Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy	Date: April 2022
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602750N / *Future Naval Capabilities Applied Research*

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	165.813	198.233	173.641	-	173.641	182.662	185.872	189.572	193.325	Continuing	Continuing
0000: *Future Naval Capabilities Applied Research*	0.000	158.090	171.233	173.641	-	173.641	182.662	185.872	189.572	193.325	Continuing	Continuing
9999: *Congressional Adds*	0.000	7.723	27.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	34.723

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) works closely across the Department of the Navy (DON) and Naval Research Enterprise (NRE) to develop high priority technological capabilities needed by the operational forces. From their beginnings, the U.S. Navy and Marine Corps have leveraged technology innovation to gain decisive advantage. However, breakthroughs don't happen overnight. Critical to sustaining the pipeline of new capabilities, is maintaining a priority-driven portfolio of naval science and technology (S&T) to deliver solutions to known requirements, and experiment with potential game-changing ideas. 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. This PE funds Future Naval Capabilities (FNC) Technology Candidates, which are at lower Technology Readiness Level (TRLs), and is focused on maturing technologies to higher TRLs to reduce FNC transition risk. Efforts in this PE are coordinated with related work in the USMC Technology Candidates Activity of PE 0602131M Marine Corps Landing Force Technology.

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 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.

B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	170.681	173.356	0.000	-	0.000
Current President's Budget	165.813	198.233	173.641	-	173.641
Total Adjustments	-4.868	24.877	173.641	-	173.641
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-2.123			
• Congressional Rescissions	-	-			
• Congressional Adds	-	27.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.406	0.000			
• SBIR/STTR Transfer	-3.462	0.000			
• Program Adjustments	0.000	0.000	0.000	-	0.000

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• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	173.641	-	173.641

Congressional Add Details ($ in Millions, and Includes General Reductions)

	FY 2021	FY 2022
Project: 9999: *Congressional Adds*		
Congressional Add: *Cooperative Engagement Capability Mission Based Networking for Data Distribution*	2.896	0.000
Congressional Add: *Improved Detection of Submarine Threats*	4.827	5.000
Congressional Add: *Long endurance, autonomous, mobile acoustic detection systems*	0.000	22.000
Congressional Add Subtotals for Project: 9999	7.723	27.000
Congressional Add Totals for all Projects	7.723	27.000

Change Summary Explanation

Funding: The FY23 decrease between the PB22 and PB23 requests for this PE was due to better than expected progress maturing several FNC Technology Candidate efforts in the C4ISR and Sea Warfare Activities that are continuing into FY23. This progress supported lower FY23 requests within these Activities than originally expected.

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: *Future Naval Capabilities Applied Research*	0.000	158.090	171.233	173.641	-	173.641	182.662	185.872	189.572	193.325	Continuing	Continuing

A. Mission Description and Budget Item Justification

Future Naval Capabilities (FNC) budget activity (BA) 2 investments develop candidate FNC technologies in an agile fashion by exploiting technology advances that respond rapidly to Naval needs. This approach facilitates an optimum response when developing and maturing the technology options that can be developed further in Program Element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development.

The FNC Program favors a high level of collaboration. PE R-2 activities are mostly organized by the Office of Naval Research (ONR) Science and Technology Departments, which are tasked to collaborate with the acquisition stakeholders and their resource sponsors. A complete accounting of the technology candidates being developed and a full disposition of each technology development effort funded in this PE is provided annually to the Congressional oversight committees.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Expeditionary Maneuver Warfare (EMW) and Combating Terrorism	14.193	16.168	16.599	0.000	16.599

Description: The objective of this activity is to develop and mature technologies in asymmetric and irregular warfare, distributed operations, information warfare, survivability and self-defense to a point where they can be proposed and continued as FNCs in PE 0603673N, Future Naval Capabilities Advanced Technology Development.

FY 2022 Plans:
Human Performance Education and Training Thrust:
- Progress and expand in the area of providing new training technologies, knowledge products, architectures, and systems that can accelerate mental, emotional and cognitive decision-making skill, to include human-machine teaming and greater naval capability to detect, localize and neutralize mines and improvised explosive devices that challenge the naval forces ability to operate in contested maritime environments.

Logistics Thrust:
- Continue novel technologies and innovative concepts that will improve the maneuverability of the Marine Corps Air Ground Task Force (MAGTF) by enhancing the movement of troops and equipment from shipboard to inland objectives.
- Investigate ways to reduce the length of the supply chain for small units to include alternative local shipping and delivery methods and storage and power production and storage.

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Force Protection Thrust: - Extend focus on the technologies that will enhance long-range fires capabilities so warfighters employed in small distributed units will have the tools they need to locate and decisively destroy larger enemy forces. - Develop technologies to improve warfighter effectiveness in command, control, computers and communication, intelligence, surveillance and reconnaissance for small unit naval expeditionary warfighters to include multi-domain sensing of the electronic spectrum. - Develop methods to defend against adversarial unmanned vehicles to include swarming attacks.					
FY 2023 Base Plans: Human Performance Education and Training Thrust: - Continue research in new training technologies, knowledge products, architectures, and systems. - Continue research to accelerate mental, emotional and cognitive decision-making skills. - Continue research to improve human-machine teaming. - Continue research in the areas of detecting, localizing and neutralization of mines and improvised explosive devices that challenge the ability to operate in contested maritime environments. - Initiate efforts to develop and evaluate modeling and simulation-based capabilities to accelerate performance in training and education settings and increase readiness in the expeditionary environment. This includes the continuation of Warfighter Training research completed in PE 0602131M in FY22.					
Logistics Thrust: - Continue research to enhance movement of troops and equipment from ship to inland objectives. - Continue research to develop higher material readiness and reduce the length of the supply chain for small units. This includes the continuation of New Repair Techniques research completed in PE 0602131M in FY22. - Continue Fleet Vehicle research completed in PE 0602131M in FY22 by continuing research in the area of unmanned platform power systems. - Initiate research in the area of advanced manufacturing materials. - Initiate applied research in the area of small scale, energy efficient water purification in support of distributed operations and Expeditionary Advance Base Operations (EABO).					
Force Protection Thrust: - Continue research to improve warfighter effectiveness in command, control, computers and communication, intelligence, surveillance and reconnaissance in the area of electromagnetic spectrum analysis and signature					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
management. This includes the continuation of Flexible Software Development research completed in PE 0602131M in FY22. - Complete applied research to defend against adversarial unmanned vehicles in the area of Counter Small Unmanned Aerial Systems (UAS). This effort will transition to Advanced Technology Demonstration. - Complete applied research to enhance long-range fires capabilities in the area of Ground Based Air Defense High Energy Laser. This effort will transition to Advanced Technology Demonstration. - Initiate research in the area of increased range and lethality for small form factor weapon systems in support of EABO. Firepower Thrust: - Initiate effort to conduct feasibility demonstration of a missile launcher capable of launching multiple calibers of militarily relevant munitions from a single platform. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The increase in funding from FY 2022 to FY 2023 is due to the initiation of investments in Firepower to conduct feasibility demonstration of a missile launcher capable of launching multiple calibers of militarily relevant munitions from a single platform. These investments will enhance the USMC fires capabilities by providing smaller and more agile, multi-platform compatible, affordable Long Range Precision Fires.					
Title: C4ISR and Special Projects ***Description:*** The objective of this activity is to develop and mature technologies in data science, mathematical optimization, computational and information sciences, quantum information sciences, electronics, command and control (C2), combat systems, communications, cyber security, cyber operations, electronic warfare (EW), sensing and surveillance, and precision timing and navigation (PTN), as well as technologies for surface and airborne vehicles, and cruise missile defense weapons to a point where they can be proposed and continued as Future Naval Capabilities (FNC) in program element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development. ***FY 2022 Plans:*** Future Naval Capabilities (FNC) Technology Candidate development in FY 2022 will initiate efforts in:	54.825	47.581	45.141	0.000	45.141

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Implementing novel hardware and development of modern algorithms for the signal processing to enable detection of advanced maritime threats. - Evolving electro-optic and infrared capabilities for threat detection and passive surveillance. - Developing tools for convergence of cyber and EW effects. - Developing frameworks with intelligent resource management for system resilience. - Understanding and analyzing Fifth generation (5G) security and protocol to identify vulnerabilities and close security gapsto increase resiliency and robustness against any adversarial actions. Continue efforts in: - Communications and Networking to mature promising over the horizon communications and low probability of detection technologies to enable distributed maritime operations. - Sensor Deception and Defeat to mature the underlying technologies, techniques and algorithms that degrade, neutralize, or destroy an adversary's C4ISR capability. - Decision Tools to develop capabilities through applied research efforts that allow Commanders to rapidly and confidently move from data-to-options-to-informed decisions. - Cyber to mature innovative cyber approaches to enhance the resilience, safety, reliability and efficiency of cyber systems in warfighting platforms. - Advanced Sensing and Processing to mature sensing system and processing technologies to deliver enhanced operational capabilities for Intelligence, Surveillance, Reconnaissance and Targeting applications. - Cross Platform Technologies to mature electro-magnetic enabling technologies that rely on geographic separation of platform sensors to deliver enhanced operational capabilities. - Advanced Systems and Components to mature the underlying components and systems for improved Electro Optical (EO), Radio Frequency (RF) and Precision, Navigation, and Timing (PNT) systems. - Developing Government Off the Shelf (GOTS) software router and apps to meet Fleet resilient networking objectives in contested warfighting scenarios - Developing key technologies for off-board RF illumination sources to enable Multi-Input Multi-Output and receive-only					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
sensing in a distributed environment. - Developing ultra-efficient neural network hardware. Complete efforts in: - A low-cost, high-fidelity network deception framework (CyberMoat) that lies to attackers' on-demand, and automated tools to coerce malware agents to deceive adversary Command and Control. - An operating system that enables automatic and efficient use of heterogeneous computing architectures for cyber resilience without requiring change to legacy source code.					
FY 2023 Base Plans: Communications and Networking Thrust: - Continue analyzing Fifth generation (5G) security and protocol to identify vulnerabilities to close security gaps to increase resiliency and robustness against adversarial attack. - Continue maturing promising over the horizon communications that include low probability of detection and low probability of intercept features to enable distributed maritime operations. - Continue developing hardware and software routing and applications for resilient networking in contested warfighting scenarios and improving data dissemination across both forward and back fit Joint heterogeneous networks. - Initiate multi-beam communications for data dissemination and unmanned and autonomous control applications. - Initiate development of promising low-frequency RF and optical technologies for multi-platform communication capabilities. Intelligence, Decision-Making Superiority, C2 and Combat Systems Thrust: - Continue developing frameworks for cross platform intelligent resource management and data dissemination providing both enhanced Distributed Maritime Operations and system resilience. - Continue developing capabilities that allow commanders to rapidly and confidently move from data-to-options-to-informed decision both at the Maritime Operations Center and Afloat. - Initiate optimization of machine learning and AI algorithms for planning to execution synchronization of hard kill, cyber and electromagnetic engagements. - Initiate development of advanced computing for machine learning on the tactical edge.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Full Spectrum Cyber Thrust: - Continue developing tools for convergence and coordinate cyber and EW effects. - Continue maturing innovative cyber approaches to enhance naval platform and warfighting resilience, safety, reliability and efficiency. - Initiate machine learning for automation of cyber defense approaches. - Initiate efforts to automate identification and leveraging of over-permissioned protocol implementations. Electromagnetic Warfare Thrust: - Continue developing technologies, techniques and algorithms that degrade, neutralize, or destroy an adversary's C5ISR capabilities. - Continue developing cross platform technologies to mature electro-magnetic techniques that rely on geographic separation of platform sensors to deliver enhanced operational capabilities. - Continue developing and maturing the necessary component technologies for spectrum access both in EO and RF that enable defeat of adversarial sensors and systems. - Initiate counter ISR technology to defeat and degrade EO sensor and seekers. Surveillance, Sensors and Phenomenology Thrust: - Continue developing and implementing novel hardware, algorithms and high speed processing to enable detection of advanced maritime threats in both manmade and natural clutter at stand-off ranges. - Continue developing and implementing new electro-optic and infrared sensing capabilities including digital readouts for improved passive sensing of difficult threats in cluttered backgrounds. - Continue providing advanced sensor processing that improve Intelligence, Surveillance, Reconnaissance and Targeting of hard targets. - Continue developing key technologies for off-board RF illumination sources to enable Multi-Input Multi-Output and receive-only sensing in a distributed environment. Quantum, Positioning, Navigation, and Timing Thrust: - Initiate development of quantum gravimetry mapping and navigation techniques.					
FY 2023 OCO Plans: N/A					
FY 2022 to FY 2023 Increase/Decrease Statement:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
The decrease from FY 2022 to FY 2023 was predominately due to the completion in FY 2022 of a high-fidelity network deception framework (CyberMoat) and an operating system that enables automatic and efficient use of heterogeneous computing architectures for cyber resilience.					
Title: Ocean Battlespace Sensing	23.613	26.421	31.977	0.000	31.977
Description: The objective of this activity is to enable maritime domain access and distributed operations for Naval forces in contested ocean environments through superior maritime battlespace awareness and undersea threat detection, identification and neutralization. Specifically, activities will develop and mature technologies that ultimately support Mine and Expeditionary Warfare, Undersea Warfare, and Ocean, Atmosphere and Space Sciences. Activities will also develop and mature methods and technological approaches for environmental sensing and prediction for the maritime battlespace. The desired outcome for efforts in this activity is to mature the applied research results to a point where they can be focused on particular enabling capabilities and proposed to be continued as Future Naval Capabilities (FNC) in program element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development. Additionally, a subset of technologies explored herein are intended to support expeditionary access and will be further matured, focused, and ultimate demonstrated under the USMC's Advanced Technology Demonstration effort in PE 0603640M MC Advanced Technology Demo. ***FY 2022 Plans:*** Continue efforts in: - Advanced minesweeping including development of compact, efficient approaches for sweeping advanced influence mines. The objective is to increase the safe standoff of various tactical platforms and surface ships. - Development of robotic technologies to respond to detected targets including work on dexterity, haptics and algorithms to achieve human-like behaviors. The objective is to interact with the mine and/or obstacle to achieve neutralization, clearance, render-safe or removal for exploitation. - Development of advanced acoustic arrays for floating ASW active sonar sensing systems. - Developing a large, low-noise volumetric array that can be deployed in an A-size sonobuoy that will have superior detection performance against relevant targets. Complete efforts in: - High temperature superconducting approaches to minesweeping; innovative naval mine delivery methods; advanced					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
acoustic sources for floating and mobile ASW sensing systems as well as expeditionary SURTASS; and storm surge and inundation forecasting models. - Algorithm development for theater-level Anti-Submarine Warfare (ASW) battle management and techniques to achieve noise reduction for expeditionary Surveillance Towed Array Sensor System (SURTASS). Initiate efforts in: - Prototype autonomous system to enhance detection and classification of emerging and novel threats in challenging operating environments. Efforts will develop and mature adaptive object recognition algorithms, modeling and simulation tools, and self-assessment autonomous behaviors. These technologies will improve MCM UUV object detection and recognition capabilities. - Compact broadband acoustic sources for floating and mobile ASW sensing systems.					
FY 2023 Base Plans: Mine and Expeditionary Warfare Thrust: - Complete the investigation of housing designs to both maximize range and improve lethality for aerial mine subcomponents. - Complete initial design and integration of unmanned platform capability for alternate deployment options. - Completed advanced minesweeping capabilities for unmanned surface vehicles. Technology transitioned to Magnetic and Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS) Future Naval Capability. - Initiate area coverage rate mine warfare capability in contested shallow water to surf zone to support expeditionary operations in the South Pacific. Undersea Warfare Thrust: - Continue to develop acoustic sources for floating and mobile anti-submarine warfare (ASW) sensing systems. - Continue testing of glider towed arrays for detection of ASW threats in the ocean environment.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Complete investigation of undersea data networking technologies for employing multi-modal communication devices for reduced latency and bandwidth, and assured connectivity. - Complete development of a large, low-noise volumetric array that can be deployed in an A-size sonobuoy that will have superior detection performance against relevant targets. - Initiate development of signal processing and displays to improve performance and reduce vulnerability for submarine active sonar. - Initiate development of computational methods to detect very quiet submarine targets by combining evidence from multiple arrays. - Initiate development of unmanned undersea vehicle (UUV) navigation concepts that fuse multiple sensing modalities into a single solution to improve performance in long duration complex environments. Ocean, Atmosphere and Space Sciences Thrust: - Complete development of new decision aid to support intelligence, surveillance and reconnaissance (ISR) mission planning tools for four-dimensional atmospheric cloud/particle prediction and impact electro-optical (EO), infrared (IR) and high-energy laser (HEL) sensors. - Complete new government-owed, open architecture paradigm in Space-Based Environmental Monitoring (SBEM) data processing and delivery needed to improve timely, accurate decision making in the maritime battlespace environment. - Complete development of high frequency (HF) signal of opportunity processing, ionospheric propagation, and ocean surface scatter algorithms to add data fusion, and prognostic capability to regional assessments to support Navy HF communications networks at sea. - Complete development of a prototype radio frequency (RF) communications and signature management tool for small unit maneuver in the coastal and terrestrial environments to assess the environmental variability spatially and temporally. - Complete development of a prototype decision support tool for tactical aircraft that can assess the most likely current refractivity environment and diagnose current observed anomalous RF propagation to exploit or mitigate environmental effects on radar and electronic warfare (EW) search performance. - Complete initial development of forward model components (e.g., coefficients), compression techniques of high-resolution ocean model reassembly on a forward deployed communications-disadvantaged platform.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Initiate development of a methodology of modeling and measurement of EO/IR naval sensors in various weather conditions to determine and predict performance in non-ideal environmental conditions. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The funding increase from FY 2022 to FY 2023 supports the initiation of additional efforts in novel signal processing for submarine active sonar, new computational methods to synergistically leverage multiple acoustic arrays for quiet targets, development of novel long duration unmanned undersea vehicle (UUV) navigation concepts for complex environments, development of prototype decision support tool to assess environmental effects on electro-optical (EO), infrared (IR) and high-energy laser (HEL) weapons, and development of new decision support products that leverage novel high fidelity atmospheric characterization for airborne and space-based ISR mission planning in FY 2023.					
Title: Sea Warfare and Weapons ***Description:*** The objective of this activity is to develop and mature technologies that enable superior warfighting capabilities for surface and sub-surface naval platforms and undersea weaponry to a point where they can be proposed and continued as Future Naval Capabilities in program element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development. ***FY 2022 Plans:*** Initiate efforts in: - Addressing platform design and engineering, power energy and propulsion, materials, manufacturing and sustainment and logistics. Continue efforts in: - Addressing platform endurance, survivability and resiliency; naval force sustainment; and logistics. These efforts include signature management, undersea weapons improvements, digital twin development and ship hull-based coatings. Complete efforts in:	24.396	33.715	30.926	0.000	30.926

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Undersea platform signature management and control to support the tactical submarine capabilities evolution plan. - Technologies to improve the long-range operational capabilities of undersea weapons. - "Digital twin" development with the expansion to integrate condition-based maintenance; and power and energy to improve overall platform resiliency. - Methods to produce rapidly low cost, high performance autonomous unmanned platforms. - Improved environmentally benign platform coatings to reduce maintenance costs and improve platform hydrodynamic efficiency.					
FY 2023 Base Plans: Initiate the following: - Efforts associated with rocket-propelled grenade (RPG)-of-the-Sea to develop and test components for a man-portable, easy-to-deploy undersea weapon effective against small surface craft. Use a build-test-build approach to refine, either individually or in combination, components for sensors, guidance, fuzing and propulsion. - Efforts associated with Wide Arc Swath Profiler (WASP) to Develop, test and assess the viability and utility of a new guidance mode for undersea weapons and vehicles. Continue the following: - Autonomous Determination of Vessel Intent (ID) efforts to develop and test an algorithm that will autonomously determine the intent of another vessel. (Initiated in FY22) - Autonomous Tactical Behaviors for M/LUSVs (ATBM/L) efforts to develop, integrate and transition mission executive and behaviors capability to USVs, such that the capability can be used on any UMAA-compliant USV. - Autonomic Readiness Management (ARM) efforts to build an onboard hardware/software infrastructure and integration to operational decision support for onboard data acquisition and analysis using AI/ML based models. - Robust Unmanned Platform Power System (RUPPS) effort to focus on the component modeling, system modeling, simulation, and subscale experimentation activities to demonstrate the suitability of modular, high endurance, alternative power system technology for Unmanned Surface Vessel platforms (USV). (Initiated in FY21) - Propulsion Gas Turbine Materials Upgrade (GTMAT) efforts to enable sustained higher engine service temperatures to meet increased ship power needs/capabilities and maintain engine life (Initiated in FY21)					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Flux-Core Additive Manufacturing (FCAM) efforts enable metal additive manufacturing afloat without creating a large logistics burden to carry shielding gas. (Initiated in FY22) - COTS Battery Phase II (COTS B II) research to develop and demonstrate a custom battery design that uses automotive industry commercial-off-the-shelf (COTS) battery hardware and lifecycle data-driven reliability approaches to battery management. (Initiated in FY22) - Electrical Ship Asset efforts: aging modelling and Reliability and Condition Assessment (ESARCA) efforts to investigate methods that lead to effective use of electrical insulation materials on ships employing high voltage electrical equipment. (Initiated in FY22) - Digital Evaluation of Implodable Composite Payloads (DEIComP) effort involves developing a suite of validated digital engineering tools and experimental findings that will improve prediction accuracy and improve speed and affordability of implodable integration with the fleet while increasing deployed technologies and survivability. (Initiated in FY22) - Flow Induced Machinery Noise Silencing (FIMNS) efforts to develop an increased knowledge base and an improved computational toolset for the design of efficient and reduced acoustic noise submarine machinery system blowers, cooling fans, and treatments; and deliver a prototype quiet cooling fan. (Initiated in FY22) - Stern Area System+ (SAS+) efforts to develop and demonstrate, through laboratory and in-water tests, algorithms which allow SAS to perform a new function to replace a legacy system, with enhanced capability, in the VIRGINIA Class. (Initiated in FY22) - Own Ship Electro-Magnetic Monitoring (OSEM) efforts to complete external sensor requirements and specifications development, continue sensor design, and develop the sensor qualification test plan. (Initiated in FY22) - Low-Observable Communications Mast for Undersea Platforms (LOCM-UP) efforts to reduce the radar cross section (RCS) and overall counterdetection risk of the submarine multifunction mast (MFM) while maintaining or increasing broad spectrum communications capability. (Initiated in FY22) - Corrosion-Informed Materials Section and Design Tool (CIMaD Tool) efforts to develop a DoN corrosion materials database and associated corrosion simulation algorithms, and validate a set of simulation algorithms using the developed database to predict corrosion damage which is critical to pursue a research to design against corrosion prior to production of DoN assets. (Initiated in FY22) - Next Generation Structural Steel for Enhanced Platform Capability (10% Ni Steel) efforts to develop processing conditions for adequate NIL-Ductility temperature, crack arrest, and stress-corrosion cracking (SCC) resistance; develop machine-learning process-structure-properties models to predict behavior and development of welding consumables and processes requiring no preheat. (Initiated in FY22)					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Complete the following: - AVIA efforts by delivering details from testing and simulation to the new ATBM/L technical candidate. - Digital twin related efforts by proposing to transition to an INP. - Condition Based Maintenance (CBM) efforts to deliver prototype EDAPO hardware and software modules for vehicle PHMS. - VIPB efforts by delivering models for the shaft-line components to the Future Naval Capability. - Own Ship Acoustic Monitoring efforts by delivering technical details from monitoring, studies and training to support transition to the Future Naval Capability. - Transparent Marine Antifouling Coatings (TMAC) efforts by delivering proposed down-select coatings for scale-up and additional testing. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The decrease from FY 2022 to FY 2023 is due to efforts associated with the Platforms and Sustainment areas completing.					
Title: Warfighter Performance ***Description:*** The objective of this activity is to conduct research and mature technologies that enhance Naval warfighting effectiveness and efficiency within the broad array of Warfighter Performance science and technology domains (Undersea Medicine, Biological Sciences, Bio-robotics, Capable Manpower, Command Decision Making, Force Health Protection, Human/Robot Interaction, Noise-Induced Hearing Loss, and Training and Simulation) to a point where they can be proposed and continued as Future Naval Capabilities (FNC) in program element (PE) 0603673N, Future Naval Capabilities Advanced Technology Development. ***FY 2022 Plans:*** Continue efforts in: - Information model for expressing and managing mission priorities and authorities between unmanned systems, autonomy, and warfighters to enable transfer of tactical control of vehicles and/or payloads during routine missions in contested communications environments. This continuing effort is derived from applied human-level artificial intelligence and	11.818	16.617	18.343	0.000	18.343

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
autonomy research identified in FY21. - Modular Live-Virtual-Constructive information environment for training, experimentation, wargaming and assessment. This continuing effort is derived from social media incorporation for C4ISR research identified in FY21. - Dive suit capability to enable mobility for divers to work on the bottom of the ocean while accomplishing majority of tasks that previously required a 'wet diver' and cannot be accomplished by robotics. This continuing effort is derived from modeling and simulation of warfighting environments and systems research identified in FY21. Complete efforts in: - Developing a customizable bio-fidelic model of the warfighter to improve risk assessment, injury and incapacitation prediction to enable better testing criterion for PPE and platforms development. This effort will transition to PE 0603673N Future Naval Capabilities for continued development in FY22. This concluding effort is derived from biomedical capabilities to increase warfighter lethality and survivability research identified in FY21. - Decision support system to evaluate alternative manpower courses of action across Manpower, Personnel, Training and Education (MPTE) enterprise. This concluding effort is derived from modeling and simulation of warfighting environments and systems research identified in FY21. - Analytic tool to reduce the number of counter-productive workplace behaviors and correlating indicators through data mining and analytics. This concluding effort is derived from modeling and simulation of warfighting environments and systems research identified in FY21. - Communication platform to monitor health status of military personnel in operational environments. This concluding effort is derived from modeling and simulation of warfighting environments and systems research identified in FY21. Initiate efforts in: - Maturing a low viscosity corrosion preventative wash primer to increase paint adhesion for the repair of tiles on					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
submarines. - Integrating automated data fusion and asset allocation techniques into a single Battle Management Aid for real-time decision support for operations and training. - Evidence-based, model-driven integrated software solution that will support, reinforce, and enhance career forecasting and manpower modeling by providing necessary data, differentiating metrics, and providing modern decision support to those involved in the selection and assignment processes.					
FY 2023 Base Plans: Advanced Analytics and Decision Making Thrust: - Continue development of an information warfare training system that teaches tactics, techniques and procedures for decisive, effective engagement that is suitable for public affairs, information operations, psychological operations, and intelligence operations. - Complete development of automated data fusion and asset allocation techniques that support the E-2D Hawkeye tactical airborne early warning aircraft's role in orchestrating Carrier Strike Group air defense. Integrate into Virtual/Constructive training environments and enable E-2D crew to train as it fights. - Initiate technology to automatically identify man-made structures in high resolution 3D datasets by defining use cases, workflows, outline methods, and algorithms for existing software applications. Program will reduce the task load for defining structures by identifying specific features unique to man-made structures and using them to outline the structures. - Initiate feasibility studies to explore next generation applications of advanced analytics and decision making in Navy and Marine Corps environments. Autonomy, Artificial Intelligence and Robotics Thrust: - Complete development of information model for expressing and managing mission priorities and authorities between unmanned vehicles, autonomous systems and warfighters to enable transfer of tactical control of vehicles and/or their payloads during missions in contested communications environments. - Initiate development of techniques to manage data sharing requirements to support logistics tools and minimize bandwidth requirement to enable meta-optimization across multiple planners and tactical decision aids. - Initiate feasibility studies to explore next generation applications of autonomy, artificial intelligence, and robotics in Navy and Marine Corps environments. Manpower, Performance, Protection, and Medical Support Thrust:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Continue development of models that provide decision support tools during the selection and assignment process of military personnel in order to maximize organizational effectiveness. - Complete development of a flexible, dry dive suit enabling mobility for divers to work on the bottom of the ocean to accomplish the majority of tasks that previously required a 'wet diver' and cannot be accomplished by robotics. - Initiate development of a Modular, Live-Virtual-Constructive integrated warfare environment to support training, mission rehearsal, and assessment of Carrier Strike Group and Air Wing forces while at sea. - Initiate feasibility studies to explore next generation applications of manpower, performance, protection, and medical support in Navy and Marine Corps environments. Materials Thrust: - Complete maturation of a low viscosity corrosion preventative wash primer to increase paint adhesion for the repair of tiles on submarines. - Complete characterization of a biomimetic and a bioinspired seawater curing adhesive to assess its suitability for adhering submarine hull treatment to steel submarine hulls. - Initiate feasibility studies to explore next generation applications of materials in Navy and Marine Corps environments. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The increase in funding from FY 2022 to FY 2023 will be used for the initiation of three new efforts to: 1) develop a Live-Virtual-Constructive warfare environment to support at-sea training, mission rehearsal, and assessment of Carrier Strike Group and Air Wing forces, eliminating the need for an expert observer to be present, 2) develop algorithms for existing software applications to automatically identify man-made structures in high resolution 3D datasets, eliminating the need to manually redefine target and collateral structures for each scenario, and 3) develop software to enable proactive logistics planning based on mission-critical events and route planning and artificial intelligence-informed decision making.					
Title: Naval Air Warfare and Weapons ***Description:*** The objective of this activity is to develop and mature technologies in directed energy, energetic materials, autonomy, electromagnetic launch, and high speed conventional air and surface weapons to a	29.245	30.731	30.655	0.000	30.655

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
point where they can be proposed and continued as Future Naval Capabilities in PE 0603673N, Future Naval Capabilities Advanced Technology Development. ***FY 2022 Plans:*** Initiate efforts in: - Developing novel energy/power generation, management and storage technologies applicable to advanced future missile capabilities and requirements. - Investigating novel concepts for solid rocket motor initiation, safety and thrust profile management. - Investigating advanced material and structural capabilities in aerodynamics for high-speed/hypersonic weapons. Continue efforts in: - Mature key solid fuel ramjet technologies identified in FY21 to increasing range, speed and maneuverability for missiles and projectiles. - Leverage ongoing collaborative weapons technologies for application to additional munitions and weapons - Leveraging ongoing reactive materials initiatives for application to additional munitions and weapons. - The investigation of advanced air-to-surface/ground seeker technologies, focusing largely on efficacy in a hypersonic regime. - Investigating and maturing system of systems concepts and associated technologies necessary to fully implement manned and unmanned teaming operations. Complete efforts in: - Maturing technologies leading to development of kinetic kill and/or directed energy for self-defense of high value, low density aircraft against next generation air-to-air threats. Includes solid state, High-Power Microwave (HPM) systems and kinetic-kill defenses against adversary hypersonic weapons research. Initiate/Complete efforts in: - Maturation of mission planning software that is able to aggregate, manage and optimize all data input for maximum					

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
effectiveness of Naval strike operations.					
FY 2023 Base Plans: Kinetic Weapons Thrust: - Continue investigating advanced material and structural capabilities in aerodynamics for high-speed/hypersonic weapons. - Continue the investigation of advanced air-to-surface/ground seeker technologies, focusing largely on efficacy in a hypersonic regime. - Continue maturing design concepts, fabricating sample components, and performing preliminary testing to inform future system level design trades. - Continue leveraging ongoing reactive materials initiatives for application to additional munitions and weapons. Establish weight/volume versus range increase potential for conceptual warhead designs. Establish warhead interface constraints for system integration. - Continue developing novel energy/power generation, management and storage technologies applicable to advanced future missile capabilities and requirements. - Complete investigating novel concepts for solid rocket motor initiation, safety and thrust profile management. - Complete maturing key solid fuel ramjet technologies for increasing range, speed and maneuverability for missiles and projectiles. - Complete leveraging ongoing collaborative weapons technologies for application to additional munitions and weapons. - Initiate feasibility studies for tactical decision aids that support advanced strike weapons. - Initiate feasibility studies and possible development of terminal defense fire control architectures that support low cost and easy integration onto ships and into expeditionary forces for terminal defense suitable for multiple engagement weapons. Directed Energy / Electric Weapons Thrust: - Continue maturing technologies leading to development of directed energy for self-defense of high value, low density aircraft against next generation advanced threats. Includes solid state and pulsed laser systems. - Continue designing, developing and testing of solid state, High-Power Microwave (HPM) systems for enhanced lethality. - Continue the initial susceptibility testing of Out Board Motor assets utilizing developed waveforms from FY21, modeling potential dynamic engagements matched to Joint Counter UAS operational requirements, and performing scaled demonstration of waveform engagement capability facility.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Continue the system design, build and testing of solid state High Power Microwave (HPM) Nonlinear Transmission Line (NLTL) power combining and phased array phase control evaluation, and platform integration study, and dynamic swarm CUAS HPM lethality testing. - Continue testing of an ensonification device to determine effects of range and amplitude. - Continue developing a conceptual RM warhead designs for 40mm grenade configurations. - Complete evaluating High Power Microwave (HPM) technologies used in counter electronic missions to defeat swarms of small Unmanned Aerial Systems (UAS). - Complete assessing the feasibility of near term solid-state HPM technologies to provide low cost and flexible counter UAS capability. - Complete conceptual designs for HPM weapons to increase defensive weapon capabilities of expeditionary ship classes against small vessels and swarming small UAS threats. - Initiate the development of compact High Power Microwave (HPM) antenna technology with reduced size, weight and cost to enable integration into Marine Corps tactical ground vehicles. - Initiate the advancement of HPM tunable source technology to adapt to evolving airborne threats. Aviation Platforms Thrust: - Continue Investigating and maturing system of systems concepts and associated technologies necessary to fully implement manned-unmanned teaming operations. - Continue maturing technologies leading to development of kinetic kill for self-defense of high value, low density aircraft against next generation advanced threats. This includes kinetic-kill defenses against adversary hypersonic weapons research and developing conceptual approaches for a podded Wide Body Defense System suitable for naval high value air assets. - Complete maturing Fuel Bladder Technologies by fabricating and testing crashworthy and self-sealing large panels. - Initiate the investigation and design of a suite of drag reduction concepts for Naval big wing aircraft, in order to improve flight performance. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** There is no significant change between FY 2022 and FY 2023.					
Accomplishments/Planned Programs Subtotals	158.090	171.233	173.641	0.000	173.641

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C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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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	7.723	27.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	34.723

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: Cooperative Engagement Capability Mission Based Networking for Data Distribution ***FY 2021 Accomplishments:*** Conducted applied research for CEC mission based networking for data distribution systems. ***FY 2022 Plans:*** N/A	2.896	0.000
Congressional Add: Improved Detection of Submarine Threats ***FY 2021 Accomplishments:*** Conducted applied research for improved detection of submarine threats. ***FY 2022 Plans:*** Conduct applied research for improved detection of submarine threats.	4.827	5.000
Congressional Add: Long endurance, autonomous, mobile acoustic detection systems ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct long endurance, autonomous, mobile acoustic detection systems applied research	0.000	22.000
Congressional Adds Subtotals	7.723	27.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A