Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Office of the Secretary Of Defense	Date: May 2017
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603680D8Z / *Defense Wide Manufacturing Science and Technology Program*

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
Total Program Element	246.689	151.999	158.398	136.159	-	136.159	115.573	88.343	69.296	70.767	Continuing	Continuing
P680: *Manufacturing Science and Technology Program*	133.902	15.501	21.442	23.375	-	23.375	23.264	30.858	35.128	35.134	Continuing	Continuing
P350: *Manufacturing Innovation Institutes*	112.787	136.498	136.956	112.784	-	112.784	92.309	57.485	34.168	35.633	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Defense-wide Manufacturing Science and Technology (DMS&T) program is the joint, defense-wide component of the DoD Manufacturing Technology (ManTech) Program directed in Title 10 U.S.C. Section 2521, the latter of which represents the Department's comprehensive advanced manufacturing program focused on enabling the strategic goals of timely, affordable delivery of dominant technologies to the warfighter, and improving the acquisition and sustainment of defense products and systems across their life cycles. Designing for manufacturability early in the development of defense-essential products and systems can yield dramatic and positive impacts for the Department's operational and modernization missions.

The DMS&T component of the DoD ManTech program specifically focuses on the development of cross-cutting and potentially game-changing manufacturing technologies, processes and capabilities that are typically beyond the scope or risk of any one Military Department or Defense Agency or platform.These high-leverage, defense-wide investments are designed to benefit the performance, affordability, and delivery timelines/deployment cycles of many of the department's most essential products and systems in ways that are not typically achievable through the efforts of a single service, agency or program office.

The DMS&T program, therefore, is a unique and fundamental DoD ManTech Program component that is needed to optimize a coordinated manufacturing technology development process across the department broadly. Concurrent development of manufacturing processes and capabilities along with S&T development enables the timely, affordable adoption and deployment of emerging technologies needed to maintain U.S. warfighting dominance. Key DMS&T technical areas for investment include Advanced Electronics and Optics Manufacturing, Advanced Materials Manufacturing, Enterprise and Emerging Manufacturing, and respective technology focus areas addressed by each of the DoD-led manufacturing innovation institutes (discussed in the next paragraph). Advanced Electronics and Optics addresses advanced manufacturing technologies for a wide range of applications such as sensors, radars, power generation, switches, and optics for defense applications. Advanced Materials addresses advanced manufacturing technologies for a wide range of materials such as composites, metals, ceramics, nanomaterials, metamaterials, and low observables. Enterprise and Emerging Manufacturing addresses advanced manufacturing technologies and enterprise business practices for defense applications. Key focus areas include the industrial information infrastructure, advanced design/qualification/cost tools, supply network integration technologies and management practices, direct digital (or additive) manufacturing, machining; robotics, assembly, and joining.

Manufacturing innovation institutes established by the DoD and part of the whole-of-government Manufacturing USA Program are also funded in this program element. Technical innovation and leadership in U.S. manufacturing are essential to sustaining the foundations of industrial competitiveness to enable our military to maintain technological advantage and global dominance. Eight DoD Manufacturing USA institutes have been established to serve as regional hubs accelerating technological

innovation and associated production processes and educational/workforce competencies for military and commercial applications via shared public-private sectors. These Manufacturing USA institutes, supported by resources from multiple U.S. Government agencies, are generating significant industry cost-share for manufacturing innovation and are forming new technology transition pathways via regional hubs spurring active collaboration among government, industry, and academia to help meet critical government and warfighter needs. The overall concept of the Manufacturing USA program (previously named the National Network for Manufacturing Innovation until changed in FY16) and the design of its manufacturing innovation institutes are provided in several key federal documents; among them: 1) the President's National Science and Technology Council (NSTC) report by the Advanced Manufacturing National Program Office entitled, "National Network for Manufacturing Innovation: A Preliminary Design," published in January 2013, and more recently, in the following two NSTC reports: 2) "National Network for Manufacturing Innovation Program Strategic Plan" and 3) "National Network for Manufacturing Innovation Annual Report," both published in February 2016.

B. Program Change Summary ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	156.743	158.398	136.848	-	136.848
Current President's Budget	151.999	158.398	136.159	-	136.159
Total Adjustments	-4.744	0.000	-0.689	-	-0.689
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• AT&L SRRB (spell this out)	-4.744	-	-0.689	-	-0.689

Change Summary Explanation

Two project codes are used in this Program Element (PE) to distinguish between DMS&T Manufacturing Technology investments (P680) and the manufacturing innovation institute investments (P350). The growth in funding in this PE from prior President's budgets is primarily associated with P350 investments.

P350 Manufacturing Innovation Institutes - issues affecting year-to-year changes:
1) Cooperative agreement (CA) and technology investment agreement (TIA) five-year funding profiles for each of eight institutes are not straight-line funded in each year, but instead are incrementally increased and then decreased across five fiscal years, with the third year being the peak year. This profile leverages the ability to optimally attain matching funds from industry and academia partners for R&D projects.
2) The number of institutes changed from six in FY 2016 to eight in FY 2017.
3) FY 2016 and FY 2017 are the peak funding years supporting establishment of the eight DoD-led Manufacturing USA institutes, with significant annual decreases programmed annually thereafter.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Office of the Secretary Of Defense			Date: May 2017
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603680D8Z / *Defense Wide Manufacturing Science and Technology Program*	Project (Number/Name) P680 / *Manufacturing Science and Technology Program*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
P680: *Manufacturing Science and Technology Program*	133.902	15.501	21.442	23.375	-	23.375	23.264	30.858	35.128	35.134	Continuing	Continuing

A. Mission Description and Budget Item Justification

The DMS&T investment strategy follows a two-pronged approach built on: 1) broad technology initiatives and 2) specific individual projects meeting more focused manufacturing technology needs. Investments in both cases are built and managed in collaboration with the Department's research, development and acquisition (RDA) communities (including active, ongoing coordination with the DoD ManTech Program's Joint Defense Manufacturing Technology Panel) and industry and target the development of defense-essential advanced manufacturing processes and associated workforce capabilities. The portfolio includes a focus on above-the-shop-floor new manufacturing processes and practices having the potential to improve manufacturing efficiencies at broader, enterprise levels. Single specific projects address investment opportunities not associated with selected technology initiatives and enable the program to more surgically apply investments to compelling and sometimes urgent manufacturing needs.

Data calls are launched through two methods to identify technology initiatives and single specific issues requiring investment. One method is through the JDMTP. The JDMTP is comprised of the ManTech Directors from the Services, Defense Logistics Agency, and Office of Secretary of Defense (OSD). The call is distributed through the ManTech Directors to the four JDMTP sub panels: Metals Processing and Fabrication Subpanel, Composites Processing and Fabrication Subpanel, Electronics Processing and Fabrication Subpanel, and Advanced Manufacturing Enterprise Subpanel. Potential candidates are evaluated by the JDMTP based on criteria set forth in the call and announcements, and then down-selected for further development prior to final selection. The other method is through funding opportunity announcements to industry. Priority is given to investments that support affordability and producibility of critical enabling manufacturing technologies that cut across multiple platforms. Investments also balance defense priorities in specialty materials, electronics, propulsion and power, and manufacturing processes including "above the shop floor" (lean and business technologies facilitating interoperable manufacturing). Final projects are selected by the OSD ManTech Director, considering input from the JDMTP,and as approved by Deputy Assistant Secretary of Defense, Manufacturing and Industrial Base Policy (MIBP). Technology initiatives and projects are executed at the Component level.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Advanced Electronics and Optics	9.810	12.681	14.076
Description: Advanced Electronics and Optics is a series of efforts addressing advanced manufacturing technologies for a wide range of applications such as sensors, radars, power generation, switches, and optics for defense applications. Focal points are productivity and efficiency gains in the defense manufacturing base to accelerate delivery of technical capabilities to impact current warfighting operations, and manufacturing technologies to reduce the cost, acquisition time and risk of our major defense acquisition programs. Future efforts will focus on advances in fuel cells, lasers, enhanced acuity microdisplays, and transparent ceramics for opto-mechanical and armor applications.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
The Transparent Ceramic Initiative will address DoD applications for electro-optics, including fibers, films, and bulk solid state components, such as windows. Typical materials include: sapphire, ALON, and spinel. Transparent ceramics offer the potential for improved ballistic strength for battlefield armor and personnel protection. Investments include but are not limited to: high strength spinel scale-up, Nanocomposite Optical Ceramics (NCOC) powder scale-up, infrared windows, and curved transparent ceramics. Projects: Mini Short-wave Infrared (SWIR) Cameras and Imagers (FY 2016): Expedite the transition of 10 um (TEC)-less SWIR cameras to the warfighter and develop wafer level processing techniques to improve yield and reduce contaminants in the SWIR focal plane array (FPA)/ camera assembly. Will establish the industrial base for SWIR technology systems and components. Reduced unit cost allows more individuals to carry imagers; 6x improved cost, reduced from $30K to $5K; 3x reduced size from 3cm3 to 1cm3; 3x reduced weight from 120 g to 40 g. Applications include COSI, INOD, COS3, AWST, Joint Effect Targeting System (JETS), IDNST, PAWS, and MTS-B. Mini Vis - SWIR Cameras and Imagers (FY 2016): Develop a manufacturing capability to produce one camera that can see the entire spectral band of Visible, Near Infrared (NIR), and Short-wave Infrared (SWIR); while being compatible with visible, NIR, and SWIR laser pointers and illuminators. Applications include: COSI, INOD, COS3, Advanced Weapon Sight Technology (AWST), Joint Effect Targeting System (JETS), Integrated Day/Night Sight Technology (IDNST), PAWS, and Multispectral Targeting System (MTS-B). Manufacturability of Vertical Cavity Surface Emitting Lasers (VCSELs) – Phase II (FY 2016-2018): Develop the capability to produce a Multi-Function Laser Illuminator and Pointer that delivers the functionality of five different devices (Green, NIR, and Short-wave Infrared (SWIR) Laser Pointers plus NIR and SWIR illuminators) in a single, high-power, lightweight unit, which would give the warfighter commonality with all other weapon systems and be covert. Would provide the SWIR VCSEL a three-fold increase in efficiency and output power to meet critical needs for covert illumination in both High Definition and SXGA formats. Applications include: PUMA, RAVEN, TigerShark, Anubis, Spectre-FINDER, Speckles, TigerMoth, WAAS, PAWS, IPODS, AngelFire, MAV-OBAT, nLoss, LOS-short, CLRF, Joint Effect Targeting System (JETS), IDNST, TLDS, Big Safari, OEF, OIF, STINGER , and ARGUS, others. Vital Infrared Sensor Technology Acceleration (VISTA) High Temp Mid-Wave Infrared (MWIR) Detectors (FY 2016-2017): Establish a critical domestic industrial base for MWIR focal plan arrays (FPA) having capabilities in III-V antimony-based Infrared (IR) FPAs to reduce size, weight, power, and cost while increasing yield and operability as an alternative to current technology.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Will achieve wafer production scale-up to 40-50 wafers per month while shortening sensor turn-on and cool down time by 50%, extending cooler lifetimes 150% - 200% as a result of reduced stress during temperature cycling, and substantially reducing the sensor lifecycle maintenance cost. Applications include: Air Force: EODAS Enhancement (F-35), EOTS Enhancement (F-35), LWIRST (F-15), Targeting System Enhancements (MQ-9, F-16), Overhead Persistent Infrared (OPIR); Army: Next Gen FLIR, Degraded Visual Environment, Rotary Wing Pilotage; Navy: Shipboard Multifunction Sensors (APDIS), Overhead Persistent Surveillance for USMC, UAV, and Navy: BAMS, F-18 (Advanced IRST), EO/IR Standard Integration System (EISIS), and Affordable Modular Panoramic Photonics Mast. Improved Focal Plane Array (FPA) – Hyperspectral – Phase II (FY 2016): Demonstrate utility of III-V based FPAs for Long-Wave Infrared (LWIR) Hyperspectral (HIS) applications. Up to $1M/year/sensor reduction in system life cycle costs compared to arsenic-doped silicon blocked impurity band (Si:As BIB) detectors. Significant reduction in up-front costs compared to Mercury Cadmium Telluride (MCT). Improved reliability, maintainability, and availability, along with increased detection range. Organic Light Emitting Diode (OLED) Microdisplays - Phase II (FY 2016-2017): Establish manufacturing capability for producing an ultra-high resolution, high brightness, high contrast, full color microdisplay at a low unit cost. Mature and combine manufacturing processes: Silicon on Insulator (SOI) and Direct Patterning technologies to enable a 5X improvement in yield and 5X longer lifetime of displays, reducing life cycle costs. $221.7M savings for aviation and Enhanced Visual Acuity (EVA) goggles (27,700 displays between 2017-2032) x $8K/unit savings). Applications include F-35 Heads-up Helmet Mounted Display System, Apache, EVA, F-18, F-15, F-16, affordable color/monochrome displays with high brightness and high contrast to enable Warfighter to fully use sensors and cuing/augmented reality hardware. Nanocomposite Optical Ceramics (NCOC)(FY 2017-2018): Advance manufacturing maturity of NCOC to replace sapphire. The large reduction of emissivity at elevated temperatures experienced during flight makes NCOC more favorable for a missile dome by increasing the signal to noise ratio. Effort will focus on scale-up NCOC dome manufacturing processes to meet projected AIM-9X full rate production quantities. ***FY 2016 Accomplishments:*** Mini Short-wave Infrared Cameras and Imagers: established plan for device transitions; continue wafer growth/processing, hybridization, sensor packaging, and camera calibration efforts. Continued and concluded process development and yield enhancement efforts.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Mini Vis - SWIR Cameras and Imagers: completed design and development of additional manufacturing processes for sensor substrate removal; developed specifications for vis-SWIR devices; and developed test and evaluation methods for extended response to <900 nm. VISTA High Temp MWIR Detectors: develop fabrication process improvements that reduce defects and increase availability and yields; target achievement of wafer production scale-up to 40-50 wafers per month while shortening sensor turn-on and cool down time by 50%, extending cooler lifetimes 150% - 200% as a result of reduced stress during temperature cycling, and substantially reducing the sensor lifecycle maintenance cost. Manufacturability of Vertical-Cavity Surface Emitting Lasers – Phase II: continued pointer device development; designed and developed electronics and packaging; and began planning for manufacturing and field testing. Organic Light Emitting Diode (OLED) Microdisplays – Phase II: conducted an initial Manufacturing Readiness Assessment (MRA); identified key processes for direct patterning; performed diagnostic tests to enhance understanding of direct patterning device performance; identified, designed, and ordered direct patterning equipment; fabricated graphics array test cells and product wafers for the direct patterning initiative; installed and tested the initial linear sources for the direct patterning initiative; completed a design and tape-out of the Silicon on Insulator (SOI) backplane; demonstrated OLED on Silicon on Insulator and direct patterning on bulk silicon. Issued a SOI qualification plan. Improved Focal Plane Array (FPA) - Hyperspectral – Phase II: focused on detector and FPA fabrication, testing, and validation; demonstrated 640x480, 20 µm Very Long Wavelength Infrared FPAs; provided detailed FPA characterization; developed cost and yield models using multi-wafer lot runs.			
FY 2017 Plans: Manufacturability of Vertical-Cavity Surface Emitting Lasers – Phase II: continue device development and product transitions; continue making gains in wall plug efficiency (WPE), illuminator power, and reliability. Organic Light Emitting Diode Microdisplays - Phase II: deliver upgraded tooling to project contractor; develop direct patterning and SOI backplane; demonstrate critical manufacturing processes (direct patterning: 0.5 um accuracy, linear source process uniformity, SOI: high dynamic range, display uniformity); qualify the SOI process at the foundry; install the final direct patterning equipment; conduct iterative improvement direct patterning lot runs. Integrate lot runs for direct patterning and SOI; conduct a qualification process; perform a final TRL/MRL assessment and produce a final TRL/MRL report.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
VISTA High Temp MWIR Detectors: continue GaSb substrate quality improvement; continue single-detector-wafer production optimization; continue molecular beam epitaxy (MBE) capability scale up to 40 - 50 wafers per month; fabricate focal plane arrays (FPAs) on 5 inch wafers. Nanocomposite Optical Ceramics (NCOC): Continue powder conditioning, blank forming, heat treatment, optical finishing and coating related activities. ***FY 2018 Plans:*** Manufacturability of Vertical-Cavity Surface Emitting Lasers – Phase II: continue device development and additional product transitions; obtain feedback from end users and implement improvements. Nanocomposite Optical Ceramics (NCOC): Continue powder conditioning, blank forming, heat treatment, optical finishing and coating related activities; measure results and assess Manufacturing Readiness Levels.			
Title: Advanced Materials Manufacturing	3.029	5.713	5.508
Description: Advanced Materials Manufacturing is a series of efforts addressing advanced manufacturing technologies for a wide range of materials such as composites, metals, ceramics, nanomaterials, and metamaterials. Through productivity and efficiency gains, these manufacturing technologies will accelerate delivery of technical capabilities to impact current warfighting operations, while reducing the cost, acquisition time and risk of our major defense acquisition programs. Advanced materials manufacturing technologies undergoing development include materials for ballistic survivability and ballistic protection, survivability and rapid fabrication of structural components. Advanced Propulsion Initiative: Advance propulsion has a crucial need to develop fuel efficient sustainable propulsion capabilities. Several technologies will be developed including Risk-based Life Cycle Management for System Sustainment and As-Manufactured and As-Maintained State Awareness. In addition, technologies will be pursued addressing capability gaps associated with adaptive engine design and high performance lightweight materials, organic matrix composites, oxide/oxide composites, thermal barrier coatings for high temperature structure and light weight alloys. Additional capabilities will focus on unique manufacturing challenges associated with affordable Medium-Small Engine fabrication methods including Expendables. Projects: 40MM M433 Warhead Producibility (FY 2016): Achieve improved anti-personnel lethality at the squad level, increasing first shot effectiveness against personnel targets through optimization of production process prior to transition to Full Rate Production,			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
avoiding high cartridge unit costs. Primary applications include Mk 19 GMG, M203 GL, M320GL, and M32 MSGL. Secondary applications include Cannon and Tank Calibers, and Hand Grenades. Cold Spray Repair and Rebuild Phase II Large Structures (FY 2016): Expand the Cold Spray product envelope from 5 feet to a target of 40 feet to enable large tubular component repair. Applications include Seawolf Class Submarine Periscopes and TD-63 Actuators. Dimensions on Day One (FY 2016): Demonstrate a methodology that accurately predicts and accounts for the numerous geometric, tooling and material factors impacting finished composite parts enabling the correct upfront process and tooling design to yield first article parts meeting the “dimensional requirements on day 1”. Applications include F-35/UCLASS/F/A-XX/Long Range Strike for maintaining part and aircraft tolerances, which enables survivable, supportable and affordable air vehicles. Large Scale Encapsulate Ceramics - Phase II (FY 2016): Enable combat vehicles to defeat the large caliber Kinetic and Chemical Energy objective threats within the allocated weight parameters. Help address affordability of the armor, with an estimated cost reduction of $10K /sq. foot. Armor panels will be producible in the shapes required by individual vehicles. Applications include Abrams, which has a known protection limitation. GCV and other vehicles will use this technology to design those areas of vehicles subject to large caliber KE and CE threats. Out of Autoclave Processing of Organic Matrix Composites (OMCs) for Advanced Propulsion (FY 2017-2018): Current state of the art out of autoclave processable OMCs are currently limited to a service life of between 325F and 375F limiting advanced propulsion applications. Expanding performance of OMCs to temperatures between 400F and 625F will dramatically increase the design trade space for developing the next generation advanced propulsion systems. Advanced propulsion structure includes front frames, vanes, stators and outer by-pass ducts. Insertion of this technology onto the AETP program will lower cost, increase range and maintain performance for the next generation tactical aircraft. Fabrication of Non-Eroding Metallic Throat (FY 2016-2018): Scale the manufacturing of Thin walled, Non-Eroding Tungsten (W) Throats from 4” up to 12” inner throat diameters. Applications include Stage 2 & Stage 3 ICBMs as well as Stage 2 Standard Missile III. Advanced Technology Capability (FY 2016-2018): Development of advanced technologies that support warfighter survivability and capability against advanced threats. Enables new capabilities to be produced in sufficient affordable quantities to allow transition to multiple platforms.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Advanced Propulsion Initiative: Advance propulsion has a crucial need to develop fuel efficient sustainable propulsion capabilities. Several technologies will be developed including Risk-based Life Cycle Management for System Sustainment and As-Manufactured and As-Maintained State Awareness. In addition, technologies will be pursued addressing capability gaps associated with adaptive engine design and high performance lightweight materials, organic matrix composites, oxide/oxide composites, thermal barrier coatings for high temperature structure and light weight alloys. Additional capabilities will focus on unique manufacturing challenges associated with affordable Medium-Small Engine fabrication methods including Expendables. Projects: 40MM M433 Warhead Producibility (FY 2016): Achieve improved anti-personnel lethality at the squad level, increasing first shot effectiveness against personnel targets through optimization of production process prior to transition to Full Rate Production, avoiding high cartridge unit costs. Primary applications include Mk 19 GMG, M203 GL, M320GL, and M32 MSGL. Secondary applications include Cannon and Tank Calibers, and Hand Grenades. Cold Spray Repair and Rebuild Phase II Large Structures (FY 2016): Expand the Cold Spray product envelope from 5 feet to a target of 40 feet to enable large tubular component repair. Applications include Seawolf Class Submarine Periscopes and TD-63 Actuators. Dimensions on Day One (FY 2016): Demonstrate a methodology that accurately predicts and accounts for the numerous geometric, tooling and material factors impacting finished composite parts enabling the correct upfront process and tooling design to yield first article parts meeting the “dimensional requirements on day 1”. Applications include F-35/UCLASS/F/A-XX/Long Range Strike for maintaining part and aircraft tolerances, which enables survivable, supportable and affordable air vehicles. Large Scale Encapsulate Ceramics - Phase II (FY 2016): Enable combat vehicles to defeat the large caliber Kinetic and Chemical Energy objective threats within the allocated weight parameters. Help address affordability of the armor, with an estimated cost reduction of $10K /sq. foot. Armor panels will be producible in the shapes required by individual vehicles. Applications include Abrams, which has a known protection limitation. GCV and other vehicles will use this technology to design those areas of vehicles subject to large caliber KE and CE threats. Out of Autoclave Processing of Organic Matrix Composites (OMCs) for Advanced Propulsion (FY 2017-2018): Current state of the art out of autoclave processable OMCs are currently limited to a service life of between 325F and 375F limiting advanced propulsion applications. Expanding performance of OMCs to temperatures between 400F and 625F will dramatically increase the design trade space for developing the next generation advanced propulsion systems. Advanced propulsion structure includes front frames, vanes, stators and outer by-pass ducts. Insertion of this technology onto the AETP program will lower cost, increase range and maintain performance for the next generation tactical aircraft.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Fabrication of Non-Eroding Metallic Throat (FY 2016-2018): Scale the manufacturing of Thin walled, Non-Eroding Tungsten (W) Throats from 4” up to 12” inner throat diameters. Applications include Stage 2 & Stage 3 ICBMs as well as Stage 2 Standard Missile III. Advanced Technology Capability (FY 2016-2018): Development of advanced technologies that support warfighter survivability and capability against advanced threats. Enables new capabilities to be produced in sufficient affordable quantities to allow transition to multiple platforms. ***FY 2016 Accomplishments:*** 40MM M433 Warhead Improvement Producibility: Developed fragment insertion methods/tools to reduce time to fill mold with fragments & settle/align fragments; enabled mold stage transitions at reduced cycle times. Fabricated updated tooling and implemented high-rate-enabling technologies, such as part inserters, pick & place, vibratory alignment feeders. Fabricated Molded Body Assemblies utilizing an improved process. Cold Spray Repair and Rebuild Phase II Large Structures: expanded the capability of Cold Spray Phase I System to accommodate larger components; incorporated a means of processing long parts (40 feet); developed a fully integrated "tube" repair processing line. Large Scale Encapsulate Ceramics - Phase II: conducted manufacturing trials to scale up solutions; tested prototype panels; refined models; produced the required thermal design to manufacture the armor panels; set up a Government manufacturing facility. Fabrication of Non-Eroding Metallic Throat: study Vacuum Plasma Spray (VPS) manufacturing capability scale-up issues; fabricate 4” diameter specimens and conduct thermal-mechanical property testing to use as a material property baseline; modify equipment for scale up to 6” diameter specimens; assess instrumentation for control and diagnostics research needed to increased size and shape (diameter, thickness, length) for inner throat diameters up to 12”; develop and test a coating system to limit reaction of the W throats with its carbon support structure; investigate non-destructive evaluation (NDE) techniques for tungsten based nozzles; Use modeling, the material properties, the nozzle size requirements and the proposed propellant temperature to determine the optimal thickness requirements for the thin walled throats.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Dimensions on Day One: Completed testing of material properties to determine model parameters. Completed modeling of three sub-elements including full-size, highly complex components. Built three sub-elements to use for validating the model, and compared models to as-built components. Advanced Technology Capability: Development of new and novel advanced manufacturing processes that enable scale up production of demonstrated prototypes. ***FY 2017 Plans:*** Out of Autoclave Processing of Organic Matrix Composites (OMCs) for Advanced Propulsion: Develop novel manufacturing capabilities for affordable OMC advanced propulsion structure including front frames, stators and ducts. Mature current state of the art OMC systems with elevated service life ranging from 375F to 625F, beyond the capabilities of BMIs and cyanate esters. Fabrication of Non-Eroding Metallic Throat: produce 6” specimens and conduct testing; modify equipment and produce 9” specimens; study post VPS processing to assure 98% density. This included sintering and hot isostatic press (HIP) consolidation scale-up issues. Conduct research to improve the manufacturability of non-eroding throats; continue investigating and updating size requirements and non-destructive evaluation techniques; assess assembly requirements for supports/insulators and recommend/assess measures to reduce step down erosion in the exit cone; construct a material property data base as a function of VPS size and processing; create a preliminary design for scale-up of non-eroding throats to 12” ID. Advanced Technology Capability: Improvement and continued development of new and novel advanced manufacturing processes to enable scale up of production capabilities. ***FY 2018 Plans:*** Fabrication of Non-eroding Metallic Throat: Modify existing system with tooling and plasma gun for 12” diameter throats; fabricate tungsten base alloyed powders; continue to refine fabrication of 6” and 9” diameter throats; make 12” diameter material property specimens; conduct sintering and Hot Isostatic Processing; improve manufacturing methods and practices to reduce unit costs and reduce rejects; finalize the design of 6” and 9” diameter throats; conduct a preliminary design analysis for 12” diameter throats; test 12” material property specimens. Out of Autoclave Processing of Organic Matrix Composites (OMCs) for Advanced Propulsion: Assess required operating parameters for processing Organic Matrix Composites without autoclaves.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Advanced Technology Capability: Improvement and continued development of new and novel advanced manufacturing processes to enable scale up of production capabilities.			
Title: Enterprise and Emerging Manufacturing	2.662	3.048	3.791
Description: Enterprise and Emerging Manufacturing addresses advanced manufacturing technologies and business practices for defense applications. Key focus areas include direct digital (or additive) manufacturing, advanced manufacturing enterprise, machining, robotics, assembly, and joining. Projects selected will accelerate delivery of technical capabilities to impact current warfighting operations while reducing cost, acquisition time, and risk of major defense acquisition programs. It is paramount for the U.S. military to improve its own agility and flexibility. The focus is to find a solution to overcome a burdensome acquisition cycle requiring a great amount of cost, time, security, and storage space. Through the use of secure satellite data links or a local parts database, warfighters can access computer-aided design (CAD) for replacement parts, allowing them to repair equipment without the need to establish supply chains or wait for shipments. It allows operators to modify a part's design based on its performance in the field. Emerging manufacturing technologies undergoing development include: a large-scale challenge for advanced, interoperable machine tool applications, and methods for exchange of 3D official technical data throughout the supply chain and between the Government and contractors. Projects: MTConnect Challenge Phase II (FY 2016): Promote academia’s educational development and implementation of production interactive solutions to the broad U.S industrial base with the expansion of MTConnect Challenge that contributes to reduced cycle times and the development of real-time production metrics for adaptable dashboard applications. Securing American Manufacturing (SAM) (FY 2016): develop a Trusted and Assured supply chain, identify threat vulnerabilities of industrial control systems, provide input to DoD policies, and shape follow-on investment to mitigate threat vulnerabilities. Applications span the US Defense Industrial Base. Cyber Security for the Shop Floor - Phase II (FY 2017-2018): The manufacturing factory floor is a growing area of concern for DoD cyber security because defense contractors throughout the DoD's supply chain are continually targeted by cyber criminals seeking to: 1) steal technical data, including critical national security information and valuable commercial intellectual property; 2) alter data, thereby affecting processes and products; and 3) impair or deny process control, thereby damaging or shutting down operations. Protecting the operational systems of a manufacturing enterprise presents a different set of challenges from protecting enterprise IT systems and networks. This phase II project will develop a Trusted and Assured supply chain, identify			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
threat vulnerabilities of industrial control systems, provide input to DoD policies, and shape follow-on investment to mitigate threat vulnerabilities. Applications span the US Defense Industrial Base. ***FY 2016 Accomplishments:*** MTConnect Challenge – Phase II: Focus on data accumulation in obtaining and exchanging information on the factory floor. Market the challenge opportunities for awareness to the Society of Manufacturing Engineers, NTMA, and Colleges for participation and submittals. Developed judging criteria and initiated development of the challenge review criteria. Securing American Manufacturing (SAM): Focused on multiple threat levels triggered on manufacturing equipment at the shop floor level. Assessed performance of companies for vulnerabilities after implementing the new Defense Federal Acquisition Regulation (DFAR) requirements. ***FY 2017 Plans:*** Cybersecurity for the Shop Floor - Phase II: develop a trusted and assured supply chain, identify threat vulnerabilities of industrial control systems, provide input to DoD policies, shape follow-on investment to mitigate threat vulnerabilities, and document assessment results that discuss DFAR requirements and suppliers' mitigation and cost implications. ***FY 2018 Plans:*** Cybersecurity for the Shop Floor – Phase II: enhance the relationship with the trusted and assured supply chain, analyze and mitigate known and suspected threat vulnerabilities of industrial control systems, provide input to DoD policies, and document and study assessment results that discuss DFAR requirements and suppliers' mitigation and cost implications.			
Accomplishments/Planned Programs Subtotals	15.501	21.442	23.375

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
• (BA3) 0603680F: *Air Force ManTech*	-	-	-	-	-	-	-	-	-		
• (BA3) 0603680N: *Navy ManTech*	-	-	-	-	-	-	-	-	-		
• (BA7) 0708045A: *Army ManTech - Industrial Preparedness*	-	-	-	-	-	-	-	-	-		
• (BA7) 0603680S: *DLA ManTech*	-	-	-	-	-	-	-	-	-		

Remarks

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D. Acquisition Strategy

Not applicable for this item. Outyear data for "Other Program Funding" is contained within the Service budgets.

E. Performance Metrics

The majority of DMS&T investment project performance metrics are specific to each effort and include measures identified in the project plans. Typical metrics include target dates and conditions-based milestones in project work breakdown schedules, production measures, production goals, production numbers and demonstration goals and dates.

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COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
P350: *Manufacturing Innovation Institutes*	112.787	136.498	136.956	112.784	-	112.784	92.309	57.485	34.168	35.633	Continuing	Continuing

A. Mission Description and Budget Item Justification

Technological innovation and leadership in manufacturing are essential to sustaining the foundations of economic competitiveness to maintain technological advantage and global dominance for our military. To support these goals, Manufacturing USA institutes, each led by non-profit 501(c) entities, have been established by the Department to serve as national assests with headquarters and regional hubs to accelerate technological innovation into commercial applications and concurrently develop the educational competencies and production processes via shared public-private sectors. Collaborative execution and funding by the Departments of Defense (DoD), Energy (DOE), and Commerce (DoC), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF) to support the establishment of these Manufacturing USA institutes will spur industry cost-share for manufacturing innovation and quickly develop a pathway for technology-focused regional hubs for collaboration among government, industry, and academia that will meet critical government and Warfighter needs. The overall concept of the Manufacturing USA program (previously named the National Network for Manufacturing Innovation until changed in FY16) and the design of its manufacturing innovation institutes are provided in several key federal documents; among them: 1) the President's National Science and Technology Council (NSTC) report by the Advanced Manufacturing National Program Office entitled, "National Network for Manufacturing Innovation: A Preliminary Design," published in January 2013, and more recently, in the following two NSTC reports: 2) "National Network for Manufacturing Innovation Program Strategic Plan" and 3) "National Network for Manufacturing Innovation Annual Report," both published in February 2016.

Each of the eight DoD-led Manufacturing USA institutes addressed in this budget is expected to be self-sustaining, without reliance on federal sustainment funding, by the end of the period defined by the respective cooperative agreement (CA) or technology investment agreement (TIA) between the federal government and the non-profit organization leading each institute consortium of members. This CA/TIA period is typically for five years, with the flexibility to extend the agreement up to two years for the benefit of DoD projects, technical achievement, etc., and to fully leverage the minimum 1:1 cost share.

Each of the eight DoD-led Manufacturing USA institutes is intended to:
1) Bring together industry, universities and community colleges, federal agencies, and state and local governments and organizations to create regionally-based but nationally-impactful public-private partnerships underpinning the formation of sustainable manufacturing innovation ecosystems
2) Accelerate innovation to bridge the gap between Research and Development (R&D) and deployment of technological innovations in domestic production of goods
3) Invest in industrially relevant manufacturing technologies with broad applications, accelerating innovation within DoD and across all manufacturing sectors to increase U.S. competitiveness
4) Provide shared assets to help companies access cutting-edge capabilities and equipment
5) Create an unparalleled environment to educate and train students and workers in advanced manufacturing skills
6) Focus on maturing the associated manufacturing technologies typically from from Manufacturing Readiness Level (MRL) 4 through 7

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The first and second year of each of these new institutes is devoted to establishing a sustainable business model and operations, with continued refinement throughout the full period of the cooperative agreement, including: expanding the institute's membership base (as appropriate); establishing and solidifying revenue streams (e.g., funding from new R&D activity, membership fees, training and workforce development, certification and licensing, etc.); establishing provisional Executive Council and Technical Advisory committees to execute the business of each institute; finalizing Intellectual Property plans; developing technology roadmaps to inform investment strategies; opening industrial commons to provide for shared resource facilities available to all institute members; initiating workforce training programs in each technology area; establishing complementary relationships between Manufacturing USA institutes; analyzing the U.S. and Global industrial base in partnership with other government agencies to build upon the institute portfolio and address critical requirements; and further developing national technology roadmaps.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Institute 1 – National Additive Manufacturing Innovation Institute (America Makes)	1.107	1.111	1.026

Description: Additive manufacturing (i.e., "3D printing") is a process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies such as traditional machining. Advanced additive manufacturing will benefit the DoD by enabling lifecycle cost savings and enhanced capabilities, including moving toward "focused logistics" – getting the right part in the right place in just the right time – for wartime and humanitarian missions using local supply chains. This Manufacturing USA institutes was established in 2012, with cooperative agreement funding included in this budget through FY 2015, and DoD program management costs included in subsequent fiscal years until all R&D projects, reporting, and fiduciary responsibilities are completed.

FY 2016 Accomplishments:
Launched a fourth call for R&D projects based on the institutes' most current technology roadmap; competitively reviewed and awarded additional applied research projects with highest potential for industry and government shared benefit; Formed a group of Standards Development Organizations to define needed industry standards; launched a project to enable low-cost sustainment capabilities for DoD; launched enhanced processes for transitioning technologies developed by the institute; implemented initiatives to increase the value proposition to members and support institute self-sustainability; continued education and workforce training initiatives.

FY 2017 Plans:
Complete technical performance of all projects awarded in FY 2015 and make results available in the knowledge base. Continue leading a group of Standards Development Organizations to define and document industry standards; continue implementing new processes for transitioning technologies developed by the institute; continue education and workforce training initiatives.

FY 2018 Plans:
Complete technical performance of all projects awarded in FY 2016 and make results available in the knowledge base. The period of performance for technical work under the Cooperative Agreement ends on August 31, 2017. Program management

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
subsequently continues to provide oversight through August 31, 2019 for the close-out of all R&D projects, cost share accrual, final reporting, and transition to sustainability, in addition to completion of RDT&E fiduciary responsibilities.			
Title: Institute 2 – Digital Manufacturing and Design Innovation Institute	24.109	13.537	4.635
Description: This national institute focus is on the implementation of the Digital Thread, the unencumbered flow of data across the lifecycle of a manufactured product encompassing data from design, production, supply, sourcing, inventory, assembly, quality, maintenance and sustainment. It includes the analysis of this data to reduce the time and cost of bringing new products to market, the elimination of barriers between design, manufacturing and sustainment by using both product data and process data in a way that is seamless and transparent. Technology thrust areas: advanced manufacturing enterprise; intelligent machines; advanced analysis; open source platform; and cyber manufacturing system security. This institute was established in February 2014, with cooperative agreement funding contribution included in this budget through FY 2018. ***FY 2016 Accomplishments:*** A total of 52 projects are underway or are in the process of award. Four calls for proposals were executed in 2016 with a topic in each of the technology thrust areas with a planned value of $7 - $10 million. Two combined Proposal Call Workshops were conducted. The Beta version of the digital manufacturing commons was launched and a call for applications for the open source system was executed with eight projects awarded. The Technology Roadmap and Strategic Investment Plan to lead the technology domain in the completion of a Digital Thread was revised. Education and workforce development projects were initiated: 1) Digital Manufacturing Skills Classification “Taxonomy” to create a comprehensive breakdown of digital manufacturing (DM) skill sets and create job profiles that match industry needs; 2) work with NIST/MEP on cooperative mechanisms such as “Train the Trainer” programs and utilization of their existing small and medium enterprises (SME) network to implement workforce development training and engagement; 3) Digital Analytics Boot Camp to develop a three to five day workshop on digital analytics in the manufacturing environment; 4) Digital Manufacturing-101 to develop DM open-source, online courses for the general public but target existing engineers, lead plant managers at Small-and-Medium-sized (SME) Manufacturers. ***FY 2017 Plans:*** Proposal calls are planned to occur approximately every six months, resulting in approximately 30 new projects with a planned value of $10 million. Conduct multiple Proposal Call Workshops, and award projects in the technology thrust areas identified above. Continue the on-going workforce development projects initiated in FY 2016. Instantiate a networking and capability matching mechanism with all new project calls and an online version on the website. Launch the commercial version of the Digital			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Manufacturing Commons. Revise the Technology Roadmap and Strategic Investment Plan to lead the technology domain in the completion of a Digital Thread. Announce the commercialization of new digital manufacturing and design technologies and industry capabilities. Significantly scale up commercialization, skill development and workforce development efforts from research projects and relationships with other government agencies. ***FY 2018 Plans:*** Proposal calls are planned to occur approximately every six months, resulting in approximately 15 new projects with a planned value of $6 million. Conduct two Proposal Call Workshops, and award projects in the technology thrust areas identified above. Continue and expand the workforce development projects initiated in FY 2016 and 2017. Expand the Digital Manufacturing Commons Open Source collaboration tool. Revise the Technology Roadmap and Strategic Investment Plan to lead the technology domain in the completion of a Digital Thread. Announce the commercialization of new digital manufacturing and design technologies and industry capabilities. Significantly scale up commercialization, skill development and workforce development efforts from research projects and relationships with other government agencies.			
Title: Institute 3 – Lightweight and Modern Metals Manufacturing Innovation Institute (Lightweight Innovations for Tomorrow (LIFT)) ***Description:*** Advanced lightweight metals retain properties comparable to heavier, traditional materials, and can enable weight reduction in a variety of components and products with significant energy savings and increased payloads. This institute will scale-up research across multiple areas to accelerate market expansion by applying an integrated materials and manufacturing approach, addressing a lack of design guides and certifications as well as cost and scale-up challenges. The goal is to catalyze the development of an advanced lightweight metal U.S. supplier base and to enable DoD to realize greater speed and agility of manned, unmanned, and Warfighter systems as well as benefits for commercial applications. Technology thrust areas: (1) priority metal classes and its alloys of advanced high-strength steels, titanium, aluminum and magnesium; (2) technology development needs grouped into six pillars: melt processing; powder processing; thermo-mechanical processing; low cost - agile tooling, coatings, and joining and assembly; (3) Crosscutting themes: Integrated Computational Materials Engineering (ICME), design, life-cycle analysis, validation/certification, cost modeling, supply chain, corrosion, and ballistic/blast This institute was established in February 2014, with cooperative agreement funds programmed in this budget through FY 2018. ***FY 2016 Accomplishments:*** Eight (8) projects released as result of first project call, with a tentative value of approximately $25 million. Second Project call status is white paper responses in eight project topic areas. 17 Workforce Development Program initiatives launched with an	27.897	13.479	4.108

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
approximate value of approximately $6.4 million. Conducted SWOT (strength-weakness-opportunity-trends) analyses along with road mapping to update mid and long-term technology investment strategies. Conducted a defense-focused workshop designed to assist in mapping investments in defense-related applications. Introduced the small and medium enterprise (SME) challenge, a “shark tank-type event which allowed SMEs to propose small technology venture projects to a panel of large industry members and subject matter experts. Expanding outreach to SMEs through workshop series to additional states within and outside the five-state region. Introduced an open-source platform of educational resource materials to supplement and improve education from K-12 through graduate degree programs. Worked with state of Indiana to design the first state-wide “work and learn” initiative to innovate and expand internships, apprenticeships, coop programs, and other models to integrate work-based learning into manufacturing programs at the secondary and post-secondary levels. Successfully launched Education and Workforce Development “infrastructure” in all five (5) State LIFT Teams. ***FY 2017 Plans:*** Project calls are planned to occur every six months, with a planned value of approximately $15 million for the year. In addition, will conduct several technology demonstrations and workshops to disseminate and implement the manufacturing technologies developed during project call number one. Complete installation and training for several pieces of critical equipment within the headquarters high bay facility. Conduct a series of workshops targeting small and medium enterprises (SME) across the nation. LIFT will develop a replicable, scalable roadmap to building a technology-competent, educated and skilled workforce – incorporating the new solutions “tested” in the five-State LIFT region – that will expand and enhance STEM education in the nation. Continue implementation and expansion of the “work and learn” initiative developed in FY 2016. ***FY 2018 Plans:*** Project calls are planned to occur every six months, with a planned value of approximately $15 million for the year. Will conduct additional technology demonstrations and workshops to disseminate and implement the manufacturing technologies developed during previous project calls. Conduct a series of workshops targeting small and medium enterprises (SME) across the nation. Complete installation of all equipment planned for the HQ high bay area. Continue to invest in education and workforce development solutions that link education, workforce development, and economic development resources to help create a coordinated economic development asset. Continue implementation and expansion of the “work and learn” initiative developed in FY 2017.			
Title: Institute 4 - Integrated Photonics Manufacturing Innovation Institute (American Institute for Manufacturing (AIM) Integrated Photonics) ***Description:*** Integrated photonics manufacturing advances the promise of unprecedented interconnection between electronics and photonics that will deliver previously unattainable performance in speed, density and power consumption, quickly providing differentiating benefits for defense applications such as high-speed signal processing, electronic warfare, information transport	33.311	25.459	25.331

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018

and computation, sensing, imaging and targeting. This institute will establish an end-to-end 'ecosystem' in the U.S. for advancing domestic integrated photonics manufacturing. This institute will include responsive integrated photonics fabrication foundry access, photonics-electronics integrated design tools, and advances in packaging, assembly and test automation. The goal will be to catalyze a vibrant, enduring integrated photonics domestic industrial base, much as SEMATECH did with the domestic semiconductor industry.

This institute was established in 2015, with cooperative agreement funding programmed in this budget through FY 2019.

FY 2016 Accomplishments:
Achieved initial operational capability of the institute, including the development and alpha release of an institute process design kit for silicon photonics, commencement of a multi-project wafer capability with a broker function to enable domestic integrated photonics production capability, and initial acquisition and buildout of new state-of-art package, assembly, and test tools and facilities in Rochester, NY. Conducted a second round of applied R&D project calls and awarded projects in the following key core areas identified in the roadmapping phase: Very High Speed Digital Data and Communication Links, Analog RF Applications, Integrated Photonics Sensors, and Photonic Integrated Circuit Array Technologies. Initiated efforts to develop a world-class integrated photonics work force through focused education, webinars, and training programs.

FY 2017 Plans:
Fully implement the integrated photonics manufacturing innovation ecosystem, including evolutionary improvements in photonic integrated circuit design tools, multi-project wafer capabilities, and package, assembly, and test tools and facilities. Provide a second domestic-wide integrated photonics manufacturing capability (in addition to silicon photonics), in this case for indium phosphide-based integrated photonics. Stand-up the packaging, assembly and test hub in Rochester, NY. Continue development of novel automated tools for cost-effective high volume end-to-end assembly and packaging of photonic integrated components. Conduct an additional round of applied R&D project calls and award projects across the eight manufacturing centers of excellence and key technology manufacturing applications areas. These projects will address common manufacturing challenges identified by the eight technology working groups and is reflected in the AIM roadmap. Transition FY 2016 projects' output to the elements of the domestic integrated photonics supply chain. Execute additional plans for development of a world-class integrated photonics work force through establishment of master's level program, design training, webinars, and training programs. Begin to transition key capabilities from this institute to ongoing DoD programs requiring integrated photonics solutions across each military service.

FY 2018 Plans:
Continue advancement of the integrated photonics manufacturing innovation ecosystem, including release of mature photonic integrated circuit design tools for both silicon and indium phosphide-based photonics, full implementation of robust, high-yield multi-project wafer capabilities, and completed buildout of state-of-the-art package, assembly, and test tools and facilities in

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Rochester, NY. Conduct additional round of applied R&D project calls and award projects in the key core areas identified in the roadmapping phase. Transition FY 2017 projects' output to the supply chain. Leverage the now mature integrated photonics domestic ecosystem to develop novel integrated photonics components for DoD programs . Incorporate emerging domestic world-class integrated photonics work force into ecosystem. Begin to see a sustainable integrated photonics institute emerging, as evidenced by fee-for-service wafer production, increased membership, licensing of institute intellectual property, and other revenues being realized. This will help extend this institute beyond the length of the Cooperative Agreement, providing key manufacturing capability for the DoD requirements through 2020 and beyond.			
Title: Institute 5 – Flexible Hybrid Electronics Manufacturing Innovation Institute (Nextflex – America's Flexible Hybrid Electronics Manufacturing Institute)	31.122	21.630	16.318
Description: Flexible hybrid electronics manufacturing involves highly tailorable devices on non-traditional, compliant substrates that combine thinned components manufactured from traditional processes with components that are added via "printing" processes. This institute will invest in prototyping and scale-up of manufacturing processes for high speed pick-and-place, printed circuits, and hybrid fabrication that will enable defense and commercial applications in wearable electronics, unattended sensors and integrated array antennas, medical devices and soft robotics devices, and the continuous improvement in SWAPC (Size, Weight And Power plus Cost) for electronic systems. This institute will establish an end-to-end domestic innovation 'ecosystem,' containing design, packaging, assembly and test automation research and workforce development capabilities which can be accessed by small, medium and large companies as well as academic institutes. The goal is to help enable the creation of a sustainable domestic industrial base which can rapidly respond to global needs using a quick technology cycle and scale-up. This institute was established in 2015, with cooperative agreement funds programmed in this budget through FY 2019.			
FY 2016 Accomplishments: NextFlex pursued a "fast-start" approach, with two project calls ($45M in investments over 25 projects for accelerating development and adoption of flexible hybrid electronics (FHE) for DoD and commercial applications) launched within the first nine months of the Institute announcement. These project call topics resulted from multiple roadmap activities by technical working groups, including a 2-day workshop with 172 subject matter experts, and subsequent meetings of nine technical working group. Built membership and released Participation Agreement and Intellectual Property Policy. NextFlex has signed agreements with 42 members, with 22 companies and 20 universities and non-profits. Began three workforce development projects, including Hack3Defense and FabLab STEM Program. Achieved initial capability for the NextFlex Institute Hub in San Jose, CA.			
FY 2017 Plans: Major plans for FY17 include building to 100 members total, updating the technology driven and application aligned Roadmap to version 2.0, and then releasing project call #3 (based upon Roadmap 2.0) targeting $20M of investment. Continue to support the innovation ecosystem, with focus on Industry transition pathways and building Hub Capabilities "Pilot Line" through installation			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
of tooling, metrology and application labs. For Workforce Development, build “Flex Factor from 30 students to 300 students in FY17, expanding from one California school district to 4 districts in California and 3 districts in two other states. Host quarterly webinares, three technical workshops and a large “Flex” conference with peer-reviewed technical papers. Finally, engage with new DoD customers to bring at least $5M in new manufacturing R&D activities to the Institute. ***FY 2018 Plans:*** Project calls are expected to be made every year, with potential for continued Phase II investment for successful Projects from PC 1.0 and 2.0. Open a functioning pilot line for prototyping, using all major EMS processing steps for FHE. Focus on dissemination of the five Manufacturing Technology Area (MTA) and Technology Development Platform (TDP) results into Industry application areas. Refine workforce development activities to ensure sufficient pipeline expertise and recruitment.			
Title: Institute 6 - Revolutionary Fibers and Textiles Manufacturing Innovation Institute ***Description:*** The RFT institute will address the spectrum of manufacturing challenges associated with revolutionary fibers and textiles, from design to end products. It will support an end-to-end innovation 'ecosystem' in the U.S. for revolutionary fibers and textiles manufacturing and leverage domestic manufacturing facilities to develop and scale-up manufacturing processes. The institute will provide innovative system demonstrations based on robust design and simulation tools, pilot production facilities, a roster of subject matter experts, suppliers, and workforce development opportunities through targeted training and curriculum programs. This institute will be established in early 2016, with cooperative agreement funds programmed in this budget through FY 2020. ***FY 2016 Accomplishments:*** update pending update pending ***FY 2017 Plans:*** update pending update pending ***FY 2018 Plans:*** update pending update pending	17.452	21.740	21.366
Title: Institute 7 - Advanced Tissue Biofabrication Manufacturing Innovation Institute (ATB-MII) ***Description:*** This institute is intended to advance state-of-the-art human tissue manufacturing innovations in cell and biomaterial processing, bioprinting, automation and non-destructive testing technologies. The motivation is to increase U.S. competitiveness	0.750	20.000	20.000

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in advanced tissue biofabrication manufacturing by encouraging insertion of disruptive technologies into multiple biotechnology sectors, streamlining integrated testing technologies and ultimately reducing the barrier to entry for new inventors. The goal is to establish a collaboration that will mature tissue-related technology across a range of manufacturing readiness levels (MRL) 4-7, enabling post-delivery assurance of tissue identity, viability, function, and efficacy. This Institute will bring together the diverse and currently fragmented collection of industry practices and institutional knowledge across many disciplines (cell biology, bioengineering, materials science, analytical chemistry, robotics, and quality assurance). Scaling up to commercial level production of tissues will require manufacturing and process automation suitable for living cells, as well as testing and preservation methods appropriate for tissue-based products with limited shelf-life and a narrow window of efficacy. Technical focus at a minimum will be comprised of four thrust areas: 1) Cell & Material Selection & Sourcing; 2) Biofabrication Platforms; 3) Process Design and Automation; 4) Tissue Finishing and Testing Technologies This institute was established in late 2016. Technology Investment Agreement funds are programmed in this budget from FY 2016 through FY 2022. ***FY 2016 Accomplishments:*** Conducted analysis of Request for Information, Institute Technology Readiness Reviews, established a program management structure at the Services and OSD levels to support this technology selection, conducted acquisition planning and execution, and selected Advanced Tissue Biofabrication topic as the 7th DoD-led institute. Awarded the Technology Investment Agreement in late calendar year 2016. Proceeded with establishment of a management structure and initial staffing. ***FY 2017 Plans:*** Establish this new Manufacturing USA institutes following the processes used for previous institutes and as refined through lessons learned in solicitations and standup of Institutes 1-6. Conduct initial technology road mapping activities. Complete a data call for a first round of S&T projects addressing common manufacturing problems in advanced tissue biofabrication and award project contracts in the key core technology areas identified within the road mapping activities. ***FY 2018 Plans:*** Continue to expand the membership and refine core investment areas supporting the innovation ecosystem. Initiate two rounds of applied R&D project calls in core areas. Execute workforce development projects.			
Title: Institute 8 - Robotics in Manufacturing Environment (RiME)	0.750	20.000	20.000
Description: The motivation for this Manufacturing Innovation Institute is to improve U.S. competitiveness in manufacturing through advancements in the smart collaborative robotic field. This technology has the potential to level the manufacturing playing field with competing low labor cost economies, with decreased manufacturing cost, better quality and timely reaction			

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Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603680D8Z / *Defense Wide Manufacturing Science and Technology Program*	**Project (Number/Name)** P350 / *Manufacturing Innovation Institutes*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
to changes needed by the customer. Smart, collaborative robotics can also enable "batch of one" production, also known as mass customization. The technologies developed in this institute will be primarily focused in making advanced manufacturing more competitive, addressing DoD needs, and contribute to improving prosperity in the United States. The Institute will focus on technology areas such as human robot interaction, adaption, learning, manipulation, autonomy, mobility and perception. This institute will be established in FY 2017. Cooperative Agreement/Technology Investment Agreement funds are programmed in this budget from FY 2017 through FY 2022. ***FY 2016 Accomplishments:*** Conducted analysis of Request for Information, Institute Technology Readiness Reviews, established a program management structure at the Services and OSD levels to support this technology selection, conducted acquisition planning and execution, and selected Robotics in Manufacturing Environment topic as the 8th DoD-led Manufacturing USA institutes. ***FY 2017 Plans:*** Award Technology Investment Agreement and establish this new institute following the processes used for previous institutes and as refined through lessons learned in solicitations and standup of Institutes 1-6. Conduct initial technology road mapping activities. Complete a data call for a first round of S&T projects and award project contracts in the key core technology areas identified within the road mapping activities. ***FY 2018 Plans:*** Continue to expand the membership and refine core investment areas supporting the innovation ecosystem. Initiate two rounds of applied R&D project calls in core areas. Execute workforce development projects.			
Accomplishments/Planned Programs Subtotals	136.498	136.956	112.784

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Each Manufacturing Innovation Institute is established through a competitive selection process. The executing military department or agency, in close and continuous coordination with OSD ManTech, publishes a formal solicitation (funding opportunity announcement) for proposals describing the scope of required activities and extensive proposal evaluation criteria. Non-Profit Organizations (including universities) are eligible to bid, and each bidder forms a broad consortium of industry and academic partners. The executing military department or agency, in close coordination with OSD, uses a team of government experts to evaluate each proposal against the evaluation criteria and selects a winning consortium. The final terms of the cooperative agreement/technology investment agreement between the selectee and

the federal government are then negotiated and the CA or TIA is signed. Throughout and after completion of this process, the federal government makes clear that members of non-selected teams are encouraged to join the selected consortium as conditions permit.

E. Performance Metrics

Assessing the performance of the DoD-led manufacturing institutess, part of the whole-of-government Manufacturing USA Program, requires a multi-faceted view of 'performance,' given the program's layered base of DoD, government-wide, and national level public-private stakeholders and interests. Notwithstanding this complexity, the Department is careful to maintain orientation with the DoD ManTech program's statutory goals and objectives and has concluded that those requirements are highly complementary to, and supportive of, the broader national goals of the Manufacturing USA Program as laid out in the Revitalize American Manufacturing and Innovation (RAMI) Act of 2014. Performance relative to both sets of goals/objectives is necessarily measured in both qualitative and quantitative terms, and many of the institutes accomplishments previously addressed represent rich and highly descriptive qualitative and quantitative measure of program performance. The Department actively reviews or oversees the review of institute metrics at four levels: 1) the overall Manufacturing USA network level (this is done in coordination with the DoD's Manufacturing USA interagency partners), 2) at the DoD/funding agency level (per the statutory requirements of DoD ManTech Program), 3) at the individual institute level (in coordination with each institute), and 4) at the specific technology project level (via DoD technical expert involvement in the institutes). Broadly, the institutes themselves are charged by the DoD, the Administration and Congress with ensuring that key elements of their innovation ecosystems will be matured and made widely available by fostering collaborations between appropriate elements of that ecosystem. The following four categories of metrics have emerged as common focus areas:

1. Impact on U.S. Innovation Ecosystem
2. Financial Leverage/Sustainability
3. Education and Advanced Manufacturing Workforce Development
4. Technical Advancement

Specific metrics and the annual cycle for measuring progress against benchmarks are developed for each institute consortium and reflect that institute's unique technology capability, expertise, and organizational structure. The Department strives to ensure that the assessment process captures and articulates the benefits to national security based upon technological advancements and the industrial base.