Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy											Date: April 2022	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602236N *I Warfighter Sustainment Applied Res*							
COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	112.119	117.738	70.957	-	70.957	71.592	73.023	74.402	75.890	Continuing	Continuing
0000: *Warfighter Sustainment Applied Res*	0.000	64.333	69.488	70.957	-	70.957	71.592	73.023	74.402	75.890	Continuing	Continuing
9999: *Congressional Adds*	0.000	47.786	48.250	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	96.036

A. Mission Description and Budget Item Justification

U.S. Sailors and Marines underpin all missions. Advances in Artificial Intelligence (AI) enabled decision aides, autonomy, human-machine training, augmented performance, command and control and protective equipment will ensure their advantage in a complex, maritime environment. This Program Element (PE) conducts applied research to address Warfighter protection and performance concerns, including efforts that focus on advanced Naval materials, biocentric technologies, decision support, intelligent and autonomous systems, human performance optimization, training and education technologies, social and cultural science, and biomedical technologies. This PE also supports the Office of Naval Research (ONR) Global mission to serve as the preeminent external facilitator for the Naval Research Enterprise. This is accomplished by establishing quality, relevant connections between the international research and development community, Naval fleet/forces, DOD, other US Government agencies and international partners.

Today's Sailors and Marines are enabled by Naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of Naval basic and applied research, and advanced technology development investments to ensure Naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. Most of the work in this PE can be classified between Technology Readiness Level (TRL) 2 (technology concept and/or application formulation) and TRL 4 (component and/or breadboard validation in laboratory environments).

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

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B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	116.051	70.547	0.000	-	0.000
Current President's Budget	112.119	117.738	70.957	-	70.957
Total Adjustments	-3.932	47.191	70.957	-	70.957
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-1.059			
• Congressional Rescissions	-	-			
• Congressional Adds	-	48.250			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.393	0.000			
• SBIR/STTR Transfer	-3.541	0.000			
• Rate/Misc Adjustments	0.002	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	70.957	-	70.957

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Project: 9999: *Congressional Adds*		
Congressional Add: *Lightweight anti-corrosion nanotechnology coating enhancement*	4.827	0.000
Congressional Add: *Polymer coatings for reduced ice and fouling adhesion*	4.827	5.000
Congressional Add: *force Health Protection and Application*	4.827	0.000
Congressional Add: *Health and Safety Research of Underground Fuel Storage Facilities*	4.827	5.000
Congressional Add: *Human Performance and injury Rehabilitation Assessment tool*	2.413	0.000
Congressional Add: *Humanoid Robotics in Unstructured Environments*	4.827	0.000
Congressional Add: *Engineered Systems to Preserve and Restore Hearing After Deleterious Stimulation*	4.827	0.000
Congressional Add: *Hypersonics Material Acceleration*	3.861	5.000
Congressional Add: *Laser Peening Technology for Submarine and Carrier Shafts*	2.896	0.000
Congressional Add: *Physics Based Neutralization of Threats to Human Tissues and Organs*	4.827	5.000
Congressional Add: *Social Networks and Computational Social Science*	1.931	0.000
Congressional Add: *Warfighter as a System Human Digital Twin Research*	2.896	0.000
Congressional Add: *Advanced nanocomposite coatings*	0.000	6.000
Congressional Add: *Anticorrosion nanotechnology*	0.000	7.500
Congressional Add: *Development of chromate-free corrosion inhibitor coatings for marine application*	0.000	1.750

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Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: *Engineered systems to preserve and restore hearing*	0.000	5.000
Congressional Add: *Human digital twin*	0.000	3.000
Congressional Add: *High mobility ground robots to assist dismounted infantry in urban operations*	0.000	5.000
Congressional Add Subtotals for Project: 9999	47.786	48.250
Congressional Add Totals for all Projects	47.786	48.250

Change Summary Explanation

Funding: No significant change.
Technical: No significant change.
Schedule: No significant change

FY 2023 funding increase reflects the fact that the FY 2022 President’s Budget request did not include out-year funding.

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COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: *Warfighter Sustainment Applied Res*	0.000	64.333	69.488	70.957	-	70.957	71.592	73.023	74.402	75.890	Continuing	Continuing

A. Mission Description and Budget Item Justification

U.S. Sailors and Marines underpin all missions. Advances in AI-enabled decision aides, autonomy, human-machine training, augmented performance, command and control and protective equipment will ensure their advantage in a complex, maritime environment. This Program conducts applied research to address Warfighter protection and performance concerns, including efforts that focus on advanced Naval materials, biocentric technologies, decision support, intelligent and autonomous systems, human performance optimization, training and education technologies, social and cultural science, and biomedical technologies. This PE also supports the Office of Naval Research (ONR) Global mission to serve as the preeminent external facilitator for the Naval Research Enterprise. This is accomplished by establishing quality, relevant connections between the international research and development community, Naval fleet/forces, DOD, other US Government agencies and international partners.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Advanced Naval Materials	15.948	17.889	17.679	0.000	17.679
Description: Advanced Naval Materials efforts support several Science and Technology (S&T) Focus Areas, in particular Platform Design & Survivability, and perform research across a broad spectrum of technical areas including: structural materials to increase platform performance and survivability at reduced weight and cost; advanced, high-performance materials for energy systems; corrosion mitigation strategies; high-temperature propulsion systems; and enhanced sonar transducers. ***FY 2022 Plans:*** Materials: - Conduct research to build Agile Manufacturing - Integrated Computational Materials Engineering (ICME) toolkit infrastructure. - Conduct ongoing research efforts to improve affordability and reliability of piezoelectric transduction materials. - Conduct research to develop advanced structural alloys and composites, joining and repair technologies. - Conduct research to pursue commercially viable processing for nano-engineered materials, including ceramics, metals, and materials systems. - Continue development of new, advanced, environmentally benign Anti-Fouling (AF)/Anti-Corrosive (AC) coating systems for Navy platforms. Sustainment & Logistics:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Conduct applied research to investigate corrosion control modeling, high performance longer-life corrosion resistant coatings, compositionally complex alloys, and corrosion resistant additive manufactured components. Manufacturing: - Develop manufacturing technology to help accelerate capability to the fleet in areas such as high-energy laser (HEL) weapons, advanced electronic warfare, electronics technology for navigation and electronic controls for unmanned vehicles. - Continue efforts focused on demonstrating the deposition of quality carbon phosphonitride materials for liquid-based additive manufacturing techniques tailored for use in true 3-D direct write processes. Efforts will enable this technology to produce inexpensive, high quality parts; and demonstrating that next generation TBCs can be optimized to meet 20-year survivability requirements for use in a marine diesel environment to support an increase in operating temperatures from 500 to 800 degrees Celsius. Materials and Chemistry: -Continue Ongoing efforts include designing new microfluidic system for direct write additive manufacturing to significantly improve the existing techniques. - Continue efforts to determine thermal barrier coating (TBC) degradation mechanisms and susceptibility and apply that understanding to optimize TBCs for marine use and enable long service-life applications in severe environments. ***FY 2023 Base Plans:*** Materials: - Continue research on Agile Manufacturing - Integrated Computational Materials Engineering (ICME) toolkit infrastructure to establish and fully utilize a naval laboratory based capability to develop and predict performance of materials and components in an agile and accelerated manor to speed technology delivery and reduce qualification costs. - Continue ongoing research efforts to improve affordability and reliability of piezoelectric transduction materials. The focus will be on Acoustic Transduction Materials Technology to reduce SWaP and improve sensitivity of sensors and SONAR.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Continue research to develop advanced structural alloys and composites, joining and repair technologies. - Continue research to pursue commercially viable processing for nano-engineered materials, including ceramics, metals, and materials systems. The focus will be on Nanostructured Materials Processing aimed at improved resilience of naval systems and platforms and capabilities for producing novel, high performance components; - Complete development of new, advanced, environmentally benign Anti-Fouling (AF)/Anti-Corrosive (AC) coating systems for Navy platforms. - Advance materials, processes and capabilities. Current efforts are focused on development of a high thermal conductivity later for high power electronic device application to improve performance. Sustainment & Logistics: - Continue applied research to investigate corrosion control technologies through investigation of corrosion inhibitor performance for coatings and corrosion mechanisms of compositionally complex alloys (CCA) and additive manufactured materials. Naval Power Systems: - Continue to advance applied research efforts to support development of naval materials in support of naval power systems. Platform Design and Engineering: - Continue to advance applied research efforts to support development of naval materials in support of naval platforms. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** There is no significant change from FY 2022 to FY 2023.					
Title: Biocentric Technologies	10.089	8.395	9.328	0.000	9.328
Description: Applied research to develop knowledge and technologies for future Naval capabilities. Research areas include: bioinspired and biomimetic materials; synthetic biology for environmental surveillance and materiel production; bioenergy harvesting and electronics; warfighter augmentation and resilience; and marine mammal health. This research provides secure and agile options to enhance performance, increase novel power					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
and energy solutions to safely extend operational duration, and improve stealth, maneuverability, and mission capability of platforms and autonomous systems. ***FY 2022 Plans:*** Bio-Inspired Autonomous Systems: - Conduct applied research on bio-inspired underwater vehicle propulsion and control. - Mature advanced search behaviors for autonomous vehicles. - Integrate sonar and image processing into a bio-inspired unmanned vehicle to evaluate obstacle detection and avoidance in congested spaces and neutralization maneuvers. - Applied research on bio-inspired cross-domain vehicles for amphibious and sea/air transitions. Human Interaction with Autonomous Systems and Human-Machine Teaming: - Conduct applied research to develop agile humanoid and quadruped robot teammates. This includes incorporation of computer vision, acoustic localization, reasoning and human communication. - Applied research on training mission-capable robots to perform complex manipulation skills essential for shipboard and urban operations. - Conduct applied research to develop technology to enhance diver performance with small autonomous underwater vehicle (AUV) assistants. Biocentric Technology: - Conduct studies of prebiotic food additives/probiotics for effects on microbiome and performance enhancement in human subjects, including divers and combat swimmers. - Develop gut microbiome-based tools to predict individual response to prebiotics for stress resilience. - Develop strategies to incorporate programmable microbial sensors for environmental monitoring into relevant Naval platforms (e.g., for non-acoustic anti-submarine warfare (ASW) or handheld devices for divers). - Initiate efforts to scale up production of biogenic mineral nanomaterials. Important for securing supply chain for electronic materials and microelectronic device fabrication. - Research effects of sample source and rapid dilution on marine environmental DNA sequencing for monitoring undersea environments. - Applied research to focus on deployment of benthic microbial fuel cells in deep water marine environments and testing the ability to power new devices (e.g., distributed mine systems, position-navigation-timekeeping transponders for unmanned underwater vehicles (UUVs)).					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Bioengineering and Life Sciences: - Conduct applied research to develop a sandcastle worm inspired adhesive effective in seawater with an on-demand curing mechanism. - Conduct applied research to determine the role of lung membrane integrity in marine mammal respiratory diseases; establish therapeutics to prevent kidney stone formation in dolphins; facilitate surveillance of marine mammal viral pathogens in marine waters and indigenous mussels/oysters/clams; and implement dolphin vocalizations as a tool for diagnosing their well-being. - Establish highly efficient proton exchange membrane fuel cells. Warfighter Augmentation & Resilience: - Conduct applied research in bio-inspired light polarization sensors and machine learning methods for predicting underwater geolocation and developing technology for underwater image dehazing. - Develop technologies to monitor and protect diver from environmental stressors such as temperature, pressure, and limited visibility and resources. - Identify predictors of critical health and safety threats to divers through advanced physiological monitoring and algorithm development. - Support development of manned-unmanned teaming platforms to aide a diver in enhanced situational awareness and to expand diving windows of opportunity by eliminating current limitations such as restricted access (cold, depth, space), visibility, and gas supply. Materials and Chemistry: - Continue the develop a semi-automated assay system that will enable our transition partners, the Naval Medical Research Center and Naval Medical Research Unit laboratories, to rapidly identify antibiotic resistance genes in bacterial pathogens of importance to the U.S. military. The science, technology and resulting system will contribute directly to warfighter health, performance and survivability.					
FY 2023 Base Plans: Bio-Inspired Autonomous Systems: Continue: - Conduct applied research on bio-inspired underwater vehicle propulsion and control. - Mature advanced search behaviors for autonomous vehicles. - Applied research on bio-inspired cross-domain vehicles for amphibious and sea/air transitions.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Complete: - Exploration of bio-inspired sonar integrated onto autonomous underwater vehicles for obstacle avoidance in congested waters. Initiate: - Integrate advanced flexible batteries into artificial muscle-based prototype underwater vehicle for field testing of speed and duration. Human Interaction with Autonomous Systems: (This thrust has been realigned to the Human Factors and Organizational Design Activity of this PE. The research has a human-machine teaming focus, which aligns better with the objectives of the Human Factors and Organizational Design Activity.) Naval Biosciences and Synthetic Biology for Naval Applications: (This thrust was previously part of the Biocentric Technology FY22 Plan. The name was changed to more accurately describe the research.) Continue: - Develop strategies to incorporate programmable microbial sensors for environmental monitoring into relevant Naval platforms. - Applied research focusing on deployment of self-burying, benthic microbial fuel cells at various depths to power new devices (e.g., a semi-submersible autonomous underwater vehicle (AUV)). Complete: - Conduct studies of prebiotic food additives/probiotics for effects on microbiome and performance enhancement in human subjects, including divers and combat swimmers. - Develop gut microbiome-based tools to predict individual response to prebiotics for stress resilience. - Efforts to scale up production of biogenic mineral nanomaterials. Initiate: - Applied research in bio/bio-inspired materials for multi-spectral camouflage. - Applied research in bioengineering systems for the bioproduction/biodegradation of military relevant materials. Bioengineering and Life Sciences:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Continue: - Conduct applied research to determine the role of lung membrane integrity in marine mammal respiratory diseases; establish therapeutics to prevent kidney stone formation in dolphins; facilitate surveillance of marine mammal viral pathogens in marine waters and indigenous mussels/oysters/clams, and implement dolphin vocalizations as a tool for diagnosing their well-being. Complete: - Development of a sandcastle worm inspired adhesive effective in seawater and transition it to a Future Naval Capability Program focused on seawater curing adhesive technologies for pier side replacement, or repair, of tiles on outer submarine hulls. - Applied research establishing highly efficient proton exchange membrane fuel cells for transportation applications, which improved their overall performance through catalyst and support engineering. Initiate: N/A Warfighter Augmentation and Resilience: Continue: - Conduct applied research in bio-inspired light polarization sensors and machine learning methods for predicting underwater geolocation and developing technology for underwater image dehazing. - Develop technologies to monitor and protect diver from environmental stressors by maturing and validating models that capture a human diver's heat loss and the ability of various wetsuit designs to provide thermal protection. - Support development of manned-unmanned teaming platforms to aide a diver in enhanced situational awareness and to expand diving windows of opportunity by eliminating current limitations such as restricted access (cold, depth, and enclosed spaces), visibility, and gas supply. Complete: - Research on feasibility of sensor development for oxygen toxicity. This resulted from the ongoing FY22 and FY23 plan to continue identifying predictors of critical health and safety threats to divers through advanced physiological monitoring and algorithm development. Initiate:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Create new oxygen-generating and carbon dioxide-disposing diving mask that would replace existing rebreathers. - Applied gas channel research in the context of respiratory fitness and/or potential mitigation strategies for targeted gas management. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The funding increase from FY 2022 to FY 2023 is due to an increased investment in microbial fuel cell research to power platforms and devices (e.g., a semi-submersible autonomous underwater vehicle (AUV) and networked sensors to monitor undersea environments).					
Title: Human Factors and Organizational Design	5.555	5.948	6.018	0.000	6.018
Description: Operational and tactical level decision-making requires making time-critical decisions with imperfect information. This activity seeks to understand how warfighters make decisions despite uncertainty, and research practical strategies for managing information for Naval warfighter decision-making. These applied research efforts will improve mixed social-technical systems design, system interface designs and human-level decision support in Naval contexts. Research areas include the development of techniques to enhance warfighter performance in managing complex, strategic tasks, human-human, human-machine teaming, and decision-making and execution in human and human-machine hybrid teams. These objectives support improvement of managing complex warfighting problems. ***FY 2022 Plans:*** Cognitive Science for Human-Machine Teaming and Computational Neuroscience: - Incorporate realistic neural systems into autonomous systems for more robust on-board perception and intelligence. - Conduct applied research on system interface designs and human-machine interaction methodologies that enable or enhance Naval Warfighter performance and human-machine teaming. This includes psychoacoustics and audio-visual scene interpretation implemented in computational models that serve as the front end for cognitive architectures. - Construct new perceptual models for intelligent autonomous systems.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Conduct applied research to develop agile humanoid robot teammates with enhancements including: (i) Embedding computer vision with visual-spatial reasoning; (ii) Auditory systems to enable human communication; and (iii) Neuromorphic (brain-like) processors. - Conduct applied research to train mission-capable robots to perform complex manipulation tasks, integrated with self-learning. - Conduct applied research to develop technology to enhance diver performance with small autonomous underwater vehicle (AUV) assistants. Social Networks and Computational Social Science: - Conduct applied research in information environment assessment, civil-military communications (public affairs), information operations and strategic communication. - Develop improved course of action guidance and capabilities to detect and defuse: disinformation, social hysteria and group polarization campaigns. - Improve efforts to study effective methods for training military personnel operating in the information environment to discover, monitor, and counter adversarial maneuvers in digital and social media. Command Decision Making: - Explore how to explain recommendations and characterize uncertainty for recommendations derived from Machine Learning (ML) algorithms. - Initiate applied research for a knowledge/skill brokering system that can detect individual knowledge weaknesses / gaps related to task performance and deliver tailored training tutorials as job aids. - Conduct applied research to assist with authoritative and peer-to-peer curation of community generated multi-media content and fusion with authoritative sources. - Conduct research on team composition and social decision-making in order to design Naval decision tools that have reduced risk of human decision biases (e.g. implicit bias, preconceived notions, and social pressure). - Conduct Human System Integration research activities in areas of human factors engineering and physical design layout (habitability, safety, personnel survivability) of naval platforms in order to understand best possible conditions for effective decision-making Naval settings.					
FY 2023 Base Plans: Cognitive Science for Human-Machine Teaming and Computational Neuroscience: Continue:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Incorporate realistic neural systems into autonomous systems for more robust on-board perception and intelligence. - Conduct applied research on system interface designs and human-machine interaction methodologies that enable or enhance Naval Warfighter performance and human-machine teaming. This includes psychoacoustics and audio-visual scene interpretation implemented in computational models that serve as the front end for cognitive architectures. - Conduct applied research to develop agile humanoid robot teammates with enhancements including: (i) Embedding computer vision with visual-spatial reasoning; (ii) Auditory systems to enable human communication; and (iii) Neuromorphic (brain-like) processors. - Conduct applied research to train mission-capable robots to perform complex manipulation tasks, integrated with self-learning. Complete: - Construct new perceptual models for intelligent autonomous systems. Initiate: - Integrate vision and language for learning and communication in human-agent systems. Social Networks and Computational Social Science: Continue: - Conduct applied research in information environment assessment, civil-military communications, humanitarian assistance / disaster relief, information operations and strategic communication. - Conduct research to support improved course of action guidance and capabilities to detect and defuse disinformation, social hysteria, and group polarization campaigns. - Refine studies to develop effective tactics, techniques and procedures for military personnel operating in the information environment to discover, monitor and counter adversarial maneuvers in digital and social media. Complete: - Course of action guidance to detect and defuse disinformation, social hysteria and group polarization campaigns. Initiate:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Applied research to explore socio-technical techniques and social decision making to affect stance, perception, identity and behavior of target audiences. Command Decision Making: Continue: - Research to automate and display recommendations and characterize uncertainty, derived from Machine Learning (ML) algorithms. Complete: - Applied research for a knowledge/skill brokering system that can detect individual knowledge weaknesses / gaps related to task performance and deliver tailored training tutorials as job aids. - Conduct applied research to assist with curation of community generated multi-media content and fusion with authoritative sources. Initiate: - Research automation algorithms for managing Man-Machine teaming & Scalability of Control to large numbers of autonomous entities (robots / swarms). - Applied research for a Collaborative Artificial Intelligence (Collaborative AI) decision support tool that allows AI to learn from human command and control tasks. Human Interaction with Autonomous Systems: (This thrust has been realigned from the Biocentric Technologies to the Human Factors and Organizational Design Activity of this PE. This research has a human-machine teaming focus, which aligns better with the objectives of the Human Factors and Organizational Design Activity.) Continue: - Conduct applied research to develop agile humanoid and quadruped robot teammates. This includes incorporation of computer vision, acoustic localization, reasoning and human communication. - Applied research on training mission-capable robots to perform complex manipulation skills essential for shipboard and urban operations. - Conduct applied research to develop technology to enhance diver performance with small autonomous underwater vehicle (AUV) assistants. This effort was previously described under Cognitive Science for Human-Machine Teaming and Computational Neuroscience, but aligns more closely to the objectives of Human Interaction with Autonomous Systems.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Initiate: - Incorporate cognitive architectures and visual reasoning on robotic teammates to enable enhanced cooperative behaviors. Naval Team Performance and Design: (This thrust was previously part of the Command Decision Making FY22 plan.) Continue: - Conduct research on team composition and social decision-making in order to design Naval decision tools that have reduced risk of human decision biases (e.g., implicit bias, preconceived notions, and social pressure). - Conduct Human System Integration research activities in areas of human factors engineering and physical design layout (habitability, safety, personnel survivability) of naval platforms in order to understand best possible conditions for effective decision-making Naval settings. Complete: N/A Initiate: - Conduct research on team composition, human factors, and decision making in order to design naval decision tools and processes that have reduced risk of human decision biases and heuristics as well as human performance errors related to combat/operational stress. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** There is no significant change from FY 2022 to FY 2023.					
Title: Human Research Protection Program (HRPP) ***Description:*** The Federal Policy for the Protection of Human Subjects is codified in the Department of Defense (DoD) as part 219 of title 32, Code of Federal Regulations (also known and hereinafter referred to as the "Common Rule"). DoD Instruction 3216.02 establishes policy and assigns responsibilities for the protection of human subjects in DoD-supported programs to implement the Common Rule and requires Heads of DoD Components to establish and oversee DoD Component policies and procedures that ensure compliance with federal and DoD requirements. The Secretary of the Navy Instruction (SECNAVINST) 3900.39E CH-1 identifies	2.652	2.766	2.798	0.000	2.798

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
the Chief of Naval Research as providing support and expertise for human research protection in research conducted or supported by the Navy and Marine Corps Systems Commands and institutions, operational forces, training Commands, and Department of the Navy (DON)-supported research involving human subjects performed by non-DoD institutions. The Human Research Protection Program (HRPP) protects the rights, safety, and welfare of human subjects in research conducted or sponsored by the Navy and Marine Corps by: 1) ensuring that research involving human subjects complies with federal regulations, DoD Directives, DON Instructions, and Marine Corps Orders governing research protection requirements; and 2) providing education and training programs in human research ethics to all levels of staff involved in the review, approval, conduct, management, or support of DON human subjects research (HSR). ***FY 2022 Plans:*** - Develop Research Protection Community of Excellence; establish 5 new HRPPs; finalize SECNAVINST 3900.39F; Program Management of the DON Research Protections Information Technology Management System for management and compliance oversight of ongoing human research protections activities; provide training for updated DoDI 3216.02, provide education and training programs in human research ethics to all levels of staff involved in the review, approval, conduct, support or management of DON HSR; provide subject matter expertise and guidance on all DON-supported research involving human subjects. ***FY 2023 Base Plans:*** Continue: - Establish five new human research protection programs (HRPP). - Program Management of the DON Research Protections Information Technology Management System for management and compliance oversight of ongoing human research protections activities. - Continue providing education and training programs in human research ethics to all levels of staff involved in the review, approval, conduct, support or management of DON human subjects research. - Provide subject matter expertise and guidance on all DON-supported research involving human subjects. Complete: - Complete revisions of all DON-authored modules hosted on the Collaborative Institutional Training Initiative (CITI) Program. - Complete finalization of draft SECNAVINST 3900.39F and submit for coordination. The revised SECNAVINST 3900.39F will implement recent updates to the revised Common Rule and DoD Instruction 3216.02, thereby ensuring compliance across the navy and Marine Corps research enterprise.					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Initiate: - Develop the Research Protection Community of Excellence to share best practices across the DON research protection enterprise. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** There is no significant change from FY 2022 to FY 2023.					
Title: Medical and Human Performance Technologies ***Description:*** This Activity will be described in two categories to better explain the program areas related to medical and human performance research. The objective of this activity is to sustain, extend, enhance, and repair warfighter endurance, resiliency and readiness while operating in multi-domain and expeditionary environments. Efforts categorized as Human Performance Technologies focus on research before injury. Efforts categorized as Medical Technologies focus on research after injury. The human performance portion of this applied research activity focuses on: improving performance of divers and submarine crews; developing biological markers of stress response; protecting warfighter performance and preventing injuries during exposure to high levels of acoustic or electromagnetic energy; and wearable physiological sensors to support safety and survivability of Naval forces during training and in operational environments. Results from this research will also be translated into operational safety guidelines. The medical portion of this applied research activity focuses on: protecting warfighters from operational health threats; developing diagnostic and treatment capabilities for use in operational environments; and prototyping new capabilities to recover injured warfighters. This research will improve the Fleet's ability to save lives, especially during prolonged field care. ***FY 2022 Plans:*** Medical Technologies: - Explore novel technologies including: (i) Nanotechnologies, microelectronics and autonomous materials and systems for improved casualty care; (ii) Non-invasive sensors in casualty prevention and treatment; and (iii) Novel designs of protective equipment for maritime casualty prevention.	5.582	8.691	8.790	0.000	8.790

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602236N / *Warfighter Sustainment Applied Res*	**Project (Number/Name)** 0000 / *Warfighter Sustainment Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Conduct applied research to improve casualty care with autonomous or 'smart' materials and systems during distributed maritime operations ashore and afloat. Mature application and treatment methods for novel anti-infectives for improved wound care. - Use modeling, microelectronics and novel composite materials for biomedical sensing and therapeutic care in wearable designs, such as protective equipment to ensure optimal performance, prevent harm and equip the DON to provide the best care for its warfighters. Human Performance Technologies: - Conduct applied research to develop noise exposure and mitigation strategies, including improving and evaluating personal protective equipment, communication technologies, noise exposure estimations, and sound localization. - Applied research to determine biomedical effects and diagnostics of electromagnetic energy exposures. - Applied research to develop countermeasures that prevent and mitigate the safety risks of decompression sickness, oxygen toxicity, and supplement metabolic diver energy requirements to advance safe and optimized performance. - Applied research to develop human physiologic and biologic sensors for real-time monitoring of performance status in training and operational environments. - Continue to mature efforts by field testing of technological solutions in multi-domain environments for ruggedizing technological solutions in multi-domain environments. - Integrate applied efforts with autonomous air and sea-based platforms for monitoring solutions in forward deployed operators. - Applied research in the development of technology enabling the Fleet's ability to save lives, especially during prolonged field care. Efforts will focus on human physiologic and biologic sensors for real-time monitoring of performance status in training and operational environments. - Develop advanced algorithms using existing "big" medical data collected from humans (all continuous vitals data, drugs given, etc.) for autonomous triage of personnel in mass casualty scenarios. These capabilities will enable field medics to immediately treat and triage patients, increasing survival rates from historically non-survivable injuries and environments. - Continue applied research efforts to reduce high performance tactical aircraft jet noise through the evaluation of Noise Reduction Concepts, for human protection. - Develop lab scale capability to investigate jet noise at afterburner conditions. - Explore active control approaches through advanced analytics and simulations.					
FY 2023 Base Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Medical Technologies: Continue: - Explore use of novel technologies including: nanotechnologies, microelectronics, artificial intelligence, non-invasive sensors, multifunctional materials and systems and protective equipment for improved warfighter survivability. - Mature application and treatment methods for novel anti-infectives for improved wound care. - Use modeling, microelectronics and novel composite materials for biomedical sensing and therapeutic care to prototype equipment (e.g., helmet system) to protect, sense, respond, and enhance human performance. - Conduct applied research to improve casualty care using autonomy and 'smart' systems with a focus on autonomous recovery of impaired/injured personnel during operations ashore and afloat. Complete: N/A Initiate: - Translate physics-based principles to prototypes for measuring material properties of biological tissues. Human Performance Technologies: Continue: - Conduct applied research to develop noise exposure and mitigation strategies, including communication technologies, sound localization, and noise mitigation strategies. - Applied research to determine biomedical effects of electromagnetic energy exposures. - Applied research to identify and validate countermeasures that prevent and mitigate the safety risks of decompression sickness, oxygen toxicity, and maintain a healthy metabolic balance for diver energy requirements to advance safe and optimized performance. - Applied research to develop novel biological sensors that autonomously monitor warfighter performance and physiology (e.g., analytes, blood pressure, heart rate, arterial saturation) in real-time. - Applied research to reduce high performance tactical jet noise through the evaluation of Noise Reduction Concepts. - Develop lab scale capability for the purpose of investigating jet noise at afterburner conditions. - Applied research to investigate approaches to excite natural instability wave of the jet flow. Complete:					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- The following effort resulted from the FY22 plan to continue applied research to develop countermeasures that prevent and mitigate the safety risks of decompression sickness, oxygen toxicity, and supplement metabolic diver energy requirements to advance safe and optimized performance. The completed portion of this effort includes research on the ketogenic diet and supplementation transitioned to advanced development. - Research to develop diagnostic tools for identification of auditory injuries. - Transition successful novel biological and physiological sensor prototypes for performance and task-based outcomes to advanced development. Initiate: - Research on the feasibility of new underwater ultrasound devices to generate individualized and deterministic decompression profiles. - Applied research for the feasibility of providing spatial auditory information to enhance understanding of visual events occurring in operational settings. - Research to validate stress reactivity predictors in a military population to support the development of a performance prediction tool. - Explore large data sets of human biology and physiology to enhance algorithms underlying human performance sensor technologies. - Research studies on using the afterburner to reduce noise during take-off. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** There is no significant change from FY 2022 to FY 2023.					
Title: The Office of Naval Research Global ***Description:*** Supports the Office of Naval Research (ONR) Global mission to serve as the preeminent external facilitator for the Naval Research Enterprise. This is accomplished by establishing quality, relevant connections between the international research and development community, Naval fleet/forces, DOD, other US Government agencies and international partners. Science Advisors (SA) This effort ensures that the operational Naval fleet/force help shape the DON investment in science and technology (S&T), develops teaming relationships to rapidly prototype, experiment, demonstrate and transition	19.777	20.833	21.321	0.000	21.321

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
technology, supports development of technology-based capability options for Naval forces, and enables warfighting innovations based on technical and conceptual possibilities. The SA Program also informs capability-based war games using current and future technology to identify future capability strengths and shortfalls that assist in shaping the DON investment strategy. The ONR Global SA Program enables continuous communication and collaboration between the warfighters, the Naval Research & Development Enterprise, and strategic development commands. International science The ONR Global mission is also accomplished through PhD-level scientists located in Asia, Europe and South America, providing coverage in these regions as well as Africa, Australia/New Zealand and the Middle East. ONR Global scientists actively search the globe for emerging scientific research and promising technologies, collaborating with international organizations and researchers through liaison visits and grants in innovative applied research. The direct impact of this investment is to leverage international research during increasingly dynamic global interdependence and improve the ability to solve DON S&T challenges through shared knowledge and technologies with partners. In addition, this investment builds global S&T awareness to reduce the risk of potential technological surprise, and supports theater security cooperation goals to sustain cooperative relationships with an expanding set of international partners. International engagement ONR Global also supports international engagement with partner nations through the development and maintenance of bilateral and multilateral relationships, international agreements, and other activities that promote RDT&E collaboration and interoperability. ***FY 2022 Plans:*** - Support all Science Advisor program efforts across Fleet and Forces Commands; objectively assess placement of current Science Advisors and requests for additional support in terms of impact to the Fleet and S&T return on investment. The increase will allow the flexibility of hiring approximately 1 additional science advisor. - Support PhD-level scientists, in multiple overseas offices (Asia, Europe, South America and Australia, Africa and the Middle East) by continuing to engage with international scientists and engineers through liaison visits to research institutions and continue actively fostering international collaboration by awarding research grants. The increase will allow the flexibility of hiring approximately 1 additional PhD-level scientist.					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Support international engagement with ten partner nations, three multi-lateral groups, and support to the Northern Atlantic Treaty Organization (NATO), in order to increase collective Naval capability, capacity, and interoperability. ***FY 2023 Base Plans:*** Continue to: - Support all Science Advisor program efforts across Fleet and Forces Commands; objectively assess placement of current Science Advisors and requests for additional support in terms of impact to the Fleet and S&T return on investment. - Support PhD-level scientists, in multiple overseas deployed locations (Asia, Europe, South America, and Australia) by continuing to engage with international scientists and engineers through liaison visits to research institutions and continue actively fostering international collaboration by awarding research grants. Maintain and report on global technical awareness. - Support international engagement with ten partner nations, three multi-lateral groups, and support to the Northern Atlantic Treaty Organization (NATO), in order to increase collective Naval capability, capacity, and interoperability. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** There is no significant change from FY 2022 to FY 2023.					
Title: Training Technologies ***Description:*** Applied research to enhance the ability to develop Naval forces from time of recruitment through separation from the military capable of competing and succeeding against novel threats and using novel, rapidly-fielded, technologies. This includes use of modern approaches for evaluation of knowledge, skills, and aptitude in school houses, field training, and point-of-need. Improved effectiveness is achieved by applying psychometric theory, data science, cognitive science, operations research, modeling and simulation, and computer sciences to the development, delivery, evaluation, and execution of training and education. Emphasis is on approaches that are robust at scale and can be implemented in a resource-constrained environment. ***FY 2022 Plans:***	4.730	4.966	5.023	0.000	5.023

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Technologies for Naval Training: - Mature immersive environments to train unit commanders in decision-making, tactics, and strategies. - Expand new methods and techniques for enhancing problem solving ability of autonomous, artificial intelligence agents. - Continue to develop methods and techniques to identify individual differences to optimize training. - Continue to mature game technology to build innovative job-performance and decision-aids. - Conduct applied research on learning-based techniques to improve decision-making and develop warfighters who are able to integrate and adapt to new technologies and threats. This effort will focus on delivery of interventions to representative populations and evaluation of intervention. Advanced Integrated Maritime Mission Modeling: - Continue work on Live-Virtual-Constructive simulation-based training technologies for Anti-submarine Warfare to include a greater range of simulated target types, behaviors, and scenarios. - Create training technologies to enhance the ability of shipboard operators, supervisors and crypto-technicians to rapidly detect cyber incursions into their radar, GPS, radio, and remote imaging systems, and to efficiently mitigate the effects of these incursions on combat effectiveness.					
FY 2023 Base Plans: Technologies for Naval Training: Continue: - Mature immersive environments (multi-player game) to train unit commanders in decision making, tactics, and strategies. - Expand new methods and techniques for enhancing problem solving ability of autonomous, artificial intelligence agents. - Develop methods and techniques to identify individual differences to optimize training. - Continue to mature game technology to build innovative job-performance and decision-aids using augmented reality. - Conduct applied research on learning-based techniques to improve decision-making and develop warfighters who are able to integrate and adapt to new technologies and threats. Complete: The following efforts resulted from the investment described in the FY21 and FY22 plans for this program: - Research on the design of an electronic tutor to be transitioned to a Navy nuclear power technical school.					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Research to design a tool for Navy recruiting. - Efforts to map knowledge and skills required to fight and win in future conflicts with unmanned ground robotic systems. Initiate: - Apply new methods for tailored training that exploits artificial intelligence agents. - Develop new techniques for obtaining and sharing of knowledge to improve individual and team performance in Naval applications. - Mature digital intelligent tutor technologies (e.g., reading tutor) by enhancing tutors ability to characterize and diagnose students errors and provide appropriate real-time remediation. - Incorporate Naval social/cultural norms into senior leadership models to inform training. - Effort to develop immersive environments (multi-player game) to train unit commanders in decision making, tactics, and strategies. Advanced Integrated Maritime Mission Modeling: Continue: - Expand work on Live-Virtual-Constructive simulation-based training technologies for Anti-submarine Warfare to include a greater range of simulated target types, behaviors, and scenarios. - Create training technologies to mitigate the effects of denied / degraded environments as well as cyber incursions on combat effectiveness. Complete: - The following effort resulted from the FY22 plan to create training technologies to enhance the ability of shipboard operators, supervisors and crypto-technicians to rapidly detect cyber incursions into their radar, GPS, radio, and remote imaging systems, and to efficiently mitigate the effects of these incursions on combat effectiveness. The completed portion of this effort includes training tools to detect cyber incursions in radar, Global Positioning System (GPS), radio, and remote imaging systems for shipboard operators, supervisors and crypto-technicians. Initiate:					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Leverage work on Live, Virtual, and Constructive simulation-based training technologies for coordinated United Stated Marine Corps and United States Navy Strike Warfare in Naval Expeditionary Advanced Based Operations (EABO). - Investigate the application of Adaptive Training methodologies into both shore and ship-based training curricula for Anti-Submarine Warfare. Learning to Integrate and Adapt to New Naval Technologies and Threats Initiate: - Applied research for learning-based techniques to improve decision-making and develop warfighters who are able to integrate and adapt to new Naval technologies and threats. Focus is on the delivery of interventions to representative populations and evaluation of such interventions. Emphasis is on tailored and scalable strategies. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** There is no significant change from FY 2022 to FY 2023.					
Accomplishments/Planned Programs Subtotals	64.333	69.488	70.957	0.000	70.957

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy											Date: April 2022	
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COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
9999: *Congressional Adds*	0.000	47.786	48.250	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	96.036

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Congressional Add: Lightweight anti-corrosion nanotechnology coating enhancement	4.827	0.000
FY 2021 Accomplishments: Identified and executed several large-scale, cross-domain pilots to determine potential cost savings and improved fleet-wide readiness via the adoption of functional coatings and surface treatments. Supported various pilot demonstrations aimed at improving performance, protect the base metal and reduce corrosion in various DOD systems including storage tanks, aircraft skin, heat exchangers, undersea vehicles and ship hulls.		
FY 2022 Plans: N/A		
Congressional Add: Polymer coatings for reduced ice and fouling adhesion	4.827	5.000
FY 2021 Accomplishments: Analyzed solids shedding mechanisms resulting in an improvent to ice release capabilities of Navy topside coatings and the biofouling release capabilities of Navy below the water line antifouling coatings.		
FY 2022 Plans: Analyze solids shedding mechanisms resulting in an improvement to ice release capabilities of Navy topside coatings and the biofouling release capabilities of Navy below the water line antifouling coatings.		
Congressional Add: force Health Protection and Application	4.827	0.000
FY 2021 Accomplishments: Conducted research on what occurs inside the brain after experiencing a blast event. The research will leverage partnerships with academia and the national laboratories to acquire a better understanding of the human cellular response and the interface between humans and their protective equipment during blast impulses. These research efforts may lead to predicting injury following a blast event using future wearable sensor systems and may inform the design of advanced protective equipment to reduce blast injuries.		
FY 2022 Plans: N/A		
Congressional Add: Health and Safety Research of Underground Fuel Storage Facilities	4.827	5.000
FY 2021 Accomplishments: Developed plans and evaluated technologies to improve the health and safety of the underground Red Hill Fuel Storage Facility in Hawaii, and other underground fuel storage tanks in the Asia-		

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Pacific AOR. Performed research for fuel tank inspect and repair protocols; advanced microscope analysis of tank corrosion products; concrete tank degradation inspection and retrofit; and advanced nanomaterials coating. ***FY 2022 Plans:*** Develop plans and evaluate technologies to improve the health and safety of the underground Red Hill Fuel Storage Facility in Hawaii, and other underground fuel storage tanks in the Asia-Pacific AOR. Perform research for fuel tank inspect and repair protocols; advanced microscope analysis of tank corrosion products; concrete tank degradation inspection and retrofit; and advanced nanomaterials coating.		
Congressional Add: Human Performance and injury Rehabilitation Assessment tool ***FY 2021 Accomplishments:*** Conducted applied research in Human Performance and Injury Rehabilitation Assessment tool. ***FY 2022 Plans:*** N/A	2.413	0.000
Congressional Add: Humanoid Robotics in Unstructured Environments ***FY 2021 Accomplishments:*** Investigated issues in robotic learning of manipulation skills, natural language interaction with robots, robotic tasks relevant for shipboard maintenance, robot navigation and human-robot collaboration. Research was conducted in humanoid robotics in complex unstructured environments. ***FY 2022 Plans:*** N/A	4.827	0.000
Congressional Add: Engineered Systems to Preserve and Restore Hearing After Deleterious Stimulation ***FY 2021 Accomplishments:*** Exposure and extended exposure to high levels of noise can cause hearing damage, which severely impacts operational performance and can lead to permanent hearing loss. While advances are being made in developing therapeutics for auditory injury and delivering them to the inner ear to restore hearing, drug placement remains a major challenge to realizing optimal and consistent outcomes. The primary objective of this effort is to develop a noise-level enabled drug dosing and delivery system that would prevent cochlear damage. Such a system would respond in real-time to prevent noise-induced hearing loss and protect the warfighter from subsequent ear trauma. ***FY 2022 Plans:*** N/A	4.827	0.000
Congressional Add: Hypersonics Material Acceleration ***FY 2021 Accomplishments:*** This funding is anticipated to use the membership and resources of the LIFT Institute to increase the manufacturing base for the US hypersonics industrial base. The work focused on additive processing of large 3D structures, joining of dissimilar metals, establishment of powder supply chain for	3.861	5.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
refractory metal alloys, and ICME tools leading to the development of new materials and processes, as well as characterization of existing materials and prediction of properties for future materials. ***FY 2022 Plans:*** This funding is anticipated to use the membership and resources of the LIFT Institute to increase the manufacturing base for the US hypersonics industrial base. The work will focus on additive processing of large 3D structures, joining of dissimilar metals, establishment of powder supply chain for refractory metal alloys, and ICME tools leading to the development of new materials and processes, as well as characterization of existing materials and prediction of properties for future materials.		
Congressional Add: Laser Peening Technology for Submarine and Carrier Shafts ***FY 2021 Accomplishments:*** Complete development and activities qualifying to certify laser peening of ship propulsion shafts. This proposed work will follow on an existing program that is addressing shaft operational risk issues and evaluating the efficacy of the laser peening process to reduce risk when applied to propulsion shafts. ***FY 2022 Plans:*** N/A	2.896	0.000
Congressional Add: Physics Based Neutralization of Threats to Human Tissues and Organs ***FY 2021 Accomplishments:*** Conducted research into a multiscale, physics-based approach to for use in preventing and mitigating both mild traumatic brain injuries (mTBIs) and blast-induced traumatic brain injuries (bTBIs). Preventing and mitigating bTBI and mTBI requires advancing the understanding of injury at a cellular level, as the exact force magnitudes and directions that initiate TBI at the cellular scale are still unknown. Knowledge of neuronal TBI thresholds is a critical and currently missing component of developing improved protective equipment, as well as equipment that addresses the full range of injury. ***FY 2022 Plans:*** Conduct research into a multiscale, physics-based approach to for use in preventing and mitigating both mild traumatic brain injuries (mTBIs) and blast-induced traumatic brain injuries (bTBIs). Preventing and mitigating bTBI and mTBI requires advancing the understanding of injury at a cellular level, as the exact force magnitudes and directions that initiate TBI at the cellular scale are still unknown. Knowledge of neuronal TBI thresholds is a critical and currently missing component of developing improved protective equipment, as well as equipment that addresses the full range of injury.	4.827	5.000
Congressional Add: Social Networks and Computational Social Science ***FY 2021 Accomplishments:*** Developed new metrics for social media analysis of social cyber-threats to military missions, to include threat characterization, behavior and tactics modeling, coordination structures, action dynamics, narrative evolution and studies of polarization and, multiplatform mapping, and platform	1.931	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
vulnerabilities and bias. Anticipated deliverables include published papers, book chapters, and presentation, technical demonstrations, and a capstone project to validate results via a technical demonstration. ***FY 2022 Plans:*** N/A		
Congressional Add: Warfighter as a System Human Digital Twin Research ***FY 2021 Accomplishments:*** Continued development of the human digital twin project known as I-PREDICT. The research will involve development of the roadmap for integration and the integration process itself of the human body model with sub-system human models, simulations of aircraft, aircraft components and equipment, personal protective equipment and specialized equipment for casualty transport. ***FY 2022 Plans:*** N/A	2.896	0.000
Congressional Add: Advanced nanocomposite coatings ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct applied research in advanced nanocomposite coatings	0.000	6.000
Congressional Add: Anticorrosion nanotechnology ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct applied research supporting anticorrosion nanotechnology	0.000	7.500
Congressional Add: Development of chromate-free corrosion inhibitor coatings for marine application ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct applied research for development of chromate-free corrosion inhibitor coatings for marine application	0.000	1.750
Congressional Add: Engineered systems to preserve and restore hearing ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct applied research in engineered systems to preserve and restore hearing	0.000	5.000
Congressional Add: Human digital twin ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct applied research supporting human digital twin	0.000	3.000
Congressional Add: High mobility ground robots to assist dismounted infantry in urban operations	0.000	5.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: N/A ***FY 2022 Plans:*** Conduct applied research for high mobility ground robots to assist dismounted infantry in urban operations		
Congressional Adds Subtotals	47.786	48.250

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A