Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy											Date: February 2020	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603680N *I Manufacturing Technology Program*							
COST ($ in Millions)	**Prior Years**	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	57.322	65.138	60.122	-	60.122	61.318	62.582	63.840	65.117	Continuing	Continuing
1050: *Manufacturing Tech*	0.000	57.322	60.138	60.122	-	60.122	61.318	62.582	63.840	65.117	Continuing	Continuing
9999: *Congressional Adds*	0.000	0.000	5.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.000

A. Mission Description and Budget Item Justification

The Office of Naval Research's (ONR) mission is to foster scientific research for the advancement of naval power. This work does not stop at the laboratory. Delivery of breakthrough capability often requires new technologies in manufacturing and supply chains of national security. The Manufacturing Technology (ManTech) Program is intended to improve the productivity and responsiveness of the U.S. defense industrial base by funding the development, optimization, and transition of enabling manufacturing technologies to key naval suppliers. In general, investments transition emerging Science and Technology (S&T) results to acquisition programs; improve industrial capabilities in production, maintenance, repair and industrial base responsiveness; and advance manufacturing technology to reduce cost, improve performance, and responsiveness. Currently, the ManTech Program is focused on affordability improvements for specific key acquisition platforms as defined in the Navy ManTech Investment Strategy. Key platforms currently targeted include: VIRGINIA Class Submarine (VCS)/OHIO Replacement Program (ORP); DDG 51 Class Destroyer; CVN 78 Class Carrier; Joint Strike Fighter (JSF); and CH-53K Heavy Lift Helicopter. Office of Naval Research (ONR) ManTech helps these Navy programs achieve their respective affordability goals by transitioning developed manufacturing technology which, when implemented, results in needed cost reduction or cost avoidance.

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

This Program Element (PE) funds 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 Program Element (PE), the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy	Date: February 2020
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603680N *I Manufacturing Technology Program*

B. Program Change Summary ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	58.657	60.138	60.122	-	60.122
Current President's Budget	57.322	65.138	60.122	-	60.122
Total Adjustments	-1.335	5.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	5.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.335	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2019	FY 2020
Project: 9999: *Congressional Adds*		
Congressional Add: *Modern shipbuilding manufacturing*	0.000	5.000
Congressional Add Subtotals for Project: 9999	0.000	5.000
Congressional Add Totals for all Projects	0.000	5.000

Change Summary Explanation

funding: No significant change.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603680N / *Manufacturing Technology Program*	Project (Number/Name) 1050 / *Manufacturing Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
1050: *Manufacturing Tech*	0.000	57.322	60.138	60.122	-	60.122	61.318	62.582	63.840	65.117	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Office of Naval Research's (ONR) mission is to foster scientific research for the advancement of naval power. This work does not stop at the laboratory. Delivery of breakthrough capability often requires new technologies in manufacturing and supply chains of national security. The Manufacturing Technology (ManTech) Program is intended to improve the productivity and responsiveness of the U.S. defense industrial base by funding the development, optimization, and transition of enabling manufacturing technologies to key naval suppliers. In general, investments transition emerging Science and Technology (S&T) results to acquisition programs; improve industrial capabilities in production, maintenance, repair and industrial base responsiveness; and advance manufacturing technology to reduce cost, improve performance, and responsiveness. Currently, the ManTech Program is focused on affordability improvements for specific key acquisition platforms as defined in the Navy ManTech Investment Strategy. Key platforms currently targeted include: VIRGINIA Class submarine (VCS)/COLUMBIA Class submarine (CLB); DDG 51 Class destroyer; CVN 78 Class carrier; F-35 Lightning II aircraft (F-35); and CH-53K Heavy Lift Helicopter. Currently, ManTech will also focus on affordability improvements for FFG(X) and wind down investments in the CH-53K program. Through its affordability efforts, ManTech helps these Navy programs achieve their respective affordability goals by transitioning developed manufacturing technology which, when implemented, results in needed cost reduction or cost avoidance. In addition to addressing affordability for key naval platforms, ManTech also addresses manufacturing technology to aid in capability acceleration to the fleet.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: Composites Processing and Fabrication	8.000	8.000	7.954	0.000	7.954
Description: The primary technical goal of the Composites Processing and Fabrication activity is improving weapon systems affordability, enhancing weapon system effectiveness and improving reliability/war-fighter readiness through the increased utilization of composite materials and structures. This is being achieved through the development, maturation, and transition of affordable and robust manufacturing, assembly, and repair processes that fully exploit the benefits of composite materials. Concentration is on affordability for the following platforms: VIRGINIA Class submarine (VCS)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, F-35 Lightning II aircraft (F-35), and CH-53K Heavy Lift Helicopter. Composites processing and fabrication technology areas include but are not limited to fiber-reinforced polymeric (organic) resin composites; ceramic-matrix, metal-matrix, and carbon-carbon composites; composite internal stiffening core materials such as foam, ceramic, balsa wood, polymeric or metallic honeycomb, or other materials; composite external stiffening concepts such as hat and blade stiffeners and methodologies to manufacture them; materials for radomes and other electrical applications; composite manufacturing and similar processes and related equipment technology; and adhesives, adhesive bonding, and related technologies (i.e., surface					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
preparation techniques), as well as mechanical fastening, and other methodologies for joining composites to other composites or metals, and similar assembly technologies. ***FY 2020 Plans:*** Technical activities include (1) Design / develop a flexible, robotic composites manufacturing cell for CH-53K fabrication for improved process repeatability, increased part quality, and reduced risk as production rates increase; (2) Develop an improved and more affordable false deck panel concept for use in equipment spaces on DDG 51 Class destroyers constructed at both Bath Iron Works and HII-Ingalls and CVN 78 Class carriers constructed at HII-Newport News Shipbuilding; (3) Develop and proof manufacturing technology for composite exhaust uptakes for the DDG 51 Class destroyers (for both Bath Iron Works and HII-Ingalls ships) for cost neutral or better acquisition cost, 60% reduction in maintenance costs, and 30% weight reduction; (4) Develop equipment, processes, and methods needed to implement a system capable of fully automated optical inspection of MOD's (minor optical defects) on F-35 production transparencies and eliminate subjective, variable visual analysis currently done by individual operators. ***FY 2021 Base Plans:*** - Develop and transition composites manufacturing technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG(X), and F-35. - Develop and transition composites manufacturing technology improvements that accelerate capability to the fleet. Areas of concentration include (1) transparencies for the F-35 Lightning II aircraft, (2) submarine coatings, (3) flares, and (4) High Energy Laser (HEL) weapon systems. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** There is no significant change between FY 2020 and FY 2021.					
Title: Electronics Processing and Fabrication ***Description:*** The primary technical goal of the Electronics Processing and Fabrication activity is improving electronic weapon systems affordability by developing and transitioning affordable, robust manufacturing processes and capabilities for electronics critical to defense applications over their full life-cycle. Efforts create new and improved electronics / electro-optics manufacturing processes for transition to the production floor. Emphasis is on affordability for the following platforms: VIRGINIA Class submarine (VCS)/COLUMBIA Class	12.000	12.000	11.930	0.000	11.930

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, F-35 Lightning II aircraft (F-35), and CH-53K Heavy Lift Helicopter. Electronics processing and fabrication technology areas include but are not limited to Electronics manufacturing technology (materials, devices, circuits, modules, subsystems); Semiconductor devices/vacuum electronics/passive components; compound semiconductors/wide bandgap semiconductors; low-cost, high-throughput manufacturing and assembly techniques; nanoelectronics; electronics packaging technologies (including tamper proof and non-hermetic approaches); optics manufacturing technology (materials devices, circuits, modules, subsystems); optical interconnects; fiber optics and photonics; technologies for electronics and electro-optics testing and evaluation; optical imaging for manufacturing operations; and directed energy weapons. ***FY 2020 Plans:*** Technical activities include (1) Develop technology to repurpose digital electronics currently used in the F-35 Active Electronically Scanned Array (AESA) radar system to accommodate F-35 global positioning system (GPS) system functions with significantly improved anti-jamming capabilities; (2) Develop a reduced cost manufacturing process for two of the most costly of seven elements in the optical train of the F-35 Helmet Mounted Display (HMD) Relay Optical Assembly (ROA) for the F-35; (3) Develop drone technology for the inspection of CVN 78 Class carrier tanks to replace currently used manual inspection techniques which are labor intensive, inefficient, and risky from a safety perspective; (4)Develop a prototype for a modern radar system architecture with open and common Radio Frequency (RF) components that demonstrate the capability to implement requirements for two significantly different radar systems to support the baseline for the Next Generation Surface Search Radar (NGSSR) for both CVN 79 Class carrier and DDG 51 Class destroyer. ***FY 2021 Base Plans:*** - Develop and transition electronics and electro-optics manufacturing technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG(X), and F-35. - Develop and transition electronics and electro-optics manufacturing technology improvements that accelerate capability to the fleet. Areas of concentration include (1) High Energy Lasers (HEL) weapon systems, (2) Surface Electronic Warfare Improvement Program (SEWIP) for FFG(X) and Large Surface Combatant, and (3) unmanned vehicles. ***FY 2021 OCO Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** There is no significant change between FY 2020 and FY 2021.					
Title: Metals Processing and Fabrication	12.000	12.000	11.930	0.000	11.930
Description: The primary technical goal of the Metals Processing and Fabrication activity is to develop affordable, robust manufacturing and repair processes/capabilities for metals and special materials critical to Navy weapon system applications. Emphasis is on affordability for the following platforms: VIRGINIA Class submarine (VCS)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, F-35 Lightning II aircraft (F-35), and CH-53K Heavy Lift Helicopter. This activity also includes the development, optimization, and transition of repair technology for the repair, overhaul, and sustainment of key navy systems. Metals processing and fabrication technology areas include but are not limited to: processing methods; metals additive manufacturing; metallic materials-based systems; casting; joining techniques; machining; surface and heat treatments; coating/cladding; assembly; metal/non-metals interfaces issues; and inspection and compliance verification. ***FY 2020 Plans:*** Technical activities include: (1) Develop a manufacturing cell concept for the automated welding of submarine appendages (for both VIRGINIA and COLUMBIA construction) to replace the currently used manual approaches that are both labor-and time-intensive; (2) Develop improvements for hull frame fabrication for the VIRGINIA and COLUMBIA Class submarines by developing and implementing a robotic solution that increases weld quality, decreases out-of-circularity fit up issues, and reduces the amount of welding and inspection man hours; (3) Develop improvements for foundry castings at HII-Newport News for CVN 78 Class carriers and VIRGINIA Class submarines by validating the use of shrouds to minimize air exposure of the molten metal and developing devices, procedures, and processes needed to implement the process with NNS legacy equipment and processes. ***FY 2021 Base Plans:*** - Develop and transition metals manufacturing technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG(X), and F-35. - Develop and transition metals manufacturing technology improvements that accelerate capability to the fleet. Areas of concentration include (1) High Energy Lasers (HEL) weapon systems and (2) unmanned vehicles.					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
- Continue Repair Technology (RepTech) Thrust to develop, optimize, and transition repair technology for key naval platforms at depots and logistics centers. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** There is no significant change between FY 2020 and FY 2021.					
Title: Manufacturing Enterprise/Other ***Description:*** The Manufacturing Enterprise/Other activity includes: (1) efforts targeted towards improving, in general, the manufacturing enterprise for the production of key naval platforms (both shipbuilding and aircraft); (2) energetic efforts; (3) naval research enterprise and laboratory support for key projects; and (4) technical program support. Manufacturing Enterprise addresses the development, optimization, and transition of manufacturing enterprise technology to key naval platform suppliers. Emphasis is on affordability for the following shipbuilding platforms: VIRGINIA Class submarine (VCS)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, F-35 Lightening II aircraft (F-35), and CH-53K Heavy Lift Helicopter. Manufacturing enterprise technology areas include, but are not limited to design for easier production/design for manufacturability; development of build/assembly strategies; modeling and simulation technologies; model-based tools and approaches to optimize ease of production; intelligent manufacturing planning and factory execution; elimination of inefficiencies in design optimization, material usage, labor utilization, work flow, etc.; supply chain procedures and improvements (such as network centric manufacturing capabilities to facilitate resilient and adaptable supply chains); development of more efficient structural fabrication product lines; streamlining of outfitting operations; prediction and reduction of welding distortion; advanced automation and robotics for manufacturing; advanced data analytics, artificial intelligence and machine learning for production environments; and inspection technologies such as digital radiography and ultrasonic technologies. Energetics efforts concentrate on developing energetics solutions to ensure the availability of safe, affordable, and quality energetics products largely in support of Program Executive Office (PEO) Integrated Warfare Systems (IWS). ***FY 2020 Plans:*** Technical activities include (1) Develop augmented reality (AR) and virtual reality (VR) manufacturing technology by exploiting product model data to improve shipbuilding affordability for VIRGINIA Class and COLUMBIA Class (VCS and CLB) submarines, CVN 78 Class carrier, and DDG 51 Class destroyer; (2) Develop a digital build	25.322	28.138	28.308	0.000	28.308

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603680N / *Manufacturing Technology Program*	**Project (Number/Name)** 1050 / *Manufacturing Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
sequence from the legacy VCS model to include the operations, material, joints, and views a worker needs to accomplish a particular unit of work to streamline both development time and rework required; (3) Develop Rapid Automated Technology Evaluation (RATE) capabilities for high rate automated F-35 aircraft assembly line automation processes to identify and predict any corrective actions necessary to not impact production schedules and product quality. ***FY 2021 Base Plans:*** - Develop and transition advanced manufacturing enterprise technology improvements that result in cost reduction for key affordability platforms: VCS/CLB, DDG 51, CVN 78, FFG(X), and F-35. - Develop and transition advanced manufacturing enterprise technology improvements that accelerate capability to the fleet. An area of concentration includes manufacturing improvements for unmanned vehicles. - Develop and transition energetics manufacturing technology improvements that result in cost reduction for Naval Systems. - Develop and transition energetics manufacturing technology improvements that accelerate capability to the fleet. An area of concentration includes manufacturing improvements for flares and energetics. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** There is no significant change between FY 2020 and FY 2021.					
Accomplishments/Planned Programs Subtotals	57.322	60.138	60.122	0.000	60.122

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Efforts are focused on affordability improvements (both acquisition and life-cycle) for specific key acquisition platforms as defined in the Navy ManTech Investment Strategy. Currently, the majority of Navy ManTech efforts are focused on affordability improvements for: VIRGINIA Class submarine (VCS)/COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class carrier, F-35 Lightning II aircraft (F-35), and CH-53K Heavy Lift Helicopter.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603680N / *Manufacturing Technology Program*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	0.000	5.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.000

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020
Congressional Add: Modern shipbuilding manufacturing	0.000	5.000
FY 2019 Accomplishments: N/A		
FY 2020 Plans: Conduct technology development research in Modern shipbuilding manufacturing.		
Congressional Adds Subtotals	0.000	5.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A