Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Office of the Secretary Of Defense	Date: February 2016
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 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	158.554	88.135	156.743	158.398	-	158.398	136.848	116.354	89.326	70.288	Continuing	Continuing
P680: *Manufacturing Science and Technology Program*	111.117	22.785	20.245	21.311	-	21.311	22.078	23.798	31.188	35.372	Continuing	Continuing
P350: *Manufacturing Innovation Institutes*	47.437	65.350	136.498	137.087	-	137.087	114.770	92.556	58.138	34.916	Continuing	Continuing

A. Mission Description and Budget Item Justification

Defense-wide Manufacturing Science and Technology (DMS&T), established within the Manufacturing Technology Program directed in Title 10 USC Section 2521, provides the Department with a comprehensive manufacturing program to achieve the strategic goals of focused technology, improved acquisition across the life cycles, and cost-effective logistics. By designing for manufacturability early in development, anticipated results will have an impact on increasing reliability and decreasing the life cycle burden of weapon systems. The mission to anticipate and close gaps in defense manufacturing capabilities and drive significant system life cycle affordability benefits makes DMS&T an increasingly important leveraging tool in the current budget environment.

DMS&T will: 1) address manufacturing enterprise game-changing initiatives that are beyond the scope of any one Military Department or Defense Agency or platform and, 2) establish and mature cross-cutting manufacturing processes required for transitioning emerging technologies which impact the time lines, affordability, and productivity of acquisition programs and shorten the deployment cycle times.

The DMS&T program is fundamental to a coordinated development process. Concurrent development of manufacturing processes with the S&T development enables the use of emerging technologies. Key technical areas for investment for DMS&T include Advanced Electronics and Optics Manufacturing, Advanced Materials Manufacturing, and Enterprise and Emerging Manufacturing. 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.

The Manufacturing Innovation Institutes program funding is also included in this program element. Technical innovation and leadership in manufacturing are essential to sustaining the foundations of economic prosperity to enable our military to maintain technological advantage and global dominance. To support these goals, Institutes for Manufacturing Innovation Institutes (MII) will serve as regional hubs to accelerate technological innovation into commercial application and concurrently develop the educational competencies and production processes via shared public-private sectors. The establishment of the MIIs, supported by resources from multiple U.S. Government agencies, 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 concept of these institutes is described in the President's

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National Science and Technology Council report by the Advanced Manufacturing National Program Office entitled, "National Network for Manufacturing Innovation: A Preliminary Design," published in January 2013.

B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	90.966	157.056	119.714	-	119.714
Current President's Budget	88.135	156.743	158.398	-	158.398
Total Adjustments	-2.831	-0.313	38.684	-	38.684
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-0.313			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.796	-			
• DoD rebalancing of accounts	-	-	-0.400	-	-0.400
• Reprogramming for Cancelled Accounts	-0.035	-	-	-	-
• Economic Assumptions	-	-	-0.916	-	-0.916
• Establish two additional Manufacturing Innovation Institutes (#7 and #8)	-	-	40.000	-	40.000

Change Summary Explanation

Two project codes are used in this Program Element (PE) to distinguish between the level of funding for the Core OSD Manufacturing Technology program (P680) and the Manufacturing Innovation Institutes (P350). The growth in funding in this PE from prior President's budgets is wholly associated with the addition of the MII (P350) program.

P350 Manufacturing Innovation Institutes (MII) - issues affecting year-to-year changes:
1) Cooperative Agreement (CA) five-year funding profiles for each of eight institutes are not straight-line funded in each year, but instead are incrementally increased and decreased across five fiscal years, with the third year being the peak year. This profile leverages the ability to attain matching funds from industry and academia partners for R&D projects.
2) The number of institutes changes from five in FY 2015 to six in FY 2016, and to eight in FY 2017.
3) FY 2016 and FY 2017 are the peak years for funding for the MII program, with significant annual decreases programmed annually subsequent to FY 2017.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Office of the Secretary Of Defense			Date: February 2016
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 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
P680: *Manufacturing Science and Technology Program*	111.117	22.785	20.245	21.311	-	21.311	22.078	23.798	31.188	35.372	Continuing	Continuing

A. Mission Description and Budget Item Justification

The DMS&T program has a two-pronged approach: 1) technology initiatives and 2) specific single projects. Technology initiatives, in collaboration with the Joint Defense Manufacturing Technology Panel (JDMTP) and industry, identify and develop investment strategies to advance the manufacturing processes needed to support the specific technology. Above-the-shop-floor investments focus on new manufacturing processes that have potential to significantly improve manufacturing efficiencies. Single specific projects address investment opportunities not associated with selected technology initiatives and enable the program to respond to urgent, compelling manufacturing needs and provide seed funding to more high risk-high payoff technologies.

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 Broad Agency 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 Director of Manufacturing, 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 2015	FY 2016	FY 2017
Title: Advanced Electronics and Optics	13.899	12.182	12.550
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 2015	FY 2016	FY 2017
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: Silicon Carbide (SiC) High Efficiency Power Switches (FY 2015): Enable a new class of power electronics that allows flexible new architectures at higher voltages, higher frequencies, less volume and weight, higher temperatures, higher efficiency (reduced fuel consumption), and better power quality that allows flexible architectures with enhanced electronics in a smaller footprint. Demonstrated on a naval power conditioning application, reduced the weight by 90% and volume by 30%. Reduce high voltage pulsed diode $/Amp from $0.40 at 6kv to $0.27 at >20kV. Applications include Army - Platform Modernization Program Navy - DDG51 Flight III (Electric Ships Office, PMS-320); and Air Force – F-35, F-22 (MEA & F-35 Offices). Photonic Crystals for Thermal Beacons (FY 2015): Drive affordability, manufacturability, and quality photonic crystal production to enable Identification of Friend or Foe (IFF), producing a thermal beacon using photonic crystals. Systems impacted include the Thermal Beacon, Intelligence Surveillance and Reconnaissance (ISR) that use Mid-Wave Infrared (MWIR) including MQ1/MQ9/ AC-130/F15/F18/Sniper Pod/Litening Pod, MWIR - Hand Held Imagers, as well as In-line WPN's Sights such as the HISS and INOD Blk3. The benefit is immediate upon reaching the battlefield. Benefits to the Warfighter include decreased fratricide and ability to employ new tactics, techniques and procedures (TTP). Mini Short-wave Infrared (SWIR) Cameras and Imagers (FY 2015-2016): 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).			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Manufacturability of Vertical Cavity Surface Emitting Lasers (VCSELs) – Phase I (FY 2015) Develop better performance for laser sights, laser illuminators, and laser designators as measured by size, weight and power and wider scale deployment of critical laser-based systems due to lower cost. Provide clearer illumination critical for positive Identification (ID) Friend vs. Foe, facial ID, weapons ID; covert wavelengths; improve packaging (10-100x smaller and lighter products); increase reliability (10,000 hrs.). 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, ARGUS, and others.			
Manufacturability of Vertical Cavity Surface Emitting Lasers (VCSELs) – Phase II (FY 2016-2017): 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 2015-2017): 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. 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 2015-2017): 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.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017

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.

Radar Affordability Initiative (RAI) (FY 2015): RAI offers DoD common, modular building blocks performing like functions across radar and electronic warfare (EW) systems. The RAI approach enables acquisitions to complete subcomponents within a design. The DoD also receives Government Purpose Rights (GPR) for each investment, enabling competition, and breaking sole source dependencies. At the completion of RAI projects, DoD will have GPR for T/R Modules, solid state amplifiers, and limiters. Additionally, the DoD will have evidence that applying the common, modular approach shortens hardware upgrade times. The RAI Affordable Transmit-Receive Modules (ATRM) project is aimed at reducing the cost of the G/ATOR T/R Module (while maintaining module form factor, performance, and reliability) through incorporating the functionality of three separate regulator chips into a single, super regulator chip and development of a high power amplifier (HPA) 2nd source.

Radar Affordability Initiative – SPS-49 (FY 2016-2017): The SPS-49 program is focused on the design and development of an affordable upgrade of the AN/SPS-49A(V)1 below deck equipment with modern, sustainable, maintainable equipment in a high reliability, high availability operational environment. This upgrade program will design, fabricate and test three Engineering Development Model 49AUs built using production processes and designed with an open system architecture which is easily maintained and easily upgraded. The 49AUs will be installed on U. S. Navy ships for operational testing and evaluation.

Nanocomposite Optical Ceramics (NCOC)(FY 2016-2017): 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 2015 Accomplishments:
Silicon Carbide (SiC) High Efficiency Power Switches: Completed Stage 1 & Stage 2 of 3-Stage expansion of Gen 2 SiC wafer seed crystals to 133 mm diameter wafer. Continued work on alternative approach to reduce defects in production Gen

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
1 150 mm SiC crystals. Continued progress on 3 x 150 mm Hot-Wall SiC epi reactor development. Completed fabrication and characterization of multiple 1200V SiC trench Metal Oxide Semiconductor Field Effect Transistor (MOSFET) fab lots. Mini Short-wave Infrared (SWIR) Cameras and Imagers: Completed the following: baseline focal plane array (FPA) production lot to establish starting cycle time and identify improvement area; initial development of wafer level diamond point turning, FPA level polishing, and FPA level anti reflective coating processes; and thermos electric cooler (TEC) stabilized camera core used for TEC-less data collection and algorithm development. VISTA High Temp MWIR Detectors: Continued efforts to integrate High Operating Temperature MWIR FPA technology developed under the larger VISTA program into the F-35 EODAS system. Began FPA fabrication, process optimization and maturation, and supporting integrated dewar cooler assembly field testing. Manufacturability of Vertical-Cavity Surface Emitting Lasers (VCSELs) - Phase I: implemented process changes to improve yield of high power pump modules; built and tested prototype VCSEL pump modules; completed high power pump module demonstration with monoblock laser; explored approaches to improve low power illuminator beam uniformity; met program threshold for low power illuminator lifetime reliability; and fulfilled customer orders for high power illuminators. Improved Focal Plane Array (FPS) - Hyperspectral – Phase II: awarded contract to 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 Photonic Crystals for Thermal Beacons: established photonic crystal foundry processes, layout, and flow. Processes established included growing, dicing, etching, and vacuum sealing. Leveraged prior investment in development of prototype beacons. Executed the photonic crystal emitter fabrication steps to enable a transition from MRL 4 to MRL 7. Radar Affordability Initiative: initiated Affordable Transmit-Receive Modules (ATRM) Super Regulator design activity for incorporating three separate regulator chips into one; began consolidation of functionality using SiGe MMIC technology as well as migrating to a non-hermetic organic package; researched and identified second source opportunities; completed Printed Circuit Board (PCB) material trade studies. PCB material Megatron 6(N) was selected to best meet performance goals. Completed the Quad Flat No-leads (QFN) packaging trade study (Sumitomo Bakelite {Gen7} material selected). Critical Design Review (CDR) milestones were achieved. ***FY 2016 Plans:***			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Mini Short-wave Infrared Cameras and Imagers: establish plan for device transitions; continue wafer growth/processing, hybridization, sensor packaging, and camera calibration efforts. 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: continue pointer device development; design and develop electronics and packaging; and begin planning for manufacturing and field testing. Organic Light Emitting Diode (OLED) Microdisplays – Phase II: conduct an initial Manufacturing Readiness Assessment (MRA); identify key processes for direct patterning; perform diagnostic tests to enhance understanding of direct patterning device performance; identify, design, and order direct patterning equipment; fabricate graphics array test cells and product wafers for the direct patterning initiative; install and test the initial linear sources for the direct patterning initiative; complete a design and tape-out of the Silicon on Insulator (SOI) backplane; demonstrate OLED on Silicon on Insulator and direct patterning on bulk silicon. Improved Focal Plane Array (FPS) - Hyperspectral – Phase II: focus on detector and FPA fabrication, testing, and validation; demonstrate 640x480, 20 µm Very Long Wavelength Infrared FPAs; provide detailed FPA characterization; develop cost and yield models using multi-wafer lot runs. Radar Affordability Initiative – SPS-49: initiate design and development of an affordable upgrade of the AN/SPS-49A(V)1 below deck equipment with modern, sustainable, maintainable equipment in a high reliability high available operational environment. Nanocomposite Optical Ceramics (NCOC): Manufacturing Readiness Levels (MRLs) for NCOC dome manufacturing needs to shift from 4 to 7 over the next two years to support transition activities associated with AIM-9X. Manufacturing tasks will target low-			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
rate initial production (LRIP) activities in 2017 followed by full rate production (FRP) starting in 2018. Manufacturing activities will include raw material costs, powder conditioning, blank forming, heat treatment, optical finishing and coatings. ***FY 2017 Plans:*** Improved Focal Plane Array (FPS) - Hyperspectral – Phase II: continue producing focal plane array (FPA) lots; continue to determine FPA yield for each lot by verifying FPA performance; modify manufacturing processes between each FPA lot to increase yield. 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: 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; initiate a SOI qualification plan; conduct an interim Manufacturing Readiness assessment. Radar Affordability Initiative – SPS-49: design and develop an affordable upgrade of the AN/SPS-49A(V)1 below deck equipment with modern, sustainable, maintainable equipment in a high reliability, high availability operational environment. 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; measure results and assess Manufacturing Readiness Levels.			
Title: Advanced Materials Manufacturing ***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.	6.303	5.401	5.713

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
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 2015): 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 with a projected $17/round cost reduction. Primary applications include Mk 19 GMG, M203 GL, M320GL, and M32 MSGL. Secondary applications include Cannon and Tank Calibers, and Hand Grenades. Automated and Rapid Boot Installation (FY 2015-2016): Achieve an F-35 Program-wide 30% reduction in touch labor for boot installation and boot hole cutting. Improve fit and finish, reducing production span times (20s/fastener to 3s/fastener for boot hole cutting), reducing kitting, eliminating time for adhesive mixing, application, and vacuum bagging. Applicable to all aircraft acquisition and sustainment communities. Cold Spray Repair and Rebuild Phase II - Large Structures (FY 2015-2017): 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 2015, FY 2017): 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			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
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): 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 Adaptive Engine Transition Programme (AETP) will lower cost, increase range and maintain performance for the next generation tactical aircraft. Fabrication of Non-Eroding Metallic Throat (FY 2016-2017): 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. ***FY 2015 Accomplishments:*** 40MM M433 Warhead Improvement Producibility: developed injection molding and discrete fragment insertion tooling and processes; optimized mold stages to decrease time to load parts, over-mold parts & transition to follow on stages; developed fragment insertion methods/tools to reduce time to fill mold with fragments & settle/align fragments; enabled mold stage transitions at reduced cycle times. Automated and Rapid Boot Installation: conducted pre-production evaluations of complex boot assemblies; determined implementation approach; solicited Request for Proposals for pressure sensitive adhesive applications. Cold Spray Repair and Rebuild Phase II - Large Structures: assessed the repair and processing requirements for the large parts on the submarine periscopes and stern tubes of the Virginia 688, Ohio 726, and Sea Wolf. Dimensions on Day One: created process methodology and identified required materials not addressed in current predictive software; tested materials for resin shrinkage and coefficient of thermal expansion; developed predictive capability methodology training; created and evaluated predictive model for a subcomponent with simple modeling characteristics and compared to “as built” hardware. ***FY 2016 Plans:***			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Cold Spray Repair and Rebuild Phase II Large Structures: expand the capability of Cold Spray Phase I System to accommodate larger components; incorporate a means of processing long parts (40 feet); develop a fully integrated "tube" repair processing line. Automated and Rapid Boot Installation: implement adhesive application development to enable reduced cycle time and improved quality. Large Scale Encapsulate Ceramics - Phase II: conduct manufacturing trials to scale up solutions; test full-size panels; refine models; produce the required thermal design power 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.			
FY 2017 Plans: Cold Spray Repair and Rebuild Phase II Large Structures: final integration and system demonstration. Dimensions on Day One: scale the model up to a full-size highly complex component, compare predictions to an as-built component, and demonstrate Manufacturing Readiness Level 7 capability. 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			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
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.			
Title: Enterprise and Emerging Manufacturing	2.583	2.662	3.048
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. Cyber Initiative: 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 initiative will focus on the objective of securing the environment for American Manufacturing on the shop floor. Efforts will include: developing cyber threat models, creating a tool to visualize and simulate an attack on manufacturing to understand dependencies; engaging an industry consortium for knowledge/data sharing/threat sharing; building an industry consortium that coalesces industry needs and shares critical data; developing a cyber-physical test environment for manufacturing cybersecurity (e.g., how to test protection for work instructions/process documentation; conducting primary research into creating secure protocols for information across the digital thread; and creating supplier management standard processes and certifications (e.g., a critical security control list). Projects:			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017

Criticality of American Manufacturing (CAM) (FY 2015): The Defense Systems Information Analysis Center (DSIAC) will provide a detailed analysis of the Criticality of American Manufacturing (CAM) to the resiliency and innovation defense industrial base. The analysis will focus on the criticality of physical and programmatic clustered activity between academia, industry and government to support manufacturing technology and capability. The analysis will address the importance of human capital investment to innovation and the resiliency of the American Manufacturing & Industrial Base.

High Power Ultrasonic Assisted Drilling (FY 2015): addresses the problem of high costs of drilling various alloys of significant strength, High KSI Steels, IN625, and Composites by developing ultrasonic technology for hole-drilling applications to improve productivity and tool life by more than 50%. This process potentially impacts all systems that require drilling of holes.

MTConnect Challenge Phase II (FY 2015-2016): 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.

Cyber Security for the Shop Floor – Phase II (FY 2016-2017): A follow-on from a previously funded Phase I Red Team evaluation, this phase II project will 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.

FY 2015 Accomplishments:
MTConnect Challenge - Phase II: Building upon the results of the first MTConnect Challenge, the phase II objective focused on challenging Academia's role in support of the MTConnect expansion in Industry use.

High Power Ultrasonic Assisted Drilling: advanced AcousTech Machining from a Manufacturing Readiness Level (MRL) of 4 to 6 by focusing on Drilling and Milling Studies of Weapons Systems Materials and AcousTech Machining Module Refinement. Feasibility of improvements were observed in the form of increased feed rates, improved surface finish, reduction in force and torque, and burr reduction.

Criticality of American Manufacturing (CAM): began framing the ontology and ecosystem dynamics that define the "Criticality" of American Advanced Manufacturing (AM). This effort focused on baselining the initial argument and scoping the assessment framework for CAM assessments, including: 1) definition of the key components/enablers of AM and its general taxonomy; 2) general mapping of the AM ecosystem and its overall composition and incentive structure; and 3) framing of areas of AM

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
"dominance" vs. "relevance" with requisite sector/technology differentiation. Addressed some general questions in order to lay out a structure for future assessments as well as to bolster future dialogue on current initiatives and communities (among U.S. manufacturing institutes and Communities of Interest). ***FY 2016 Plans:*** 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. Develop judging criteria and initiate development of the challenge review criteria. Cybersecurity for the Shop Floor – Phase II: follow-on efforts from a previously funded Phase I Red Team evaluation that focused on multiple threat levels triggered on manufacturing equipment at the shop floor level. Assess performance of companies for vulnerabilities after implementing the new 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. Cybersecurity Initiative: continuing and expanded efforts will include developing cyber threat models, creating a tool to visualize and simulate an attack on manufacturing to understand dependencies; engaging an industry consortium for knowledge/data sharing/threat sharing; building an industry consortium that coalesces industry needs and shares critical data; developing a cyber-physical test environment for manufacturing cybersecurity (e.g., how to test protection for work instructions/process documentation; conducting primary research into creating secure protocols for information across the digital thread; and creating supplier management standard processes and certifications (e.g., a critical security control list).			
Accomplishments/Planned Programs Subtotals	22.785	20.245	21.311

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
• (BA3) 0603680F: *Air Force ManTech*	-	-	-	-	-	-	-	-	-		
• (BA3) 0603680N: *Navy ManTech*	-	-	-	-	-	-	-	-	-		

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C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
• (BA7) 0708045A: *Army ManTech - Industrial Preparedness*	-	-	-	-	-	-	-	-	-		
• (BA7) 0603680S: *DLA ManTech*	-	-	-	-	-	-	-	-	-		

Remarks

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 project performance metrics are specific to each effort and include measures identified in the project plans. The metrics include items such as target dates from project work break down schedules, production measures, production goals, production numbers and demonstration goals and dates. In addition, generic performance metrics applicable to the Defense-Wide Manufacturing, Science and Technology (DMS&T) program includes attainment of a previous administration goal, "Speed technology transition focused on warfighting needs". The metrics for this objective and the objective of DMS&T is to transition 30% of completing demonstrations program per year.

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COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
P350: *Manufacturing Innovation Institutes*	47.437	65.350	136.498	137.087	-	137.087	114.770	92.556	58.138	34.916	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 Innovation Institutes (MIIs), each led by non-profit 501(c) entities, will serve as 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 MIIs 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 concept of these institutes is described in the President's National Science and Technology Council report by the Advanced Manufacturing National Program Office entitled, "National Network for Manufacturing Innovation: A Preliminary Design," published in January 2013.

Each of the eight DoD-led MIIs addressed in this budget is expected to be self-sustaining, without reliance on federal sustainment funding, by the end of the respective cooperative agreement (CA) period between the federal government and the non-profit-led consortium. This CA period is typically for five years, with the option to extend the agreement up to two years for the benefit of DoD projects, technical achievement, etc., to fully leverage the minimum 1:1 cost share. All subsequent (post-CA) federal funding provided to any MII will be on a specific project basis by the requirements generators, either within or external to DoD.

Each of the eight DoD-led MIIs 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 from Manufacturing Readiness Level (MRL) 4 to 7

The first and second year of each of these new institutes is devoted to establishing a sustainable business model, 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;

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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 MIIs; 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 2015	FY 2016	FY 2017
Title: Institute #1 – National Additive Manufacturing Innovation Institute (America Makes)	15.492	1.011	1.038
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 MII 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 2015 Accomplishments:*** Launched a third call for R&D projects based on an updated industry-driven technology roadmap; competitively awarded additional applied research projects with highest potential for industry and government shared benefit; created an ecosystem that formed new supply chains for DoD, including small businesses; established a Satellite Center at University of Texas at El Paso to extend reach into that region. Launched education and workforce training initiatives, including partnering with multiple Government agencies for training and certification programs. Rolled out upgrades to on-line collaboration tools including a capabilities search and knowledge base of institute-developed intellectual property and data. ***FY 2016 Plans:*** Launch a fourth call for R&D projects based on the institutes' most current technology roadmap; competitively review and award additional applied research projects with highest potential for industry and government shared benefit; lead a group of Standards Development Organizations to define needed industry standards; launch a project to enable low-cost sustainment capabilities for DoD; launch enhanced processes for transitioning technologies developed by the MII; implement initiatives to increase the value proposition to members and support MII self-sustainability; continue education and workforce training initiatives. ***FY 2017 Plans:*** Complete execution of all prior year awarded projects and make results available in the knowledge base. Period of performance for the Cooperative Agreement ends on August 31, 2017. Program management subsequently continues to provide oversight through Aug 31, 2019 for the close-out of all R&D projects, cost share accrual, reporting, and transition to sustainability, in addition to completion of RDT&E fiduciary responsibilities.			
Title: Institute #2 – Digital Manufacturing and Design Innovation Institute	13.542	24.021	13.488

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017

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 MII was established in February 2014, with cooperative agreement funding contribution included in this budget through FY 2018.

FY 2015 Accomplishments:
Awarded 32 projects in 12 proposal calls in the technology thrust areas listed above totaling approximately $61 million, of which $30 million was from DoD and $31 million was Cost Share. Worked with the DARPA Adaptive Vehicle Make (AVM) Program to move technologies developed in the AVM program to transition and commercialization. Initiated workforce development projects with World Business Chicago and the Department of Commerce National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP). Completed the DMDII Headquarters by securing $16.5M in funding for the build out of the new facility from the State of Illinois and the City of Chicago and the donation of more than $3 million in equipment and multiple software systems in the manufacturing lab. Initiated the Digital Manufacturing Commons open platform project which will democratize access to the tools of manufacturing innovation for companies, universities, institutes and entrepreneurs.

FY 2016 Plans:
Launch a call for proposals in the Spring of 2016 with a particular topic in each of the technology thrust areas, with an anticipated result of approximately 15 new projects with a planned value of $7 - $10 million. Conduct multiple Proposal Call Workshops, and award projects in the technology thrust areas identified above. Launch the Beta version of the digital manufacturing commons. Revise the Technology Roadmap and Strategic Investment Plan to lead the technology domain in the completion of a Digital Thread. Activate education and workforce development projects: 1Digital Manufacturing Skills Classification “Taxonomy” to create a comprehensive breakdown of digital manufacturing (DM) skill sets and create job profiles that match industry needs; 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; Digital Analytics Boot Camp to develop a three to five day workshop on digital analytics in the manufacturing environment; Digital Manufacturing-101 to develop DM

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
open-source, online courses through Coursera for 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 consisting of 3 to 4 project calls each, 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. 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 (e.g. NIST/MEP).			
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 MII 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 MII was established in February 2014, with cooperative agreement funds programmed in this budget through FY 2018. ***FY 2015 Accomplishments:*** Completed project call #1 with a portfolio of 13 projects totaling approximately $9 million, awarded in technology scope areas described above. Second Project call initiated with a planned portfolio value of approximately $10 million in government funds, with projects targeted in key core areas of: applications of new/novel metals and alloys, primary and secondary metal	13.428	27.913	13.521

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017

manufacturing processes, and development of additional products utilizing lightweight and modern metals. Launched three education workforce projects. Built infrastructure to design and implement workforce education solutions in its five-State region [OH, MI, IN, TN, KY]. The five-State teams involve over 135 officials in education, workforce development, economic development, labor, industry, state and local government. Launched an advanced manufacturing student engagement video contest partnering Tennessee manufacturers and student teams to raise career awareness and increase enrollment in career and technical education.

With Tennessee Tech, designed a virtual reality demonstration and “challenge” to illustrate the benefits of lightweight metals and lightweighting technologies. Created an interactive, web-based Science, Technology, Engineering and Mathematics (STEM) Mission bringing lightweight technologies and materials and put it in schools in 22 states with over 25,000 students registered to use it. Created 45 boot camps integrating metals and materials, lightweighting, and engineering concepts for high school teachers and community college instructors, reaching over 1,000 teachers in the summer of 2015. Total number of organizations in the LIFT partnership reached 206. Includes 108 organizations with membership letters of intent and 98 workforce development partners.

FY 2016 Plans:

Project calls are planned to occur every six months, with a planned value of approximately $12 million for the year. Conduct project calls and award projects in the previously described technology scope areas. Conduct SWOT (strength-weakness-opportunity-trends) analyses along with road mapping to update the mid, and long-term technology investment strategies. As part of that exercise, will conduct defense-focused workshop designed to assist in mapping investments in defense-related applications. Will introduce the small and medium enterprise (SME) challenge, a “shark tank-type event that will allow SMEs to propose small technology venture projects to a panel of large industry members and subject matter experts. Will complete layout and equipment installation in the headquarters laboratory facility. Plan to introduce an open-source platform of educational resource materials to supplement and improve education from K-12 through graduate degree programs. Will integrate modules on metals, materials, lightweighting technologies and processes. Work 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. Will launch workshop series to expand outreach to small and medium enterprises (SME) to additional states within and outside the five-state region. Will also launch workforce initiatives targeting military veterans. Initiate technology transition phase for initial technology development projects, to include training across various levels of the workforce as needed.

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

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
developed during our initial project calls. 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 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 2016.			
Title: Institute #4 Integrated Photonics Manufacturing Innovation Institute (American Institute for Manufacturing (AIM) Integrated Photonics)	14.019	33.330	25.390
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 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 MII 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 MII was established in 2015, with cooperative agreement funding programmed in this budget through FY 2019. ***FY 2015 Accomplishments:*** Awarded a Cooperative Agreement, and initiated the stand-up of this new institute following the processes used for previous institutes that have been refined through lessons learned. Convened first institute leadership council meeting. Established DoD steering committee. Integrated DoD and Other Government Agencies with industry's roadmapping activities. Completed a data call for a first round of applied R&D pilot projects and selected project contracts in the key core areas with emphasis given to Manufacturing Centers of Excellence in Inline Control and Test, Electronic-Photonic Design Automation, and Multi-Project Wafer and Assembly. Initiated institute functions for design submission, design rule checking, tape-out, mask, hardware build, coordination of assembly, multi-project wafer runs and product validation. ***FY 2016 Plans:*** Achieve initial operational capability of the integrated photonics manufacturing innovation ecosystem, including more robust photonic integrated circuit design tools, a multi-project wafer capability with a broker function, and new package, assembly, and test tools and facilities. Conduct second round of applied R&D project calls and award projects in the key core areas identified in the roadmapping phase. These core areas include: Very High Speed Digital Data and Communication Links, Analog RF			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Applications, Integrated Photonics Sensors, and Photonic Integrated Circuit Array Technologies. Develop process design kits for silicon and indium phosphide photonics integrated circuits that can be used to prove out new designs by DoD labs and defense contractors through an affordable multi-project wafer capability. Establish a state-of-the-art integrated photonics prototype packaging facility to drive down costs in this critical area. Develop automated tools for cost-effective high volume end-to-end assembly and packaging of photonic integrated components. Continue development of a world-class integrated photonics work force through focused education, webinars, and training programs. ***FY 2017 Plans:*** Implement lessons-learned optimizations of 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. Conduct additional rounds of applied R&D project calls and award projects in the key core areas identified in the roadmapping phase. Transition FY 2016 projects' output to the supply chain. Execute plans for development of a world-class integrated photonics work force through establishment of master's level program, webinars, and training programs. Begin to transition key capabilities from this institute to ongoing DoD programs requiring integrated photonics solutions.			
Title: Institute #5 – Flexible Hybrid Electronics Manufacturing Innovation Institute (Nextflex – America's Flexible Hybrid Electronics Manufacturing Institute) ***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 MII was established in 2015, with cooperative agreement funds programmed in this budget through FY 2019. ***FY 2015 Accomplishments:*** Awarded a Cooperative Agreement and established this new MII following the processes used for previous institutes as refined through lessons learned in solicitations and standup of Institutes 1-4. Conducted initial technology road mapping activities with	8.144	31.140	21.688

Exhibit R-2A, RDT&E Project Justification: PB 2017 Office of the Secretary Of Defense		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Government Subject Matter Experts. Released the first project call (PC-1) for applied manufacturing projects in the key core areas identified within the road mapping activities. ***FY 2016 Plans:*** Build membership and release Participation Agreement and Intellectual Property Policy. Continue to refine core investment areas through industry-led technology roadmapping supporting the innovation ecosystem. Initiate two rounds of applied manufacturing project calls in core areas identified within the road mapping activities. Initiate plans for workforce development projects. ***FY 2017 Plans:*** Continue to refine core investment areas supporting the innovation ecosystem. Initiate two rounds of applied manufacturing project calls in core areas, with each project including components of workforce development.			
Title: Institute #6 - Revolutionary Fibers and Textiles Manufacturing Innovation Institute ***Description:*** The RFT-MII 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 RFT-MII 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 MII will be established in early 2016, with cooperative agreement funds programmed in this budget through FY 2020. ***FY 2015 Accomplishments:*** Programmatic planning for establishment of this new institute, including program management and acquisition teams BAA development, proposal reviews, and awardee selection, to support planned cooperative agreement award in September 2015. ***FY 2016 Plans:*** Award a Cooperative Agreement and establish this new MII following the processes used for previous institutes and as refined through lessons learned in solicitations and standup of Institutes 1-5. Conduct initial technology road mapping activities. Complete a data call for a first set of applied R&D projects and award project contracts in the technology areas of: Fiber and textile knowledge management repository and textile design tools, Innovative Product realization in Next Generation Wearable Technology, and Innovative product realization in Next Generation non-Wearable Technology. ***FY 2017 Plans:*** Continue to refine core investment areas supporting the innovation ecosystem. Initiate two rounds of applied R&D project calls in core areas. Execute workforce development projects.	0.725	17.583	21.962
Title: Institutes #7 and #8 - Technology Areas in Development	-	1.500	40.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Description: Two new Manufacturing Innovation Institutes are in acquisition planning, one to be established in late 2016, and one to be established in 2017. Some of the candidate technology focus areas currently under consideration for these two institutes are: Biotech - Regenerative Medicine; Biotech - Continuous Manufacturing of Pharmaceuticals; Securing the Manufacturing Digital Thread – Cybersecurity in manufacturing; Advanced Machine Tools and Control System; and Soft Robotics – Humans working in close proximity to robots. Cooperative Agreement funds are programmed in this budget from FY 2017 through FY 2021. ***FY 2016 Plans:*** Establish program management structure at the Services and OSD levels to support technology selection for each institute, and implementation and acquisition planning and execution, establishing one new institute in 2016 and one in 2017. ***FY 2017 Plans:*** Award Cooperative Agreements and establish each new MII 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.			
Accomplishments/Planned Programs Subtotals	65.350	136.498	137.087

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 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 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 between the selectee and the federal government are then negotiated and the CA 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

Experience gained to-date reinforces that the MIIs themselves must be principally responsible, with the Government's oversight, input, and concurrence, for managing metrics to measure progress against objectives. The DoD continues reviewing metrics for each MII at several levels (for example, DoD/funding agency level, individual institute level, and specific technology project level) and is working with each institute to refine specific technology or site-specific measures. At a minimum, the institutes

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are charged with ensuring that key elements of their innovation ecosystem 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 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 consortium and reflect that MII's unique technology capability, expertise, and organizational structure. The Department is striving to ensure that the assessment process captures and articulates the benefits to national security based upon technological advancements and the industrial base.