Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602236N: *Warfighter Sustainment Applied Res*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**FY 2011 Base Estimate**	**FY 2011 OCO Estimate**	**FY 2011 Total Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	114.262	118.783	113.724	0.000	113.724	97.518	92.886	92.352	92.861	Continuing	Continuing
0000: *Warfighter Sustainment Applied Res*	92.082	103.726	113.724	0.000	113.724	97.518	92.886	92.352	92.861	Continuing	Continuing
9999: *Congressional Adds*	22.180	15.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	135.425

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Feb 2009). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE supports the Future Naval Capabilities (FNCs) of Littoral Combat/Power Projection, Capable Manpower, Force Health Protection Future Capability, Seabasing and Enterprise and Platform Enablers (EPE) FNC; and innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on manpower and personnel; naval systems training; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; high speed sealift; cost reduction technologies; and seabasing technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts; the critical human system, "Sea Warrior"; and Naval business efficiencies within "Sea Enterprise."

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy	DATE: February 2010
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B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	115.700	104.169	0.000	0.000	0.000
Current President's Budget	114.262	118.783	113.724	0.000	113.724
Total Adjustments	-1.438	14.614	113.724	0.000	113.724
• Congressional General Reductions		-0.495			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.011			
• Congressional Adds		15.120			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.597	0.000			
• SBIR/STTR Transfer	-2.035	0.000			
• Program Adjustments	0.000	0.000	113.724	0.000	113.724

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Project: 9999: *Congressional Adds*		
Congressional Add: *Managing and Extending DOD Asset Lifecycles (Medal)*	0.000	1.593
Congressional Add: *Nanotechnology for Anti-Reverse Engineering*	0.000	2.390
Congressional Add: *Productization of Anti-Fouling and Fouling Release Coating Systems*	0.000	2.788
Congressional Add: *Acoustic Research Detachment Test Support Platform Upgrade*	1.496	0.000
Congressional Add: *Advanced Composite Maritime Manfacturing*	1.995	1.593
Congressional Add: *Assistive Technologies for Injured Servicemembers*	1.596	0.797
Congressional Add: *Biosensors for Defense Applications*	1.994	0.797
Congressional Add: *Composite Materials Enhancements through Polymer Science Research and Development*	2.235	5.099
Congressional Add: *Digital Directed Manufacturing Project*	1.695	0.000
Congressional Add: *Intelligent Retrieval of Imagery*	2.393	0.000
Congressional Add: *Friction Stir Welding*	0.798	0.000

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Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Congressional Add: *Nanotechnology Engineering & Manufacturing Operation (NEMO)*	1.596	0.000
Congressional Add: *On-Board Vehicle Power Systems Development*	2.393	0.000
Congressional Add: *Optimization of New Marine Coatings*	1.596	0.000
Congressional Add: *PULSE Virtual Clinical Learning Lab*	2.393	0.000
Congressional Add Subtotals for Project: 9999	22.180	15.057
Congressional Add Totals for all Projects	22.180	15.057

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010
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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
0000: *Warfighter Sustainment Applied Res*	92.082	103.726	113.724	0.000	113.724	97.518	92.886	92.352	92.861	Continuing	Continuing

A. Mission Description and Budget Item Justification

This PE supports the FNC's of Littoral Combat/Power Projection, Capable Manpower, Force Health Protection Future Capability, Enterprise and Platform Enablers (EPE) FNC; and innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on manpower and personnel; Naval systems training and education; human systems integration; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; high speed sealift; cost reduction technologies; and Sea Basing technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts; the critical human system, "Sea Warrior"; and Naval business efficiencies within "Sea Enterprise."

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
ADVANCED NAVAL MATERIALS	12.788	15.515	23.876	0.000	23.876
Advanced Naval Materials efforts include: developing advanced, high-performance materials; processes to reduce weight and cost; and enhanced sonar transducers. The increase between FY 2010 to FY 2011 is due to energy initiative. *FY 2009 Accomplishments:* - Continued multi-laser-processing technique development for the fabrication of ultra hard materials for wear resistance applications. - Continued development of advanced, cost-efficient joining of titanium for >25% weight reduction of large seaborne structures.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued development of advanced composites and polymers with fire resistance for ship structures. - Continued development of nanotube reinforced composite materials for next generation air and naval platforms. - Continued development of acceptance testing methodologies for advanced transducer single-crystal high-strain materials and definition of standardized materials properties and composition ranges. - Continued development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications. - Continued development of cavitation resistant ship rudder coatings based on the FY 2004 shipboard coating study. - Continued marine titanium alloy design and processing development, exploiting anticipated cost reductions for high performance, reduced maintenance naval applications. - Continued development of continuous single wall carbon nanotube composite materials for next generation air and naval platforms. - Continued stainless steel carburization study to enhance corrosion performance. - Continued development of surface preparation methods and characterization of corrosion performance for future naval ship materials. - Continued evaluation of low temperature carburized materials for marine application. - Continued development of coating performance and knowledge database for Naval use. - Continued development of mechanistic model for stress corrosion cracking in Nickel Aluminum Bronze (NAB). - Continued friction stir welding development for control of residual stresses and elimination of distortion in naval steels. - Continued development of innovative sonar transducers based on high-strain, high-coupling piezoelectric single crystals. piezoelectric single crystals. - Continued development of integrated structural composites with blast resistance, manufacturing technologies, and low-cost organic resins with improved fire resistance.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued development of novel processing technologies for increasing the fatigue strength and corrosion resistance of weldments for ship structures with reduced weight and maintenance requirements. - Continued development of materials processing methods for single crystal piezoelectrics to make strong, robust sonar transducers. - Continued modeling and process development of single-melt cold hearth casting of naval titanium alloys including Ti 5-1-1-1 for enhanced mechanical properties and formability. - Continued development of models and characterization methods for dynamic loading (water slamming and blast loading) in polymer composite materials. - Continued ballistic test program to assess dependence of penetration velocity on coating thickness and substrate properties. - Continued acoustic damping coatings for ship tank application. - Continued development of portable, real-time, Non-Destructive Examination (NDE)/Non-Destructive Inspection (NDI) technology for heat damage detection in composite materials. (Transitioned from Cost Reduction Technologies Activity in FY 2009). - Continued development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines. (Transitioned from Cost Reduction Technologies Activity in FY 2009). - Continued development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines. (Transitions from Cost Reduction Technologies Activity in FY 2009). - Completed development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications. - Continued development of new 3D mechanical characterization technique for polymer composites based on dissipative energy density principles. - Continued development of continuous based monitoring techniques of new synthetic fuels and lubricants based on electromagnetic signature analysis. - Continued development and application of distributed fiber optic Bragg gratings for structural health					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
monitoring of ships and aircrafts. - Initiated development of novel growth methods to specialized single crystal transducer materials tuned to requirements of specialized naval systems. - Initiated assessment of the degree of sensitization potential of marine grade Al alloys. - Initiated investigation of criteria for stable pitting of stainless steel. - Initiated development of surface assessment technologies to measure surface profile and chlorine. - Initiated evaluation of advanced material coating for erosion control on helicopter main rotor blade leading edges. The following efforts transition from Cost Reduction Technologies in this PE in FY 2009: - Continued development of portable, real-time, Non-Destructive Examination (NDE)/Non-Destructive Inspection (NDI) technology for heat damage detection in composite materials. - Continued development of a revolutionary new thermal spray technology for repair and refurbishment of worn and/or corroded components on ships, aircraft and combat vehicles. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete ballistic test program to assess dependence of penetration velocity on coating thickness and substrate properties. - Initiate development of seamless joining technologies for large, complex shaped conventional ceramic windows from small, inexpensive components using electorphoretic deposition of ceramic nanoparticles. - Initiate development of intelligent corrosion sensor systems for intergranular corrosion cracking. - Initiate studies on fuel cell corrosion. - Initiate development of superhydrophobic surface modification technology. - Initiate studies on mitigation of pitting corrosion and stress corrosion cracking in marine aluminum alloys.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010, less those noted as completed above. - Initiate development of quantitative coating quality assurance tools. - Initiate development of surface tolerant coating removal methods. - Initiate development of processing technologies to fabricate piezoelectric single crystals into complex transducer assemblies. - Initiate development of thermal management system(s) to arrest excessive heat fluxes and loads on amphibious ship by advanced Naval/USMC aircraft. - Initiate development of MEMS based sensor nodes, with energy harvesting and wireless communication capabilities, for system health management and prognosis.					
BIOCENTRIC TECHNOLOGIES	6.346	5.636	5.800	0.000	5.800
Biocentric technologies provide novel solutions for naval needs based upon the applications of biosensors, biomaterials, and bioprocesses. Topic areas include, but are not limited to development of biologically-based signal processing for medical, surveillance and security applications; bioinspired robotics; microbial or plant engineering to produce high-value naval materials such as energetic compounds or to develop sentinel organisms, and marine mammal diagnostics to support the Navy's Fleet Marine Mammal Systems. *FY 2009 Accomplishments:* - Continued engineered microbial synthesis and processing of energetic materials. - Continued development of innovative naval biosensors, biomaterials, and bioprocess technology (i.e., engineered plants for explosives detection, study of human stress biomarkers and bioinspired panoramic imaging systems). - Continued efforts on naval biosensor to detect brain structures and blood vessels through skull bones. - Continued, developed and demonstrated methods for determining multiple microbial genetic					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
sequences which will have profound implications for detection of environmental pathogens and marine sensory systems using microorganisms. - Continued a program to develop a microfabricated analytical system for trace detection of illicit materials including explosives, and other hazardous chemicals. - Continued efforts in bioinspired quiet, and maneuverable self-propelled line array using high-lift propulsors based on animal wing and fin biomechanics. - Continued engineering development and optimization of sea-floor sediment energy harvesting system for sustainable and autonomous powering of underwater sensor networks. - Continued effort to power AUV recharging station using (sediment) microbial fuel cell. - Continued effort to develop single domain antibodies for the recognition of explosives and small toxins. - Continued marine mammal immunomarker efforts, including the characterization of the dolphin fore-stomach microbial community, identification of probiotic immunostimulating species and immunobioassays for stress and infection detection. - Completed biomimetic temporal pattern recognition for security breaching noise detection and biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing. - Completed development of an initial set of molecular diagnostic tests for bacterial, fungal and viral pathogens of marine mammals. - Completed program to aid warfighter protection that will provide versatile systems for tagging and tracking using chemical tangents tailored to simultaneously satisfy operational requirements and match optical or physio-chemical detection. enable effective collaboration of warfighters and autonomous systems. - Initiated development of underwater chemical sensors powered by sediment fuel cell. - Initiated research for detection or mitigation of microbes or compounds of naval relevance in various settings. - Initiated integration of biomimetic sonar with bioinspired autonomous undersea vehicles (with high-lift propulsors) to achieve closed loop control.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiated effort to develop living fluidic networks. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete research on microbial synthesis of phloroglucinol, an energetic material precursor. - Complete effort to develop and demonstrate methods for determining multiple microbial genetic sequences which will have profound implications for detection of environmental pathogens and marine sensory systems using microorganisms. - Complete development of a microfabricated analytical system for trace detection of illicite materials including explosives, and other hazardous chemicals. - Initiate development of a second set of molecular diagnostic tests for recently discovered viral, bacterial, and fungal pathogens of marine mammals. *FY 2011 Base Plans:* - Continue all efforts of FY 2010, less those noted as completed above. - Initiate long duration, realistic field tests of autonomous microbial fuel cell power systems for underwater sensor networks. - Initiate efforts for bio-inspired massively parallel vision systems.					
COST REDUCTION TECHNOLOGIES Cost Reduction Technology efforts include: developing ultrareliable materials and sensors to reduce cost by enabling condition-based and zero maintenance capabilities; and airframe and ship corrosion efforts for advanced cost effective prevention and life cycle management technologies. This activity includes the Navy's share of the Versatile, Affordable, Advanced Turbine Engine (VAATE) program for materials. Investments under this activity were previously reported under Advanced Naval Materials and were broken out to provide improved clarification of the overall investment scope. The decrease from FY 2009 through FY 2010 is due to FNC EPE-FY10-03 being pushed out and an Accounting Management Reduction. The increase from FY 2010 to FY 2011 is to support FNC EPE-FY10-03.	9.278	8.854	11.620	0.000	11.620

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued development of ceramic matrix composite turbine blades for gas turbine engines. - Continued development of cavitation resistant ship rudder coatings. - Continued development of durable alloys and materials for shipboard and aircraft gas turbine engines and spallation-resistant thermal barrier coatings for shipboard/aircraft marine gas turbine hot sections. - Continued development of advanced materials and processes for high temperature marine turbine disks and combustors. - Continued development of oxidation and vanadium/sulfate-resistant high temperature coatings for shipboard/aircraft gas turbine engines. - Continued development of calcium magnesium aluminum-silicate (CMAS)-resistant coatings for ceramic matrix composites. - Continued development of high temperature foil bearing coatings for aircraft engine weight reduction. - Continued development of high temperature organic matrix composites. - Continued development of low-platinum and platinum-free aluminide coatings that are phase compatible with turbine blade alloys and exhibit low oxidation rates. - Continued efforts to assess manufacturing issues and reliability of ceramic matrix composites for turbine engines. - Continued integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section. - Continued development of materials processing for future gas turbine molybdenum-based alloys. - Continued efforts to conduct warfighter sustainment applied research, including technology management of investments supporting the naval enterprise and naval capability pillars. - Continued efforts to perform technology analyses to support the development and validation of FNC technology performance metrics for enabling capabilities structured to close naval capability gaps. - Continued efforts to assess technology options for the development of applied FNC technologies packaged into deliverable science and technology products. - Continued applied research and development of improved coatings for (1) non-skid surfaces, (2) ship					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
rudders, (3) high performance ship topsides, and (4) high performance airfield pavements. - Continued analytical model and reduced scale component development of shipboard compact power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers, focusing on closing technology gaps associated with Alternative Integrated Power System Architectures. (This effort transferred to PE 0602123N in FY 2009). - Initiated applied research in determining lifting of hot section materials exposed to alternative synthetic fuels and petroleum-synthetic fuel blends. - Initiated applied research development of Calcium Magnesium Aluminum-Silicate (CMAS)-resistant coatings for molybdenum-base alloys. - Initiated life prediction research for modeling of hot section gas turbine materials, including blades, in mixed naval environments. - Initiated development of an Adaptive Expert System to automatically and rapidly analyze aircrew performance (1M+ flight hours annually) to detect human factors related mishap leading indicators using a new technique with anomaly detection and corroboration. *FY 2010 Plans:* - Continue all efforts from FY 2009. - Complete integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section. - Initiate durable environmental barrier coatings for 2700F ceramic-matrix composites. - Initiate research on Nb-Cr-Si alloys for improved corrosion resistance at high temperatures. - Initiate, develop and apply emerging technologies that support delivery of Navy. approved FNC enabling capabilities structured to close operational capability gaps in warfighter sustainment. - Initiate package emerging warfighter sustainment technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period. - Initiate and develop mature warfighter sustainment technologies that support naval requirements identified within the Naval Power 21 capability pillars.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate development of novel seawater pretreatment strategies to optimize performance of prefiltration membranes (microfiltration or ultrafiltration membranes or filters). - Initiate further development of novel high flux and chlorine resistant reverse osmosis membranes. *FY 2011 Base Plans:* - Continue all efforts of FY 2010 less those noted as completed above. - Complete development of high temperature foil bearing coatings for aircraft engine weight reduction. - Complete integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section. - Initiate research and development of ceramic matrix composite vanes for Naval aircraft. - Initiate applied research on radiation barrier coatings. - Initiate development of 1500F capable disk coatings. - Initiate development of advanced ASGS (Active Shaft Grounding System) with integrated shaft current sensing and extremely low frequency electromagnetic (ELFE) control. - Initiate development of novel ICCP (Impressed Current Cathodic Protection) anodes, reference cells and sensors with high Mean Time Between Failure(MTBF). - Initiate development of dual-use ICCP and novel sensor technology for CBM and closed-loop deamping to extend hull/ballast coating longevity and reduce recalibration frequency. - Initiate applied research in modeling and simulation to identify key corrosion drivers and target problem areas for material modification and improved barrier dielectrics. - Intitiate development of spatial corrosion recognition and diagnostic models for hull, ballast tanks and propulsor condition.					
ENVIRONMENTAL QUALITY Environmental Quality technologies enable sustained world-wide Navy operations in compliance with all local, state, regional, national and international laws, regulations and agreements, and support the Navy Transformational Roadmap in the areas of Sea Basing, Sea Strike and Sea Warrior. Compliant operations enable training evolutions and exercises that are critical for maintaining readiness.	2.995	3.116	3.139	0.000	3.139

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued development of new, advanced, environmentally benign AF/Anti-Corrosive (AC) coating systems for Navy platforms, far-term noise and air pollution emissions abatement technology for unrestricted operations, and multiple aqueous metal ion sensor to incorporate copper sensor developed in the Strategic Environmental Research and Development Program (SERDP) program for planned combined transition to the Environmental Security Technology Certification Program (ESTCP). - Continued initial development of robotic Hull Biomimetic Underwater Grooming (BUG) and associated grooming approaches. - Continued development of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems. - Continued pilot scale system development of miniature gasification process for treatment of shipboard solid waste. - Continued and completed initial decision report on impact of synthetic lubricants on shipboard oily waste treatment systems. - Continued development and modifications to shipboard oily waste treatment systems to accommodate processing of synthetic lubricants. - Completed development of the Mobile Cleaning Recovery and Recycling System (MCRRS) vehicle for cleaning of aircraft non-skid decks as a part of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems. - Completed initial development of robotic Hull BUG and associated grooming approaches. - Initiated field evaluation of prototype robotic Hull BUG to identify gaps needed to refine and advance the technology. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete pilot scale system development of miniature gasification process for treatment of shipboard solid waste.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Complete far-term noise and air pollution emissions abatement technology for unrestricted operations. - Complete multiple aqueous metal ion sensor to incorporate copper sensor developed in the Strategic Environmental Research and Development Program (SERDP) program for planned combined transition to the Environmental Security Technology Certification Program (ESTCP). - Initiate efforts on ballast tank and system design optimization that minimize fuel discharges from compensated systems, minimize sedimentation in clean ballast and compensated ballast tanks, and maximize exchange of organisms during ballast tank exchanges. - Initiate efforts on solids separation/removal from shipboard liquid waste streams. *FY 2011 Base Plans:* - Continue all efforts of FY 2010 less those noted as completed above. - Complete field evaluation of prototype robotic Hull BUG and transition to FNC program. - Complete development and modifications to shipboard oily waste treatment systems to accommodate processing of synthetic lubricants. - Initiate efforts on improved handheld, waterborne, underwater hull cleaning technologies. - Initiate studies on oil emulsion issues on existing and new ships.					
HUMAN SYSTEMS DESIGN This activity supports the warfighter by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention. Congressional, DoD, and Navy policies and instructions require the Navy and Marine Corps to have a comprehensive plan for Human Systems Design (HSD) in the acquisition process to optimize total system performance, minimize total ownership costs, and ensure the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the systems.	3.357	2.171	3.197	0.000	3.197

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued research to develop automation and human interface technologies to support collaborative decision-making in which multiple unmanned system operators manage groups of vehicles with optimal manning. - Continued research to develop tactical decision making concepts to integrate spatially disparate displays and reduce the reliance of crew support to achieve superior ship commanding officer and crew decision making. - Continued HSD tool research, development, and application to engineering efforts to develop robust standardized set of human systems integrated specific modeling and simulation tools to assess the interaction between operators performance by system design by manning levels. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate research into mission performance optimization encompassing task centered design and advanced human performance modeling for achieving the requisite manning, both in numbers and capabilities, for the complex ships and systems of the future fleet. - Initiate research into enhancing the ability to identify and fuse relevant multi-sensor data and then effectively presenting this information to the decision making team in order to gain tactical knowledge and improve their operational performances. *FY 2011 Base Plans:* - Continue all efforts of FY 2010. - Complete research to develop automation and human interface technologies to support decisionmaking in which multiple system operators manage groups of with optimal manning. - Complete research to develop tactical decision making concepts to integrate spatially disparate displays and reduce the reliance of crew support to achieve superior ship commanding officer and crew decision making.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate research into incorporating environmental stressors impact (fatigue, motion, vibration and extreme temperatures) into systems engineering tool for the development of complex systems.					
LITTORAL COMBAT / POWER PROJECTION	6.015	13.333	11.593	0.000	11.593
This activity provides for technologies that enhance the ability of the Navy-Marine Corps team to assure access and sustained operations in the Littorals. The FNC Program considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); fires; strike; maneuver; sustainment; and fleet/force protection. This activity includes technical assessments and trade studies for FNC Enabling Capabilities that transition high priority technologies to the Navy and Marine Corps in support of the Sea Strike, Sea Shield, Sea Basing, and ForceNet Naval Power 21 pillars as well as Enterprise and Platform Enabling Science and Technology requirements. The increase from FY 2009 to FY 2010 is due to the initiation of new FNC efforts to reduce the load of dismounted combatants and to improve SSN/SSGN next generation photonics mast capabilities. The decrease from FY2010 to FY 2011 is due to the realignment of FNC efforts to other PE's. *FY 2009 Accomplishments:* - Continued efforts to conduct FNC warfighter sustainment applied research, including technology management of FNC investments supporting the naval enterprise and naval capability pillars. - Continued efforts to perform technology analyses to support the development and validation of FNC technology performance metrics for enabling capabilities structured to close naval capability gaps. - Continued efforts to assess technology options for the development of applied FNC technologies packaged into deliverable S&T products. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate development of technologies to reduce the load of warfighters by 1) reducing the weight					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing GUI-based software for tradeoff analyses based on Military Operational Posture. (Concurrent funding provided by PE 0603236N) - Initiate research to develop technology to reduce fabrication and life cycle costs of SSN/SSGN next generation photonics mast and to improve SSN surface situational awareness through faster image acquisition rates, improve range performance under adverse weather conditions and improve autonomous detection and classification. (Concurrent funding provided by PE 0603236N) - Initiate efforts to assess technology options for the development of applied FNC technologies packaged into deliverable S&T products. *FY 2011 Base Plans:* - Continue all efforts of FY 2010. - Realign development of technologies to reduce the load of warfighters by 1) reducing the weight of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing GUI-based software for tradeoff analyses bases on Military Operational Posture to PEs 0602131M, 0603236N and 0603640M.					
MANPOWER/PERSONNEL These technologies enhance the Navy's ability to select, assign, and manage its people by responding to a variety of requirements, including: managing the force efficiently and maintaining readiness with fewer people and smaller budgets; providing warfighting capabilities optimized for low-intensity conflict and littoral warfare; and operating and maintaining increasingly sophisticated weapons systems while managing individual workload and supporting optimal manning. This activity further supports the warfighter by providing enhanced capabilities by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention.	2.735	2.737	2.391	0.000	2.391

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Continued development of a virtual, experimental-based software environment to test and evaluate the effect of various incentive structures on resource allocation decision making. - Continued development of artificial intelligence and optimization techniques to create simulation based decision support tools for resource allocations across units and battle groups. - Continued development of Unit-level tools to enable commanders to analyze the cost implications of their actions and weigh tradeoffs between readiness, cost, and risk. - Continued development of intelligent agents to empower total force members to make training and assignment choices that enhance their careers and meet personal goals. - Continued research to provide results for guiding the development on an interface allowing experts in HSI to work with subject matter experts to define and refine critical intra-domain concepts while capturing information for future use. - Continued a continuous engineering process evaluation and adaptation to show that the developing process is executable and effective. - Completed low-velocity impact and shaker table dynamic internal response mapping with new anatomical features and sensor suite GelMan thoracic surrogate. *FY 2010 Plans:* - Continue all efforts of FY 2009. *FY 2011 Base Plans:* - Continue all efforts of FY 2010.					
MEDICAL TECHNOLOGIES This program supports the development of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs	9.595	18.329	18.092	0.000	18.092

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care. The National Institutes of Health (NIH) focuses on the basic science of disease processes and not applied research related to development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee, and Joint Technical Coordinating Group (JTCG) process, to prevent duplication of effort. This project funds the Force Health Protection FNC that will provide technology options for future Navy and Marine Corps capabilities and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike". The increase from FY 2009 to FY 2010 reflects the initiation of Naval Noise-Induced Hearing Loss (NIHL) efforts to reduce the incidence of NIHL. *FY 2009 Accomplishments:* - Continued program to develop enhanced First Responder capabilities. - Continued program to develop enhanced Forward Resuscitative Surgical capabilities. - Continued program to develop enhanced En Route Care capabilities. - Continued efforts to mitigate the effects of environmental and other threats to health. - Continued program, with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM)). - Continued efforts to reduce operational injuries. - Continued efforts to reverse NIHL. - Continued studies on decompression sickness (DCS) and arterial gas embolism (AGE), to include novel approaches to the prevention, detection and treatment of DCS/AGE, particularly by nonrecompressive methods. - Continued efforts to develop prophylactic agents preventing hyperbaric oxygen toxicity. Prolonged exposure to hyperbaric oxygen can be toxic to lungs, nervous system and eyes.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued efforts to assess the impact of thermal (i.e., heat and cold) stress on operational performance. Underwater thermal extremes can affect diver performance and alter risk of incurring decompression sickness. - Continued studies related to optimization of diver performance. Operational performance in the undersea environment can be hampered by a variety of environmental stressors. - Continued studies related to optimization of submariner health and performance. Submarine crewmembers are exposed to a variety of unique stressors including prolonged deployments, effects of altered diurnal rhythms, non-standard breathing gases, lack of sunlight, etc that can impact health and performance. - Continued studies related to biomedical effects of underwater sound. Military divers must operate safely and effectively in potentially complex underwater sound fields. - Continued efforts for "stress inoculation" to mitigate the impact of exposure to stressful combat environments prior to deployment. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Continue efforts to develop advanced technologies to support Rapid Blood Treatment. (Previously identified as First Responder in FY09 in this activity) - Continue efforts to develop advanced technologies to support Warfighter Restoration. (previously identified as FRSS/ERSS in FY09 in this activity). - Continue efforts to develop advanced technologies to support Warfighter Restoration. (Previously identified as En Route Care in FY09 in this activity). - Continue efforts to model accelerated head and neck injuries; operational injuries. - Completed safety studies and analysis of compartmental shipboard heat exposure levels; environmental threats to health. - Initiate research to reduce noise at the source, i.e. jet engine quieting and flight deck noise reduction. - Initiate research to study the incidence and susceptibility of Noise Induced Hearing Loss (NIHL) and tinnitus, and to evaluate mitigation strategies.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate research in medical prevention and treatment of NIHL and tinnitus (ringing in the ears). - Initiate research to improve personal protective equipment technology. - Initiate research to develop a Human Injury and Treatment (HIT) model for predicting outcomes of personnel exposure to shipboard damage. - Initiate and develop mature force health protection technologies that support naval requirements identified within the Navy and Marine Corps. *FY 2011 Base Plans:* - Continue all efforts of FY 2010. - Initiate program in hypothermics. - Initiate development of multifunctional blood substitute program.					
SEA BASING TECHNOLOGIES This activity includes development and advancement of technologies to support Seabasing. Areas include: advanced hull forms, propulsion, and materials to support high speed, shallow draft, and beachable connectors; innovative connector interface and transfer technologies; advanced wave and position sensors and autonomous controls to support vessel to vessel interfaces; and autonomous conveyance systems to support automated and integrated warehousing. The decrease in funding from FY 2009 to FY 2010 is due to the beginning of technical evaluation and down-selection for the T-CRAFT as well as the beginning of prototype and component development for the T-CRAFT. *FY 2009 Accomplishments:* - Continued planning of T-CRAFT prototype and component development. - Continued Sense and Respond Logistics (S&RL) research in: battlefield fuel management; decision support systems for S&RL; emergent intelligence/intelligent agents for S&RL; and advanced sensors/ processes for S&RL.	27.560	23.577	24.127	0.000	24.127

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued efforts for the development of technologies supporting automated shipboard assembly of air-delivered weapons. (Transitions from Cost Reduction Technologies activity in this PE in FY 2009.) - Continued multiple INP contracts for preliminary designs in the area of a T-CRAFT and a Rapidly Deployable Seabasing Stable Transfer Platform. - Continued the down-selection of T-CRAFT designs for further development and model construction and testing. - Continued T-CRAFT model construction and testing. - Continued the construction of a scaled model of a Rapidly Deployable Stable Transfer Platform demonstrator. - Continued a second evaluation of potential Seabasing INP efforts. - Initiated the down-selection of Sense and Respond Logistics Information Architecture prototype development. Acquisition Workforce Fund: - Funded DoD Acquisition Workforce Fund. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete the down-selection of T-CRAFT designs for prototype and component development. - Complete T-CRAFT model testing and evaluation. - Initiate contract design and develop shipyard building plans for T-CRAFT prototype and component construction. - Initiate procurement of components and material to support T-CRAFT prototype construction. - Initiate development of agent based decision support and logistics planning algorithms. *FY 2011 Base Plans:* - Continue all efforts of FY 2010 less those noted as completed above. - Complete T-CRAFT contract design and shipyard building plans.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate development of a detailed T-CRAFT prototype test and demonstration plan. - Initiate T-CRAFT and component construction. - Initiate the modeling and simulation of first article prototypes of Sense and Respond demonstration systems; Logistics Common Operating Picture, Decision Support Tools, Prognostics Embedded Health Management, Maco Fuel Quantity Management, Portable Fuel Quality Analysis. - Initiate development of the Connectors and the Sea Base Enabling Capability including Environmental Ship Motion Forecasting and Advanced Mooring System Technologies.					
TRAINING TECHNOLOGIES Training technologies enhance the Navy's ability to train effectively and affordably in classroom settings, in simulated environments, while deployed, and to operate effectively in the complex, highstress, information-rich and ambiguous environments of modern warfare such as asymmetric warfare. Technology development responds to a variety of requirements, including providing more affordable approaches to training and skill maintenance. Improved training efficiency and cost-effectiveness is achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the development, delivery, evaluation, and execution of training. *FY 2009 Accomplishments:* - Continued development of optimized strategies for performance aiding and training. - Continued development of virtual technologies for warfare training application. - Continued development of technologies to support human performance in networked warfighting environments. - Continued development of training technologies for culture, values, and language training and opponent simulation for training systems.- Continued program on intelligent agents for objective-based training. - Continued Computer Generated Forces (CGF) task aimed at improved techniques for human cognitive and behavioral modeling.	11.413	10.458	9.889	0.000	9.889

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued work on effective feedback in artificially intelligent tutoring for dynamic task environments such as anti-air warfare, instrument flying and other characteristic military tasks. - Continued a systematic program of applied research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring. - Continued work on software tools to facilitate building natural language tutorial dialogs for artificially intelligent tutoring. - Continued task to apply recently developed learning techniques that can be used in a model interacting with its application environment to extend or refine its knowledge base and behavioral competence. - Continued task to develop multi-agent based architectures for modeling human behavior, improve techniques for human cognitive and behavioral modeling, and create highly realistic simulated teammates. - Continued field studies and user tests evaluating new features and job aiding tools. - Initiated research to create computational models of human behavior in selected non-Western environments that reflect the dominant cultural, social, ethnic, and economic determinants of behaviors, attitudes, and beliefs of individuals, groups, and organizations operating in these environments, and exploit these models to forecast responses to our actions and those of others attempting to exert influence in these environments. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate research into computational neuron-models in the design of training systems - Initiate the integration of cognitive and neuron-computational models of human learning. - Initiate research into intelligent tutoring systems for adaptive competency in submarine bridge team and surface ship combat information center trainers. *FY 2011 Base Plans:* - Continue all efforts of FY 2010.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Complete development of optimized strategies for performance aiding and training - Complete development of virtual technologies for warfare training application. - Initiate research to identify the perceptual cues in the urban and dense infrastructure and environment that may improve warfighter performance.					
Accomplishments/Planned Programs Subtotals	92.082	103.726	113.724	0.000	113.724

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0603236N: *WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY*	38.414	50.625	56.311	0.000	56.311	63.410	43.106	35.585	17.278	0.000	304.729
• 0603729N: *WARFIGHTER PROTECTION ADVANCED TECHNOLOGY*	8.603	12.463	12.471	0.000	12.471	13.580	12.359	5.083	2.493	0.000	67.052

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

As discussed in Section A, there are a significant number of varied efforts within this PE. For the most part these efforts support the FNC program. As such, each is monitored at two levels. At the lowest level each is measured against both technical and financial milestones on a monthly basis. Annually each FNC and its projects are reviewed in depth for technical and transition performance by the Chief of Naval Research against goals which have been approved by the Navy.

The FNC managers conduct routine site visits to performing organizations to assess programmatic and technical progress and most projects conduct an annual or biannual
review by an independent board of visitors who assess the level and quality of the Science and Technology (S&T) basis for the project.

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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
9999: *Congressional Adds*	22.180	15.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	135.425

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
Congressional Add: Managing and Extending DOD Asset Lifecycles (Medal) *FY 2010 Plans:* This effort supports Managing and Extending DOD Asset Lifecycles (MEDAL) research.	0.000	1.593
Congressional Add: Nanotechnology for Anti-Reverse Engineering *FY 2010 Plans:* This effort supports Nanotechnology for Anti-Reverse Engineering research.	0.000	2.390
Congressional Add: Productization of Anti-Fouling and Fouling Release Coating Systems *FY 2010 Plans:* This effort supports Productization of Anti-Fouling and Fouling Release Coating Systems research.	0.000	2.788
Congressional Add: Acoustic Research Detachment Test Support Platform Upgrade	1.496	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
FY 2009 Accomplishments: This effort supported the exploration of the assembly of the Acoustic Research Detachment Test Support Platform Upgrade - the development of a modern test support platform configured with modern systems, acoustically isolated generators, and an effective laboratory space.		
Congressional Add: Advanced Composite Maritime Manfacturing *FY 2009 Accomplishments:* This effort supported research into the ability of the Navy to build advanced ships more economically and to build ships that will be more capable, have a longer service life, and be less costly to maintain. *FY 2010 Plans:* Continued efforts to support Advanced Composite Maritime Manufacturing research.	1.995	1.593
Congressional Add: Assistive Technologies for Injured Servicemembers *FY 2009 Accomplishments:* This effort supported research into the development and deployment of novel, non-invasive methods of sensory augmentation and replacement to permit wounded service-members who suffer from sensory loss to regain some level of basic sensation that will allow them to interact with others and with the environment around them. *FY 2010 Plans:* Continued efforts to support Assistive Technologies for Injured Servicemembers research.	1.596	0.797
Congressional Add: Biosensors for Defense Applications	1.994	0.797

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
FY 2009 Accomplishments: This effort supported research into the potential of a novel, Navy-developed lead-free nanomaterial munitions primer (or other anthropogenic pollutants such as quantum dots) and the possibilities of unintended environmental, cellular and organism-level effects. *FY 2010 Plans:* Continued efforts to support Biosensors for Defense Applications research.		
Congressional Add: Composite Materials Enhancements through Polymer Science Research and Development *FY 2009 Accomplishments:* This effort supported research and development of composite materials in the area of composite matrix and technology for lighter weight, stronger, stiffer, higher toughness, more accurate property predictions, and accurate service life prediction through fundamental and applied research and development. The three primary areas are matrix materials and matrix characterization, specialty materials for matrix protection and healing, and fiber modification and characterization. *FY 2010 Plans:* Continued efforts to support Composite Materials Enhancements Through Polmer Science Research.	2.235	5.099
Congressional Add: Digital Directed Manufacturing Project *FY 2009 Accomplishments:* This effort supported the enhancement of the Digital Direct Manufacturing technology for manufacturing net shape metal and polymeric parts by characterizing the properties of parts made of thermoplastics and metals, developing models to achieve dimensional control, exploring new	1.695	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
design opportunities and develop design rules, and exploring new materials such as high temperature thermoplastics and Naval metals and alloys.		
Congressional Add: Intelligent Retrieval of Imagery *FY 2009 Accomplishments:* This effort supported the protection of harbors and Naval facilities from asymetric warfare threats by researching the development of intelligent imagery retrieval.	2.393	0.000
Congressional Add: Friction Stir Welding *FY 2009 Accomplishments:* This effort supported the demonstration of the feasibility of expanding Friction Stir Welding (FSW) technology beyond aluminum alloys to High Strength Low Alloy (HSLA) steels that are of interest to the Navy and to expand the fundamental understanding of the FSW process to other metals.	0.798	0.000
Congressional Add: Nanotechnology Engineering & Manufacturing Operation (NEMO) *FY 2009 Accomplishments:* This effort supported the development of anti-corrosive, flame retardant interior coatings for military application using nano-technology.	1.596	0.000
Congressional Add: On-Board Vehicle Power Systems Development *FY 2009 Accomplishments:* This effort supported the expansion upon the current on board vehicle power program by investigating the possibility of providing this technology on other ground vehicle platforms such as the new HMMWV variants: ECV and ECV-II, and MRAP vehicle variants. Stationary and on the move vehicle power is	2.393	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
a combat multiplier that enables U.S. forces to increase their mission range, duration, and efficiency while reducing the logistical burden of the small unit.		
Congressional Add: Optimization of New Marine Coatings *FY 2009 Accomplishments:* This effort supported the application of capabilities in combinatorial coatings synthesis, formulation and characterization to the development of marine anti-fouling and fouling release coatings.	1.596	0.000
Congressional Add: PULSE Virtual Clinical Learning Lab *FY 2009 Accomplishments:* This effort supported active virtual environment infrastructures using game-base technologies at the Virtual Clinical Learning Lab.	2.393	0.000
Congressional Adds Subtotals	22.180	15.057

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Congressional Interest Items not included in other Projects.