Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Navy	Date: May 2021
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603640M *I MC Advanced Technology Demo*

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	0.000	228.703	249.340	224.155	-	224.155	-	-	-	-	-	-
2223: *Marine Corps ATD*	0.000	93.104	104.642	115.332	-	115.332	-	-	-	-	-	-
2297: *Futures Directorate*	0.000	93.128	92.319	104.071	-	104.071	-	-	-	-	-	-
2958: *Cyberspace Activities*	0.000	4.340	4.779	4.752	-	4.752	-	-	-	-	-	-
9999: *Congressional Adds*	0.000	38.131	47.600	0.000	-	0.000	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

The U.S. Navy/Marine Corps team is the most potent naval fighting force in the world. Fundamental to their success are the technologies necessary for effective distributed maritime operations. The Office of Naval Research (ONR) combines knowledge of the naval mission with researchers to select and explore solutions critical to expeditionary warfighting needs. This Program Element (PE) addresses requirements outlined. Additionally, an emergent operation stressor is the contested urban environment which exemplifies the characterizations listed above. The urban environment is one of the most complex terrains with physical compartmentalization and canalization, additional physical dimensions (subterranean and multi-story structures), crowded conditions and associated threat obscuration, communications challenges, informational and human aspects, and proliferation of observation and fires technologies. This environment requires capabilities addressing all the activities within this PE and while it provides many challenges, unique opportunities are also presented and can further shape technology approaches.

These future challenges and portents demand robust technologies for the Marine Corps, but the technology options are constrained. They must have a lightweight deployable character, and the ability to operate in austere conditions with little fixed infrastructure or support while retaining the agility and lethality of an integrated maneuver force. Technology must provide full spectrum capability against robust and complex peer and near-peer adversaries while meeting Size, Weight, Power, Cost limitations, and information availability within Distributed, Intermittent and Limited environments.

The approach within this PE encompasses ideas that support both revolutionary and evolutionary capabilities, and in this way considers and balances both "push" and "pull" aspects of technology projects. This PE matures technologies emerging from PE 0602131M-Marine Corps Landing Force Technology to develop concept prototypes and initial experimentation to confirm feasibility in an environment relevant to operations.

This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	212.347	219.045	221.406	-	221.406
Current President's Budget	228.703	249.340	224.155	-	224.155
Total Adjustments	16.356	30.295	2.749	-	2.749
• Congressional General Reductions	-	-0.952			
• Congressional Directed Reductions	-	-16.353			
• Congressional Rescissions	-	-			
• Congressional Adds	-	47.600			
• Congressional Directed Transfers	-	-			
• Reprogrammings	21.492	0.000			
• SBIR/STTR Transfer	-5.136	0.000			
• Program Adjustments	0.000	0.000	5.000	-	5.000
• Rate/Misc Adjustments	0.000	0.000	-2.251	-	-2.251

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2020	FY 2021
Project: 9999: *Congressional Adds*		
Congressional Add: *Robotic protection system*	4.827	0.000
Congressional Add: *Expeditionary mission planning enabled by high fidelity simulation*	9.654	0.000
Congressional Add: *Extended range 155mm projectile*	2.413	0.000
Congressional Add: *Adaptive threat force*	6.757	0.000
Congressional Add: *Air drop extended range munitions*	14.480	0.000
Congressional Add: *Expeditionary Process, Exploitation, and Dissemination*	0.000	5.000
Congressional Add: *Adaptive Threat Force Footprint*	0.000	6.000
Congressional Add: *Ensure Defense and Operational Resilience for USMC Tactical Cyber & Spectrum Man*	0.000	10.000
Congressional Add: *USMC Force Design - Closed Classified Wargaming Network and Naval Integration*	0.000	1.000
Congressional Add: *USMC Force Design - Organic Reconnaisance, Surveillance, and Target Acquisition*	0.000	4.500
Congressional Add: *Marine Corps force Design Acceleration - Project Artemis*	0.000	11.100
Congressional Add: *Marine Corps Mission Support Station Demonstration*	0.000	10.000
Congressional Add Subtotals for Project: 9999	38.131	47.600
Congressional Add Totals for all Projects	38.131	47.600

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Change Summary Explanation

The funding increase in FY22 is due to enhanced and extended experimentation opportunities in the Pacific Area of Responsibility (AOR) for MCWL Fused Integrated Naval Network technology. As FINN continues to mature, we are seeing a higher level of demand from the fleet for FINN to play in fleet level exercises. The additional $2.749M will support those operational opportunities, as well as the refinement of Concepts of Operations, Concepts of Employment (CONEMPs (CONOPS), and tactics, techniques, and procedures (TTPs).

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy			Date: May 2021
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603640M / *MC Advanced Technology Demo*	Project (Number/Name) 2223 / *Marine Corps ATD*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
2223: *Marine Corps ATD*	0.000	93.104	104.642	115.332	-	115.332	-	-	-	-	-	-
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project funds technology demonstration, experimentation, and prototyping; and more technologically mature projects within the Future Naval Capability (FNC) process as means to inform, enhance, enable, and invent future concepts and capabilities with new Science and Technology (S&T). This project is organized into ten activities, the core of which is represented by the eight Expeditionary Warfighting Capability Areas.

Emphasized within this project are increased efforts to actively demonstrate advanced technologies and system concepts. These demonstrations and experiments focus on the specific technologies, not necessarily their operational application, and vary based on the technical maturity of the project. This early technology exposure gives Marines a view into the future and enables them to use their imagination and innovation to envision novel employment of the technology and inform the acquisition process.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Command, Control, Communications, Computers (C4)	9.767	23.158	28.116	0.000	28.116
Articles:	-	-	-	-	-
Description: This activity investigates robust, resilient, and secure networked communications pathways and capability that support an expeditionary force's distributed and disaggregated operations. Research supports both networked and local computation for communications that exploits the expeditionary forces close physical proximity to threats while mitigating shortfalls commensurate within Distributed, Intermittent, and Limited environments. Expeditionary forces must operate in the cyber domain and in addition to defending communications networks, vehicles, and weapons systems, are reliant on electronic controllers for basic operations and as such are susceptible to cyberattacks. Technologies addressed within this activity include secure, robust, self-forming, mobile communications networks; distributed computing to support information dissemination to all echelons; improved capabilities in over-the-horizon, beyond line-of-sight, and restricted environment communications and sensors; and software and data processing to support formation of an appropriate common picture. Other efforts include power management, low detectability, conforming to Size, Weight, Power, Cost constraints, and interoperability within the joint environment.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Further, this activity integrates and demonstrates enhanced communications and situational awareness capabilities in experimental and warfighting environments reflecting USMC operations. Advanced technology resources will be developed and applied to complement commercial, other service, and defense agency investments to produce a technology base addressing identified Marine Corps technology gaps. Focus will be on developing component level prototypes and experimentation in relevant environments. ***FY 2021 Plans:*** - Continue to emphasize operating in contested and denied electromagnetic spectrum (EMS) environments. The goal of operating ubiquitously in multifunction electronic warfare domains will be achieved by reducing size to handheld form factor focused heavily on the continued development and integration of multiple underlying technologies into systems and subsystems with the purpose of demonstrating the tactical exploitation of information and the EMS. To address resiliency requirements of Command, Control, Communications, Computers (C4) this effort is closely coordinated with the Intelligence, Surveillance, and Reconnaissance and Expeditionary Cyber research portfolio also described herein so as to most efficiently exploit multifunction capabilities in portable reduced Size, Weight, Power, and Cost systems. This integrated rapid co-design, prototyping, and experimentation approach will reduce time needed to provide new capabilities to the US Marine Corps. The following efforts are in collaboration with the CRIT and MuDRaCE FNC activities in this PE/project and leverage experimental discoveries under the MAGTF C4 project to accelerate development of high priority capabilities. - Initiate the development to demonstrate technologies that include advanced signature management, machine learning, interoperability, spectrum maneuver, damage assessment monitoring, and information dominance for tactical edge systems. - Initiate the development to demonstrate portable distributed multi-domain sensor and surveillance technologies in portable expeditionary warfare form factor to protect forces in denied and contested EM environments. ***FY 2022 Base Plans:*** -Continue to emphasize operating in contested and denied electromagnetic spectrum (EMS) environments. The goal of operating ubiquitously in multifunction electronic warfare domains will be achieved by reducing size to handheld form factor focused heavily on the continued development and integration of multiple underlying technologies into systems and subsystems with the purpose of demonstrating the tactical exploitation of information and the EMS. To address resiliency requirements of Command, Control, Communications,					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Computers (C4) this effort is closely coordinated with the Intelligence, Surveillance, and Reconnaissance and Expeditionary Cyber research portfolio also described herein so as to most efficiently exploit multifunction capabilities in portable reduced Size, Weight, Power, and Cost systems. This integrated rapid co-design, prototyping, and experimentation approach will reduce time needed to provide new capabilities to the US Marine Corps. The following efforts are in collaboration with the CRIT and MuDRaCE FNC activities in this PE/project and leverage experimental discoveries under the MAGTF C4 project to accelerate development of high priority capabilities. -Continue development to demonstrate technologies that include advanced signature management, machine learning, interoperability, spectrum maneuver, damage assessment monitoring, and information dominance for tactical edge systems. -Continue the development to demonstrate portable distributed multi-domain sensor and surveillance technologies in portable expeditionary warfare form factor to protect forces in denied and contested EM environments. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** The funding increase from FY2021 to FY2022 reflects an alignment to Naval priorities and a targeted investment in signature management, multi-domain sensors and robust communications networks necessary to close high priority capability gaps, and meet the demands of the National Defense Strategy "forward force maneuver and posture resilience." Funding associated with C4 directly supports the NDS direction to modernize key capabilities for C4, missile defense, and posture resilience by gaining and exploiting signature management information, providing layered air/missile defense, and supporting transition from large, centralized systems to smaller, dispersed, resilient, adaptive basing that includes distributed, low-power and passive defense. Efforts in these areas directly support Navy and Marine Corps operating concepts Distributed Maritime Operations (DMO), Expeditionary Advanced Base Operations (EABO) and Littoral Operations in a Contested Environment (LOCE). They include upgrades to passive sensing capability, remote operation, automated Electro-Magnetic Spectrum (EMS) identification, and holistic exploitation/dissemination of spectrum information.					
Title: Firepower	8.790	7.368	6.831	0.000	6.831
Articles:	-	-	-	-	-

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Description: The activity investigates a large variety of weapons to provide the warfighter with a decisive, yet surgical, tactical advantage to collectively address 21st-century combined-arms warfare against peer and near-peer states. Research efforts increase the reach, lethality, and capacity while retaining mobility and tempo beneficial to expeditionary maneuver warfare. Maintaining focus on Size, Weight, Power, Cost and Distributed, Intermittent and Limited environments stresses the technical solutions available. This activity furthers the maturity of researched technology solutions by also developing the integration required to effectively demonstrate and test emergent capabilities. Achieving a true combined arms state involves a full systems approach for both kinetic and non-kinetic capabilities all driven by a holistic targeting capability. This activity develops technology for application on current and future expeditionary weapons. It includes, but is not limited to, the following technologies: fuze, fire control, targeting, launch/propulsion, lethality, and accuracy. ***FY 2021 Plans:*** - Progress development of automated fire control technologies enabling automated target classification and prioritization for weaponized unmanned ground vehicles - Munition development will continue to focus on low-cost, extended range, precision guided munitions, having improved lethality warheads for use against various types of stationary and moving targets on land and water, and in satellite and network denied environments ***FY 2022 Base Plans:*** Continue development of integrated technologies for low-cost, extended range, precision guided munitions, having improved lethality and special effects payloads for use against various types of stationary and moving targets on land and water, and in satellite and network denied environments. - Complete development of automated fire control technologies enabling automated target classification and prioritization for weaponized unmanned ground vehicles. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** The decrease from FY 2021 to FY 2022 is due to the completion of research associated with development of automated fire control technologies enabling automated target classification and prioritization for weaponized unmanned ground vehicles.					
Title: Force Protection	13.102	12.562	13.196	0.000	13.196
Articles:	-	-	-	-	-

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Description: This activity investigates new ways and means to protect forces and materiel across all operational settings from contested sea-land surface interfaces to complex urban environments. The portfolio protects against adversaries' challenges such as guided-rockets and missiles, mobile coastal artillery, threat Electronic Warfare and Counter Intelligence, and Surveillance and Reconnaissance. Mines and obstacles both in the water and ashore also complicate amphibious landings. The activity invests in vehicle survivability aspects that are exacerbated due to Size, Weight, and Power Cost constraints inherent to Marine Corps operation and the harsh nature of the amphibious environment. Technologies addressed include lightweight armor for ballistic and underbody blast protection, advanced sensors for counter tactical surveillance, active protection, and signature management. This activity also considers technology for payloads, packages and sensors that are needed by amphibious vehicles (both manned and unmanned) including mine counter measures; explosive hazard defeat systems; and obstacle and threat detection systems as well as technologies for improved protection for individuals against blast, ballistic and blunt impact threats. Technologies in this activity enable Marine Corps forces to maintain operational tempo through a range of environments by avoiding or detecting surveillance and targeting capabilities before engagement; counter detection and targeting (e.g. long range sniper, urban shooter, rocket propelled grenades) and delay vehicle detection and identification through signature management/control. ***FY 2021 Plans:*** - Efforts that emphasize the further development of sensors and systems to enable autonomous amphibious assault under mined and obstacle environments will continue. This continues the work on buried object detection, and combines it with other sensor modalities such as magnetometers and electro-optical and integrate on a range of unmanned platforms. These platforms are capable of operating in and from the very shallow water/ surf-zone under contested conditions as well as in-land cluttered environments. - Technologies and systems supporting the neutralization of threat systems via kinetic and non-kinetic/directed energy means will continue. These threats include unmanned aerial vehicles as well as defenses against direct-fire precision weapon systems. - Miniaturized hardware sensing systems will be developed for the detection of threats across a variety of sensing modalities to take advantage of unique susceptibilities of threat systems at significant ranges.					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Develop advanced technologies that enable detection of hazards and surveillance/targeting systems in complex operational environments such as jungles and littorals. Demonstrate use of autonomous vehicles in the detection, neutralization, marking, and reporting of hazards. ***FY 2022 Base Plans:*** - Technologies and systems supporting the neutralization of threat unmanned aerial systems via kinetic means will complete - Efforts that emphasize sensors and systems to enable autonomous amphibious assault under mined and obstacle environments will continue. The efforts will focus on multi-domain operations and extending the range at which these unmanned systems are able to perform and execute the assault mission. - Efforts looking at counters to autonomy and sensors/perception will initiate. - Examine technologies for the utility of High Energy Laser (HEL) in Expeditionary operations, including robust, compact, lightweight lasers, with tracking, and optical components to enable Low Altitude Air Defense (LAAD) with non-kinetic weapon hard kill Develop disposable heterogeneous multi-domain unmanned vehicles (UxVs), capable of rapid manufacture at scale. The UxVs will operate as swarms, utilizing and mimicking the organizational principles found in social insects/birds/fishes to overwhelm the adversaries' kill chain. - Develop low-cost robotic autonomy systems in support of amphibious operations (e.g., ISR, mine-counter-measure, breaching, fire support, and logistics). - Develop and demonstrate human-machine teaming concepts and appropriate military tactics. The end state will demonstrate swarming multi-domain platforms capable of delivering military capabilities over land and sea. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** There is no significant change between FY 2021 and FY 2022					
Title: Human Performance, Training and Education	5.176	5.227	5.495	0.000	5.495
Articles:	-	-	-	-	-
Description: This activity investigates several technology investment areas; warrior resilience, and decision-making and expertise development. Warrior resilience is focused on advanced training technologies and methodologies that enhance neural, cognitive, and physical readiness. Decision making and expertise development accelerates development					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
and improves the retention of skills in decision making, situation awareness, and individual and team adaptability and coordination on decentralized, dynamic and dispersed battlefields. Focus will be on developing component level prototypes for Marine for evaluation and experimentation. ***FY 2021 Plans:*** Demonstrate capability to increase physical readiness and reduce potential injuries by using wearable physiological monitoring devices, predictive algorithms, health tracking capability, and related technologies that support Marine Corps' 'Force Fitness Division' programs. The use of these Warrior Resilience programs may be demonstrated as integral elements of larger, multipurpose exercises focused on all aspects of military tasks, or as stand-alone events where the primary purpose is to illustrate the capability to achieve improved awareness of the physical and physiological readiness of the individual. Continue efforts demonstrating 3D terrain visualization, battlefield control measures and effects, and target identification and classification will continue. This robust and ever increasing capability will increase decision making efficiency - in both speed and accuracy of information processing. Develop assessment tools and experiential training solutions to place, retain, and educate the right Marine for the right military occupation. ***FY 2022 Base Plans:*** Conduct technology development to assess marksmanship lethality via automated capture of shot timing, accuracy, and physical performance. - Conduct technology development focused on human-machine teaming and multi-modal interactions at the small unit level that augment the warfighter and accelerate the Observe, Orient, Decide and Act (OODA) loop to improve decision-making capabilities. - Continue technology demonstrations to increase physical readiness and reduce potential injuries by using wearable physiological monitoring devices, predictive algorithms, health tracking capability, and related technologies that support Marine Corps' Human Performance programs. - Transition 3D terrain visualization, battlefield control measures and effects, and continue technology development with target identification and classification. - Develop assessment tools and experiential training solutions to train and educate Marines for the right military occupation, and expand research to include adaptive training technologies ***FY 2022 OCO Plans:***					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** There is no significant change between FY 2021 and FY 2022					
Title: Intelligence, Surveillance, and Reconnaissance (ISR)	8.204	8.847	9.109	0.000	9.109
Articles:	-	-	-	-	-
Description: This activity investigates enhanced situational awareness, persistent surveillance, and tactical decision making through automated analysis of data and rapid integration of information and acquired knowledge. Specific technologies in this activity effectively present actionable information to decision-makers, especially those at the lower command levels. This includes biometric monitoring for expeditionary operations, operational Course of Action development, and autonomous surveillance in support of distributed operations. Conduct advanced development research on the impact of machine learning on mission outcomes. Will investigate the operational relevance of enhanced situational understanding and machine-aided tactical decision-making. This includes presenting actionable information (e.g. support to planning, mission monitoring, and re-planning to decision makers). Further, this activity supports the demonstration of technologies to enhance situational awareness and tactical decision making through automated analysis, fusion of data, rapid integration of information, and acquired knowledge resulting in actionable intelligence at the lower command levels. The activity includes the demonstration of ISR efforts involving enhanced reconnaissance and persistent surveillance, and sensors for unmanned ground and aerial vehicles. Advanced technology demonstrations also include the collection of information [monitoring, sensing, and locating] in the 3-Dimensional urban battlespace as well as exploiting information [identifying and classifying data] as part of the intelligence preparation of the battlespace in order to facilitate operational maneuver and distributed operations. ***FY 2021 Plans:*** Conduct advanced development research on the operational utility of artificial intelligence/machine learning algorithms and develop applications to specifically apply these techniques to Marine Corps intelligence and operations activities. Increase emphasis on the use of model-based simulators to generate data useful for machine learning while learning how to combine real data with operational data. Conduct experimentation with operational forces to					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
understand the utility and impact of these tools on improving and accelerating understanding and information-based decision-making as well as reductions in operator workload ***FY 2022 Base Plans:*** Develop and demonstrate new artificial intelligence (AI) systems to automate monitoring and alerting. Research will integrate video analytics with edge processing to create high-throughput detection, classification, and tracking across multiple operational domains. - Prototype development using recommendation engines to adapt strategies based on adversary actions. - Continue advanced technology development on the operational utility of artificial intelligence/machine learning algorithms, and develop and demonstrate applications to apply these techniques to Marine Corps operations activities. - Continue development to generate synthetic data useful for machine learning while learning how to combine real data from training or operations. - Conduct demonstrations and experimentation with training and operational forces to understand the utility and impact of decision aids on improving and accelerating understanding and information-based decision-making, as well as reductions in operator workload. FY 2022 OCO Plans: ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** There is no significant change between FY 2021 and FY 2022					
Title: USMC Future Naval Capabilities	26.223	26.666	27.017	0.000	27.017
Articles:	-	-	-	-	-
Description: This R-2 Activity addresses the advanced technology development associated with the Marine Corps' participation in the Department of the Navy's (DoN) Future Naval Capabilities (FNC) Program. The objective of the work in this Program Element (PE) is to develop promising technologies emerging from the FNC technology candidates funded in PE 0602131M that have been matured to higher Technology Readiness Levels (TRLs). Investments in this activity are coordinated with similar and non-duplicative efforts in PE 0603673N. The FNC Program is structured to accelerate the transition of new technologies to the Fleet and Force. Each effort is assessed for its technology maturity and transition commitment. Funding for FNCs, which have Technology Readiness Levels (TRLs) of 4/5 to 6 and also have transition funding commitments from acquisition Programs of Record, are resourced in this PE 0603640M MC Advanced Technology Demo. Funding for FNC technology					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
candidates at lower TRLs (3 to 4) is resourced in PE 0602131M Marine Corps Landing Force Tech. ONR is working closely with the Resource Sponsors and acquisition stakeholders to develop high priority technological capabilities needed by the operational forces. 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 this PE 0603640M MC Advanced Technology Demo. The FNC Program favors a high level of collaboration. Collaboration with the acquisition stakeholders and their resource sponsors is required. 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. ***FY 2021 Plans:*** This activity will continue to focus on developing promising technologies emerging from the FNC Applied Research program that have been matured to a Technology Readiness Level of 4 to 5. Technologies being developed include, but are not limited to: CRIT - In collaboration with Command, Control, Communications, Computers (C4) activity in this PE/project, initiate the accelerated development of capabilities to demonstrate small form factor technologies that provide improved signature management of the Marine Air-Ground Task Force (MAGTF) in electromagnetic and information environments. This effort addresses a high priority Marine Corps capability gap and directly supports the National Defense Strategy by providing an 'advanced autonomous system' for 'forward force maneuver and posture resilience'. Enabling Dynamic Operational RF (ENDOR) - Continue work on ENDOR by initiating development of a more secure tactical computing infrastructure, reducing its attack surface for modern C-UAS and C-IED applications that use standardized interfaces for rapid hardware and software integration. Armored Reconnaissance Vehicle (ARV)					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Complete the integration of technologies into transformational advanced reconnaissance vehicle technology demonstrators and test and evaluate the land and water propulsion system, sensors, weapons, survivability, and unmanned systems in a relevant environment to assess enhanced capabilities. Enhanced Lethality for Maritime Operations (ELMO) - In collaboration with a complementary effort funded in PE 0603673N - FNC Advanced Technology Demonstration, initiate development of new Multi-Function Sensor (MFAS) modes for the MQ-4C Triton Unmanned Aircraft System (UAS), enhancing Distributed Maritime Operations (DMO) with the Next Generation Network (NGN). Streamlined Marine After-Action Review Tool- Visualization (SMART-Viz) - In collaboration with a complementary effort funded in PE 0603673N - FNC Advanced Technology Demonstration, initiate technologies that provide timely and improved feedback to warfighters to enhance learning in live and simulated environments. Multi Domain Radar for the Contested Environment (MuDRaCE) - In collaboration with the C4 activity in this PE/project, initiate the accelerated development of capabilities for a highly mobile multi-domain radar system with improved effectiveness and survivability to support MAGTF units in contested environments. This effort leverages MAGTF C4 networking and sensor development for system of systems capability to ensure key National Defense Strategy requirement for expeditionary 'forward force maneuver and posture resilience' and addresses a high priority Marine Corps capability gap. All Signal Tactical Real-Time Analyzer (ASTRAL) - Initiate the development of sensors able to detect, identify, and characterize complex signals in contested and congested electromagnetic environments. This program will explore novel topologies that help to address these applications using photonics. Particular emphasis will be given to the use of integrated photonics as a path to reduce overall system cost, size, weight and power (C-SWAP). ***FY 2022 Base Plans:*** Cognitive Radio Frequency Inference Technology (CRIT): - In collaboration with Command, Control, Communications, Computers (C4) activity in this PE/project, continue the accelerated development of capabilities to demonstrate small form factor technologies that provide improved signature management of the Marine Air-Ground Task Force (MAGTF) in electromagnetic and information					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
environments. This effort addresses a high priority Marine Corps capability gap and directly supports the National Defense Strategy by providing an 'advanced autonomous system' for 'forward force maneuver and posture resilience. Enabling Dynamic Operational RF (ENDOR): - Complete work on ENDOR by finishing fundamental development on its secure tactical computing infrastructure through incorporating the next generation of software cyber practices including a secure Linux operating system, containerization and application orchestration, leading to planned major demonstrations. Streamlined Marine After-Action Review Tool- Visualization (SMART-Viz): - Continue development of rapid, automation-assisted Streamlined Marine After-Action Review (AAR) Tools for Visualization that provide the right information, at the right time, at the right place, to the right echelon of command to improve training and lethality. Multi Domain Radar for the Contested Environment (MuDRaCE): - In collaboration with the Command, Control, Communications, Computers (C4) activity in this PE/project, continue the accelerated development of capabilities for a highly mobile multi-domain integrated radar system with improved effectiveness and survivability to support Marine Air-Ground Task Force (MAGTF) units in contested environments. This effort leverages MAGTF C4 networking and sensor development for system of systems capability to ensure key National Defense Strategy requirement for expeditionary 'forward force maneuver and posture resilience' and addresses a high priority Marine Corps capability gap. All Signal Tactical Real-Time Analyzer (ASTRAL) - Continue the development of a sensor receiver module able to detect, identify, and characterize complex signals in contested and congested electromagnetic environments. This program will develop novel topologies that help to address these applications using photonics. Particular emphasis will be given to the use of integrated photonics as a path to reduce overall system cost, size, weight and power (C-SWAP). Maintenance Tools for Operations and Training (MTOT)					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Develop software applications (e.g. augmented reality) to improve training availability and accessibility, as well as analytics to support student assessment to address training gaps within the Marine Corps Deliberate Universal Needs Statement (D-UNS) on Enterprise Level Maintenance Simulation Training Solution. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** There is no significant change from FY 2021 to FY 2022.					
Title: Logistics	7.654	8.956	10.123	0.000	10.123
Articles:	-	-	-	-	-
Description: This activity investigates the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. This includes efficient and responsive force sustainment, planning and directing logistics operations, logistics demand reduction, fleet maintenance, and expeditionary energy. Expeditionary Energy enhances combat capability of expeditionary warfighters by increasing the efficiency and effectiveness of energy production, storage, distribution and use. Beyond traditional energy efforts, this portfolio also looks at other issues, including energy-efficient behaviors and hybridization of energy sources. These pillars are thoroughly integrated and perpetually related in execution. ***FY 2021 Plans:*** Advance the broad range of technologies to demonstrate the military utility of enhancing combat capability by increasing energy production, storage, distribution, and curbing energy consumption of the individual Marine and other tactical assets. Conduct advanced system research into the scaled use of high specific power solar cell for Marine Corps applications ranging from the individual warfighter to augmenting the power and combat endurance unmanned robotic vehicles. Progress efforts to investigate energy-efficient planning for unmanned aircraft, enabling modular and reconfigurable tactical microgrids and wave energy technologies. ***FY 2022 Base Plans:*** - Advance the broad range of technologies to demonstrate the military utility of enhancing combat capability by increasing energy production, storage, distribution, and curbing energy consumption of the individual Marine and other tactical assets.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Conduct advanced system research into the scaled use of high specific power solar cell for Marine Corps applications ranging from the individual warfighter to augmenting the power and combat endurance unmanned robotic vehicles. - Progress efforts to investigate energy-efficient planning for unmanned aircraft, enabling modular and reconfigurable tactical microgrids and wave energy technologies. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** There is no significant change between FY 2021 and FY 2022					
Title: Maneuver	14.188	11.858	15.445	0.000	15.445
Articles:	-	-	-	-	-
Description: This activity investigates new ways and means to land forces and material through contested sea-land surface interfaces and then conduct maneuver warfare. In order to enable future Amphibious Operations, research efforts will support autonomous operations across the sea-surf-ground environment, improved fuel efficiency and speed of amphibious vehicles, amphibious vehicle technologies, water performance, and amphibious payloads to change the dynamics of a surface amphibious assault. This includes the emergence manned-unmanned teaming and autonomous vehicle collaboration. The technologies included in this work address areas of mobility, materials, propulsion, signature reduction, modularity, and unmanned systems. This also encompasses navigating the surf zone by a small autonomous vehicle, navigating negative obstacles on land at speed, overcoming adversarial intent, and developing low-cost robotic autonomy kits to support expeditionary amphibious operations (e.g., ISR, mine-counter-measures, breaching, fire support, and logistics). ***FY 2021 Plans:*** Progress the development and evaluation of mobility technologies and future concepts for the ground and amphibious fleet to improve maneuverability across a range of challenging terrain environments. Demonstration platforms will continue to be used for further development of technologies to enable enhanced land operations and seamless transition between land and water environments. Expand efforts on the automation and autonomy systems to include development of low-cost, unmanned swarming amphibious assault capable platforms with a focus on performance in the surf zone and beach environments. Conduct experimentation in increasingly					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
challenging environments to evaluate system performance. Transition enabling technologies for the Armored Reconnaissance Vehicle from this activity to the Future Naval Capabilities activity ***FY 2022 Base Plans:*** Continue the development and evaluation of mobility technologies and future concepts for the ground and amphibious fleet to improve maneuverability across a range of challenging terrain environments. Demonstration platforms will continue to be used for further development of technologies to enable enhanced land operations and seamless transition between land and water environments. - Expand efforts on the automation and autonomy systems to include development of low- cost, unmanned swarming amphibious assault capable platforms with a focus on performance in the surf zone and beach environments. Conduct experimentation in increasingly challenging environments to evaluate system performance. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Increase in FY22 is related to additional efforts to develop and demonstrate autonomous and automated systems that will increase combat zone effectiveness while reducing risk to the individual Marine.					
Accomplishments/Planned Programs Subtotals	93.104	104.642	115.332	0.000	115.332

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
2297: *Futures Directorate*	0.000	93.128	92.319	104.071	-	104.071	-	-	-	-	-	-
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The mission of the Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) is to identify future challenges and opportunities, develop warfighting concepts, and comprehensively explore options in order to inform the combat development process to meet the challenges of the future operating environment. The Deputy Commandant, Combat Development and Integration (DC, CD&I) is the United States Marine Corps (USMC) advocate for Science and Technology (S&T). MCWL's Commanding General (CG) is the proponent of USMC S&T and serves as the USMC Executive Agent for Marine Corps S&T. The MCWL/FD also serves as the Marine Corps' liaison to the Joint Staff for Joint Concept Development and Experimentation; thereby facilitating service-specific experiments as well as participation in joint service experimentation.

As reflected in strategic guidance, expeditionary forces will provide an ever-ready quick strike force to protect United States (US) interests. MCWL/FD pursues concepts, capabilities, and solutions to ensure that Marines of the future force will be effectively organized, trained, and equipped to win across the range of military operations in an uncertain and complex environment. Prioritized investments in S&T are necessary to enable the future Marine Corps and maintain a technological advantage over our adversaries.

This project is organized into 6 activities, the core of which are represented by the Warfighting Capability Areas of the Marine Air-Ground Task Force (MAGTF). The project emphasizes development and demonstration of advanced technology capability concepts, and the examination of their operational application and military utility in the context of formal wargames, Modeling, Simulation, and Analysis (MS&A), and live-force field experimentation with Marines. This operational experimentation directly supports Marine Corps combat development to inform future capability requirements and optimize the acquisition process.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Combat Service Support (CSS) and Force Protection	8.814	16.501	34.559	0.000	34.559
Articles:	-	-	-	-	-
Description: This activity includes Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) Combat Service Support and Force Protection experimentation efforts, to include overarching experimentation planning/execution, management, technical, and engineering support, assessment of equipment, new Tactics, Techniques, and Procedures (TTPs), training opportunities, and proposed organizational changes associated with enhanced capabilities. This activity develops technology in support of a more distributed technologically advanced force, increasing range, effectiveness, and survivability of the Marine Corps Air-Ground Task Force (MAGTF). Most programs listed below are considered major (valued at $500K or more) or have near real-time					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
operational impact. Investments in this activity are conducted under the Thrust Areas of Expeditionary Logistics, Expeditionary Medicine, Force Protection, or Autonomy and Robotics. ***FY 2021 Plans:*** - Unmanned Logistics and Defense - Continued prototype development and experimentation of logistics enablers and air defense enhancements in support of a more distributed technologically advanced force, in support of Expeditionary Advanced Base Operations (EABO). This effort develops platforms that assess and analyze execution of high-tempo unmanned support to dispersed and disaggregated forces during joint air-ground operations. Continued development and experimentation with autonomous sea-based surface connectors for over-the-horizon missions during ship-to-shore maneuvers. This effort addresses maneuvering from seabases and littorals and includes autonomous beaching, well deck operations, payload integration, and bulk transport of personnel and equipment. - Sustainment - Sustained multiple technologies and supported integration efforts within the Marine Air-Ground Task Force (MAGTF), experimenting with alternate vehicle power, extended mobility, hybrid energy, expeditionary fuel distribution, and small unit water purification to enable logistics demand reduction and provide alternate sustainment to the MAGTF at all levels. This included continuing experimentation with efficient and redundant hybrid energy platforms providing reliable electrical power using multiple fuel input sources. - Counter UAS - Continued development of counter unmanned aerial systems (UAS) architectures, integration of sensors for detection, tracking, and defeat of unmanned aerial threats. Evaluated a host of technologies for frangible rounds and added equipment attachments to counter small UAS rounds. - Explosive Detection/Defeat - Continued to develop an autonomous explosive detection and defeat capability; integrating specialized sensors for enhanced neutralization. - Medical - Completed development of power management and energy scavenging capability to enable a more effective casualty warming and blood storage/distribution. Continued to experiment with systems to provide battlefield medical command and control and information management. Initiated the design and integration of an Automated Artificial Intelligence Medical Information System (AAIMIS), facilitating a medical logistics push from the Capabilities Based Medical Treatment Facility (CBMTF) by providing the situational awareness via Medical Common Operating Picture (MedCOP) for medical supply utilization at forward deployed medical units.					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Warfighter Performance - Provided increased lethality and mobility to the warfighter through the integration of technology directly attributable to individual combat equipment. Emphasis placed on voice reaction / voice enhanced technologies, as well as multi-mode unmanned systems command and control with augmented reality technologies. Littoral Connectors - Pursued development and enhancement of capabilities for end-to-end distribution, storage, and supply of fuel to air, ground, and sea platforms.					
FY 2022 Base Plans: - Unmanned Logistics and Defense - Continue development and experimentation with highly autonomous and synchronous logistics capabilities in support of expeditionary MAGTF operations. Assess execution of high tempo unmanned sustainment to dispersed and disaggregated forces during joint combined air-ground operations in contested environments including transiting over water from surface vessels to shore and other surface vessels. Continue to utilize autonomous connectors to conduct littoral staging and autonomous resupply. Objectives include providing a hardened autonomous landing craft, utility (LCU) system that can be deployed with Marine Expeditionary Units as part of extended user evaluations (EUEs) to inform requirements for autonomous and unmanned crafts in the littorals. - Sustainment - Continue to sustain and investigate multiple technologies integrated within the MAGTF to experiment with alternate vehicle power, extended mobility, hybrid energy, expeditionary fuel distribution, and small unit water purification to enable logistics demand reduction and provide alternate sustainment to the MAGTF at all levels. Continue experimentation with hybrid power systems, providing the MAGTF with a tactical, highly mobile, transportable, and versatile power generating and power scavenging platform. Design, develop, manufacture, and test an amphibious towable fuel container (unit / system); improving the MAGTFs capability to rapidly transport and distribute fuel to support units maneuvering and conducting operations in a contested environment. Conduct a Limited Technical Assessment (LTA) on the ability to organically construct expeditionary air fields, roadways, and hardened structures. Investigate and leverage existing water purification technologies to enable purification, storage, and distribution to sustain disaggregated units. - Counter UAS - In response to the emergent small UAS (Group I & II) threats, continue to develop an enhanced capability to locate, identify, access, and neutralize small UAS threats. Tasks include exploring/developing autonomous and semi-autonomous counter UAS solutions; developing and demonstrating the capability to execute an end-to-end kill chain in multiple environments; neutralizing targets in an effective, cost efficient					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
manner; and demonstrating the ability to employ counter UAS assets from the seabase to support Marine forces in austere locations. Develop automatic target recognition algorithm for radar optics as well as a library of 3-dimensional imagery to enhance current technology, reduce false positives, and shorten the systematic kill-chain for targeting. - Explosive Detection/Defeat - Continue to develop an autonomous explosive detection and defeat capability; integrating specialized sensors for enhanced neutralization. Efforts include merging the technologies of detection defeat and autonomy in order to address multiple threats resulting in a robust system that will be markedly more capable over the current single modality systems. The objective is to develop a system capable of detecting 95% of commonly faced explosive hazards and/or defeating them with no more than a 20% false alarm rate in a time period adequate to support Marine Corps ground maneuver elements. - Medical - Continue to experiment with systems to support a smaller, modular, multifunctional medical concept that can support medical care ashore and Marine Littoral Regiments (MLR) by performing studies, integration with unmanned systems, demonstrations, and experimentation. Integrate automated casualty care to provide therapeutic care during movement. Integrate, test, and demonstrate wearable bio-sensors and their applicability to a multifunctional medical team supporting the MLR. - Warfighter Performance - Continue to provide increased lethality and mobility to the warfighter through the integration of technology directly attributable to individual combat equipment. Develop, test, and assess a Radio Agile Integrated Device (RAID) Plate, removing the functional components from multiple handheld radios and consolidating them on the warfighter's back in order to provide a fully integrated communication and power solution designed to interface with the dismounted Marine's end user device. - Littoral Connectors - Expand development and enhancement of capabilities for diversified distribution, providing risk worthy, inexpensive platforms for maneuver and sustainment distribution. Utilize current commercial technology to enhance maneuver to and from seabases and expeditionary advanced bases in the littorals with the ability to deliver directly to the users at shore. Objective is to provide direct logistical support to forces ashore, inform program of record (POR) (Light Amphibious Warship) and acquisition strategy, increase performance ability, survivability, and resiliency of current surface connectors (range, endurance, payload, utility), and mitigate distribution gaps by delivering from the seabase directly to the beach.					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Robotic Modernization - Initiate effort to provide ground combat element robotic asset maintenance, repair, and upgrades; ultimately ensuring systems viability for experimentation. Efforts include evaluating and integrating both POR and non-POR payloads, leveraging developed, commercially available technologies, and performing tests, demonstrations, and assessments prior to dedicated live-force experimentation. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** The funding increase from FY 2021 to FY 2022 is directly attributable to the following areas: - Littoral Connectors - Initiate a multi-year experimentation effort centered on enhanced distribution and littoral mobility in distributed maritime operations. Specifically, this effort focuses on maritime surface vessels, providing improved maneuver and distribution between various naval platforms and ashore expeditionary advanced bases in the littorals. Surface platforms will have the ability to deliver personnel, equipment, and supplies across the shore by means of a full-width stern ramp. Experimentation objectives will support the assessment and evaluation of stern-landing technology for mobility and beach access, continued refinement of ship-to-shore, shore-to-shore, and ship-to-ship concepts of employment, and integration and assessment of complementing technology solutions on a 'risk-worthy' amphibious platform. In close cooperation with the Navy, these experimentation activities will best inform requirements and concepts of employment for future amphibious platforms. - MCWL/FD Technical, Engineering, and Experimentation Support - This is a mere re-alignment of resources, as costs transferred from the MCWL/FD Operations (Support) R2 Activity (now titled MCWL/FD Technical, Engineering, and Management Support) did not experience any growth or decline from FY 2021 to FY 2022. Prior to FY 2022, overarching program management support costs, to include planning, technical, and engineering support, were grouped and discussed within the MCWL/FD Operations (Support) category. Beginning in FY 2022, in an effort to better represent cost distributions, program area costs related to CSS and Force Protection are now reflected within this R2 Activity.					
Title: Marine Air-Ground Task Force (MAGTF) Command, Control, Communications, and Computers (C4)	10.177	6.900	9.799	0.000	9.799
Articles:	-	-	-	-	-
Description: This activity encompasses all Marine Corps Warfighting Laboratory/Futures Directorate (MCWL/FD) Command, Control, Communications, and Computers (C4) experimentation efforts, to include overarching					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
experimentation planning/execution, management, technical, and engineering support, assessment of equipment, new Tactics, Techniques, and Procedures (TTPs), training programs, and proposed organizational changes associated with enhanced C4 capabilities. The area provides cutting edge/enhanced Over-The-Horizon (OTH), Beyond Line of Sight (BLOS), satellite and non-satellite based C4 capabilities to support experimentation. Programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. Investments in this activity are conducted under the Thrust Areas of Command, Control, Communications, and Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) and Cyber/Electronic Warfare (Cyber/EW). ***FY 2021 Plans:*** - Asymmetric Command and Control (C2) - Continued research to identify and assess a collaborative solution, providing tailorable OTH, On-the-Move (OTM), and BLOS communications, situational awareness, and fires for units across a wide spectrum of air, ground, and sea operations. Efforts included upgrading radios with service specific cryptology. - Integrated C2 - Continued experimentation with an organic and persistent capability to wirelessly receive, process, and disseminate digital information from organic sensors (to dismounted users), with relevant and/or immediately actionable information. Efforts included maintenance of experimentation assets as well as development to enable receipt of ground entry point information from an aerial fused integrated network asset. In addition, continued to pursue automatic target recognition, identification, and prosecution. - Electronic Warfare / Information Environment Operations - Continued experimentation with a cyber mission execution framework enabling military commanders, planners, and operators to collaborate, understand, plan, and manage cyber operations in real-time against large-scale and dynamic network environments. Pursuits included evaluating cyber anomaly detection hardware devices that possess artificial intelligence (AI), identifying abnormal behaviors and notifying the user of deviations. Continued experimentation of cyber and communication infrastructure common operational picture TTPs, increasing situational awareness and battlefield effects. Investigated defensive, offensive, and cyberspace warfare protection and monitoring capabilities through all echelons of the Marine Expeditionary Forces (MEF). - Information Operations - Completed experimentation with worldwide social media mapping.					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Air Command - Developed, integrated, and experimented with a Tactical Air Control Element (TACE); improving mobility and digital interoperability internal to the Marine Air C2 System. Efforts were to provide an ability to control and de-conflict airspace.					
FY 2022 Base Plans: - Asymmetric C2 - Continue to improve the stability, reliability, security, and performance of the current Iridium-based, push-to-talk (PTT), and position location information (PLI) system architecture for use in experiments with live-force units across a wide spectrum of ground, air, and surface operations. Continue to expand the use of mini-crypto on a Trellis Ware network and apply the mini-crypto capability to end user devices using the established experimental network / service via the Iridium 9523 modem. - Integrated C2 - Continue experimentation with an MV-22 (aircraft) internally transportable communications platform that receives, processes, and disseminates digital information from organic sensors wirelessly to dismounted users. Tasks include advanced waveform development and integration, advanced track and video processing development, and satellite OTM efforts. Initiate development of a persistent satellite communications (SATCOM) point-of-presence to enable Expeditionary Advanced Base (EAB), Distributed Maritime Operations (DMO), and Joint All-Domain C2 (JADC2) experimentation. - Electronic Warfare / Information Environment Operations - Continue pursing electronic warfare efforts; to include providing tactical and deployable capabilities to locate, degrade, and/or deny adversaries use of the electromagnetic spectrum (EMS) encompassing elements of Electronic Warfare Support, Electronic Protection, and Electronic Attack measures. Initiatives include: Sensors and Jammers, C2, signal classification, and signal simulation. Initiate the development of a contested environment simulation tool. Initiate efforts to test and assess Tactical Spectrum Warfare Analysis Tools (TSWAT). Continue cyberspace warfare efforts, focusing on integrated cyber-hardening capabilities, external hacking / counterfeit electronics detection, and initiate development, testing, and assessment of combat systems for cyberspace monitoring. - Air Command - Complete development, assessment, and experimentation with tactical and itinerant air C2; specifically supporting a dispersed and disaggregated joint force.					
FY 2022 OCO Plans: N/A					
FY 2021 to FY 2022 Increase/Decrease Statement:					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
The funding increase from FY 2021 to FY 2022 is directly attributable to a re-categorization of MCWL/FD Technical, Engineering, and Experimentation Support costs. This is a mere re-alignment of resources, as costs transferred from the MCWL/FD Operations (Support) R2 Activity (now titled MCWL/FD Technical, Engineering, and Management Support) did not experience any growth or decline from FY 2021 to FY 2022. Prior to FY 2022, overarching program management support costs, to include planning, technical, and engineering support, were grouped and discussed within the MCWL/FD Operations (Support) category. Beginning in FY 2022, in an effort to better represent cost distributions, program area costs related to MAGTF C4 are now reflected within this R2 Activity.					
Title: Fires, Targeting, and Maneuver	9.108	4.824	6.499	0.000	6.499
Articles:	-	-	-	-	-
Description: This activity includes Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) experimentation efforts in the areas of fires, targeting, and maneuver, to include overarching experimentation planning/execution, management, technical, and engineering support, assessment of equipment, new Tactics, Techniques, and Procedures (TTPs), training programs, and proposed organizational changes associated with enhanced capabilities. This area increases fires, targeting, and maneuver related troop environmental awareness, lethality, and mobility using fused sensors as well as unmanned weaponized and reconnaissance air and ground vehicle platforms to support experimentation. Most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. Investments in this activity are conducted under the Thrust Areas of Marine Air-Ground Task Force (MAGTF) Fires, Maneuver, and Autonomy and Robotics.					
FY 2021 Plans: - Unmanned Ground Vehicle (UGV) - Continued to provide a multi-purposed UGV, with modular payload architecture, with specific focus on counter battery. Continued to integrate payloads for the UGV platform that enhance dismounted units across the warfighting functions.					
- Aerial Munitions - Continued to pursue company level precision guided munitions to increase responsiveness, survivability, and lethality to the ground combat element. Continued experimentation with loitering munitions launched from a variety of platforms (air, ground, and sea) to develop distributed, cognitive, collaborative, and cooperative swarming behaviors for maximum effect and complexity on target. Continued experimentation of long range low-cost unmanned aerial vehicle (UAV) swarming technology. Objectives included integration of					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
command and control, multi-tubed launchers, and autonomous ground platforms to test capability of remotely launching unmanned aerial systems (UASs) from distributed positions. - Multi-Domain Fires - Continued the examination and testing of precision guided munitions, to include the development of an integrated communications architecture. Effort informed anti-ship missile concept development. Initiated experimentation of an end-to-end kill chain in multiple environments, neutralizing targets in an effective and cost efficient manner. - Marksmanship - Completed assessment of potential solutions to identified marksmanship capability gaps. - Naval Surface Missile - Completed assessment of Naval Surface Missile simulators for experimentation of weapons system and integration with naval system queuing. ***FY 2022 Base Plans:*** - Unmanned Ground Vehicle (UGV) - Continue to provide a multi-purposed UGV, with modular payload architecture, with specific focus on vehicle sustainment as well as command and control structure. Continue to integrate program of record (POR) and non-POR payloads for the UGV platform that enhance dismounted units across the warfighting functions. Perform tests, demonstrations, and assessments prior to dedicated live-force experimentation. Focus areas include hostile threat detection, route clearance, common launcher integration, and automated target detection. Objective is to integrate a series of kinetic and non-kinetic payload options onto UGVs in order to enhance maneuverability, survivability, and lethality across warfighting communities. - Aerial Munitions - Continue to pursue company level precision guided munitions to increase responsiveness, survivability, and lethality to the ground combat element. Continue experimentation with fully autonomous, remotely operated UAS that serves as a dual electro-optical (day) and infra-red (IR) (night), precision-guided, loitering munition designed to seek, locate, and engage selected targets. - Multi-Domain Fires - Continue the examination and testing of precision guided munitions. Efforts promote artillery force protection. Initiate investigations into low cost hypersonic technologies as well as multi-Domain Over the Horizon (OTH) Targeting. ***FY 2022 OCO Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
N/A					
FY 2021 to FY 2022 Increase/Decrease Statement: The funding increase from FY 2021 to FY 2022 is directly attributable to a re-categorization of MCWL/FD Technical, Engineering, and Experimentation Support costs. This is a mere re-alignment of resources, as costs transferred from the MCWL/FD Operations (Support) R2 Activity (now titled MCWL/FD Technical, Engineering, and Management Support) did not experience any growth or decline from FY 2021 to FY 2022. Prior to FY 2022, overarching program management support costs, to include planning, technical, and engineering support, were grouped and discussed within the MCWL/FD Operations (Support) category. Beginning in FY 2022, in an effort to better represent cost distributions, program area costs related to Fires, Targeting, and Maneuver are now reflected within this R2 Activity.					
Title: Marine Air-Ground Task Force (MAGTF) Intelligence, Surveillance, and Reconnaissance (ISR)	35.181	22.875	24.474	0.000	24.474
Articles:	-	-	-	-	-
Description: This activity includes Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) Intelligence, Surveillance and Reconnaissance (ISR) related experimentation efforts, to include overarching experimentation planning/execution, management, technical, and engineering support, assessment of equipment, new Tactics, Techniques, and Procedures (TTPs), training programs, and proposed organizational changes associated with enhanced ISR capabilities. Using a variety of fused sensors to mesh data, video, and images and incorporating a common tactical controller to operate multiple air and ground ISR platforms, this area enhances small unit situational awareness as well as exploitation and forward engagement ability via experimentation. Programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. Investments in this activity are conducted under the Thrust Areas of Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) and Autonomy and Robotics.					
FY 2021 Plans: - Small Unmanned Aerial Systems (UASs) - Continued to expand experimentation and development of government-owned UAS architectures to allow for rapid design iterations. Continued experimentation with an autonomous reconnaissance system, improving threat situational awareness and reducing tactical surprise to assault forces on long range missions. Objectives included rapid design, build, test, and experimentation of technologies to increase ground maneuver force capabilities.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Robotic Autonomous Command and Control (C2) - Continued to investigate/experiment with enabling technologies; combining sensor and telemetry data from multiple unmanned platforms (ground, surface (water), and air). Efforts included conducting multi-manned and unmanned system missions focusing on intuitive control and robust localization. - Universal Controller - Completed development of a common controller for ISR as well as target identification and prosecution. Program aspects successfully transitioned into programs of record. - Mapping - Continued investigations into providing a small, lightweight, semi-autonomous system that can self-navigate structure interiors and subterranean environments while simultaneously creating real-time three-dimensional (3D) maps. - Fused Integrated Networking - Continued experimentation and development to receive, transmit, and fuse joint asset specialized sensor information to communication nodes afloat and ashore via an aerial gateway. Efforts include sharing of aerial obtained fused sensor data information and/or organically produced sensor information with other air, ground, space, surface, and sub-surface platforms. - Air-Launched Reconnaissance - Continued to provide a multi-role, long reach, expeditionary, next generation network of ISR capabilities. Efforts included providing a deployable UAS capable of dashing ahead of MV-22 aircraft to conduct final reconnaissance of the landing zone to update threat situation in route to the objective. - Information Operations - Developed and enhanced capabilities to increase situational awareness and influence decision making. Specifically, efforts supported the operational utility of artificial intelligence/machine learning. - Space - Initiated development of disruptive space-based capabilities to Marine Air-Ground Task Force (MAGTF) planners at the tactical edge, increasing cognitive awareness to the adversary space threat, and developing unique space-based tools for wargaming and concept development.					
FY 2022 Base Plans: - UASs - Continue to explore, expand mission sets, and exploit the tactical potential of small UASs across multiple Marine Corps domains, focusing on autonomy, innovative applications, and the most advanced small UAS technology. Objectives include increasing ground maneuver force capability with small UASs by integrating critical payloads for immediate use and incorporating new platforms, sensors, and command and control					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
into USMC UAS operations. Seek to develop Group I long endurance (24+ hour) small UAS. Investigate and assess vertical take-off and lift (VTOL) Group II UAS capabilities. Efforts support providing a small tactical UAS, compatible with the Naval Surface Fleet to align with long-term USMC UAS ship-board requirements. Objectives include integrating, testing, and demonstrating a heavy fuel engine to expand DoN organic ship-board operations; modifying to address other threshold requirements such as Type 1 encryption, electromagnetic interference (EMI) shielding, and global positioning system (GPS) hardening. In addition, explore Group II fixed wing and VTOL payload development as well as investigate the militarized use of Group I/II Law Enforcement Drones to develop TTPs to augment law enforcement capabilities. Initiate efforts using larger UASs to develop shipboard operations using an Electric VTOL (EVTOL), evaluating new power and propulsion technology as well as leveraging the rapidly advancing Urban Air Mobility (UAM) commercial segment. Effort will inform an Analysis of Alternatives (AoA) for an inexpensive next generation helicopter, capable of performing and surviving within an Expeditionary Advanced Base (EAB) construct, reducing maintenance requirements, and dependence on fossil fuels. - Robotic Autonomous C2 - Continue to investigate and experiment with enabling technologies; combining sensor and telemetry data from multiple unmanned platforms (ground, surface (water), and air). Incorporate large, medium, and small autonomous as well as C2 (radio and tablet) platforms to integrate, test, and demonstrate fully integrated manned-unmanned teaming concepts with collaborative control between Marines and robotic autonomous assets. - Mapping - Complete investigations into providing a small, lightweight, semi-autonomous system that can self-navigate structure interiors and subterranean environments while simultaneously creating real-time three-dimensional (3D) maps. - Fused Integrated Networking - Continue development and experimentation using an aerial communications gateway platform. Objectives include networking mobile distributed multi-domain sensors, fires, and C2 platforms; supporting high throughput at operationally relevant ranges; leveraging low probability of intercept/ low probability of detection/anti-jam (LPI/LPD/AJ) attributes; reconfiguration to optimize throughput and reduce latency in a given threat environment; and optimized pass fires/C2 information in the form of pre/post-processed information between sensors, shooters, and/or C2 agencies in order to enable a "kill web". - Air-Launched Reconnaissance - Complete efforts to provide a multi-role, long reach, expeditionary, next generation network of ISR capabilities. Program objective is to demonstrate an unmanned attritable aerial asset					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
arriving at least 5 minutes ahead of a manned assault aircraft, providing threat updates on objective for go/no go landing decision. - Information Operations - Continue to develop and enhance capabilities to increase situational awareness and influence decision making. Integrate capabilities in the information operation environment, to include monitoring, engaging, and producing effects. Conduct limited technical assessments and exercises to evaluate emergent technologies and develop TTPs. Investigate technologies and experimentation opportunities to support the operational utility of artificial intelligence/machine learning algorithms, developing Marine Corps intelligence and logistics applications. Effort will seek to develop tools to improve and accelerate information-based decision-making as well as reductions in operator workload. - Space - Continue to develop capabilities to conduct electronic warfare against UASs in support of MAGTF operations. Provide LPI/LPD C2 link for autonomous surface vessels and demonstrate a communication pathway in a C2 degraded environment. Initiate experimentation efforts to reduce overall cost of distributed, space-based observations. Objective will seek to deploy micro satellites made from semi-conductor fabrication technology. Investigate theory that satellites can be made inexpensively and powerful by leveraging existing high volume design/manufacturing/test infrastructures. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** The funding increase from FY 2021 to FY 2022 is directly attributable to a re-categorization of MCWL/FD Technical, Engineering, and Experimentation Support costs. This is a mere re-alignment of resources, as costs transferred from the MCWL/FD Operations (Support) R2 Activity (now titled MCWL/FD Technical, Engineering, and Management Support) did not experience any growth or decline from FY 2021 to FY 2022. Prior to FY 2022, overarching program management support costs, to include planning, technical, and engineering support, were grouped and discussed within the MCWL/FD Operations (Support) category. Beginning in FY 2022, in an effort to better represent cost distributions, program area costs related to ISR are now reflected within this R2 Activity.					
Title: Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) Technical, Engineering, and Management Support	15.154	19.602	5.795	0.000	5.795
Articles:	-	-	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Description: Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) Technical, Engineering, and Management Support efforts include lab-wide, non-program specific experimentation doctrine, planning, management, and technical/engineering support, as well as technology transition tracking efforts. Tasks listed below are considered major (valued at $500K or more) or have near real-time operational impact. ***FY 2021 Plans:*** - Experimentation Analysis - Building upon lessons learned in previous experimentation, continued to design, collect data, and provide independent analytical evaluations of experiments. Analysts took active roles in supporting experimentation concept refinement, capability development, and identification of tactics, techniques and procedures; organizational changes; technologies; and training that the experiments are designed to test. - Commercial Forecasting - Explored new mechanisms to identify long-range commercially available technologies/innovations that may influence future Marine Corps investments. - Management Support - Continued to provide program level engineering, technical, and managerial support. Efforts included detailed program planning and tracking and encompassed technology development and experimentation insertion; troop development and concepts of operation; and portfolio development and execution. - War Room - Continued to investigate Artificial Intelligence (AI) capabilities to streamline data collection and program presentation, facilitating informed rapid decision-making. Promoted transparent communication, problem-solving, risk mitigation, and status reporting by visually communicating project activities, milestones, and transition opportunities. - Collaboration - Provided a laboratory facility to co-locate experimentation designers/implementers with project teams and technologists to enhance effectiveness of experimentation design, development, implementation, reporting, prototyping, and outreach of results. ***FY 2022 Base Plans:*** - Experimentation Analysis - Efforts now discussed within the Warfighting Excellence area, Modeling, Simulation, and Analysis paragraph.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Commercial Forecasting - Continue to explore new mechanisms to identify long-range commercially available technologies and innovations that may influence future Marine Corps investments. Program goals are to identify commercial innovations which will impact future Marine Corps capabilities and leverage commercial dual use investments to preserve military S&T resources. Efforts focus on military focused technologies available in 10 to 20 years. discussed within applicable sections of the exhibit. - War Room - Continue to build a comprehensive visualization tool for MCWL's portfolio and integrate it with Science and Technology (S&T) efforts across the Department of the Defense's (DoD's) S&T community. Provide strategic portfolio management, simplifying the process of gathering and organizing organizational content into systemized digital - Technical Support - Provide a full range of overarching, lab-wide, engineering, analytical, technical, management, and business services; directly related to live-force experimentation. Efforts support the development of new or existing operational concepts, tactics, techniques, procedures, and technologies to prepare Marines for combat. These are critical components to feed into the combat development process. Related, program specific tasks/funding is now frameworks for the automation of data driven reports, road mapping, and strategic planning. Increase awareness of performance and other project metrics due to high-level data analysis and visualization. - Collaboration - Continue to provide critical infrastructure to support the execution of S&T projects. The environment supports S&T development/execution as well as experimentation planning. Effort seeks to facilitate communication, problem solving, risk mitigation, and status reporting in the execution of S&T projects at all classification levels. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** The funding decrease from FY 2021 to FY 2022 is directly attributable to the following areas: - Management Support - This is a re-alignment of resources, as costs transferred from this R2 Activity (formerly titled MCWL/FD Operations (Support)) did not experience any growth or decline from FY 2021 to FY 2022. Prior to FY 2022, non-program specific management support costs, to include experimentation planning, technical, and engineering support, were grouped and discussed within this category. Beginning in FY 2022, in an effort					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
to better represent cost distributions, program area costs directly related to Combat Service Support (CSS) and Force Protection; Marine Air-Ground Task Force (MAGTF) Command, Control, Communications, and Computers; Fires, Targeting, and Maneuver (FTM); MAGTF Intelligence, Surveillance, and Reconnaissance (ISR); and Warfighting Excellence are now reflected within those respective R2 Activities. This MCWL/FD Technical, Engineering, and Management Support category continues to represent and augment resources in each of the listed Warfighting Capability areas addressed within this exhibit; however, efforts/funding contained herein now feature only overarching, lab-wide, non-program specific support and are described as Technical Support beginning in FY 2022. - Experimentation Analysis - This too is a mere re-alignment of resources, as costs transferred from this R2 Activity did not experience any growth or decline from FY 2021 to FY 2022. Prior to FY 2022, costs related to the independent, broad range of unique analytical expertise to evaluate experiments in various warfighting areas were included within category. Beginning in FY 2022, in an effort to better represent cost distributions, experimentation analysis costs are now grouped with related Modeling, Simulation, and Analysis efforts, located within the Warfighting Excellence R2 Activity of this exhibit.					
Title: Warfighting Excellence	14.694	21.617	22.945	0.000	22.945
Articles:	-	-	-	-	-
Description: This activity includes Marine Corps Warfighting Laboratory / Futures Directorate (MCWL/FD) efforts in the development and assessment of joint and service warfighting concepts, joint and service missions, analysis of emerging threats and opportunities, and joint capability experimentation. It also includes MCWL/FD service experimentation (to include planning and analysis) in areas that impact multiple warfighting functions. Programs listed below are considered major (valued at $500K or more) or have near- real-time operational impact.					
FY 2021 Plans: - Wargaming - Continued to plan and execute executive agent responsibilities for the Marine Corps Title Ten Wargame, Expeditionary Warrior, as well as other wargames to examine Marine Corps capstone, operating, and functional concepts and explore assigned topics. A minimum of 11 wargames will be conducted (4 large, 5 medium, and 2 small); all examining concept and combat development issues, experimentation, and other assigned topics. Established a stand-alone Wargame Network (develop, test, train, and operate) that provides visualization support (tools, methods, and procedures) as well as modeling and simulation (M&S) capabilities during wargames.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Emerging Threats and Opportunities - Continued to assess and analyze the future security environment; identifying and analyzing emerging threats; developing and appraising promising concepts, opportunities and technologies; and serving as a catalyst to stimulate thought and debate on issues of importance to the Marine Corps. - Joint Concept Technology Demonstrations (JCTDs) - Continued to monitor and contribute to approved efforts that address joint and combatant command warfighting needs through the execution and demonstration of prototypes within two to four years. The program delivered developmental and operational prototypes to affordably operationalize technologies that enable warfighters to explore novel concepts and to facilitate informed transition to formal acquisition programs. Completed high-altitude balloon-borne communications and bulk-fuel logistics efforts. Developed technology to enable barges/vessels to serve as distributed resupply nodes in support of littoral operations. - Exercise Support - Continued multi-year effort to enhance the ability of the Marine Air-Ground Task Force (MAGTF) to conduct operations in the dense urban environment. Developed and refined objectives and capability areas to address challenges in the future operating environment. - Innovation - Conducted warfighter driven challenges to develop prototypes and foster innovation with the Marine Corps. Reaching out to fleet organizations, engaged entities and developed required capabilities for further testing and evaluation. - Modeling, Simulation, and Analysis - Expanded the use of modeling and simulation (M&S) tools and techniques to provide analysis to support capability development activities. Modeled and assessed naval operations with a focus on current pacing threat and theater. Provided analytical support to the Marine Corps Capability Based Assessment and Integration Process (MC CIP) and other complementary efforts. - Experimentation Opposition Force - Continued to demonstrate the abilities of a live adversary force. Force provides a realistic, adaptive, and cohesive adversary as well as civilian environmental characteristics. This concept strongly enhances experimentation and strengthens experiment hypotheses and objectives. - Autonomous First Wave - Initiated a multi-year campaign to assess an ecosystem of technologies to better understand and advance capabilities to ultimately increase the lethality and effectiveness of the warfighter on					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2297 / *Futures Directorate*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
tomorrow's battlefield. Efforts included manned and unmanned teams capable of conducting military operations in complex urban terrains and multi-domain environments. - Joint Assessment Strategies - Initiated investigations to pursue a lethal, resilient, and rapidly adaptive Joint Force capable of defeating and deterring potential adversaries. Experimentation efforts sought to inform future warfighting architectures, address/solve identified challenges, and analyze the hardest military challenges facing the United States (US) and our allies. - Artificial Intelligence (AI) - Initiated operational integration of AI into concept based experimentation. Delivered AI enabled capabilities that addressed key missions, including improvement of situational awareness and decision-making, implementation of predictive maintenance and supply, and streamlining business processes. ***FY 2022 Base Plans:*** - Wargaming - Continue to plan and execute executive agent responsibilities for the Marine Corps Title Ten Wargame, Expeditionary Warrior, as well as other wargames to examine Marine Corps capstone, operating, and functional concepts and explore assigned topics. Efforts include all elements of the Commandant's Planning Guidance and National Defense Strategy. Permit improved wargaming collaboration, quantitative output, and qualitative output by utilizing technical personnel who will provide scenario development, database management, simulation training to players, over the shoulder instruction to players, server management, network management, and accreditation of network and system support. This will enabled an agile wargaming capability, capable of exploring problems, developing insights, expanding assessment and analytical results, and supporting deliberations and excursions. - Emerging Threats and Opportunities - Continue to assess and analyze the future security environment; identify and analyze emerging threats; and develop and appraise promising concepts, opportunities and technologies. Efforts provide broad-based technological and analytical support for USMC combat development and experimentation programs at the component, Service, and Joint levels. Support covers the full spectrum of combat development related missions and tasks, to include assessment of the strategic environment, future threats and adversaries, and associated geographic, environmental, economic, and demographic conditions that may influence the development of future warfighting concepts, experimentation, and capabilities. - JCTD - Continue to monitor and contribute to approved efforts that address joint and combatant command warfighting needs through the execution and demonstration of prototypes within two to four years. Complete					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
technology development to enable barges/vessels to serve as distributed resupply nodes in support of littoral operations. Initiate efforts to provide kitted solutions to increase the survivability of expeditionary and permanent logistical support networks in an Anti-Access/Area Denial (A2/AD) environment. - Exercise Support - Continue multi-year effort to enhance the ability of the MAGTF to conduct operations in the dense urban environment. Focus areas include manned-unmanned teaming functionality. - Innovation - Continue to conduct warfighter driven challenges to develop prototypes and foster innovation with the Marine Corps. Continue to reach out to fleet organizations, engage entities and develop required capabilities for further testing and evaluation. Integrate emergent technologies into experimental venues to access feasibility. - Modeling, Simulation, and Analysis - Continue to use M&S tools and techniques to provide analysis to support capability development activities. Efforts provide sustained and progressive examination of 21st century warfighting concepts, plans, and capabilities. Force development activities include campaign level and mission/ engagement level M&S, systems planning and analysis, model development, table top exercise support, assessment, and product generation for development of Marine Corps and Naval capabilities. Previously reported within the Operations (Support) area (now titled Technical, Engineering, and Management Support), continue to provide unique and comprehensive analytical expertise to facilitate and evaluate experiments in various warfighting areas. Analysts assist in experiment design, data collection during experiments, and performance of reconstruction and analysis of experiments. End products include comprehensive independent experiment analysis reports; detailing results and suggestions to increase effectiveness and efficiency. - Experimentation Opposition Force - Continue to demonstrate the abilities of a live adversary force. Force provides a realistic, adaptive, and cohesive adversary as well as civilian environmental characteristics. - Autonomous First Wave - Complete campaign to assess an ecosystem of technologies to better understand and advance capabilities to ultimately increase the lethality and effectiveness of the warfighter on tomorrow's battlefield. Conduct limited objective assessments to portray a multi-disciplinary, cross-functional, and intra-branch approach towards the larger foci of Maritime Collaborative Campaign (MC2) and the Sea Dragon Campaign, albeit assessing technologies at different phases of ship-to-shore maneuver and combat operations in an urban environment.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Joint Assessment Strategies - Complete participation in joint Defense Advanced Research Projects Agency (DARPA)-led initiative to analyze the hardest military challenges facing the US and our allies. Experimentation efforts seek to inform future warfighting architectures and address / solve identified challenges. - AI - Continue to leverage joint Component investments to investigate concepts, methods, toolkits, software applications, and ideologies to provide/promote AI support/use for MCWL concept based experimentation. Overall investment amounts have decreased due to augmentation and support from joint partners within the DoD. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** The funding increase from FY 2021 to FY 2022 is directly attributable to the following areas: - MCWL/FD Technical, Engineering, and Experimentation Support - This is a mere re-alignment of resources, as costs transferred from the MCWL/FD Operations (Support) R2 Activity (now titled MCWL/FD Technical, Engineering, and Management Support) did not experience any growth or decline from FY 2021 to FY 2022. Prior to FY 2022, overarching program management support costs, to include planning, technical, and engineering support, were grouped and discussed within the MCWL/FD Operations (Support) category. Beginning in FY 2022, in an effort to better represent cost distributions, program area costs related to Warfighting Excellence are now reflected within this R2 Activity. - Experimentation Analysis - This too is a mere re-alignment of resources, as costs transferred from this R2 Activity did not experience any growth or decline from FY 2021 to FY 2022. Experimentation provides an opportunity to insert un-fielded technologies into a controlled operational environment to gain insight on system maturity, effectiveness, and military utility. Prior to FY 2022, costs related to the independent, broad range of unique analytical expertise to evaluate experiments in various warfighting areas were included within the MCWL/FD Operations (Support) category. Beginning in FY 2022, in an effort to better represent cost distributions, experimentation analysis costs are now grouped with related Modeling, Simulation, and Analysis efforts.					
Accomplishments/Planned Programs Subtotals	93.128	92.319	104.071	0.000	104.071

C. Other Program Funding Summary ($ in Millions)

N/A

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C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy			Date: May 2021
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603640M / *MC Advanced Technology Demo*	Project (Number/Name) 2958 / *Cyberspace Activities*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
2958: *Cyberspace Activities*	0.000	4.340	4.779	4.752	-	4.752	-	-	-	-	-	-
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project activity provides freedom of maneuver and influence in the cyber-electronic warfare domain while simultaneously denying the same to the adversary and protecting critical command systems. Technologies are being developed using a multi-disciplinary approach that combines Radio Frequency electronics, digital signal processing, computer engineering, software engineering, machine learning and data science to support Naval Expeditionary warfighters operating with size, weight and power constrained equipment in Disrupted, Intermittent, Limited environments. Areas of applied research include distributed precision time, predictive software defined radio architectures, coordinated Cyber and Spectrum maneuver to mitigate detection and exploitation, tactical Cyber visualization, discovering and mapping networks in dense urban environments, contextual awareness and blind channel characterization.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Expeditionary Cyber	4.340	4.779	4.752	0.000	4.752
Articles:	-	-	-	-	-
FY 2021 Plans: - Cyber related research will initiate the advanced technology development of mitigation techniques related to USMC systems - Cyber related activities will continue to improve the overall cyber protection strategy for deployed systems at the battalion level and below that feed into the Marine Air-Ground Task Force (MAGTF) Information Group Integrated Command Center - Further research to better identify key cyber terrain at the physical, logical, and cyber persona layers that can be visualized at small unit level - Completion of integrating a framework to quickly reconfigure hardware accelerator devices to understand unknown signals of interest in the wild					
FY 2022 Base Plans: -Continue cyber related research into mitigation techniques related to USMC systems -Continue research to better identify key cyber terrain at the physical, logical, and cyber persona layers that can be visualized at small unit level -Complete cyber related activities to improve the overall cyber protection strategy for deployed systems at the battalion level and below that feed into the Marine Air-Ground Task Force (MAGTF) Information Group Integrated Command Center					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 2958 / *Cyberspace Activities*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
-Initiate research to develop of RF enabled EW/cyber networking that will deliver actions at scale through the integration of secure orchestration, cyber secure sensors, distributed beamforming and resilient networking technologies -Initiate research into automating cyber analysis and testing tools to enable software developers and reverse engineers to reduce the time required to conduct vulnerability analysis and software testing tasks. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** There is no significant change between FY 2021 and FY 2022					
Accomplishments/Planned Programs Subtotals	4.340	4.779	4.752	0.000	4.752

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy			Date: May 2021
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603640M / *MC Advanced Technology Demo*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	38.131	47.600	0.000	-	0.000	-	-	-	-	-	-
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021
Congressional Add: Robotic protection system ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	4.827	0.000
Congressional Add: Expeditionary mission planning enabled by high fidelity simulation ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	9.654	0.000
Congressional Add: Extended range 155mm projectile ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	2.413	0.000
Congressional Add: Adaptive threat force ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	6.757	0.000
Congressional Add: Air drop extended range munitions ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	14.480	0.000
Congressional Add: Expeditionary Process, Exploitation, and Dissemination	0.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 9999 / *Congressional Adds*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021
FY 2020 Accomplishments: N/A ***FY 2021 Plans:*** Conduct advanced technology development in expeditionary process, exploitation, and dissemination.		
Congressional Add: Adaptive Threat Force Footprint ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** Sustained by the FY 2020 Congressional Enhancement, the Adaptive Threat Force (ATF) has proved itself as a valuable addition to live-force experiments as the Marine Corps moves forward with the concepts of Expeditionary Advanced Base Operations (EABO), Littoral Operations in a Contested Environment (LOCE), and Force Design 2030 (FD 2030). The ATF continues to participate in experiment design to ensure that peer threat capabilities and operational methodologies are incorporated into each experiment. The ATF also continues to train and equip a peer threat adversary force to oppose experiment forces as they develop EABO, LOCE and assess FD 2030. This increases the accuracy and reliability of the data and results obtained. The ATF is central to the ongoing Infantry Battalion 2030 (IBX30) series of experiments that conclude in FY 2022. The ATF will support experiments with the Marine Littoral Regiment (MLR) which will begin in FY 2022 and extend at least until FY 2024. Explorations will inform MLR requirements through imaginative and innovative methods to understand the potential challenges involved in their insertion, command and control viability, sustainment, and survivability. Due to the size of the anticipated forces involved in the MLR experiments, MCWL foresees an increased use of modeling and simulation (M&S) within the experiment plans. To support this the ATF is working to advance a simulation system and incorporate threat force current and emerging capabilities to ensure opponents within the simulation truly represent the identified opposition. MCWL envisions expanding the ATF capability in the area of M&S to meet these requirements.	0.000	6.000
Congressional Add: Ensure Defense and Operational Resilience for USMC Tactical Cyber & Spectrum Man ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** Develop a Reference System Manager. Integrate ENDOR application orchestrator with SOSA reference task manager. Investigate MORA MDM message. Develop distributed mission planning reference tool. Build ENDOR enabled sensor mounted nodes.	0.000	10.000
Congressional Add: USMC Force Design - Closed Classified Wargaming Network and Naval Integration	0.000	1.000

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603640M / *MC Advanced Technology Demo*	**Project (Number/Name)** 9999 / *Congressional Adds*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021
FY 2020 Accomplishments: N/A ***FY 2021 Plans:*** The Marine Corps Warfighting Laboratory's (MCWL's) Wargaming Division is establishing a closed, classified wargaming network (WarNet) capability at secret and top secret levels to incorporate new software tools in support of USMC Service wargames. Efforts include further development of a multi-domain/multiplayer software solution to enable player immersion, visualization, and realistic computer assisted adjudication, as well as data generation for post-game analysis. Program leverages emerging cloud capabilities to extend the WarNet architecture to the Marine Expeditionary Forces (MEFs) and Marine Corps Force Pacific (MARFORPAC) to enable collaborative and distributed wargaming. In conjunction, this Congressional Enhancement also accelerates multi-level-security modeling, simulation, and analysis capacity and capability to develop Marine Corps Mission Engineering Threads into Operational Navy (OPNAV) Naval Capabilities Integrated Process (NCIP) efforts. In total, these efforts build necessary analytical and modeling and simulation (M&S) rigor to support Commandant of the Marine Corps (CMC) Force Design programmatic decision-making.		
Congressional Add: USMC Force Design - Organic Reconnaisance, Surveillance, and Target Acquisition ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** Current levels of Marine Expeditionary Forces (MEU)-organic Airborne Intelligence Surveillance, and Reconnaissance (ISR)/Reconnaissance, Surveillance, and Target Acquisition (RSTA) are inadequate to meet demands and inflexible to meet operational constructs like Expeditionary Advanced Base Operations (EABO) and Littoral Operations in a Contested Environment (LOCE). Efforts support MEU operations with an advanced technology vertical take-off-and-landing (VTOL) unmanned aerial system (UAS) ISR platform to inform requirements towards Initial Operating Capability (IOC) of a replacement maritime MEU ISR platform which will operationalize new Commandant of the Marine Corps (CMC) Force Design capabilities for EABO/LOCE.	0.000	4.500
Congressional Add: Marine Corps force Design Acceleration - Project Artemis ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** Using rapid prototyping, Project Artemis outfits the Marine Corps' experimental Marine Littoral Regiment (MLR) with a cohesive set of next generation equipment. Project Artemis modernizes Marine Corps infantry squads with emerging and disruptive technologies in order to develop joint tactics, techniques, and procedures (TTPs) through an extended user evaluation - equipping six Marine Corps Rifle Squads (two rifle platoons) and supporting company headquarters with the latest technological advances in squad lethality. Efforts build the capabilities of "stand-in" forces in accordance with Commandant of the Marine Corps (CMC) Force Design 2030, by developing Manned-Unmanned Teaming (MUM-T) and next generation communication	0.000	11.100

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021
systems TTPs for the infantry squad. Program develops a family of common controllers for current and future weaponized and ISR unmanned ground and air vehicles (UGVs and UAVs), as well as outfits three squads with individual voice mesh network radios and surrogate heads-up displays.		
Congressional Add: Marine Corps Mission Support Station Demonstration ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** Conduct advanced technology development in Marine Corps Mission Support Station Demonstration.	0.000	10.000
Congressional Adds Subtotals	38.131	47.600

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A