Missile Defense Agency (MDA) Exhibit R-2 RDT&E Budget Item Justification	Date: May 2009
APPROPRIATION/BUDGET ACTIVITY: **RDT&E, DW/03 Advanced Technology Development (ATD)**	R-1 NOMENCLATURE: **0603175C Ballistic Missile Defense Technology**

COST ($ in Thousands)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total PE Cost	106,437	119,308	109,760					
WX25 Advanced Technology Development	100,510	113,709	107,485					
ZX40 Program-Wide Support	5,927	5,599	2,275					

Beginning in FY 10, Advanced Technology Development will allocate the 3 major focus areas (Sensors, Weapons, and Innovation Technologies) to five Strategic Technology Portfolios (STPs).

In FY08, the Advanced Communications Technology program was funded in the BMD C2BMC Program Element 0603896C Project CX01.

A. Mission Description and Budget Item Justification

A.1 System Element Description

As the United States develops and deploys increasing capabilities within the Ballistic Missile Defense System (BMDS), our potential adversaries continue to develop more advanced missile technology. The Advanced Technology Program Element develops technologies for potential integration into the BMDS to out-pace this evolving ballistic missile threat. The five focus areas of the Strategic Technology Portfolio are Persistent Sensors; Pervasive Weapons; Global Battle Management; Effective Targeting; and Effectiveness in Adverse Environments.

A.2 System Element Budget Justification and Contribution to the Ballistic Missile Defense System (BMDS)

The Strategic Technology Portfolio includes capabilities across all phases of the BMDS engagement space (early intercept, boost, mid-course, and terminal). The Strategic Technology Portfolio balances the pursuit of the promising next generation technology with revolutionary, high-payoff, technology solutions to enhance the BMDS. The Strategic Technology Portfolio next generation, high-payoff technologies include: Electro-Optic/Infrared (EO/IR) & Radio Frequency technologies for persistent sensor coverage; directed energy and interceptor technologies to enable early engagements for pervasive weapons coverage; battle management/fusion/tracking algorithms and kill assessment capabilities to improve engagement success globally; sensors and algorithms to enhance probability of kill for effective targeting; and effective BMDS capability under stressing and adverse environments.

A.3 Major System Element Goals

The three major goals for Advanced Technology are:

- Identify innovative concepts and game changing technologies that can be applied across the BMDS to out pace the threat, improve system performance, and lower life cycle costs.
- Develop and demonstrate advanced technologies for insertion into the BMDS to eliminate capability gaps and enable future architectures to remain ahead of evolving threats.
- Leverage technology investments of other DoD organizations, industry, other government agencies and international partners.

A.4 Major Events Schedule and Description

Major Event	Project	Timeframe

B. Program Change Summary	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget (FY2009 PB)	108,423	118,718	115,234	
Current President's Budget (FY2010 PB)	106,437	119,308	109,760	
Total Adjustments	-1,986	590	-5,474	
Congressional Program Reductions	0	0	0	
Congressional Rescissions	0	0	0	
Total Congressional Increases	0	590	0	
Total Reprogrammings	-258	0	0	
SBIR/STTR Transfer	-1,728	0	0	
Adjustments to Budget Years	0	0	-5,474	

FY08 decrease is a result of MDA programmatic changes.
FY09 increase is a result of Congressional Actions.
FY10 decrease is a result of MDA programmatic changes.

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COST ($ in Thousands)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
WX25 Advanced Technology Development	100,510	113,709	107,485					
RDT&E Articles Qty	0	0	0					

Note: Beginning in FY 10, Advanced Technology Development will allocate the 3 major focus areas (Sensors, Weapons, and Innovation

A. Mission Description and Budget Item Justification

The Advanced Technology seeks to develop new innovative concepts and technologies that can be applied across the BMDS in order to stay ahead of the threat, improve system performance, and lower life-cycle costs. The Strategic Technology Portfolio investments are managed in five primary areas: Persistent Sensor Coverage; Pervasive Weapons Coverage; Global Battle Management; Effective Targeting; and Effectiveness in Adverse Environments. The Advanced Technology program will invest in low Technology Readiness Level (TRL)-High payoff technologies with priorities in EO/IR and RF Sensor Technologies to achieve Persistent Sensor Coverage and support Boost Phase Engagements; Directed Energy and Interceptor Technologies to enable early engagements; Battle Management, Kill Assessment and Data Processing technologies to improve BMDS engagement success; and Material and Algorithms to ensure Effective Operations Under stressing Conditions.

B. Accomplishments/Planned Program

	FY 2008	FY 2009	FY 2010	FY 2011
Sensors Technology	45,132	47,539	0	
RDT&E Articles (Quantity)	0	0	0	

NOTE: To meet the BMDS technology needs, the Sensors Technology area will be allocated into the five Strategic Technology Portfolios (STPs) beginning in FY10.

The Advanced Sensors technology area focused on developing new sensor technologies that operate in adverse environments to enable threat detection, threat identification, launch-to-destruction threat tracking, and discrimination in all phases of flight. Promising technologies in this area included active electro-optical (EO), passive electro-optical and infrared (EO/IR), and passive radio frequency (RF) sensors for detection and identification; radar systems technologies; concepts for Early Launch Detection and Tracking (ELDT), and spectral sensing for kill assessment.

FY08 Accomplishments

- Passive EO/IR Technology

- Provided an alternative IR sensor solution for the BMDS on type II Super-Lattice Structure (SLS) focal plane array (FPA) development for long wavelength infrared (LWIR).
- Validated a 256x320 single-color LWIR SLS FPA at the Infrared Radiation Effects Laboratory (IRREL).
  - SLS successes set up the foundation for future kill vehicle systems.
  - Significant results were achieved in increased Quantum Efficiency and a reduction noise current.

- Explored alternate Infrared FPA materials.
  - Developed and tested a 512x512 single-color LWIR FPA. Results showed similar performance as CdZnTe (cadmium zinc telluride) substrate at 300 K background.

- Demonstrated 1kx1k MWIR camera onboard Big Crow aircraft, and delivered 1024x1024 QWIP LWIR camera for the High Altitude Observatory (HALO) I platform.
- Demonstrated Digital Readout Integrated Circuits (DROIC) concept by hybridizing it on HgCdTe (mercury cadmium telluride) Array.

- Radar System Technology
  - Fabricated, assembled, integrated and tested two 256 element low power density Scalable Panels for Efficient Affordable Radar (SPEAR) RF tiles.
    - Achieved key low power density knowledge point with successful test of a SPEAR Increment 1 RF tile.

  - Conducted Next Generation Transmit Receive Integrated Multi-Channel Module (NGT) Preliminary and Critical Design Reviews.
    - Demonstrated reliability sufficient to proceed with the NGT program.

  - Finalized and initiated execution of collaborative MDA-DARPA Gallium Nitride (GaN) Power Amplifier Technology Transition Agreement.
    - Achieved key knowledge point GaN power amplifier reliability.

  - Completed Coherent Distributed Aperture Demonstration feasibility study and program definition; this will allow BMDS radar performance to be provided despite the presence of difficult counter-measures.
  - Demonstrated and tested a single-chip silicon germanium transmit receive module that offers state of the art performance at significantly lower cost than current production technologies.

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- Early Launch Detection and Tracking Technology
  - Developed and tested a SkyLOS-C2BMC data interface in the Missile Defense Integrated Operations Center (MDIOC) X-Lab to investigate message format, data latency, and data fusion.
  - Extended the detection and tracking algorithms being developed for SkyLOS measurements to accommodate Overhead Persistent Infra-Red (OPIR) measurements.
  - Analyzed the utility of fused HF radar and OPIR data to support forward based X-Band radars.
  - Demonstrated a cooperative Multiple-Input Multiple-Output (MIMO) waveform and adaptive processing test using Australian operational assets that produced a first ever demonstration of Over the Horizon (OTH) radar spread clutter mitigation.
  - Conducted flight and ground tests using First Alert and Cueing (FAC) sensors.
  - Developed technical specifications for a Hyper-Temporal Infrared (HTI) System to be demonstrated and flown aboard an Air Force Research Laboratory (AFRL) technology satellite.
  - Conducted testing of real-time HTI launch detection techniques, to include detection algorithms and advanced sensors.
  - Used data collected by current OPIR asset to demonstrate earlier launch detection using HTI processing techniques.
  - Demonstrated through-cloud detection of developmental HTI sensor.
  - Developed jitter mitigation techniques for HTI sensor.
  - Began development of advanced HTI processing to provide robust performance in a jitter environment.

- Spectral Sensing for Kill Assessment
  - Completed development of high speed spectrometer instrument package for support of data collection during intercept flight tests.
  - Investigated BMDS hyper/multi-spectral sensor prototype design, development, and testing.
  - Performed ground based experiments to verify exploitable impact features derived from modeling and small scale tests.

FY09 Planned Program/Accomplishments

- Passive EO/IR Technology
  - Maintain improvement of type II super-lattice (SLS) material quality and passivation.
    - Increase quantum efficiency via optimized material quality and device structure design.
    - Reduce noise current by a factor of 2 (compared to FY08).
    - Develop SLS FPA in 256x320 format for future KV seekers.
    - Develop 512x512 two-color FPA for future KV seekers.

- Sustain optimization efforts to reduce the buffer layer dislocation defects of the HgCdTe (mercury cadmium telluride) on Si (silicon) substrate.
  - Procure HgCdTe on GaAs FPA from Selex and test it at low background.
  - Deliver an optimized 512x512 single-color long-wavelength focal plane array for lab testing.
  - Continue efforts to develop a qualified domestic vendor for 211 CdZnTe (cadmium zinc telluride) substrate.

- Deliver 1k x 1k two-color QWIP arrays for Airborne Laser (ABL) Block upgrades. Lab validate and field test to increase the technology readiness level (TRL).
  - Continued to develop 2k x 2k two-color (two IR wavebands) QWIPs for ABL Block upgrades.

- Resumed investigating new concepts in infrared technologies in dilute III-V material for future potential infrared material and Digital Readout Integrated Circuits (DROIC).
- Initiated Strained Layer Superlattice (SLS) Fabrication program to develop SLS material as a production quality material.

- Radar System Technology
  - Fabricate, assemble, integrate and chamber test element SPEAR Increment 1 RF panel.
  - Initiated design activities for SPEAR Increment 2 RF panel array development to further improve performance and reduce cost.
  - Continued development of gallium nitride (GaN) monolithic microwave integrated circuit (MMIC) for the Next Generation Transmit Receive Integrated Multi-Channel Module.
  - Continued the Radar Trade Study to identify key enabling radar technologies and architectures that offer significantly improved BMDS performance at a reduced cost.
  - Initiated GaN producibility program to mature manufacturing processes for GaN MMICs.

- Early Launch Detection and Tracking Technology
  - Perform integrated Multiple-Input Multiple-Output (MIMO), multi-site, multi-channel SkyLOS RX data collection at Woomera, AU, using LOS TX and targets of opportunity.
  - Support the Australia Defense Science and Technology Organization by contributing to the tested capability at Woomera.
  - Perform development testing of MIMO transmit waveforms with Australia to demonstrate real time radar clutter mitigation using Australian operational assets.

- Collected and analyzed data for the PURE Mission processor.
- Integrate operational Hyper-Temporal Infrared (HTI) prototype for Science Experiment Review Board selected flight on AFRL technology demonstration satellite.
- Began initial test for verification and validation of HTI processing algorithms into ground processing station for existing OPIR asset.
- Conduct ground tests of operational HTI sensor.

- Spectral Sensing for Kill Assessment
  - Restructured Kill Assessment program into functions (Hit/Hit Assessment, Kill Assessment and Warhead Typing).
  - Develop roadmap leading from program initiation to potential transition of functional capabilities.
  - Complete development of high speed spectrometer instrument package for support of data collection during intercept flight tests.
  - Continued with BMDS hyper/multi-spectral sensor prototype design, development, and testing.
  - Develop ground based experiment strategies to improve models of impact phenomena and the comparison of model output with flight test data.
    - Improve decision algorithm logic to enable hit/kill assessment from multispectral radiometry measurement of impact flash signatures after kinetic kill intercepts.

	FY 2008	FY 2009	FY 2010	FY 2011
Weapons Technology	34,621	39,399	0	
RDT&E Articles (Quantity)	0	0	0	

NOTE: To meet the BMDS technology needs, the Weapons Technology area will be allocated into the five Strategic Technology Portfolios (STPs) beginning in FY10.

The Advanced Weapons area focused on developing technologies and new concepts to enable the successful destruction of any ballistic missile threat, in any phase of flight, via kinetic energy interceptors or directed energy systems. Promising new directed energy technologies are developed within the Laser Technology Program (LTP) and promising technologies for hit-to-kill interceptors are being developed within the Interceptor Technology Program (ITP).

FY08 Accomplishments

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- Laser Technology Program
  - Advanced Inertial Reference Unit (aIRU) - Completed initial testing and experimentation.
  - Chemical Oxygen Iodine Laser (COIL) Improvements - Successfully tested deuterated fuels.
  - Ultra-Sensitive Detectors - Completed Detector system modeling, final design documentation. Delivery of prototype camera system for testing at government location delayed till 3QTR FY09.
  - Advanced Track Illuminator Laser (ATILL) - Completed concept development phase and conducted Concept Design Review (CDR).
  - High Brightness / High Efficiency Lasers - Successfully completed and demonstrated a 100 W laser. 1 kW demo scheduled for 4QTRFY09.
  - Fiber Laser Beam Combining - Completed a detailed design and began hardware procurements for FY09 8-element demonstration.
  - Spherical Primary Optical Telescope (SPOT) Optics - Segment 1 polished and characterized and mirror control system currently in design phase.

- Interceptor Technology Program
  - General Interceptor Technology
    - Propulsion - Established Propellant Ignition Test Chamber. Successfully conducted proof of principle testing of hot fire, thermally decomposed Hydroxyl Ammonium Nitrate (HAN) meso-scale thruster in heavy-weight configuration.
    - Sensors and Seekers - Completed high fidelity seeker simulation with Distributed Aperture algorithms.
    - Structures and Materials - Selected Advanced Composite Materials and Powder Metal candidates for thermal, shock, vibration and radiation testing. Completed finite element analysis for prescribed aeroshell material system. Initiated Powdered Metal Composite fabrication and thermo-mechanical coupon testing.
    - Lethality - Conducted comparative hyper-velocity lethality testing with inert and reactive material penetrators against identical targets.
    - Guidance, Navigation and Control: Modified Engagement Simulation Tools in Preparation for Agile Kill Vehicle Missile Concept and Guidance Law Assessments.

- Agile Kill Vehicle Technologies
  - Published Broad Agency Announcement to identify possible technologies to improve or enhance Kill Vehicle agility.
  - Developed a high fidelity IR scene to be used in their laboratory evaluation of seekers and Infrared Search and Track System (IRSTS) during Boost and Terminal Phase Intercepts.
  - Verified AIM-9X seeker performance prior to flight test through simulation.

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- Air-Launched Concepts
  - Completed a successful flight test and Boost-Phase Intercept demonstrating the AIM-9X seeker capability of the plume-to-hard body handover.
  - Successfully simulated a Patriot PAC-3 MSE release from a pod on the wing of an F-15.

FY09 Planned Program/Accomplishments

- Laser Technology Program
  - Chemical Oxygen Iodine Laser (COIL) Improvements - Conduct subscale deuterated fuels demonstration.
  - Advanced Track Illuminator Laser (ATILL) - Conduct Interim Design Review for a 6kW illuminator and conduct half-power demonstration.
  - High Brightness / High Efficiency Lasers - Demonstrate 1kW laser and characterize the ceramic laser.
  - Optically Triggered Q-Switch / High Average Power Pump Arrays - Deliver pump arrays with associated electronics and conduct lifetime testing.
  - Fiber Laser Beam Combining - Demonstrate an 8-fiber Coherent Array.
  - SPOT Optics - Demonstrate wave front sensing and control utilizing the SPOT test bed.
  - High Power Vertical Cavity Surface-Emitting Laser (VCSEL) - Begin construction on 2kW/cm2 emittance array.

- Interceptor Technology Program
  - General Interceptor Technology
    - Advanced Active/Passive Seeker - Demonstrate the performance advantage of a high frame-rate focal plane array with low noise read out integrated circuit to enhance long range acquisition for boost, mid-course, and terminal phase intercepts.
    - Propulsion: Demonstrate HAN Micro-thrusters performance, including thrust, response time, ISP and longevity.
    - Structures and Materials: Demonstrate strength, weight and radiation hardening properties of advanced materials through analysis and coupon characterization.
    - Lethality Enhancement - Demonstrate component lethality with light gas gun testing. Guidance, Navigation and Control (GNC): Select prototype optimal GNC algorithm versus a representative maneuvering threat for future HWIL testing.

  - Agile Kill Vehicle Technologies
    - AKV Maneuver Demonstration - Conduct preliminary design and critical technology identification.
      - AKV Seeker - Conduct preliminary design and critical technology identification.

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- N-UCAS Sensor Prototype - Conduct preliminary design and critical technology identification.

- Air-Launched Concepts
  - Develop models and integrate into operational simulation.
  - Complete development of ALHTK 6 Degrees of Freedom simulation.

	FY 2008	FY 2009	FY 2010	FY 2011
Innovative Technology and Analysis	7,327	7,372	0	
RDT&E Articles (Quantity)	0	0	0	

NOTE: To meet the BMDS technology needs, the Innovative Technology and Analysis area will be allocated into the five Strategic Technology Portfolios (STPs) beginning in FY10.

This effort identified emerging concepts and technology solutions to enhance the future BMDS. Through efforts with domestic and foreign corporate, academic, government and individual technologists, this effort identified new missile defense concepts and solutions with the intent of maturing the most promising to a level where they can be evaluated for transition directly to the BMDS or alternately to the Sensors, Weapons, or Hercules technology areas for continued development in an effort to keep pace with the evolving threat.

FY08 Accomplishments

- Managed congressionally directed and statutory and mandated technology programs.
- Collaborative Technology Support and Advanced Technology Broad Area Announcement (BAA)
  - Conducted four Industrial Partnership Days for MDA sponsored SBIR companies to seek out opportunities to partner with BMDS prime contractors.
  - Sought out innovative and breakthrough technologies from domestic and international sources.
  - Examined opportunities and established initial agreement with a key BMDS ally to leverage their technology investment for the benefit of the BMDS.
  - Continued to seek collaboration opportunities with MDA and other Government, Industry, and International efforts.

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- Missile Defense Science Technology and Research (MSTAR) Program
  - Extended five MSTAR contracts that were nearing their contract end date in order to take advantage of demonstrated successes in the areas of Propulsion, Materials and Sensors.
  - Awarded five MSTAR contracts to five universities for research involving target identification, tracking and destruction.
  - Continued periodic review of individual MSTAR contract performers to ensure maximum returns on fiscal investment.

- Advanced Technology Portion of the SBIR/STTR
  - Generated fifteen new topics for SBIR/STTR Phase I solicitation.
  - Sponsored eighty one SBIR/STTR Phase I and II selections, coordinating corresponding evaluations.
  - Led five SBIR/STTR Phase I and II Research Areas.
  - Coordinated independent assessment team to evaluate forty eight SBIR proposals for transition to Phase II.

- Advanced Technology Portion of the SBIR/STTR
  - Selected fifteen STTR Phase I efforts in the Interceptor Technology, Manufacturing and Producibility, and Radar Technology research areas.
  - Selected seven STTR Phase II efforts in the Discrimination, Radar Technology, and Space Technology research areas.
  - Selected eighteen SBIR Phase I efforts in the Radar Technology research area and twenty four Co-Sponsored SBIR Phase I efforts in Interceptor Technology research area.
  - Selected twenty four SBIR Phase II efforts in the Discrimination, Interceptor Technology, Manufacturing and Producibility, and Integration research areas.

FY09 Planned Program/Accomplishments

- Managed congressionally directed and statutory and mandated technology programs.
- Collaborative Technology Support and Advanced Technology BAA.
  - Closed out the Czech Academy of Science contract and received delivery of Czech selected technology database.
  - Awarded contract to Sparta to subcontract with a Czech Technical University for stereoscopic image analysis and conducted the first program review.
  - Awarded contract to Northrop Grumman with a subcontract to Rosving to integrate the Danish Sensor Shooter Model with Northup Grumman's GEM. Conducted the kickoff meeting and viewed a demonstration of the GEM.

- Participate in future Industry Partnership days with the prime contractors.
- Investigating a DARPA technology for possible partnership with MDA Advanced Technology Directorate.
- Prepared and released a two-year Advance Technology Innovation BAA to seek innovative and breakthrough technologies from domestic and international sources.
- Received and coordinated the technical review of twenty nine White Papers generated from the Advanced Technology Innovation Cell Broad Agency Announcement.
- Innovation Established an Advanced Technology Workshop with JPL and the BMDS Knowledge Center to build a community of visionary researchers from academia, government labs, and industry with focus on technologies for the next Generation of the BMDS.
- Awarded International contract for the Multinational BMDS.
- Conducted SLS Focal Plan Array Industrial Day and award numerous contracts for material growth and fabrication.

- Missile Defense Science Technology and Research (MSTAR) Program
  - Kick-off new awards to the five universities for research involving fiber laser technology, active imaging, tracking algorithms, spectral imaging, and detection of RF emissions.
  - Accept proposals on the MSTAR Broad Agency Announcement containing eight research topics in radar systems, lasers and electro-optics, passive/active IR sensors, signal processing, mathematics, materials, mechanical engineering, and battle management.
  - Aligned projects that dealt with aspects of lethality enhancement or gauging lethality success with MDA's Engineering Corporate Lethality Plan that coordinates activities to enhance mission effectiveness intercepts.

- Advanced Technology Portion of the SBIR/STTR
  - Formulated the SBIR/STTR technology investment strategy and associated budget. Included eight research areas and thirty nine topics under SBIR and seven research areas and ten topics under STTR.
  - Briefed strategy to the steering committee. Implementation was approved.
  - Assigned and managed research area leads to implement the strategy.

- Congressional Interest Program
  - Initiated Task Order 4 of the OCEANIT contract. OCEANIT, under Task Order 4, will participate in several intercept test events and fly their detector technology aboard HALO I to collect data to enhance MDA's understanding of engagement success and access their technology as a viable option for the Spectral Sensing for Kill Assessment program.

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- Initiated SiC mirror production with TREX to continue to construct various SiC mirrors that will be transitioned to DTR for insertion into ground and airborne sensors for data collection during intercept events.

	FY 2008	FY 2009	FY 2010	FY 2011
Technology Development	0	0	67,106	
RDT&E Articles (Quantity)	0	0	0	

Beginning in FY 10, Advanced Technology Development will allocate the 3 major focus areas (Sensors, Weapons, and Innovation Technologies) to five Strategic Technology Portfolios (STPs).

STP 1 - Persistent Sensor Coverage - Develop electro-optical and infrared (EO/IR) and radio frequency (RF) technologies for persistent sensor coverage. Develop technologies that improve the performance of the current sensors and significantly reduce the overall life-cycle cost, expanding the battle space to provide early and continuous sensor coverage. Development of EO/IR and RF beyond-line-of-sight sensors for all-weather cueing and typing to provide robust, early launch detection and tracking of ballistic missile launches resulting in a seamless birth to death coverage with higher performing sensors.

FY10 Planned Program

- Multiple Phenomenology Sensors
  - Pursue technology development in multiple phenomenology sensors.
- Seamless Birth-to-Death Coverage
  - Continue development of Digital Focal Plane Array and initiate research topic areas in seamless birth to death coverage.
- Higher Performance Sensors
  - Continue contributions in Focal Plane Array SBIR effort. This research effort is for large field of view infrared search and track systems.
  - Continue development of the Early Launch Detect and Track technology.
  - Continue development of the Strained Layered Superlattice program for high-performance infrared focal plane arrays.
  - Continue to develop domestic substrate capability to address the manufacturing of substrates needed for focal plane arrays.

- Initiate research topic areas in higher performance sensors.

- Initiate research topic areas in phenomenology collection and analysis.
- Initiate research topic areas in sensor registration.

STP 2 - Pervasive Weapons Coverage - Develop directed energy and interceptor technologies to enable early engagements. The application of these innovations will provide the capabilities for boost phase intercepts as well as a more robust mid-course and terminal intercept capability against more advanced threats.

FY10 Planned Program

- Boost Phase, Midcourse and Terminal Intercepts
  - Continue development of Agile Kill Vehicle technologies for improved robustness against endgame countermeasures and miniaturized components.
  - Continue development of the Diode Pumped Alkali Laser to produce high output power and wallplug efficiencies.
  - Continue Chemical Oxygen Iodine Laser development to reduce logistics tail and long term chemical storage.

- Advanced Weapons Components
  - Continue to refine guidance, navigation and control (GN&C) algorithms to improve system performance and reduce the kill vehicle performance requirements.
  - Continue development of the High Maneuverability Divert Attitude Control System (DACS) to increase interceptor missile agility.
  - Develop basis of knowledge to enable design, development and test of reactive materials for future kill vehicles with enhanced lethality.
  - Initiate research topic areas advanced weapons components.

- Initiate research topic areas for new concepts in boost, mid-course and terminal intercepts.

STP 3 - Global Battle Management - Battle Management/fusion/tracking algorithms and Kill Assessment capabilities to improve engagement success. Develop options for a global engagement management and fire control architecture that will allow any platform in the network to engage anytime, anywhere based on available fire control data. Sensors and decision logic which exploits the physics and phenomenology associated with interceptor engagement of hostile reentry vehicles (RVs) to enable Assessment of Engagement Success (AES).

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FY10 Planned Program

- Decision Making
  - Spectral Sensing for Kill Assessment (SSKA) - Improves Battle Management, Consequence Mgt, and National Command Decision process.
  - Initiate research topic areas in global battle management decision making.

- Initiate research topic areas for robust and reliable communications.

STP 4 - Effective Targeting - Develop sensors and algorithms to enhance the probability of kill. This includes innovative systems that will provide the BMDS with a precision tracking capability and radio frequency (RF) radar technologies that will enhance system sensitivity.

FY10 Planned Program

- Effective Target Selections
  - Continue development in Advanced Track Illuminator Laser (ATILL).
  - Continue development of Fiber Laser Beam Combining technologies.
  - Initiate research topic areas in effective target selections.

- Ability to Determine Discrimination Features
  - Continue development of high performance radio frequency (RF) amplifier technology to improve performance and reliability.

STP 5 - Effectiveness in Adverse Environments - Develop effective BMDS capabilities under stressing conditions. Develop capabilities in radar sensing focusing on revolutionary technology associated with low-power-density radar systems, miniaturized components to enable next generation small and lightweight kill vehicles and space products and new system concepts that defeat maneuvering targets and evolving threats.

FY10 Planned Program

- Initiate research topic areas for operations in adverse natural environments.
- Countermeasures

- Continue development of Scalable Panels for Efficient Affordable Radar (SPEAR) Spiral 2 RF panels to improve detection range, increase number of tracking beams, develop improved waveforms.

- Operation in a Nuclear Environment (OPINE)
  - Continue development of structures with advanced materials to enable the use of material properties for the relevant environments.

	FY 2008	FY 2009	FY 2010	FY 2011
Program Office	0	0	26,452	
RDT&E Articles (Quantity)	0	0	0	

This includes the management of the Strategic Technology Portfolios (STPs) and technology program analysis. This effort is comprised of entirely Program Management costs associated with Advanced Technology development, no article quantities are reported.

FY10 Planned Program

- Funds government personnel salaries for program management, project support, project costs and travel.
- Support activities for technology development.

	FY 2008	FY 2009	FY 2010	FY 2011
Statutory and Mandated	1,589	1,611	1,290	
RDT&E Articles (Quantity)	0	0	0	

This effort provided MDA with the Technology Application Program which conducted technology applications reviews and business focus workshops. This effort also assisted in accelerating technology maturation via techniques such as commercialization assistance by expert reviews and advice, out reach publications and web site, consultation and training of technology developers, and application of standard metrics to validate technology maturation gains. Included is the management and technical oversight of the Historically Black Colleges and Universities/Minority Institutions Program (HBCU/MI) (FFAR direction). This effort developed research topics and selected BMDS relevant proposals from HBCU/MI.

FY08 Accomplishments

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- Technology Applications Program
  - Conducted Business Focus Workshops, working with thirty one MDA-funded companies.
  - Conducted Technology Applications Reviews to assist technology developers to find and enter technology transfer opportunities beyond their direct MDA application.
  - Populated and maintained the MDA Technology Applications website with articles and publications describing BMDS-funded projects having commercial application.
  - Produced quarterly issues of the MDA TechUpdate and two commercialization publications.

- Historically Black Colleges and Universities/Minority Institutions (HBCU/MI)
  - Continued technical oversight of sixteen HBCU/MI contracts addressing BMDS technology requirements.
  - Awarded eight HBCU/MI contracts to seven universities for research involving target identification, tracking and destruction.

FY 09 Planned Program/Accomplishments

- Technology Applications Program
  - Conducted Technology Applications Reviews to assist MDA-funded technology developers find and enter technology transfer opportunities beyond MDA- applications.
  - Conduct Business Focus Workshops with MDA SBIR Phase I companies to help develop a successful business model for their technology early in the development cycle.
  - Published the MDA Technology Applications annual report, The Spirit of Innovation, and a report on biomedical and life science technology transfer from MDA technology on the Web.
  - Administered, updated, and expanded MDA's dedicated Web site for technology transfer.
  - Improved Technology Applications program information resident on the MDA portal.
  - Continue to manage and continually update the Technology Applications program's internal data handling and tracking system SpinTrack to manage all aspects of the Technology Applications program including historical data.
  - Continue to work with the program managers of the MDA Technology Applications to provide support for duties such as attendance at DoD's Defense Technology Transfer Working Group meetings, Federal Laboratory Consortium for Technology Transfer (FLC) activities, MDA symposia and conferences, and Industry Participation Days with major defense contractors.

Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification	Date: May 2009
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- HBCU/MI
  - Projects that dealt with lethality were aligned to the MDA Corporate Lethality Plan.
  - Close out HBCU/MI contracts that conducted research involving target identification, tracking and destruction.

FY10 Planned Program

- Conduct technology applications reviews and business focus workshops.
- Assist in accelerating technology maturation.

	FY 2008	FY 2009	FY 2010	FY 2011
Congressional Action	11,841	6,000	0	
RDT&E Articles (Quantity)	0	0	0	

The four congressionally directed technology programs are listed below.

FY 08 Accomplishments:

- Provided programmatic oversight and technical influence for the following programs:
  - Aluminum Nitride for Substance and Devices
  - Massively Parallel Optical Interconnects
  - Multiple-Target-Tracking Sensor-Array Technology (MOST)
  - Net Centric Airborne Defense Element (NCADE)

FY09 Planned Program:

- Provide programmatic oversight and technical influence for the following programs:
  - Multiple-Target-Tracking Sensor-Array Technology (MOST)
  - Night Vision Sensor

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	FY 2008	FY 2009	FY 2010	FY 2011
Advanced Communications Technology	0	11,788	12,637	
RDT&E Articles (Quantity)	0	0	0	

Note: In FY08, the Advanced Communications Technology program was funded in the BMD C2BMC Program Element 0603896C Project CX01.

The Advanced Communications effort focuses on developing the next generation command and control and battle management concepts and the enabling technologies required to implement them among the BMDS. These activities will develop, integrate, and demonstrate advanced Command and Control, Battle Management and Communications (C2BMC) concepts and enabling technologies for improving BMDS performance across all mission areas to include defense of friends and allies. Advanced BMDS integration concepts and techniques are demonstrated and evaluated in system-wide flight tests to facilitate the transition to the operational C2MBC.

FY09 Planned Program/Accomplishments

- Commence/continue activities to enable the integration of advanced C2BMC capabilities into BMDS subsystems.
  - Demonstrate and evaluate advanced C2BMC capabilities in live-flight test events using the C2BMC X-Lab.
  - Align war fighter concept of operations (CONOPS) with appropriate engagement sequence group (ESG) in the areas of OPIR phase tracking and classification, sensor resource management, weapons resource management, post-intercept debris information flow, and communication with allies.

- Develop and demonstrate next generation command and control capabilities.
  - Continue to develop, demonstrate, and evolve net centric services to demonstrate the value of exchange C2BMC data with other mission areas system to improve warfighting capability.

- Develop and demonstrate next generation sensor netting and sensor resource management techniques.
  - Conduct sensor netting experiments associated with tracking, integrated discrimination, sensor resource tasking, and communications/bandwidth constraints.
  - Continue to evolve models and tools to assess the next generation algorithms.

- Develop and demonstrate advanced battle management (BM) and integrated fire control capabilities.

- Conduct architecture assessments of BM functions federated between C2BMC and various allied/coalition partners.
- Integrate the CONOPS information and engagement sequence group (ESG) priorities for advanced and emerging BMDS capabilities (such as multiple kill vehicles) into battle management constructs.

- Develop and demonstrate advanced battle management (BM) and integrated fire control capabilities.
  - Conduct architecture assessments of BM functions federated within C2BMC and various allied/coalition partners.
  - Integrate the CONOPS information and engagement sequence group (ESG) priorities for advanced and emerging BMDS capabilities (such as multiple kill vehicles) into battle management constructs.

FY10 Planned Program:

- Commence/continue activities to enable the integration of advanced C2BMC capabilities into BMDS subsystems.
  - Demonstrate and evaluate advanced C2BMC capabilities in live-flight test events using the C2BMC X-Lab.
  - Continue to evolve war fighter concept of operations (CONOPS) with appropriate engagement sequence group (ESG) in the areas of boost phase tracking and classification, sensor resource management, weapons resource management, post-intercept debris information flow, and communication with allies.

- Develop and demonstrate next generation sensor netting and sensor resource management techniques.
  - Conduct sensor netting experiments associated with tracking, integrated discrimination, sensor resource tasking, and communications/bandwidth constraints.

- Develop and demonstrate advanced battle management (BM) and integrated fire control capabilities.
  - Conduct architecture assessments of BM functions federated within C2BMC and various allied/coalition partners.
  - Integrate the CONOPS information and ESG priorities for advanced and emerging BMDS capabilities (such as Space Tracking and Surveillance System (STSS)) into battle management constructs.

Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification	Date: May 2009
APPROPRIATION/BUDGET ACTIVITY: RDT&E, DW/03 Advanced Technology Development (ATD)	R-1 NOMENCLATURE: 0603175C Ballistic Missile Defense Technology

C. Other Program Funding Summary

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Total Cost
PE 0603881C Ballistic Missile Defense Terminal Defense Segment	1,034,478	956,686	719,465						
PE 0603882C Ballistic Missile Defense Midcourse Defense Segment	2,198,664	1,507,481	982,922						
PE 0603883C Ballistic Missile Defense Boost Defense Segment	503,475	400,751	186,697						
PE 0603884C Ballistic Missile Defense Sensors	574,231	777,693	636,856						
PE 0603886C Ballistic Missile Defense System Interceptors	330,874	385,493	0						
PE 0603888C Ballistic Missile Defense Test and Targets	619,137	919,956	966,752						
PE 0603890C Ballistic Missile Defense Enabling Programs	416,937	402,778	369,145						
PE 0603891C Special Programs – MDA	193,157	175,712	301,566						
PE 0603892C Ballistic Missile Defense Aegis	1,126,337	1,113,655	1,690,758						
PE 0603893C Space Tracking & Surveillance System	226,499	208,923	180,000						
PE 0603894C Multiple Kill Vehicle	223,084	283,481	0						
PE 0603895C BMD System Space Program	16,237	24,686	12,549						
PE 0603896C BMD C2BMC	439,997	288,287	340,014						
PE 0603897C BMD Hercules	51,387	55,764	48,186						
PE 0603898C BMD Joint Warfighter Support	45,400	69,743	60,921						
PE 0603904C Missile Defense Integration & Operations Center (MDIOC)	77,102	106,040	86,949						
PE 0603906C Regarding Trench	1,945	2,968	6,164						
PE 0603907C Sea Based X-Band Radar (SBX)	155,244	146,895	174,576						
PE 0603908C BMD Europ Intercep Site	0	362,007	0						
PE 0603909C BMD Europ Midcourse Radar	0	76,537	0						
PE 0603911C BMD European Capability	0	0	50,504						
PE 0603912C BMD European Comm Support	0	27,008	0						
PE 0603913C Israeli Cooperative	0	0	119,634						
PE 0605502C Small Business Innovative Research BMDO	137,409	0	0						
PE 0901585C Pentagon Reservation	5,971	19,667	19,709						
PE 0901598C Management Headquarters – MDA	83,907	81,174	57,403						

Note: The Ballistic Missile Defense System (BMDS) is an integrated, interoperable, global defense system. The programs which comprise the BMDS are interdependent.

Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification	Date: May 2009
APPROPRIATION/BUDGET ACTIVITY: RDT&E, DW/03 Advanced Technology Development (ATD)	R-1 NOMENCLATURE: 0603175C Ballistic Missile Defense Technology

D. Acquisition Strategy

BMD Technology does not have any major performers that qualify for this category based on the Financial Management Regulations.

Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification	Date: May 2009
APPROPRIATION/BUDGET ACTIVITY: **RDT&E, DW/03 Advanced Technology Development (ATD)**	R-1 NOMENCLATURE: **0603175C Ballistic Missile Defense Technology**

COST ($ in Thousands)	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
ZX40 Program-Wide Support	5,927	5,599	2,275					
RDT&E Articles Qty	0	0	0					

A. Mission Description and Budget Item Justification

Program-Wide Support provides funding for common non-headquarters support functions across the entire program. Includes costs for both government civilians performing these functions, as well as outside services and support contractors that augment government staff in these areas. Other costs included provide facility capabilities for MDA Executing Agent locations, such as physical and technical security, legal services, travel and training, office and equipment leases, utilities and communications, supplies and maintenance, and similar operating expenses. Also includes funding for charges on canceled appropriations in accordance with Public Law 101-510, legal settlements, and foreign currency fluctuations on a limited number of foreign contracts.

B. Accomplishments/Planned Program

	FY 2008	FY 2009	FY 2010	FY 2011
Civilian Salaries and Support	5,927	5,599	2,275	
RDT&E Articles (Quantity)	0	0	0	

See Section A: Mission Description and Budget Item Justification

Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification	Date: May 2009
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