Force Protection (CFP) program developed concepts for defending forces and civilian enclaves against air threats including high rate of fire missile artillery carrying submunitions. The program explored advanced sensors, munitions and deployment concepts to counter this evolving threat, including both active defense and counterforce options.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-04

(U) Program Accomplishments and Plans:

(U) FY 2000 Accomplishments:

- NetFires (formerly Advanced Fire Support System). ($ 12.074 Million) [Future Combat Systems – related = $12.074 Million]
  - Completed detailed design for an objective demonstration system, including launch, fire control, and each of the demonstration flight systems.
  - Tested component hardware and software.
  - Continued advanced concept feasibility assessments.
  - Initiated hardware-in-the-loop tests.
  - Awarded follow-on options for NetFires precision and loitering attack missiles, container launcher unit, and command and control modules.

- Counter-artillery Force Protection (CFP). ($ 1.006 Million)
  - In conjunction with the Army, defined system architectures, including sensors, munitions and deployment to meet the mission needs for enclave protection against missile artillery.

- Unexploded Ordnance Detection. ($ 5.982 Million)
  - Continued the development of chemical sniffers for land mine detection.
  - Reduced sized, improved field response to interferents, and improved sampling system.
  - Demonstrated a condensed phase detector in the field in multiple configurations (handheld and vehicle mounted) and formalized transition with the user.

- Antipersonnel Landmine Alternatives. ($ 6.972 Million)
  - Began preliminary development of antitank minefield healing algorithms.
  - Conducted initial experimentation of self-healing minefield subsystems – individual mine-surrogate mobility concepts and mine-to-mine communication methods.
  - Developed and demonstrated tagging concepts in the laboratory.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-04

(U) FY 2001 Plans:

- Antipersonnel Landmine Alternatives. ($ 9.572 Million)
  - Conduct initial field experiments of self-healing minefield system.
  - Demonstrate autonomous location of individual mines and minefield mapping.
  - Evaluate tag communication range.

- Close-In Sensing. ($ 5.565 Million)
  - Investigate potentially promising radio frequency phenomenology collection techniques.
  - Investigate extremely lightweight, low cost active array technologies.
  - Explore multiple mission platform concepts.

(U) FY 2002 Plans:

- Antipersonnel Landmine Alternatives. ($ 8.281 Million)
  - Integrate final self-healing minefield system concept.
  - Build and test in field 50 mine prototypes.
  - Evaluate collective behaviors for breaching in simple minefields.

- Close-In Sensing. ($ 8.371 Million)
  - Continue trade off studies in advanced technologies for use in data infiltration and exfiltration.
  - Continue development of active array technologies
  - Explore multi-sensor architectures and waveforms.
  - Initiate novel radio frequency exploitation concepts.
  - Investigate novel platform propulsion and drag reduction concepts.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-04

- Low Cost Guided Medium Caliber Projectiles. ($ 7.773 Million)
  - Perform system analyses and studies to determine the increase in battlefield effectiveness possible with greatly improved accuracy for medium caliber bullets.
  - Determine which existing medium caliber weapons would serve as best first demonstrator and which missions would benefit most.
  - Conduct studies to identify several candidate technologies/approaches and to understand challenges, risks and scaling factors for each potential concept.

(U) Other Program Funding Summary Cost:

- Not Applicable.

(U) Schedule Profile:

- Not Applicable.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE June 2001					
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research					R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-06					
COST *(In Millions)*	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Advanced Tactical Technology TT-06	37.483	26.207	57.062	52.313	48.230	41.371	41.371	41.371	Continuing	Continuing

(U) Mission Description:

(U) This project focuses on five broad technology areas: (a) compact, efficient, frequency-agile, diode-pumped, solid-state lasers for infrared countermeasures, laser radar, holographic laser sensors, and high-power laser applications; (b) high performance computational algorithms for signal processing, target recognition and tracking, electromagnetic propagation, and processing of advanced materials and microelectronics; (c) precision optics components for critical DoD applications; (d) aerospace electronic warfare systems (e.g. coherent spoofers, decoys, jammers); and (e) very high speed aerospace vehicle and enabling technology. Additionally, this project will develop new tactical systems for enhanced air vehicle survivability, advanced airbreathing weapons, enabling technologies for advanced space systems, and emerging payload delivery concepts.

(U) The Laser program will develop compact diode-pumped, solid-state lasers (10x improvement in efficiency) with at least tens of watts average power output and wavelength tuneability in the mid-infrared spectral regions to provide laser sources for infrared countermeasures against heat-seeking missiles for rotary wing/fixed wing aircraft and sea-borne platforms. Additionally, it will develop ultra broadband and very short pulse solid-state laser technology and ultra high power short pulse lasers. These programs will develop and demonstrate single mode fiber lasers with output powers of nearly one kilowatt from a single aperture. Tens of kilowatts output power and capability to scale to greater than hundreds of kilowatts output power and beyond will be demonstrated through coherent combining of the output power from multiple fiber lasers. High power fiber lasers will provide a quantum leap in defense capabilities by simplifying the logistic train and providing a deep magazine, limited only by electronic power, in a compact footprint. The advent of high power, reliable diodes with tunable ultra-short pulse widths and scaleable irradiance levels represents a technological advance of great potential utility to the DoD. The successful demonstration of a compact, efficient, and powerful laser diode could lead to incredible advances in communications, ultra-short pulse spectroscopy, micro-machining, LIDAR and directed energy applications with performance benefits with respect to its size, efficiency, and damage potential. These programs will also explore a combination of microelectromechanical systems (MEMS) based electro-optic spatial light modulators in combination with very short pulse solid state lasers to provide powerful new capabilities for secure communication up-links (multi-gigabits per second), aberration free 3-dimensional imaging and targeting at very long ranges (> 1000 kilometers). Lastly, innovative design concepts and system integration of MEMS-based spatial light modulators (SLMs), that provide a quantum leap in wavefront control, photonics and high speed electronics, will be explored for an affordable and high value communications, image sensing and targeting system for use well into the 21st century.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-06

(U) The Mission Specific Processing (MSP) program, previously funded from PE 0602301E, Project ST-19, High Performance and Global Scale Systems, extends Adaptive Computing Systems (ACS) technologies to support the design of highly optimized embedded processors that are required in the most severely constrained DoD applications. ACS developed new approaches to the design of computer hardware that incorporated dynamic configuration capabilities. The technology developed by the MSP program will facilitate high performance processing in future space based and miniature aero systems (unmanned air vehicles and missiles) that require extremely high processing throughput while consuming the minimum possible volume, weight and power. The focus is on compressing the design time for such full custom designs to match that of standard cell systems, while providing a 10x gain in performance.

(U) The High Performance Algorithm Development and Advanced Mathematics for Microstructural Process Control programs identify, develop and demonstrate new mathematical paradigms enabling maximum performance at minimum cost in a variety of DoD systems applications. They will look for opportunities to aggressively leverage the power of mathematical representations in order to effectively exploit the power of large-scale computational resources as they apply to specific problems of interest. The products are typically advanced algorithms and design methodologies. DARPA is pursuing the development of well-conditioned fast algorithms and strategies for the exploitation of high-dimensional data (i.e., data with a high number of degrees of freedom) in order to deal with a variety of complex military problems including virtual integrated prototyping of advanced material and device processing, digital representation and analysis of terrain, efficient high fidelity scattering computations of radar scattering for predictive design and exploitation of radar cross sections, and efficient automatic mapping and optimization of signal processing kernels onto advanced DoD computational hardware architectures.

(U) The Integrated Sensing and Processing (ISP) program will open a new paradigm for application of mathematics to the design and operation of DoD sensor/exploitation systems and networks of such systems by developing and applying novel optimization methodologies for integrating sensing, processing, and information exploitation functionality in DoD sensor systems. This program will create tools enabling the design and global optimization of advanced sensor system architectures comprising fully interdependent networks of functional elements, each of which can fill the roles and functions of several distinct subsystems in current generation sensor systems. Payoffs will include improved performance with reduced complexity hardware and software in a wide variety of systems, including agile adaptive arrays for missile seekers, unmanned air vehicles, and spaceborne sensors; novel waveforms and processing for object identification in dispersive and turbulent media; and novel approaches to multiplexed hyperspectral chemical/biochemical sensing systems.

(U) The Rapid Access, Small Cargo, Affordable Launch (RASCAL) program will develop and demonstrate the capability to launch small (<110 lb) satellites and commodity payloads into low Earth orbit (LEO) on demand and for a total launch cost of $5,000 per pound or less. This

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-06

capability will enable cost effective use of on-orbit replacement and re-supply. This capability will also provide a means for rapid launch of orbital assets for changing national security needs. While the payload cost goal is commensurate with current large payload launch systems, it is more than a factor of five less than current capabilities for dedicated launch of payloads of this small size. This program will utilize reusable aircraft technology for the first stage and will take advantage of low-cost hybrid advanced rocket fuel technologies for the expendable upper stages. With recent advances in design tools and simulations this program will prudently reduce design margins and trade-off system reliability to maximize cost effectiveness. This program will also leverage advancements in autonomous range safety; first-stage guidance; and predictive vehicle health diagnosis, management and reporting to lower the recurring costs of space launch.

(U) The Water Rocket program will support research and development of a robust concept for space power and propulsion supported by water as a replenishable propellant and fuel. Water is an inexpensive and easily handled propellant. The program will develop and demonstrate thrusters that use either water or its constituents, hydrogen and oxygen. High power thrusters will be developed for rapid maneuvering and high specific impulse thrusters will be developed for greater economy in use of the water propellant. A regenerative fuel cell system, enabled by emerging new technologies, will be developed and demonstrated. The regenerative fuel cell will serve two purposes. It will convert the water to hydrogen and oxygen for use in thrusters. It will also generate electricity while converting some of the hydrogen and oxygen back to water, thereby replacing the heavy batteries routinely used in satellites to supply electric power during nighttime. The Water Rocket program will develop technologies and demonstrate that the subsystems can be designed and built as space qualified. As a result of this program, future spacecraft will be more easily refueled for extensive maneuvering and changes of orbit to accomplish advanced missions.

(U) The Precision Optics program developed mathematical design tools and fabrication strategies for conformal sensor windows, cylinders, toroids, and diffractive optical elements. These tools and strategies provide distortion-free imaging with greater than hemispherical field-of-regard and reduced aerodynamic drag for precision strike and integrated bomb damage assessment for next-generation airborne platforms/high-speed missiles.

(U) The Miniature Air-Launched Decoy (MALD) advanced concept technology demonstration (ACTD) program developed and demonstrated a small, inexpensive air-launched decoy system for Suppression of Enemy Air Defenses (SEAD). MALD will be employed to enhance the survivability of friendly aircraft by establishing air superiority through stimulating, diluting and confusing enemy Integrated Air Defense Systems (IADS). Other applications of the miniature air vehicle system will employ other electronic warfare approaches, which include coherent radio frequency (RF) spoofers, and RF jammers. The Air Force has budgeted procurement funding for this effort starting in FY 2001.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-06

(U) The Affordable Rapid Response Missile Demonstrator (ARRMD) pursued a high-speed air breathing propulsion system with more than triple the installed specific impulse (ISP) of current rocket power systems.

(U) Program Accomplishments and Plans:

(U) FY 2000 Accomplishments:

- Compact Lasers. ($ 12.037 Million)
  - Initiated development of system applications concept and preliminary design of spatial light modulators and integrated electronics for Coherent Communications, Imaging and Targeting (CCIT).
  - Performed feasibility studies and concept development of enabling alignment and docking technologies using compact solid-state laser technology.

- Precision Optics. ($ 6.111 Million)
  - Completed assembly and test of conformal optics Stinger missile dome to quantify performance improvements.
  - Demonstrated imagery through Stinger conformal missile dome.

- High Performance Algorithm Development. ($ 8.499 Million)
  - Demonstrated utility of multiscale segmentation and registration algorithms in DoD automatic target recognition applications.
  - Developed advanced mathematical algorithms for high throughput hyperspectral infrared imaging.
  - Validated fast algorithms for electromagnetic scattering at subwavelength scales and off of rough surfaces.
  - Developed codes for predicting antenna radiation patterns and scattering off of electrically large, smooth impenetrable bodies.

- Advanced Mathematics for Microstructural Process Control. ($ 2.197 Million)
  - Constructed and tested control/optimization codes for sputtering, evaporation and molecular beam epitaxy reactors.
  - Extended level set methodology to complex diffusion processes in thin film processing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-06

- Miniature Air-Launched Decoy (MALD). ($ 0.535 Million)
  - Continued operational assessment exercises with thirty-two test assets to support transition to Air Force.
  - Continued to investigate ACTD design shortfalls and testing anomalies. Supported redesign efforts to increase reliability.
  - Coordinated transition of the MALD Program to the Air Force for initial quantity buy (150 units).

- Affordable Rapid Response Missile Demonstrator (ARRMD). ($ 5.738 Million)
  - Conducted booster configuration trade study.
  - Conducted second force and moment test series.
  - Performed design optimization studies.
  - Selected demonstration booster configuration.
  - Conducted structural validation testing.
  - Completed system preliminary design.
  - Continued exploration of supporting technologies for hypersonic missiles.

- Advanced Tactical Technology Concepts. ($ 2.366 Million)
  - Explored and assessed feasibility of new concepts for high-speed launch of small payloads and autonomous maintenance capabilities, exploiting next generation space-based sensors (e.g. lasers, electro optic, and millimeter wave).

(U) FY 2001 Plans:

- Compact Lasers for Coherent Communication, Imaging and Targeting. ($ 6.664 Million)
  - Continue development of system applications concept and preliminary design of spatial light modulators and integrated electronics for Coherent Communications, Imaging, and Targeting (CCIT).
  - Develop breadboard system with high-speed electronics integration.
  - Develop very high power short pulse lasers using plasma based pulse compression.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-06

- High Performance Algorithm Development. ($ 13.495 Million)
  - Demonstrate feasibility and portability of optimized portable application library generation approaches for a complete signal-processing algorithm.
  - Develop and test algorithms for variable precision filters for adaptive signal processing.
  - Develop tool set implementing algorithmic, memory, and compilation models applied to a multipole test problem.
  - Develop algorithms for predicting and optimizing antenna radiation patterns and scattering, both off of, and through, inhomogeneous materials and deep cavities.
  - Develop computationally efficient geometric compression and registration algorithms for topography/imagery databases.

- Advanced Mathematics for Microstructural Process Control. ($ 3.300 Million)
  - Validate reduced order model and algorithms for sensing and control of thin film vapor deposition processes.
  - Demonstrate advanced molecular dynamics/accelerated molecular dynamics simulation techniques for the growth of multilayer materials.

- Advanced Tactical Technology Concepts. ($ 2.748 Million)
  - Perform feasibility evaluation studies of emerging advanced tactical technology concepts, including enhanced air vehicle survivability, innovative engines and propulsion techniques, payload delivery methods, and enabling technologies for advanced space systems.

(U) FY 2002 Plans:

- Compact Lasers for Coherent Communication, Imaging and Targeting. ($ 7.785 Million)
  - Develop 32x32 unit cell scalable spatial light modulator with integrated electronics.
  - Develop breadboard system with application specific hologram processor, receiver, and short pulse amplifier.
  - Demonstrate greater than 1-kilometer operation for static platform and target.

- High Power Lasers. ($ 13.000 Million)
  - Develop large mode-field area (LMA) fiber designs and perform fabrications techniques.
  - Develop multiple designs for coherent combining of greater than 100 fiber lasers.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-06

- Model and evaluate concepts for ultra-short pulse widths and high irradiance.
- Demonstrate divergence angles of ~0.1?.
- Demonstrate tunable pulse widths from continuous wave to 10 nsec.

- Mission Specific Processing. ($ 10.000 Million)
  - Conduct simulation and benchmarking of initial custom design techniques.
  - Verify 10x improvement in GOPS watts per square centimeter operations per second for key Digital Signal Processor (DSP) functions.
  - Develop detailed system architecture of wideband adaptive radar/electronic intelligence (ELINT)/seeker receiver.
  - Begin development of a wideband adaptive radar receiver based on custom cell libraries and module generators.

- High Performance Algorithm Development/Virtual Electromagnetic Testrange. ($11.000 Million)
  - Demonstrate validated, high fidelity, efficient electromagnetic scattering prediction at frequencies up to X-band for cruise missile sized objects with simple boundary conditions (i.e., perfect electrical conductor and impedence boundary condition).
  - Demonstrate tool kit software for optimized design for thin film vapor deposition processes including real-time process control.
  - Demonstration of prototype tensor product language compilers for efficient automatic generation of digital filterbank algorithms.
  - Initiate design of digital representations for map and terrain imagery that will support highly efficient storage, query, and registration of geographical information from disparate sources.
  - Develop reduced-order models and algorithms for sensing and control of biochemical materials growth process.

- Integrated Sensing and Processing. ($ 6.000 Million)
  - Develop and demonstrate feature extraction and three-dimensional imaging capability in passive interferometric sensors.
  - Demonstrate feasibility of designs for quadrature thinning of 2-D conformal arrays, which exhibit the same or better beam patterns than conventional arrays and yet use only one-third of the transmit/receive modules.

- Rapid Access, Small Cargo, Affordable Launch (RASCAL). ($ 4.277 Million)
  - Demonstrate aircraft propulsion adaptation to first-stage mission requirements.
  - Design and demonstrate first-stage guidance software.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-06

- Conduct system requirements review and conceptual design review of approach.

- Water Rocket. ($ 5.000 Million)
  - Perform critical technology demonstrations and analysis of the system design for the regenerative fuel cell and other developmental components of Water Rocket.

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

	FY 2000	FY 2001	FY 2002
Miniature Air-Launched Decoy (MALD), PE 0603750D, Advanced Concept Technology Demonstrations	2.000	3.000	0.000

(U) **Schedule Profile:**

- Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE June 2001					
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research					R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-07					
COST *(In Millions)*	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Aeronautics Technology TT-07	43.854	32.835	43.941	34.887	42.450	44.291	47.291	47.291	Continuing	Continuing

(U) Mission Description:

(U) Aeronautics Technology efforts will address high payoff opportunities to dramatically reduce costs associated with advanced aeronautical systems and/or provide revolutionary new system capabilities for satisfying current and projected military mission requirements.

(U) Micro-Air Vehicles (MAVs), which are at least an order of magnitude smaller (about 15 cm in any dimension) than currently available flying systems, have been demonstrated under this program. The next phase of the program will focus on the development of MAVs to accomplish unique military missions, particularly with regard to flight operations in restricted environments. Such mission areas include: small unit reconnaissance and surveillance, inspection of ships and floating vehicles, support of military operations in urban terrain, targeting and tagging high-value targets in denied areas, biological/chemical agent detection, and characterization of gases and/or explosives. The resulting capability should be beneficial in varied warfighting environments such as: ports and harbors, complex topologies, heavily forested areas/dense foliage, confined spaces (often internal to buildings) and high concentrations of civilians where it may be critical to determine the neutral or hostile intent of a crowd. The initial MAV program focused on the technologies and components required to enable flight at small scales, including flight control, power and propulsion, navigation and communications. The program will continue to build upon these and leverage other DARPA technology development efforts, including advanced communications and information systems, high performance computer technology, Microelectromechanical Systems (MEMS), advanced sensors, advanced electronic packaging technologies, and lightweight, efficient high-density power sources. The primary goal of the upcoming efforts within the MAV program is to further develop and integrate MAV technologies into militarily useful and affordable systems suitable for mission applications.

(U) Micro Adaptive Flow Control (MAFC) technologies enable control of large-scale aerodynamic flows using small-scale actuators. MAFC technologies combine adaptive control strategies, with advanced actuator concepts like micro-scale synthetic jets, MEMS-based microactuators, pulsed-blowing and smart structures to delay or prevent fluid flow separation. MAFC technologies will be explored for applications such as adaptive lift-on-demand for agile missiles and uninhabited tactical aircraft, lightweight gas turbine engines, and low-drag, non-intrusive methods to aerodynamically steer projectiles for extended range and precision. Advanced flow control concepts will be explored in the context of system level performance benefits and cost assessments. MAFC technology evaluations will be made under system-relevant flow conditions, and the most promising approaches will be selected for component- or system-level demonstration.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-07

(U) Concepts for a new, small-scale class of propulsion systems will be developed in the size range from 0.5 cm to 5.0 cm in diameter, with thrust levels from 10 g to 10.0 kg. They will enable future development of a new generation of very small weapons and military platforms including micro air vehicles, unmanned combat air vehicles, missiles and space launch vehicles. Radical new capabilities to be explored range from shirt-button-sized micro gas turbine and micro rocket engines to 5-cm scale gas turbine and pulse detonation engines. Engines may be explored at larger scale to prove feasibility. Examples of new mission capabilities may include delivery of very small (200g) satellites to low earth orbit, extended range small-scale precision munitions, and lightweight, long endurance miniature reconnaissance vehicles. These small-scale munitions would complement emerging unmanned vehicle systems and greatly increase mission capabilities by simultaneously increasing loadout, range and precision.

(U) The Quiet Supersonic Platform (QSP) program is directed towards development and validation of critical technology for long-range advanced supersonic aircraft with substantially reduced sonic boom, reduced takeoff and landing noise, and increased efficiency relative to current-technology supersonic aircraft. Improved capabilities include supersonic flight over land without adverse sonic boom consequences with boom overpressure rise less than 0.3 pounds per square foot, increased unrefueled range approaching 6,000 nmi, gross take-off weight approaching 100,000 pounds, increased area coverage, and lower overall operational cost. Highly integrated vehicle concepts will be explored to simultaneously meet the cruise range and noise level goals. Advanced airframe technologies will be explored to minimize sonic boom and vehicle drag including natural laminar flow, aircraft shaping, plasma, heat and particle injection, and low weight structures. In FY 2001, this program is funded in the 6.3 based Advanced Aerospace Systems (PE 0603285E).

(U) DARPA, in partnership with the Office of Naval Research (ONR) and industry, formulated the Canard Rotor/Wing (CRW) program to explore an innovative vertical take-off and landing (VTOL) concept with the potential for significant performance improvements that would satisfy stressing mission needs. The CRW aircraft offers the potential for a high speed (350 knots), rapid response capability from a VTOL unmanned air vehicle with significant range (500 nm) and stealth improvements as compared to other VTOL concepts. Funding under this project will be used to complete fabrication and perform flight tests of this scaled vehicle concept in order to validate the command and control, stability and control system and aerodynamic performance required for vertical take-off, landing and hover via a rotating center wing that stops and locks in place for efficient high speed cruise.

(U) The Hypersonics program will develop and demonstrate advanced technologies for hypersonic flight. Flight-testing will be initiated as early in the program as possible and progress from relatively simple and low-risk tests through the demonstration of an increasingly more difficult set of objectives. The ultimate goals of the program are to demonstrate a vehicle range of 600 nautical miles with a average speed above Mach 4, maximum sustainable cruise speed in excess of Mach 6, and the ability to dispense a simulated or surrogate submunition. Technical challenges

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-07

include propulsion systems, hot primary and control surfaces, integral thermal/structural/fuel management, adaptive (possibly autonomous) guidance and control, conformal antennas/apertures, reliable health management and prognostics. An enabling element of hypersonic vehicles is the materials and structures necessary to meet these challenges. DARPA aims to develop lightweight, high temperature-capable and high reliability multifunctional (e.g. integral antennas and apertures; self diagnostic and self healing) material systems specifically optimized for hypersonic flight.

(U) DARPA is continuing its investment in innovative, long endurance UAV technology. The military application of such vehicles is the provision of reliable, tactically controlled ISR and communications equivalent to LEO satellites. To achieve endurance on the order of two weeks, at operationally significant altitudes (60,000+ ft), with 250+ lb payloads it is necessary to develop airframes with very high strength and low structural weight. It is also necessary to develop high efficiency propulsion systems with sufficient peak power to provide station keeping in periodic high winds. Recent advances in high strength, all composite airframes, hydrogen fuel cell technology and high strength, composite, hydrogen dewars suggest that such a vehicle design is realizable.

(U) Ceramic components directly enable high performance propulsion systems and advanced air vehicles. Propulsion system performance is greatly improved by increasing combustion and turbine inlet temperatures. Current propulsion systems are temperature limited because of temperature fatigue limits of conventional metal alloy engine components, particularly in the turbine. Ceramic materials have superior high temperature performance compared to metals. Ceramics applied to key propulsion system components will enable higher temperature operation with an additional benefit of lower weight compared to conventional metal alloy systems. New engine paradigms will be developed that utilize the unique characteristics of ceramic materials.

(U) The goals of the Advanced Rotorcraft Technology (ART) program were to investigate the merits of various advanced rotorcraft technologies and to conduct technology maturation efforts for select high risk, high payoff technologies: face gear, split torque transmissions, and variable diameter tilt rotors.

(U) Program Accomplishments and Plans:

(U) FY 2000 Accomplishments:

- Micro Air Vehicle (MAV). ($ 7.393 Million)
  - Continued development of flight enabling technologies for MAVs.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-07

- Completed prototype fabrication, flight-testing and demonstration of multiple fixed-wing and rotary-wing vehicles.
- Completed development of MAV compatible power and propulsion subsystems, autonomous navigation and control subsystems using GPS for fixed wing MAVs, and video sensor subsystems.
- Continued concept of operations evaluation for military use and identified new mission opportunities.
- Completed development of basic enabling MAV technologies and subsystems.

- Micro Adaptive Flow Control (MAFC). ($ 8.498 Million)
  - Continued MAFC actuator and controller development. Assessed actuator and control system performance, control authority, bandwidth and power requirements.
  - Integrated open-loop MAFC technology into feasibility demonstrations for selected military applications, including high-work compressors, maneuvering of uninhabited air vehicles, and fixed-and rotary wing air vehicles.
  - Initiated systems studies for new applications of closed-loop MAFC under full scale system conditions for hydrodynamic drag reduction, 40-mm grenade flight control, integrated inlet and compressor flow control, stator vane flow control and short take-off and vertical landing (STOVL) exhaust acoustic control.

- Small Scale Propulsion Systems (SSPS). ($ 4.465 Million)
  - Completed concept evaluation of several small-scale propulsion systems, including turbines, rockets and internal combustion designs.
  - Began detailed design of selected prototype propulsion systems.

- Advanced Aeronautic Concepts. ($ 3.030 Million)
  - Conducted technology assessments and feasibility testing of advanced aeronautic concepts, including supersonic laminar flow, air-to-air resupply and continuous aerodynamic control surfaces.

- Canard Rotor/Wing (CRW). ($ 1.588 Million)
  - Continued propulsion, aerodynamic and flight control risk reduction activities in conjunction with ongoing demonstrator fabrication for CRW concept.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-07

- Advanced Rotorcraft Technology (ART). ($ 3.880 Million)
  - Completed the mechanical reliability testing of the variable diameter tilt rotor sliding bearing under various environmental conditions including ice and exposure to sand as well as extreme hot and cold ambient temperature conditions.
  - Completed design and testing of an AH-64 sized face gear helicopter transmission.

- Quiet Supersonic Platform. ($ 15.000 Million)
  - Initiated development of technologies for long-range supersonic aircraft having low sonic boom and noise signature, range augmentation through low vehicle drag and system weight reduction.
  - Initiated development of highly integrated systems concepts for a supersonic long-range aircraft.

(U) FY 2001 Plans:

- Micro Air Vehicles. ($ 3.379 Million)
  - Continue enabling technology development, including power/propulsion, aerodynamics, guidance, navigation and control, and conduct system integration studies.
  - Perform IR Micro-sensor and collision avoidance sensor demonstrations.
  - Conduct MAV system lab demonstrations for new mission opportunities.

- Micro Adaptive Flow Control (MAFC). ($ 14.871 Million)
  - Initiate fully implemented MAFC technology development and validation tests for scale model of V-22 lift enhancement, high speed inlet mesoflaps, large scale wing model synthetic jet lift control, and delayed retreating blade stall.
  - Complete demonstration of high-speed compressor stage with aspiration flow control to give pressure rise of 3.4 across the stage.
  - Complete demonstration of biomorphic flapping flight.
  - Initiate the development of closed-loop MAFC technologies toward feasibility demonstrations.

- Small Scale Propulsion Systems (SSPS). ($ 10.401 Million)
  - Complete detailed design for propulsion systems.
  - Complete critical subsystem fabrication and testing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-07

- Begin fabrication of full propulsion systems.

- Advanced Aeronautic Concepts. ($ 2.990 Million)
  - Continue technology assessments and feasibility testing of advanced aeronautic concepts, including coordinated unmanned multi-ship complex aerobatic flying, single aircraft composed of multiple air vehicles, and application of natural flight mechanics to robotic systems.

- Canard Rotor/Wing (CRW). ($ 1.194 Million)
  - Complete demonstrator fabrication and conduct hardware in the loop and ground testing.

(U) FY 2002 Plans:

- Micro Air Vehicles (MAV). ($ 3.000 Million)
  - Continue enabling technology development and system integration studies.
  - Initiate designs of MAV systems for restricted maneuvering.
  - Conduct lab demonstration of geo-location and relative position location without GPS.
  - Perform MAV system mission demonstration.

- Micro Adaptive Flow Control (MAFC). ($ 8.014 Million)
  - Continue closed-loop MAFC actuator and controller development. Assess actuator and control system performance, control authority, bandwidth and power requirements.
  - Complete MAFC feasibility demonstrations for selected military applications, including scale model of V-22 lift enhancement, high speed inlet mesoflaps, large scale wing model synthetic jet lift control, and delayed retreating blade stall.
  - Initiate studies to integrate MAFC technologies into full-scale engine and aircraft systems. Initiate demonstration plan, including flight and field tests of integrated MAFC systems.

- Small Scale Propulsion Systems (SSPS). ($ 7.627 Million)
  - Complete initial fabrication and testing of propulsion systems.
  - Complete vehicle integration studies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-07

- Canard Rotor/Wing (CRW). ($ 0.800 Million)
  - Conduct demonstrator flight tests and produce final report.

- Ceramics for Propulsion Systems (CPS). ($ 4.500 Million)
  - Initiate technology development for advanced ceramic components.
  - Complete systems studies to determine payoff of monolithic ceramics and ceramic matrix composites in propulsion systems.

- Hypersonics. ($ 15.000 Million)
  - Evaluate concepts for lightweight, high temperature, multifunctional material systems.
  - Demonstrate thermal/structural load capability of candidate materials systems.
  - Conduct freejet engine testing.
  - Perform advanced combustion systems studies and fuel delivery system development.
  - Conduct vehicle system analysis and concept of operations studies.

- Long Endurance Hydrogen Powered Unmanned Air Vehicles. ($ 5.000 Million)
  - Conduct design trades and critical item demonstrations on structural and propulsion concepts.
  - Prepare preliminary design of 14 day, 250+ lb payload, 60,000 ft cruise UAV.

(U) Other Program Funding Summary Cost:

- Not Applicable.

(U) Schedule Profile :

- Not Applicable.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE June 2001					
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research					R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-10					
COST *(In Millions)*	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Advanced Logistics Technology TT-10	14.958	27.596	23.564	23.800	23.758	24.294	24.294	24.294	Continuing	Continuing

(U) Mission Description:

(U) The overarching objective of the Advanced Logistics Technology project is to revolutionize the way the DoD plans, executes, monitors, and dynamically replans logistics support across the entire spectrum of operational environments from day-to-day routine peacetime operations, disaster relief, non-combatant evacuation, peacekeeping, peacemaking, and minor and major contingencies. The project consists of two major programs, the Advanced Logistics Program (ALP) and the UltraLog Program.

(U) The Advanced Logistics Program (ALP) is investigating and demonstrating technologies that will make a fundamental difference in transportation and logistics. The program will define, develop and demonstrate enabling technologies that will permit forces and sustainment material to be deployed, tracked, refurbished, sustained, and redeployed more effectively and efficiently than ever before. Currently, this is accomplished using isolated, independent, and sometimes incompatible systems, processes and data. Therefore, the very rapid replanning and redirection necessary to support missions involving simultaneous local and major regional conflicts is extremely labor intensive, inefficient, and time consuming. The ALP will leverage information technologies to address these shortcomings. In addition, the program has enormous potential for cost savings through greatly improved management of transportation and logistics assets. ALP will develop automated, multi-echelon, collaborative logistical/transportation technologies that will provide warfighters with an unprecedented capability to monitor, rapidly replan, and execute the revised logistics plan, as the situation requires, even while assets are enroute to the theater. The ALP is focusing on the following three areas: 1) development of applications providing a technology environment that allows warfighters to rapidly understand and assess the logistics and transportation implications of a crisis situation, to generate effective plans and courses of action, to monitor a plan's execution and to use that information to re-plan; 2) automated systems that will enable significant efficiency improvements in transportation and logistics, such as improving access to data, monitoring the condition and status of shipments, personnel, inventories, logistics assets and the infrastructure, the creation of "plan sentinels" to serve as an early warning system for plan deviations, and improved theater distribution; and 3) development of a computer network infrastructure that allows distributed real-time visualization and interaction with all phases, elements and components of the military and commercial transportation infrastructure. The capabilities from these three areas will be integrated to demonstrate a prototype end-to-end system solution.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-10

(U) The UltraLog program will build on the baseline security, robustness and scalability investigation and analysis initiated during the Advanced Logistics Program and develop and demonstrate advanced military grade measures for security, robustness, and scalability to enable the wide-scale application of large-scale agent technology to U.S. military logistics and command and control domains operating in high-tempo conventional and information warfare (IW) environments. Using the infrastructure developed by the Advanced Logistics Program, UltraLog will pursue research breakthroughs in four main areas: (1) Security: Investigate information pedigree, white-noise generation, dynamic random routing, agent gateways, dynamic Public Key Infrastructure (PKI) management, recovery reconstruction protection, dynamic communications and security measures, information rovers, correlation and isolation of compromised agents and other techniques to achieve a secure, trusted system even under directed information warfare attack; (2) Scalability: Investigate assured convergence, automatic dampeners, adaptive configuration, resource pooling/proxy, variable fidelity processes, sliding temporal horizons, ultra-efficient agent negotiations, reactive plan space management and other techniques to achieve a highly scalable and stable system even under very chaotic wartime environments; (3) Robustness: Investigate non-local persistence, fault tolerance and recovery, distributed consistency checking, partial state validation, dynamic communications-aware redundancy, dynamic adaptation, temporal horizons and other techniques to achieve a state of high survivability; and (4) Systems Integration and Development: Synergistically combine security, scalability and robustness techniques that will provide the highest level of capability while ensuring the overall functionality of the distributed logistics enterprise is preserved. Though many of the research efforts will be accomplished independently and in parallel, the real challenge will come in the integration synergy of the various techniques to produce the desired systemic effects.

(U) Program Accomplishments and Plans:

(U) FY 2000 Accomplishments:

- Advanced Logistics Program (ALP). ($ 14.958 Million)
  - Developed capability to automatically plan and schedule movements from installation to the theater of operations and integrated the resulting movement plan with operations within the theater. Demonstrated capability for users to visualize multiple facts of the transportation schedule.
  - Developed capability to dynamically manage stockage levels across multiple supply chain levels and, multiple echelons, services and agencies.
  - Developed capability to automatically notify users when projected completion of an executing task differs from planned timeline.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-10

- Constructed and conducted a detailed baseline analytical evaluation of the ALP architecture for security, scalability and robustness.
- Established the development and experimental environments, which included the necessary security considerations and classifications for large-scale experimentation of agent societies under kinetic and information warfare environments.

(U) FY 2001 Plans:

- Advanced Logistics Program (ALP). ($ 9.855 Million)
  - Develop capability to automatically build and compare logistics plans in support of four operational courses of action in four hours.
  - Develop capability to monitor resource information, availability, capacity, costs and to view past, present and projected logistical situations.
  - Conduct a pilot test of advanced logistic technology using the Focused Logistics Wargame 2001.
  - Develop plans for conducting follow-on pilot tests.

- UltraLog. ($ 17.741 Million)
  - Establish the development and experimental environments and the metrics and methods by which the experimentation will be evaluated.
  - Design, develop and evaluate a variety of independent technologies for security, scalability and robustness that demonstrate the potential for extending and enhancing large-scale, distributed agent systems, with special attention to experimentally proving the feasibility of each technique based on the technical and functional requirements.
  - Perform systemic analysis of combinations and layering of developed technologies for overall effectiveness under varying experimental and environmental conditions.

(U) FY 2002 Plans:

- UltraLog. ($ 23.564 Million)
  - Develop, integrate and evaluate a synergistic collection of technologies providing dynamic information security, agent architecture survivability in an information warfare environment and sustained wartime logistics operations.
  - Establish instrumented and configurable wartime operating environment with chaotic real time systems, communications and event failures.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-10

– Conduct review by external, independent evaluation teams (red teams) of both the concept of operations and technical designs of the various system components to identify deficiencies and recommend improvements. Incorporate recommendations and mitigating approaches to ongoing development effort.

(U) Other Program Funding Summary Cost:

- Not Applicable.

(U) Schedule Profile :

- Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE June 2001					
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research					R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-11					
COST *(In Millions)*	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Joint Logistics ACTDs TT-11	8.366	9.856	9.893	0.000	0.000	0.000	0.000	0.000	0.000	N/A

(U) Mission Description:

(U) The Joint Logistics project is composed of two Advanced Concept Technology Demonstrations (ACTDs) that will develop and migrate interoperable web-based joint logistics decision support tools (JDSTs) to the Global Combat Support System (GCSS). The initial Joint Logistics ACTD addressed Commander-in-Chief (CINC) and Service requirements to develop JDST capability in the areas of Force Capability Assessment; Logistics Support Concept Generation and Evaluation; Distribution, Materiel Management, Maintenance Analysis; and Visualization. The follow-on ACTD, the Joint Theater Logistics ACTD (JTL ACTD) integrates and expands upon those and other capabilities to provide real-time management and analysis tools for logistics and operations interoperability. Tools developed in this second ACTD are called Joint Theater Logistics Decision Support Tools (JTLDSTs) to distinguish them from the tools developed in the original ACTD and to emphasize the focus upon forces associated with a Joint Task Force in a theater of operations. These tools will provide warfighters and logisticians with the abilities to: assess support force capabilities to perform mission tasks; develop and evaluate logistics operational support plans; monitor logistics operations; and, react to deviations from projected support. JTL tools will provide the fusion and correlation of plans and information for critical components of theater support, sustainment, and transportation systems providing effective management, analysis, and situational awareness to the logistics commanders. JTL capabilities will include real-time interoperability between logistics and operations during all phases of planning and execution. Key data sources include Joint Total Asset Visibility, Joint Personnel Asset Visibility, the Global Transportation Network, the Joint Operational Planning and Execution System, and the Global Status of Readiness and Training System. This project concludes in FY 2002.

(U) Program Accomplishments and Plans:

(U) FY 2000 Accomplishments:

- Joint Logistics ACTD. ($ 3.776 Million)
  - Expanded development of Joint Decision Support Tools (JDSTs) to depict both planned logistics unit support capabilities and actual capabilities.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-11

- Successfully completed the final Military Utility Assessment that recommended JDST transition into Global Combat Support System (GCSS).
- Began to transition proven JDST capability through the Advanced Information Technology Services (AITS) Joint Program Office (JPO) into the Global Combat Support System.

- Joint Theater Logistics (JTL) ACTD. ($ 4.590 Million)
  - Began development of Joint Theater Logistics Decision Support Tools (JTLDSTs).
  - Started development of computer-assisted capabilities to evaluate operational and logistics tasks.
  - Initiated development of an operations/logistics collaboration capability using web-based visualization environment.
  - Began integration of fuel requirements and availability models into web-based collaboration.
  - Incorporated logistics support capabilities and operational concepts into a single integrated view.
  - Prepared to demonstrate JTL capabilities in a joint warfighting exercise.

(U) FY 2001 Plans:

- Joint Logistics ACTD. ($ 0.986 Million)
  - Transition Joint Decision Support Tools (JDST) capability into the Global Combat Support System.

- Joint Theater Logistics (JTL) ACTD. ($ 8.870 Million)
  - Expand JTLDST capability to integrate in-theater distribution support planning and infrastructure assessment, and to generate and compare alternative logistics support force concepts to support multiple operational courses of action. Track the execution of fuel sourcing, consumption, and sustainment.
  - Incorporate and enhance planned deviation detection technology and sentinels to compare planned resource requirements with near real-time operational logistic activity for select support items by location, provider, and intended consumer.
  - Develop capability to rapidly assess the impact of operational changes upon the logistics support structure. Develop a real-time in-theater management capability for critical resources including fuel and engineering support, which integrates execution of logistics support plans with logistics and operational data feeds.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-11

- Begin to develop the capability to forecast the impact of deviations and alternative support concepts upon future operations.
- Demonstrate multi-echelon collaboration of in-theater management capabilities in a joint warfighting exercise.

(U) FY 2002 Plans:

- Joint Theater Logistics (JTL) ACTD. ($ 9.893 Million)
  - Incorporate and enhance planned deviation detection technology and sentinels to compare planned resource requirements with near real-time operational logistic activity for select support items by location, provider, and intended consumer.
  - Provide the warfighter with near real-time operations and logistics collaborative capabilities to support planning and execution.
  - Incorporate technologies that will track planned versus actual movements and assess logistics readiness, selected weapons systems, and classes of supply.
  - Develop and demonstrate a watchboard capability to track and report operational and logistics status of current operations through a web-based framework.
  - Provide interactive models for requirements, availability and costs.
  - Integrate watchboard and common operational picture views to provide logistics overlays for the warfighter.
  - Demonstrate multi-echelon interoperability and in-theater management capabilities in a joint warfighting exercise.

(U) Other Program Funding Summary Cost:

- Not Applicable.

(U) Schedule Profile :

- Not Applicable.

THIS PAGE INTENTIONALLY LEFT BLANK

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE June 2001			
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research					R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-12					
COST *(In Millions)*	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Cost to Complete	Total Cost
Unmanned Systems TT-12	0.000	99.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	N/A

(U) Mission Description:

(U) This project will pursue the development of unmanned advanced capability aircraft and ground combat vehicles consistent with Public Law 106-259 and 106-398. Systems to be developed under this project include Air Force and Navy Unmanned Combat Air Vehicles (UCAV) and Army Future Combat Systems (FCS). Funding for UCAVs in FY 2002 is contained in PE 0603285E, Advanced Aerospace Systems. Funding for Army FCS is budgeted in PE 0603764E, Project LNW-03.

(U) Funding in this project will accelerate risk reduction and "Concept of Operation" evaluation for the Unmanned Combat Air Vehicle program. Specific tasks include: (1) a full system level refinement of the current baseline UCAV Operating System design incorporating lessons learned from earlier Phase II efforts and recent AF operations, (2) additional constructive analysis to refine the existing mission effectiveness and affordability analysis, (3) design of the third demonstrator system (X-45B air vehicle, mission control system, and support segment) to a level equivalent to a critical design review for long lead items, and (4) design of the Block 3 system software build to demonstrated increased levels of adaptive autonomy by embedding the decision aid software, currently being designed into the mission control segment, into the on-board mission management system. Ultimately, this program will support the goal to demonstrate the technical feasibility for a UCAV system to effectively and affordably perform suppression of enemy air defenses (SEAD)/Strike missions in the post 2010 timeframe.

(U) The goal of the Naval Unmanned Combat Air Vehicle (UCAV-N) advanced technology demonstration program is to validate the technical feasibility for a naval unmanned combat air system to effectively and affordably perform 21st century naval SEAD/Strike and Surveillance missions within the emerging global command and control architecture. This advanced technology demonstration initiative will investigate and validate the critical technologies, processes and system attributes associated with the development of a UCAV-N system, including: (1) demonstration of shipboard suitability; (2) demonstration of robust and secure command, control and communications; (3) exploration of the full range of man-in-the-loop controls and mission planning approaches; (4) evaluation of sensors, weapons load-out and mission effectiveness; and (5) demonstration of real time targeting and weapons delivery compatibility.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-12

(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 was developed to provide enhancements in land force lethality, protection, mobility, deployability, sustainability, and command and control capabilities.

(U) The Future Combat Systems (FCS) program will develop network centric concepts for a multi-mission combat system that will be overwhelmingly lethal, strategically deployable, self-sustaining and highly survivable in combat through the use of an ensemble of manned and unmanned ground and air platforms. The goal of the FCS program is to design an ensemble that strikes an optimum balance between critical performance factors, including ground platform strategic, operational and tactical mobility; lethality; survivability; and sustainability. This system of systems design will be accomplished by using modeling and simulation and experimentation to evaluate competitive concepts. The Future Combat System will be capable of adjusting to a changing set of missions, ranging from warfighting to peacekeeping, as the deployment unfolds. An FCS-equipped force will be capable of providing mobile-networked command, control, communication and computer (C4) functionalities; autonomous robotic systems; precision direct and indirect fires; airborne and ground organic sensor platforms; and precision, three-dimensional, air defense; non-lethal; adverse-weather reconnaissance, surveillance, targeting and acquisition (RSTA). The funds provided under this project will be used to accelerate the development of enabling technologies for unmanned systems within the FCS program. In addition, the funding under this project will be used to add an unmanned, remotely controlled aspect to the Future Combat Systems program.

(U) Program Accomplishments and Plans:

(U) FY 2000 Accomplishments:

- Not Applicable.

(U) FY 2001 Plans:

- Unmanned Combat Air Vehicle (UCAV). ($ 49.650 Million)
  - Design the X-45B system to a level equivalent to a critical design review for long lead items and develop the block 3 intelligent system software.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project TT-12

- Naval Unmanned Combat Air Vehicle (UCAV-N). ($ 24.825 Million)
  - Acelerate conceptual designs of the naval unmanned operational systems and begin maturation of critical enabling technologies.

- Future Combat Systems (FCS). ($ 24.825 Million)
  - Conduct studies of unmanned ground vehicle resupply, air drop, cooperative behaviors, and artificial intelligence data processing.
  - Develop NetFires program boost test vehicles, seeker tower and captive flight tests and wind tunnel tests.
  - Develop low cost, low profile scanning K band antenna for the A160 hummingbird unmanned rotorcraft.
  - Mature technologies for communication relays between command and control elements and ground based fighting elements via unmanned airborne assets.
  - Develop 3-dimensional model-based environmental mapping capabilities using an active vision system incorporating a laser range finder and omni-directional camera.
  - Characterize the diversity of perception tasks that humans perform while driving vehicles for adaptation to robotic vehicle navigation.
  - Develop algorithms to differentiate vegetated from non-vegetated regions through innovative processing of the inputs from diverse sensors.
  - Utilize FOPEN radar and other sensors to conduct experiments to characterize terrain features including topography, biomass, cover and man-made objects.
  - Investigate C4ISR, command and control and employment issues for air and ground robots within the FCS force including the effectiveness of these robotic assests.

(U) FY 2002 Plans:

- Not Applicable.

(U) Other Program Funding Summary Cost:

- Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE June 2001
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA2 Applied Research	R-1 ITEM NOMENCLATURE Tactical Technology PE 0602702E, Project Unmanned Systems TT-12

(U) Schedule Profile:

- Not Applicable.