Project Call for America Makes Applied Research Projects

Improvements in Manufacturing Productivity via Additive Capabilities and Techno-Economic Analysis (IMPACT)

Prepared by

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1 EXECUTIVE SUMMARY

Funding Opportunity Title: Improvements in Manufacturing Productivity via Additive Capabilities and Techno-Economic Analysis (IMPACT)

Announcement Type: Directed Project Call. Proposals for projects outside of this topic will not be considered at this time. The funding source for this project call is the Office of the Under Secretary of Defense, Research and Engineering Manufacturing Technology Office (later referred to as OSD(R&E)) and Air Force Research Laboratory (later referred to as AFRL). The effort will feature a projected funding profile of **$11,700,000.**

Dates: Proposal submissions must be submitted by e-mail to projectcall@americamakes.us and marked with "America Makes IMPACT PROJECT PROPOSAL – Topic Area #".

Submissions in response to topic areas 1 through 8 shall be received no later than 5 p.m. Eastern on Wednesday, June 28, 2023.

Submissions in response to topic areas 9 and 10 shall be received no later than 5 p.m. Eastern on Friday, July 7, 2023.

Submissions received after the deadline will not be considered.

Submission Address: All proposals are to be submitted electronically to projectcall@americamakes.us. All submissions will be acknowledged with an email confirmation from NCDMM within 24 hours of receipt. If confirmation email is not received within 24 hours, please follow up to ensure delivery. NCDMM is not responsible for email system malfunctions or undeliverable email.

Funding Opportunity Description: NCDMM is soliciting competitive proposals supporting the America Makes mission of promoting and accelerating the development and deployment of innovative, cost-effective, energy-efficient additive manufacturing technologies to meet defense and/or commercial needs.

The Directed Project call aims to demonstrate productivity and yield benefits for casting and forging manufacturing via additive manufacturing (AM) technologies, execute techno-economic analyses for metal powder AM, and to bridge component sourcing gaps with AM parts for casting and forging applications. Furthermore, the project call seeks innovative solutions for robotic AM process planning in the case of continuous fiber reinforced composite structures.

Proposals must demonstrate necessity and value for addressing topic areas listed within Section 2, a means of measurably substantiating success, and why the proposer believes the approach will exhibit a high probability of technical and programmatic success within the allotted maximum period of performance. Technology dissemination to America Makes members/stakeholders in an organized, reusable, and interoperable manner will be evaluated as described in Section 4. In addition, proposals shall address impact to components of the Department of Defense, especially OSD(R&E) and AFRL using quantitative metrics to verify improvements in productivity, lead time, and yield. Impact will be evaluated as described in Section 4. Proposals shall clearly outline a technology transition plan (i.e., into one or more programs of record) which outlines not only the proposed effort as a result of this project call, but how efforts may be conducted at the conclusion of the proposed effort. **There is no guarantee of follow on funding.**

Technology transition plans shall address industrially relevant (product type, application, platform, etc.) needs of DoD components, OSD(R&E), and AFRL. Technology transition plans shall be practical, exhibit conservative time phasing, include milestones, objectives, key performance parameters, risks, etc. to realize MRL7 (whether or not that is obtained within the proposed scope of work) and will be evaluated according to criteria outlined in Section 4.

Proposers shall describe how deliverables will be transferred to the membership and government stakeholders and readily integrated within the America Makes CORE (formerly known as Digital StoreFront). Project deliverable titles, file formats, and associated content (tangible artifacts) should be summarized in concise detail. America Makes CORE features the ability for America Makes members to upload data. Uploading, structuring, naming, characterizing (meta data tagging) of all data in CORE shall be the primary responsibility of the proposer to complete. An approach which outlines how data will be managed, curated, and regularly uploaded to CORE is required. **Approaches which detail a substantial level of effort for data upload in the later portion of the program are not favored and are highly discouraged.** Time, resources, and any expectation for NCDMM support for these tasks and efforts should be clear in all proposals.

Total Amount to be Awarded: NCDMM, OSD(R&E), and AFRL will conduct a competitive proposal process targeting to make available approximately **$11,700,000**. The number of anticipated awards and maximum request for federal funding varies depending upon the topic area being addressed. **Proposers are welcome to submit multiple proposals. Each proposal is limited to addressing one topic area only.** The following table is a summary of the number of anticipated awards by topic area and maximum federal funding available per award.

Topic Area Number	Number of Awards Anticipated	Maximum Federal Award Available Per Proposal
1	5	$2,000,000
2		
3		
4		
5		
6		
7		
8	1	$500,000
9	1	$350,000

10	1	$800,000

NCDMM, OSD(R&E), and AFRL reserve the right to select multiple awards, one, or no awards in the topic areas outlined in section 2.

Proposer Eligibility:

The lead proposer for responses to topic areas 1 through 8 is a current member of America Makes and in good standing by Wednesday, June 14, 2023.

The lead proposer for responses to topic areas 9 or 10 is a current member of America Makes and in good standing by Friday, June 23, 2023.

Information on how to join America Makes is available at www.americamakes.us/membership. Any non-America Makes members contributing to proposed effort execution are not permitted to participate in project team discussions until completing a fully executed America Makes Membership Agreement. (Note: The foreign membership approval process requires a minimum of three weeks to complete.)

Any foreign persons conducting work on the project shall be declared within the Project Team Appendix. Any project activities occurring outside of the U.S. or by non-U.S. persons must be reported and approved in advance by the America Makes Program Management Office. Execution of activity outside of the U.S. in response to this project call is discouraged.

For topic areas 8 and 9 all project team members must have a valid DD2345 in order to participate in projects in response to these topic areas. It is anticipated that the outcomes of this effort will be able to be desensitized at its conclusion (at a later time) to benefit a wider cross section of the casting, forging, and AM community. **No foreign national participation for topic areas 8 or 9 will be allowed.**

Cost Share Requirement: The project call requires a cost share of at least 50% match and must be from non-Federal funding sources. Example: If $1.00 of federal funding is requested from America Makes, $0.50 in cost share must be committed against that $1.00 for a total scope of $1.50.

Period of Performance: Maximum allowable periods of performance are dependent upon which topic area the proposal intends to address. **Proposals are limited to addressing one topic area only.** The following table is a summary of maximum allowable period of performance by topic area.

Topic Area Number	Maximum Number of Months of Technical Effort Execution	Expected Number of Months Required for Final Report Production and Finalization	Maximum Allowed Period of Performance in Months – Shorter Periods Are Acceptable
1	24	3	27
2			
3			
4			
5			
6			
7			
8	18	3	21
9	9	3	12
10	18	3	21

2 PROPOSED RESEARCH PROGRAM

Program Description and Technical Requirements:

AM is of significant interest to the U.S. manufacturing base as the technology enables shorter lead times, mass customization, energy reduction, complex shapes, and production of parts on demand providing benefits to both new acquisitions and legacy systems.

America Makes seeks to promote and accelerate the development and deployment of innovative, cost effective, energy-efficient AM and 3D printed (3DP) technologies to meet defense and/or commercial needs. The projects being proposed should be applicable to Technology Readiness Level (TRL) 4-7 and Manufacturing Readiness Level (MRL) 4-7 at the start of the proposed project (DoD MRL guidance is located at www.dodmrl.com). Reference – MRL 4: Capability to produce the technology in a laboratory environment. This level of readiness is typical for Science and Technology (S&T) Programs in the budget activity 6.2 and 6.3 categories and acts as an exit criterion for the Materiel Solution Analysis (MSA) Phase approaching a Milestone A decision. Technologies should have matured to at least TRL 4. This level indicates that the technologies are ready for the Technology Development Phase of acquisition. At this point, required investments, such as manufacturing technology development, have been identified. Processes to ensure manufacturability, producibility, and quality are in place and are sufficient to produce

technology demonstrators. Manufacturing risks have been identified for building prototypes and mitigation plans are in place. Target cost objectives have been established and manufacturing cost drivers have been identified. Producibility assessments of design concepts have been completed. Key design performance parameters have been identified as well as any special tooling, facilities, material handling, and skills required.

The purpose of this RFP is to solicit competitive proposals for ten (10) topic areas including:

Demonstrating Lead Time, Productivity, and Yield Improvements for Casting and Forging Manufacturing Operations Using Additive Manufacturing Technologies

The DoD seeks casting and forging-related AM technologies that improve cost efficiency and provide increased capabilities, quality, and/or capacity. Proposed efforts should address areas of relevance to the Department of Defense which include:

- Thin-walled light alloy sand castings (e.g., magnesium, aluminum, and other lightweight metals)
- Casting and forgings for high-tensile, high yield strength, low alloy steel
- Large and very large titanium/specialty alloy castings
- Complex castings for high performance turbine engines with specific application-driven material systems and stringent quality requirements
- Nonferrous, corrosion-resistant castings and forgings using material systems such as, but not necessarily limited to, CuNi, NiAlBr, and Ni-alloys
- Addressing the need for extra-large forgings for naval and aerospace applications
- Reducing forging lead-times for all DoD applications

In March of 2023, America Makes launched a program looking at the value of AM technologies to increase casting and forging productivity, reduce lead time, and increase casting and forging yield. The intent of the activity is not to replace casting or forging processes. The purpose is to understand the interrelationships of casting, forging, and additive manufacturing to identify opportunities where AM technology can increase capacity, capability, and/or speed of production within the existing U.S. industrial base and reduce lead times for the acquisition of cast and wrought (forged) products. Throughout March and May of 2023, America Makes and members of the U.S. additive manufacturing, casting, and forging supply chain participated in a series of expert interviews, manufacturing site visits, and workshops. The workshops were hosted in Youngstown, OH, and Milwaukee, WI, to deliver a strategy to develop, demonstrate, validate/qualify, and deliver AM technologies to the defense industrial base which improve productivity, reduce lead time, and increase yield for the acquisition of cast and wrought products. Our findings showed several common themes where AM presents value to casting and forging manufacturing operations of which are most relevant to the IMPACT project call including:

- AM for tooling – Not altering the final part may limit qualification risks and challenges while demonstrating reduced lead time and cost.

- Improving confidence in AM – Material properties, design methods, manufacturing practices, and AM technologies are not widely understood and there is substantial opportunity to standardize best practices and disseminate lessons learned within the context of AM for forging and casting.
- Improving competency for decision making and quickly accessing qualified manufacturing capacity – Access to data, relevant product manufacturing demonstrations, qualification efforts, characterization techniques, and validated modeling and simulation tools which mitigate risks to executing material, process, and product qualification but enabling an understanding of the techno-economic viability which AM presents for casting and forging manufacturing operations.

As a direct consequence of the inputs gathered from the U.S. supply chain, seven topics were identified as near-term priorities. The following topic areas exhibit a mixture of potential for high impact and acceptable risk to demonstrate lead time, productivity, and yield improvements for casting and forging manufacturing operations using AM seven technologies.

Topic Area 1 – Develop/disseminate leading practices and accelerate adoption of 3D printed molds/cores for sand castings

Sand casting offers opportunities to integrate AM technologies which use ceramic particulate (sand) feedstock for the manufacturing of molds (cope & drag) and cores. Limited need for tooling when using AM offers potential to reduce cost and lead time. However, a lack of supply chain familiarity, standard manufacturing practices and design tools present risk to rapid cast product qualification when leveraging AM technologies. Technical approaches in response to this topic area shall consider all or some of the following:

- Gather various industry and government stakeholders to identify and prioritize qualification requirements, risks, and validate qualification test matrices
- Leverage expert advice and inputs to mitigate technological and programmatic risks
- Value proposition framework demonstration which may consider feedstock/precursor costs, labor, depreciation, production volumes, equipment size (part size limitations), productivity factors (for AM and casting) that facilitates techno-economic tools for determining when to deploy AM capabilities for certain sand cast products
- Assess and demonstrate product size/features and AM process manufacturing capabilities for components and materials of priority to U.S. defense industrial base
- Large scale casting applications
- Development of solutions which improve green sand strength
- Innovations in sand printing which enable casting of key DoD alloys not currently supported by sand printing
- Cleaning, processing, post-processing of cores and molds
- Reclamation requirements and practices
- Consequence to manufacturing operations and product qualification as a result of choosing an AM technology which is mitigated through development,

demonstration, and qualitative or quantitative key performance parameters in comparison to commercial off the shelf (COTS) or legacy casting solutions
- Identify product use cases which exhibit the right mix of demand, criticality, and applicability to AM augmented casting and execute relevant qualification tasks or product manufacturing demonstrations
- Identify, develop, and validate AM processing capabilities for the manufacturing of sand castings which meet acceptance criteria
- Binder and binder burnout development
- Core handling and coating
- Baseline assessments of various AM technologies/equipment OEMs
- Design guides, tools, methods, and practices to manage product yield, GD&T, or other critical to quality factors (surface finish, porosity, inclusions, etc.)
- Process modeling and simulation tools to address critical to product quality metrics
- Piloting technology via cast product manufacturing demonstrations relevant to needs of U.S. defense industrial base
- Casting at multiple foundries
- Complete mold, core, and cast product characterization, inspection, and testing to accelerate qualification
- Benefits, impact, and trade-off analysis for consolidation of cores
- Technology transition plan

Proposers are required to provide key performance parameters (KPPs) which constitute an industrially relevant measure of success/acceptance and shall be aligned to the tasking, trials, experiments, or measurements within the project technical approach(scope). Responses shall propose key performance parameters using factors similar to common industry acceptance criteria. For example, tensile strength minimum, average, or standard deviation, maximum pore size, or other relevant quality metrics as a means of validating the outcomes of tasking in a manner conducive to technology or manufacturing readiness level assessments. For those unfamiliar with technology readiness level assessments, please see the following reference (https://www.gao.gov/assets/710/706680.pdf). Responses are required to use a threshold (minimum acceptable value) and objective (ideal or stretch goal) value approach which aligns KPPs with tasking, data, and data types as well as how the KPP will be demonstrated. For example, verification of a not to exceed a certain maximum pore size KPP may be demonstrated using metallographic sectioning, microscopy, and image analysis over a 0.5 in cross section of cast material in the fully heat-treated condition.

Proposers shall maintain traceability and data management practices which facilitate dissemination and reuse of the findings in a manner which makes the proposed effort reproducible, transparent, and a well-posed and controlled technical approach. Effort and data gathering shall be conducted in a manner similar to common quality management practices standard to industry and leveraged as much as reasonably practical for ensuring data integrity and program relevancy and validity. Examples of this may include standards, specifications, certifications, calibration details, process control documentation, and verification of qualified material sources (precursors or feedstock,

etc.), processes, post processes, inspection, testing, and quality control protocols. Data management not only promotes the long-term viability of America Makes research, it also facilitates trust and reuse of the data generated by our efforts. Furthermore, it diminishes concern for unknown or unrecorded sources of variance within development activities.

Responses to this topic area are required to demonstrate impact through quantitative metrics which exhibit a threshold and objective value. For those unfamiliar with such approaches, please see the following reference (https://acqnotes.com/acqnote/acquisitions/key-perfrormance-parameter). Examples of high priority factors for consideration to successfully demonstrate impact for this topic area include:

- Baseline cost, cost reduction %, and opportunities for future cost savings
- Baseline lead time, lead time reduction %, and opportunities for future lead time reduction
- Baseline yield/scrap, reduced scrap %, and opportunities for future yield improvements
- Reduced time to realize/on-time delivery of first articles demonstrated (or other industrially recognized qualification metrics)
- Baseline man hours per part, % reduction or reduced number man hours per part, and opportunities for future labor reduction
- Baseline tonnage, increased tonnage due to introduction of AM technology, and opportunities for future increase in tonnage
- Baseline throughput, %increase in throughput due to introduction of AM technology, and opportunities for future increase in throughput
- Verification of specific critical to quality metrics (porosity, inclusions, geometric dimensioning and tolerancing [GD&T] factors, etc.)
- Number of qualified part numbers
- Number of qualified/approved vendors or suppliers

Topic Area 2 – Mature AM ceramic technology and promote adoption for rapid, low volume production of investment castings for defense applications

AM of shell ceramics offers an opportunity to produce molds directly and may limit necessity for wax patterns. Investment casting typically involves the use of wax patterns which are then shelled using slurries and ceramic particulate to build up a ceramic shell mold over successive coating operations. Manufacturing of the shell can influence shell integrity and investment cast product quality (surface finish, GD&T, microstructure/performance). Shells are fired to cure the ceramic and remove the wax pattern prior to pouring. Many complex cast products are produced by investment casting. It is commonly used in aerospace applications. There exists opportunity to develop and demonstrate how AM may offer improvements in productivity, lead time, yield, and cost for the manufacturing of shells for investment casting applications. Similar to sand casting applications, the use of AM for investment shell manufacturing is not well understood. There is a need for demonstrations of the baseline AM process capability, standard manufacturing practices, and design tools in order to realize rapid cast product

qualification when leveraging ceramic AM technologies. Technical approaches in response to this topic area shall consider all or some of the following:

- Gather various industry and government stakeholders to identify and prioritize qualification requirements, risks, and validate qualification test matrices
- Leverage expert advice and inputs to mitigate technological and programmatic risks
- Value proposition framework demonstration which may consider feedstock/precursor costs, labor, depreciation, production volumes, equipment size (part size limitations), productivity factors (for AM and casting) that facilitates techno-economic tools for determining when to deploy AM capabilities for certain investment cast products
- Assess and demonstrate product size/features and AM process manufacturing capabilities for components and materials of priority to U.S. defense industrial base
- Identify, develop, and validate AM processing capabilities for the manufacturing of investment castings which meet acceptance criteria (for example, grade C casting requirements)
- Validate surface finish requirements are met using AM ceramic printing for the manufacturing of investment castings
- Identify product use cases which exhibit the right mix of demand, criticality, and applicability to AM augmented casting and execute relevant qualification tasks or product manufacturing demonstrations
- Develop and improve precursor, feedstock, shell, and/or cast material quality metrics
- Deliver data which successfully demonstrates investment casting qualification criteria
- Baseline assessments of various AM technologies/equipment OEMs
- Processing and post-processing of AM shells
- Mitigation of risks due to warping and shrink through post processing
- Reclamation requirements and practices
- Consequence to manufacturing operations and product qualification as a result of choosing an AM technology which is mitigated through development, demonstration, and qualitative or quantitative key performance parameters in comparison to commercial off the shelf (COTS) or legacy casting solutions
- Shell handling and shipping practices
- Design guides, tools, methods, and practices to manage product yield, GD&T, or other critical to quality factors (surface finish, porosity, inclusions, etc.)
- Process modeling and simulation tools to address critical to product quality metrics
- Piloting technology via cast product manufacturing demonstrations relevant to needs of U.S. defense industrial base
- Casting at multiple foundries
- Characterization, inspection, and testing to accelerate qualification
- Benefits, impact, and trade-off analysis
- Technology transition plan

Proposers are required to provide key performance parameters (KPPs) which constitute an industrially relevant measure of success/acceptance and shall be aligned to the tasking, trials, experiments, or measurements within the project technical approach (scope). Responses shall propose key performance parameters using factors similar to common industry acceptance criteria. For example, tensile strength minimum, average, and/or standard deviation, maximum pore size, or other relevant quality metrics as a means of validating the outcomes of tasking in a manner conducive to technology or manufacturing readiness level assessments. For those unfamiliar with technology readiness level assessments, please see the following reference (https://www.gao.gov/assets/710/706680.pdf). Responses are required to use a threshold (minimum acceptable value) and objective (ideal or stretch goal) value approach which aligns KPPs with tasking, data, and data types as well as how the KPP will be demonstrated. For example, verification of a not to exceed a certain maximum pore size KPP may be demonstrated using metallographic sectioning, microscopy, and image analysis over a 0.5 in cross section of cast material in the fully heat-treated condition.

Proposers shall maintain traceability and data management practices which facilitate dissemination and reuse of the findings in a manner which makes the proposed effort reproducible, transparent, and a well-posed and controlled technical approach. Effort and data gathering shall be conducted in a manner similar to common quality management practices standard to industry and leveraged as much as reasonably practical for ensuring data integrity and program relevancy and validity. Examples of this may include standards, specifications, certifications, calibration details, process control documentation, and verification of qualified material sources (precursors or feedstock, etc.), processes, post processes, inspection, testing, and quality control protocols. Data management not only promotes the long-term viability of America Makes research, it also facilitates trust and reuse of the data generated by our efforts. Furthermore, it diminishes concern for unknown or unrecorded sources of variance within development activities.

Responses to this topic area are required to demonstrate impact through quantitative metrics which exhibit a threshold and objective value. For those unfamiliar with such approaches, please see the following reference (https://acqnotes.com/acqnote/acquisitions/key-perfrormance-parameter). Examples of high priority factors for consideration to successfully demonstrate impact for this topic area include:

- Baseline cost, cost reduction %, and opportunities for future cost savings
- Baseline lead time, lead time reduction %, and opportunities for future lead time reduction
- Baseline yield/scrap, reduced scrap %, and opportunities for future yield improvements
- Reduced time to realize/on-time delivery of first articles demonstrated (or other industrially recognized qualification metrics)
- Baseline man hours per part, % reduction or reduced number man hours per part, and opportunities for future labor reduction

- Baseline tonnage, increased tonnage due to introduction of AM technology, and opportunities for future increase in tonnage
- Baseline throughput, %increase in throughput due to introduction of AM technology, and opportunities for future increase in throughput
- Verification of specific critical to quality metrics (porosity, inclusions, geometric dimensioning and tolerancing [GD&T] factors, etc.)
- Number of qualified part numbers
- Number of qualified/approved vendors or suppliers

Topic Area 3 – Develop and disseminate tools/frameworks to improve die (die casting) life with AM-printed cooling channels

Die casting is a third casting technology domain where AM technologies present potential benefit and impact. Reusable dies provide the molding structures necessary for feeding metal, producing component geometric features, facilitating component removal from the dies, and are designed to facilitate auxiliary equipment or manufacturing personnel access for activities such as die lubricant application. AM offers potential to manufacture dies and enhance die performance through the introduction of cooling channels or surface engineered features which facilitate product release, extend die life, or increase the potential for die casting process throughput. There is a need for demonstrations of the baseline AM process capability, standard manufacturing practices, and design tools in order to realize rapid die cast product qualification when leveraging AM technologies for these purposes. Technical approaches in response to this topic area shall consider all or some of the following:

- Gather various industry and government stakeholders to identify and prioritize qualification requirements, risks, and validate qualification test matrices
- Leverage expert advice and inputs to mitigate technological and programmatic risks
- Value proposition framework demonstration which may consider feedstock/precursor costs, labor, depreciation, production volumes, equipment size (part size limitations), die life, productivity factors (for AM and casting) that facilitates techno-economic tools for determining when to deploy AM capabilities for certain die cast products
- Assess and demonstrate product size/features and AM process manufacturing capabilities for components and materials of priority to U.S. defense industrial base
- Identify, develop, and validate AM processing capabilities for the manufacturing of die castings which meet acceptance criteria
- Identify product use cases which exhibit the right mix of demand, criticality, and applicability to AM augmented die casting and execute relevant qualification tasks or product manufacturing demonstrations
- Develop and improve feedstock, AM process, die, and/or cast material quality metrics
- Deliver data which successfully demonstrates die casting qualification criteria
- Develop and demonstrate various die designs and materials (for example H13 tools steels or similar)

- Baseline assessments of various AM technologies/equipment OEMs (for example, directed energy deposition [DED], solid state [friction stir or others] AM, hybrid AM, or other metal AM modalities) which may include assessment of productivity, geometric feature capability studies, repeatability/reproducibility, and die material compatibility
- Processing and post-processing of dies and characterization of associated critical to product quality metrics for cast parts (examples include GD&T and/or surface finish)
- Consequence to manufacturing operations and product qualification as a result of choosing an AM technology which is mitigated through development, demonstration, and qualitative or quantitative key performance parameters in comparison to commercial off the shelf (COTS) or legacy casting solutions
- Design guides, tools, methods, and practices to manage product yield, GD&T, or other critical to quality factors (surface finish, porosity, inclusions, etc.)
- Process modeling and simulation tools to address critical to product quality metrics
- Piloting technology via cast product manufacturing demonstrations relevant to needs of U.S. defense industrial base
- Casting at multiple manufacturing sites
- Characterization, inspection, and testing to accelerate qualification
- Benefits, impact, and trade-off analysis
- Technology transition plan

Proposers are required to provide key performance parameters (KPPs) which constitute an industrially relevant measure of success/acceptance and shall be aligned to the tasking, trials, experiments, or measurements within the project technical approach (scope). Responses shall propose key performance parameters using factors similar to common industry acceptance criteria. For example, tensile strength minimum, average, and/or standard deviation, maximum pore size, or other relevant quality metrics as a means of validating the outcomes of tasking in a manner conducive to technology or manufacturing readiness level assessments. For those unfamiliar with technology readiness level assessments, please see the following reference (https://www.gao.gov/assets/710/706680.pdf). Responses are required to use a threshold (minimum acceptable value) and objective (ideal or stretch goal) value approach which aligns KPPs with tasking, data, and data types as well as how the KPP will be demonstrated. For example, verification of a not to exceed a certain maximum pore size KPP may be demonstrated using metallographic sectioning, microscopy, and image analysis over a 0.5 in cross section of cast material in the fully heat-treated condition.

Proposers shall maintain traceability and data management practices which facilitate dissemination and reuse of the findings in a manner which makes the proposed effort reproducible, transparent, and a well-posed and controlled technical approach. Effort and data gathering shall be conducted in a manner similar to common quality management practices standard to industry and leveraged as much as reasonably practical for ensuring data integrity and program relevancy and validity. Examples of this may include standards, specifications, certifications, calibration details, process control

documentation, and verification of qualified material sources (precursors or feedstock, etc.), processes, post processes, inspection, testing, and quality control protocols. Data management not only promotes the long-term viability of America Makes research, it also facilitates trust and reuse of the data generated by our efforts. Furthermore, it diminishes concern for unknown or unrecorded sources of variance within development activities.

Responses to this topic area are required to demonstrate impact through quantitative metrics which exhibit a threshold and objective value. For those unfamiliar with such approaches, please see the following reference (https://acqnotes.com/acqnote/acquisitions/key-perfrormance-parameter). Examples of high priority factors for consideration to successfully demonstrate impact for this topic area include:

- Baseline cost, cost reduction %, and opportunities for future cost savings
- Baseline lead time, lead time reduction %, and opportunities for future lead time reduction
- Baseline yield/scrap, reduced scrap %, and opportunities for future yield improvements
- Reduced time to realize/on-time delivery of first articles demonstrated (or other industrially recognized qualification metrics)
- Baseline man hours per part, % reduction or reduced number man hours per part, and opportunities for future labor reduction
- Baseline tonnage, increased tonnage due to introduction of AM technology, and opportunities for future increase in tonnage
- Baseline throughput, %increase in throughput due to introduction of AM technology, and opportunities for future increase in throughput
- Verification of specific critical to quality metrics (porosity, inclusions, geometric dimensioning and tolerancing [GD&T] factors, etc.)
- Number of qualified part numbers
- Number of qualified/approved vendors or suppliers

Topic Area 4 – Mature and promote methods to add high wear layers and complex geometric features to forgings

Forgings and wrought materials are manufactured by mechanically working materials to improve microstructure and product performance. These products are often used in more critical applications. While there is tremendous talent and ample capacity in the U.S. for the manufacturing of forgings and wrought materials, there exists opportunity to increase forging productivity, reduce lead times, and increase yield using AM technologies. In this topic area, technical approaches should develop, demonstrate, and deliver evidence and lessons learned to understand the value of AM for applying surface engineered features (wear, corrosion, etc.) on forged products. In addition, the application of added material to produce geometric features (for example, embossed features) to forged product forms. These efforts should aim to demonstrate improved productivity of wrought products by limiting post processing time (cladding for example) or expanding the number of forging suppliers (facilitating a “simpler” forging design by later adding “complex” features). An example of this may include adding geometric features to a rolled ring when previously a

specialized forging process was only used to make a more complex geometry forged product form. There is a need for demonstrations of the baseline AM process capability, standard manufacturing practices, and design tools in order to realize rapid forged product qualification when leveraging AM technologies for these purposes. Technical approaches in response to this topic area shall consider all or some of the following:

- Gather various industry and government stakeholders to identify and prioritize qualification requirements, risks, and validate qualification test matrices
- Leverage expert advice and inputs to mitigate technological and programmatic risks
- Value proposition framework demonstration which may consider feedstock/precursor costs, labor, depreciation, production volumes, equipment size (part size limitations), productivity factors (for AM and forging) that facilitates techno-economic tools for determining when to deploy AM capabilities for certain forged products
- Assess and demonstrate product size/features and AM process manufacturing capabilities for components and materials of priority to U.S. defense industrial base
- Identify, develop, and validate AM processing capabilities for the manufacturing of forgings which meet acceptance criteria
- Ranking of surface engineering application types and geometric feature types which offer the most impact, benefit, or value for the use of AM technologies
- Identify product use cases which exhibit the right mix of demand, criticality, and applicability to AM augmented forging manufacturing and execute relevant qualification tasks or product manufacturing demonstrations
- Characterization of materials and interfaces for engineered surfaces or geometric feature additions
- Development and validation of ICME tools
- Physical and mechanical material property data for dissimilar materials or interfaces, etc.
- Develop and improve feedstock, AM process, and/or forging quality metrics
- Deliver data which successfully demonstrates forging qualification criteria
- Develop and demonstrate various surface engineering applications (wear, corrosion, etc.) and materials
- Baseline assessments of various AM technologies/equipment OEMs (for example, directed energy deposition [DED], hybrid AM, solid state [friction stir or others] AM, or other metal AM modalities) which may include assessment of productivity, geometric feature capability studies, repeatability/reproducibility, and material compatibility
- Establishing validated processing and post-processing practices and characterization of associated critical to product quality metrics for forgings (examples include GD&T, wear resistance, corrosion resistance, and/or surface finish)
- Consequence to manufacturing operations and product qualification as a result of choosing an AM technology which is mitigated through development, demonstration, and qualitative or quantitative key performance parameters in comparison to commercial off the shelf (COTS) or legacy forging solutions

- Design guides, tools, methods, and practices to manage product yield, GD&T, or other critical to quality factors (surface finish, microstructure, wear resistance, etc.)
- Process modeling and simulation tools to address critical to product quality metrics
- Piloting technology via forged product manufacturing demonstrations relevant to needs of U.S. defense industrial base
- Collaboration with multiple forging suppliers
- Characterization, inspection, and testing to accelerate qualification
- Benefits, impact, and trade-off analysis
- Technology transition plan

Proposers are required to provide key performance parameters (KPPs) which constitute an industrially relevant measure of success/acceptance and shall be aligned to the tasking, trials, experiments, or measurements within the project technical approach (scope). Responses shall propose key performance parameters using factors similar to common industry acceptance criteria. For example, tensile strength minimum, average, and/or standard deviation, maximum pore size, or other relevant quality metrics as a means of validating the outcomes of tasking in a manner conducive to technology or manufacturing readiness level assessments. For those unfamiliar with technology readiness level assessments, please see the following reference (https://www.gao.gov/assets/710/706680.pdf). Responses are required to use a threshold (minimum acceptable value) and objective (ideal or stretch goal) value approach which aligns KPPs with tasking, data, and data types as well as how the KPP will be demonstrated. For example, verification of a not to exceed a certain maximum pore size KPP may be demonstrated using metallographic sectioning, microscopy, and image analysis over a 0.5 in cross section of cast material in the fully heat-treated condition.

Proposers shall maintain traceability and data management practices which facilitate dissemination and reuse of the findings in a manner which makes the proposed effort reproducible, transparent, and a well-posed and controlled technical approach. Effort and data gathering shall be conducted in a manner similar to common quality management practices standard to industry and leveraged as much as reasonably practical for ensuring data integrity and program relevancy and validity. Examples of this may include standards, specifications, certifications, calibration details, process control documentation, and verification of qualified material sources (precursors or feedstock, etc.), processes, post processes, inspection, testing, and quality control protocols. Data management not only promotes the long-term viability of America Makes research, it also facilitates trust and reuse of the data generated by our efforts. Furthermore, it diminishes concern for unknown or unrecorded sources of variance within development activities.

Responses to this topic area are required to demonstrate impact through quantitative metrics which exhibit a threshold and objective value. For those unfamiliar with such approaches, please see the following reference (https://acqnotes.com/acqnote/acquisitions/key-perfrormance-parameter). Examples of high priority factors for consideration to successfully demonstrate impact for this topic area include:

- Baseline cost, cost reduction %, and opportunities for future cost savings
- Baseline lead time, lead time reduction %, and opportunities for future lead time reduction
- Baseline yield/scrap, reduced scrap %, and opportunities for future yield improvements
- Reduced time to realize/on-time delivery of first articles demonstrated (or other industrially recognized qualification metrics)
- Baseline man hours per part, % reduction or reduced number man hours per part, and opportunities for future labor reduction
- Baseline tonnage, increased tonnage due to introduction of AM technology, and opportunities for future increase in tonnage
- Baseline throughput, %increase in throughput due to introduction of AM technology, and opportunities for future increase in throughput
- Verification of specific critical to quality metrics (porosity, inclusions, geometric dimensioning and tolerancing [GD&T] factors, etc.)
- Number of qualified part numbers
- Number of qualified/approved vendors or suppliers

Topic Area 5 – Pilot the industrialization of AM preforms to expedite the forging process for low volume forged components

Forging processes rely on stock material in the form of billet or cast (ingots) material commonly. Forging stock material is frequently an ingot or mult (specific section [length, weight] of an ingot [or billet] to facilitate forging and ensuring the final product meets acceptance criteria) which is then worked via a forging operation. There are a variety of forging process types which use these stock material forms. AM offers potential to improve access to preforms (stock material) which can then be further worked to obtain a final forged product form. AM may offer potential to realizing increased forging productivity, reduced lead time, increased yield, and reduced costs compared to legacy forging manufacturing approaches. There is a need for demonstrations of the baseline AM process capability, standard manufacturing practices, and design tools in order to realize rapid forged product qualification when leveraging AM technologies for these purposes. Technical approaches in response to this topic area shall consider all or some of the following:

- Gather various industry and government stakeholders to identify and prioritize qualification requirements, risks, and validate qualification test matrices
- Leverage expert advice and inputs to mitigate technological and programmatic risks
- Value proposition framework demonstration which may consider feedstock/precursor costs, labor, depreciation, production volumes, equipment size (part size limitations), productivity factors (for AM and forging) that facilitates techno-economic tools for determining when to deploy AM capabilities for certain forged products
- Assess and demonstrate product size/features and AM process manufacturing capabilities for components and materials of priority to U.S. defense industrial base

- Identify, develop, and validate AM processing capabilities for the manufacturing of forging preforms which meet acceptance criteria
- Identify product use cases which exhibit the right mix of demand, criticality, and applicability to AM augmented forging manufacturing and execute relevant qualification tasks or product manufacturing demonstrations (including first article testing)
- Physical and mechanical material property data for forged materials
- Develop and validate acceptable AM feedstock, AM process, AM preform, and/or forging quality metrics
- Deliver data which successfully demonstrates forging qualification criteria
- Baseline assessments of various AM technologies/equipment OEMs (for example, directed energy deposition [DED], hybrid AM, solid state [friction stir or others] AM, or other metal AM modalities) which may include assessment of productivity, geometric feature capability studies, repeatability/reproducibility, and material compatibility
- Establishing validated processing and post-processing practices and characterization of associated critical to product quality metrics for forgings (examples include GD&T, microstructure, mechanical properties, etc.)
- Consequence to manufacturing operations and product qualification as a result of choosing an AM technology which is mitigated through development, demonstration, and qualitative or quantitative key performance parameters in comparison to commercial off the shelf (COTS) or legacy forging solutions
- Design guides, tools, methods, and practices to manage product yield, GD&T, or other critical to quality factors (microstructure, mechanical properties, etc.)
- Process modeling and simulation tools to address critical to product quality metrics
- Piloting technology via forged product manufacturing demonstrations relevant to needs of U.S. defense industrial base
- Collaboration with multiple forging suppliers
- Characterization, inspection, and testing to accelerate qualification
- Benefits, impact, and trade-off analysis
- Technology transition plan

Proposers are required to provide key performance parameters (KPPs) which constitute an industrially relevant measure of success/acceptance and shall be aligned to the tasking, trials, experiments, or measurements within the project technical approach (scope). Responses shall propose key performance parameters using factors similar to common industry acceptance criteria. For example, tensile strength minimum, average, and/or standard deviation, maximum pore size, or other relevant quality metrics as a means of validating the outcomes of tasking in a manner conducive to technology or manufacturing readiness level assessments. For those unfamiliar with technology readiness level assessments, please see the following reference (https://www.gao.gov/assets/710/706680.pdf). Responses are required to use a threshold (minimum acceptable value) and objective (ideal or stretch goal) value approach which aligns KPPs with tasking, data, and data types as well as how the KPP will be demonstrated. For example, verification of a not to exceed a certain maximum pore size KPP may be demonstrated using metallographic sectioning, microscopy, and

image analysis over a 0.5 in cross section of cast material in the fully heat-treated condition.

Proposers shall maintain traceability and data management practices which facilitate dissemination and reuse of the findings in a manner which makes the proposed effort reproducible, transparent, and a well-posed and controlled technical approach. Effort and data gathering shall be conducted in a manner similar to common quality management practices standard to industry and leveraged as much as reasonably practical for ensuring data integrity and program relevancy and validity. Examples of this may include standards, specifications, certifications, calibration details, process control documentation, and verification of qualified material sources (precursors or feedstock, etc.), processes, post processes, inspection, testing, and quality control protocols. Data management not only promotes the long-term viability of America Makes research, it also facilitates trust and reuse of the data generated by our efforts. Furthermore, it diminishes concern for unknown or unrecorded sources of variance within development activities.

Responses to this topic area are required to demonstrate impact through quantitative metrics which exhibit a threshold and objective value. For those unfamiliar with such approaches, please see the following reference (https://acqnotes.com/acqnote/acquisitions/key-perfrormance-parameter). Examples of high priority factors for consideration to successfully demonstrate impact for this topic area include:

- Baseline cost, Cost reduction %, and opportunities for future cost savings
- Baseline lead time, lead time reduction %, and opportunities for future lead time reduction
- Baseline yield/scrap, reduced scrap %, and opportunities for future yield improvements
- Reduced time to realize/on-time delivery of first articles demonstrated (or other industrially recognized qualification metrics)
- Baseline man hours per part, % reduction or reduced number man hours per part, and opportunities for future labor reduction
- Baseline tonnage, increased tonnage due to introduction of AM technology, and opportunities for future increase in tonnage
- Baseline throughput, %increase in throughput due to introduction of AM technology, and opportunities for future increase in throughput
- Verification of specific critical to quality metrics (porosity, inclusions, geometric dimensioning and tolerancing [GD&T] factors, etc.)
- Number of qualified part numbers
- Number of qualified/approved vendors or suppliers

Topic Area 6 – Develop and disseminate leading DED and cold spray practices to promote adoption of die repair for forging applications

Forging processes rely on thermomechanical work to shape stock materials and produce fine-grained wrought material microstructures. Work is realized through the use of pressure applied by dies which exhibit a mixture of hardness, elevated temperature

mechanical stability, wear, and oxidation resistance. Dies can be relatively simple or complex in terms of their geometry. Dies may feature various section thickness, various radii or curved surfaces, and incredibly tight dimensional tolerances (<< 0.005") depending upon the forging design (material, size, reduction ratio, application, etc.) and forging process type. Dies are produced using different materials which may or may not be readily processed by AM technologies. Die quality and durability is important to forging manufacturing cost, productivity, quality, and lead time. AM offers a means of repairing or refurbishing dies to improve uptime and/or turn-around time for forging manufacturing operations. It is anticipated by better understanding the repair of dies, it may be possible to begin to understand the value of AM for the production of certain dies as well. In addition, it is anticipated these efforts will lead to a better understanding of various technical and programmatic risks for AM of forging dies. DED (including hybrid AM) and solid state AM (including cold spray) technologies present an opportunity to quickly and successfully repair forging dies. There is a need for demonstrations of the baseline AM process capability, standard manufacturing practices, and design tools in order to realize rapid forged product qualification when leveraging AM technologies for these purposes. Technical approaches in response to this topic area shall consider all or some of the following:

- Gather various industry and government stakeholders to identify and prioritize qualification requirements, risks, and validate qualification test matrices
- Leverage expert advice and inputs to mitigate technological and programmatic risks
- Value proposition framework demonstration which may consider feedstock/precursor costs, labor, depreciation, production volumes, equipment size (part size limitations), productivity factors (for AM and forging) that facilitates techno-economic tools for determining when to deploy AM capabilities for certain forged products
- Assess and demonstrate die size/features, operating conditions, materials and AM process manufacturing capabilities for components and materials of priority to U.S. defense industrial base
- Identify, develop, and validate AM processing capabilities for the repair of forging dies which meet acceptance criteria
- Identify product use cases which exhibit the right mix of demand, criticality, and applicability to AM augmented forging manufacturing and execute relevant qualification tasks or product manufacturing demonstrations (including first article testing)
- Physical and mechanical material property data for repaired dies
- Processing and post process development which includes cost, quality, and opportunities for future improvement
- Develop and validate acceptable AM feedstock, AM processes, die post-processing, and/or forging quality metrics
- Deliver data which successfully demonstrates forging qualification criteria
- Baseline assessments of various AM technologies/equipment OEMs (for example, directed energy deposition [DED], hybrid AM, solid state [friction stir or others] AM, or other metal AM modalities) which may include assessment of productivity,

geometric feature capability studies, repeatability/reproducibility, performance, and material compatibility
- Establishing validated processing and post-processing practices and characterization of associated critical to product quality metrics for forgings (examples include GD&T, microstructure, mechanical properties, etc.)
- Consequence to manufacturing operations and product qualification as a result of choosing an AM technology which is mitigated through development, demonstration, and qualitative or quantitative key performance parameters in comparison to commercial off the shelf (COTS) or legacy forging solutions
- Design guides, tools, methods, and practices to manage product yield, GD&T, or other critical to quality factors (die life, microstructure, mechanical properties, etc.)
- Process modeling and simulation tools to address critical to product quality metrics
- Piloting technology via forged product manufacturing demonstrations relevant to needs of U.S. defense industrial base
- Collaboration with multiple forging suppliers
- Characterization, inspection, and testing to accelerate qualification
- Benefits, impact, and trade-off analysis
- Technology transition plan

Proposers are required to provide key performance parameters (KPPs) which constitute an industrially relevant measure of success/acceptance and shall be aligned to the tasking, trials, experiments, or measurements within the project technical approach (scope). Responses shall propose key performance parameters using factors similar to common industry acceptance criteria. For example, tensile strength minimum, average, and/or standard deviation, maximum pore size, or other relevant quality metrics as a means of validating the outcomes of tasking in a manner conducive to technology or manufacturing readiness level assessments. For those unfamiliar with technology readiness level assessments, please see the following reference (https://www.gao.gov/assets/710/706680.pdf). Responses are required to use a threshold (minimum acceptable value) and objective (ideal or stretch goal) value approach which aligns KPPs with tasking, data, and data types as well as how the KPP will be demonstrated. For example, verification of a not to exceed a certain maximum pore size KPP may be demonstrated using metallographic sectioning, microscopy, and image analysis over a 0.5 in cross section of cast material in the fully heat-treated condition.

Proposers shall maintain traceability and data management practices which facilitate dissemination and reuse of the findings in a manner which makes the proposed effort reproducible, transparent, and a well-posed and controlled technical approach. Effort and data gathering shall be conducted in a manner similar to common quality management practices standard to industry and leveraged as much as reasonably practical for ensuring data integrity and program relevancy and validity. Examples of this may include standards, specifications, certifications, calibration details, process control documentation, and verification of qualified material sources (precursors or feedstock, etc.), processes, post processes, inspection, testing, and quality control protocols. Data management not only promotes the long-term viability of America Makes research, it also

facilitates trust and reuse of the data generated by our efforts. Furthermore, it diminishes concern for unknown or unrecorded sources of variance within development activities.

Responses to this topic area are required to demonstrate impact through quantitative metrics which exhibit a threshold and objective value. For those unfamiliar with such approaches, please see the following reference (https://acqnotes.com/acqnote/acquisitions/key-perfrormance-parameter). Examples of high priority factors for consideration to successfully demonstrate impact for this topic area include:

- Baseline cost, Cost reduction %, and opportunities for future cost savings
- Baseline lead time, lead time reduction %, and opportunities for future lead time reduction
- Baseline yield/scrap, reduced scrap %, and opportunities for future yield improvements
- Reduced time to realize/on-time delivery of first articles demonstrated (or other industrially recognized qualification metrics)
- Baseline man hours per part, % reduction or reduced number man hours per part, and opportunities for future labor reduction
- Baseline tonnage, increased tonnage due to introduction of AM technology, and opportunities for future increase in tonnage
- Baseline throughput, %increase in throughput due to introduction of AM technology, and opportunities for future increase in throughput
- Verification of specific critical to quality metrics (porosity, inclusions, geometric dimensioning and tolerancing [GD&T] factors, etc.)
- Number of qualified part numbers
- Number of qualified/approved vendors or suppliers

Topic Area 7– AM for casting and forging innovations relevant to DoD acquisition or sustainment programs

This topic area includes approaches which fall outside of topic areas 1 through 6 or offers the opportunity to combine concepts aligned to multiple topic areas. Proposals in response to this topic are required to include an OEM or tiered supplier commitment as a contributing member of the project team. **Letters of interest are insufficient.** Proposals in response to this topic are required to specifically outline quantifiable improvements in quality, cost, yield, or performance results from the implementation of this technology if successful. A **detailed** technology transition plan **from the OEM/supplier** must be included in responses for this topic area.

Proposers are required to provide key performance parameters (KPPs) which constitute an industrially relevant measure of success/acceptance and shall be aligned to the tasking, trials, experiments, or measurements within the project technical approach (scope). Responses shall propose key performance parameters using factors similar to common industry acceptance criteria. For example, tensile strength minimum, average, and/or standard deviation, maximum pore size, or other relevant quality metrics as a means of validating the outcomes of tasking in a manner conducive to technology or

manufacturing readiness level assessments. For those unfamiliar with technology readiness level assessments, please see the following reference (https://www.gao.gov/assets/710/706680.pdf). Responses are required to use a threshold (minimum acceptable value) and objective (ideal or stretch goal) value approach which aligns KPPs with tasking, data, and data types as well as how the KPP will be demonstrated. For example, verification of a not to exceed a certain maximum pore size KPP may be demonstrated using metallographic sectioning, microscopy, and image analysis over a 0.5 in cross section of cast material in the fully heat-treated condition.

Proposers shall maintain traceability and data management practices which facilitate dissemination and reuse of the findings in a manner which makes the proposed effort reproducible, transparent, and a well-posed and controlled technical approach. Effort and data gathering shall be conducted in a manner similar to common quality management practices standard to industry and leveraged as much as reasonably practical for ensuring data integrity and program relevancy and validity. Examples of this may include standards, specifications, certifications, calibration details, process control documentation, and verification of qualified material sources (precursors or feedstock, etc.), processes, post processes, inspection, testing, and quality control protocols. Data management not only promotes the long-term viability of America Makes research, it also facilitates trust and reuse of the data generated by our efforts. Furthermore, it diminishes concern for unknown or unrecorded sources of variance within development activities.

Responses to this topic area are required to demonstrate impact through quantitative metrics which exhibit a threshold and objective value. For those unfamiliar with such approaches, please see the following reference (https://acqnotes.com/acqnote/acquisitions/key-perfrormance-parameter). Examples of high priority factors for consideration to successfully demonstrate impact for this topic area include:

- Baseline cost, Cost reduction %, and opportunities for future cost savings
- Baseline lead time, lead time reduction %, and opportunities for future lead time reduction
- Baseline yield/scrap, reduced scrap %, and opportunities for future yield improvements
- Reduced time to realize/on-time delivery of first articles demonstrated (or other industrially recognized qualification metrics)
- Baseline man hours per part, % reduction or reduced number man hours per part, and opportunities for future labor reduction
- Baseline tonnage, increased tonnage due to introduction of AM technology, and opportunities for future increase in tonnage
- Baseline throughput, %increase in throughput due to introduction of AM technology, and opportunities for future increase in throughput
- Verification of specific critical to quality metrics (porosity, inclusions, geometric dimensioning and tolerancing [GD&T] factors, etc.)
- Number of qualified part numbers

- Number of qualified/approved vendors or suppliers

Disseminating the Value Proposition of Bridging Component Sourcing Gaps with AM Parts for Critical Casting and Forging Production

Topic Area 8 – Techno-economic analysis and manufacturing readiness assessments to address bridging component sourcing gaps with AM parts for critical casting and forging production.

There are instances where AM can uniquely serve as a method to "bridge" gaps in component sourcing for casting and forging applications. Based upon the discussions and workshop inputs received prior to the IMPACT project call release, these applications and opportunities lack definition and understanding which fosters immediate ability to execute targeted and high impact potential effort. All of the inputs and feedback gathered suggest a preliminary analysis of product types, considerations, and acceptance standards analysis in concert with an AM technology/manufacturing readiness assessment is needed to deliver a techno-economic framework for when, where, and how to utilize AM technologies to bridge gaps in component sourcing.

Responses to this topic area are required to establish an advisory group. This group is highly encouraged to feature government, industry, and academia subject matter experts. Examples of organizations within government which should be highly considered include, but are not limited to Army DEVCOM GVSC, Army DEVCOM AvMC, ONR, Naval Warfare Centers, NAVSEA, NAVAIR, AFRL, AFLCMC, USMC, OSD(R&E), OSD(R&E), DLA, MDA, NASA, and DOE. Advisory groups should feature those with experience in cast, wrought, and AM product acceptance or acquisition. It is encouraged that advisory groups feature organizations with design approval (acceptance authority). The advisory group is to serve in a capacity as much as reasonably possible to avoid duplication of effort and drive rapid awareness to prior and existing activities which can be used to establish the current state of the art as well as detail gaps, needs, etc. for furthering domestic capability to address bridging gaps in component sourcing under various conditions.

In order for this effort to exhibit the highest potential for relevancy and expediency to benefit the U.S. defense industrial base, all project team members must have a valid DD2345 in order to participate in projects in response to this topic area. It is anticipated that the outcomes of this effort will be able to be desensitized at its conclusion (at a later time) to benefit a wider cross section of the casting, forging, and AM community. **No foreign national participation will be allowed in this topic area.**

Technical approaches in response to this topic area shall include all or some of the following:

- Establishing a matrixed approach which captures understanding or readiness, economic viability according to explicit product categories/types, materials, and current material forms (cast, wrought, etc.)
- Conditions and circumstances influencing viability of AM (cost, benefit, risk) as a method to bridge sourcing gaps using at least four (4) metal AM modalities

- Roadmap of gaps and opportunities to further advance the state of the art and accelerate implementation of AM as an accepted component sourcing method including factors such as documented manufacturing capabilities (geometries, productivity, materials, and limitations), material/qualification data availability, qualification and certification risks, costs, demand data, or other information necessary to facilitate broad acceptance for multiple application/product types (MRL 7)
- Documentation of leading practices that can be applied to various AM technologies to help bridge component sourcing gaps.
- Documentation of existing or necessary benchmarking studies between AM and conventional (casting, forging) manufacturing and establishment of key performance indicators
- Value proposition framework which may consider feedstock/precursor costs, labor, depreciation, various supply chain models, production volumes (demand), equipment size (part size limitations), productivity factors facilitate techno-economic tools for determining when to deploy AM capabilities for certain cast or forged products and when not to utilize AM
- Necessary data, methods, modeling/simulation tools, manufacturing technology development/demonstrations, supply chain resources, testing methods or techniques, inspection protocols in order to realize MRL 7 (technology transition plan) for at least four (4) application/product types [two casting and two forging]
- Necessary tools, methods, and decision-making factors needed in order to effectively identify relevant AM processes for casting or forging applications
- Documentation to support rapid supplier qualification
- Documentation of gaps in understanding of AM capability, manufacturing process controls, quality management practices, productivity, validation methods, and cost models to aid in accelerating MRL progression to 7 in a manner relevant to application/product types and “representative” (theoretical is acceptable) demand levels.
- Documentation of bridge component sourcing gap application KPPs, qualification, and/or acceptance criteria to fast track and focus subsequent research/development efforts based upon these requirements
- Assessment of product certification risks
- Identification of bridge component sourcing gap opportunities for cast and wrought product which may serve as high potential impact opportunities over the course of ≤ 2 years, 3 to 4 years, or > 4 years.

Proposals in response to this project are required to deliver a findings report via an in-person program review (presentation) no later than the end of August of 2024. At a minimum, the program review shall deliver background, objectives, approach, and findings for the following:

- Identification of bridge component sourcing gap opportunities for cast and wrought product which may serve as high potential impact opportunities over the course of ≤ 2 years, 3 to 4 years, or > 4 years.
- Documentation of gaps in understanding of AM capability, manufacturing process controls, quality management practices, productivity, validation methods, and cost models to aid in accelerating MRL progression to 7 in a manner relevant to application/product types and "representative" (theoretical is acceptable) demand levels.
- Necessary data, methods, modeling/simulation tools, manufacturing technology development/demonstrations, supply chain resources, testing methods or techniques, inspection protocols in order to realize MRL 7 (technology transition plan) for at least four (4) application/product types [two casting and two forging]
- Assessment of product certification risks
- Summary of necessary research and development efforts, data, validation, etc. needed to bridge the gap in component sourcing application acceptance

Identifying and Disseminating the Impact of Strategic R&D to Scale Powder Bed AM Technology

Topic Area 9 – Powder AM techno-economic analysis

Powder bed additive manufacturing, also known as powder bed fusion, is a specific type of additive manufacturing that uses a laser or electron beam to selectively melt layers of powdered material to build up a 3D object. It has the potential to revolutionize manufacturing in the aerospace and defense industry, particularly for complex and low-volume parts. However, there is currently a lack of understanding about how to best allocate resources to have the biggest impact on the Air Force (AF) mission in the context of powder bed additive manufacturing.

To address this challenge, a techno-economic analysis specific to powder bed additive manufacturing can be performed to evaluate potential investments in this technology. This analysis would involve a comprehensive evaluation of the costs and benefits of different powder bed additive manufacturing technologies, materials, and processes and their potential impact on the AF mission.

One of the challenges with performing a techno-economic analysis for powder bed additive manufacturing is that this technology is still relatively new and rapidly evolving. As a result, there may be limited data available on the costs and benefits of different powder bed additive manufacturing processes and materials. Furthermore, the performance and reliability of powder bed additive manufacturing technologies may not be well understood in the context of aerospace and defense applications.

To address these challenges, a paper study could be conducted to review the existing literature on powder bed additive manufacturing and identify the most promising technologies and applications for the AF mission. Additionally, interviews with experts in powder bed additive manufacturing and aerospace and defense could also be conducted

to gather additional information on the potential benefits and challenges of different powder bed additive manufacturing technologies.

By combining a paper study with expert interviews and a thorough techno-economic analysis, decision-makers can gain a more comprehensive understanding of the potential benefits of powder bed additive manufacturing and make more informed decisions about how to allocate resources to achieve the AF mission. This could include investments in new powder bed additive manufacturing technologies, materials, or processes that could improve the speed, reliability, and cost-effectiveness of manufacturing for aerospace and defense applications.

In order for this effort to exhibit the highest potential for relevancy and expediency to benefit the U.S. defense industrial base, all project team members must have a valid DD2345 in order to participate in projects in response to this topic area. It is anticipated that the outcomes of this effort will be able to be desensitized at its conclusion (at a later time) to benefit a wider cross section of the casting, forging, and AM community. **No foreign national participation will be allowed for this topic area.**

Technical approaches in response to this topic area shall:

- Examine the potential impact to the Department of the Air Force from future investment in the various metal and ceramic powder-based AM technologies
- Survey and understand current demand signals and determine primary users
    - Collate identified needs to potential powdered AM technologies
    - Broader DoD needs may be considered, but the focus should remain on USAF applications
- Interface with technical and business experts in the identified technical areas including:
    - Identify investment areas to enable/enhance current AM technologies to provide value to the USAF. Example investment areas may include, but are not limited to:
        1. New powder material formulations
        2. Process refinement to better utilize current commercial hardware
        3. Novel uses of AM to bolster the traditional supply chain responsiveness
    - Project impact of investment in the identified investments areas. Focus on quantitative analysis, such as:
        1. Projections of amount of part cost reduction per investment dollar
        2. Projections of amount of time saved per investment dollar
        3. Projections on broader associated cost savings per investment dollar
- Capture insights on value statements for manufacturing technology investment

E.g., “Where is our money best spent to have the biggest impact to the USAF mission”

- Conduct interchange meeting with identified entities from surveyed community with government partners
    - Identify low, medium, and high-impact focus areas, focusing on quantitative returns
    - Identify future investment opportunities and areas of upcoming interest which lack current data to perform adequate quantitative analysis

Proposals in response to this project are required to deliver the following:

1. Distro D Interim and Final report to be distributed solely to AFRL, including:
    - Value statements from specific entities
    - Current/projected demand signals for Powdered AM withing the Aerospace and USAF communities
    - Notes from interchange meeting identifying entities
    - Techno-economic analysis projecting quantifiable returns on potential investments in the identified technology areas
2. Distro D/C/A final report created from Deliverable 1 but scrubbed to remove sensitive information with regards to specific plans. Report shall include:
    - Generic value statements
    - Current and projected demand signals that can be distributed to contractors and other entities

Advancing AM Processing for Continuous Fiber Reinforced Composites

Topic Area 10 – Innovations in robotic additive manufacturing process planning

In recent years, the United States Department of Defense has shifted away from a focus on counter-terrorism and counter-insurgency operations and oriented toward deploying capabilities to counter near-peer adversaries. Fundamentally, the capabilities needed to conduct counter-insurgency are different than those to keep pace with modern militaries. To that end, the USAF has published a set of Operational Imperatives that describe the challenges imposed by near-peer adversaries and the capabilities that must be developed to deter, counter, and defeat these challenges.

https://www.af.mil/Portals/1/documents/2023SAF/OPERATIONAL_IMPARITIVES_INFOGRAPHIC.pdf.

Against this backdrop, the AFRL is developing science and technology to deliver the complexity, unpredictability and mass required to enable solutions for the Operational Imperatives.
https://www.af.mil/Portals/1/documents/2019%20SAF%20story%20attachments/Air%20Force%20Science%20and%20Technology%20Strategy.pdf.

One aspect of this strategy is to augment existing manned aircraft with fleets of unmanned, autonomous systems. As stated in the USAF 2030 Science and Technology Strategy, “To become more agile, the Air Force must augment its high-end platforms with larger numbers of inexpensive, low-end systems. Swarms of low-cost, autonomous air and space systems can provide adaptability, rapid upgradability, and the capacity to absorb losses that manned systems cannot.”

While this vision is intriguing, it cannot be achieved affordably by using existing design and manufacturing practices. Thus, AFRL is maturing a broad set of technologies that will allow attrition-tolerant platforms to meet diverse mission requirements while also being affordable, agile, scalable, and reconfigurable. One line of effort to achieve this vision is to develop the ability to print primary composite structures for attrition-tolerant platforms. Printing of continuous fiber reinforced composites offers an array of attractive benefits. Once matured, these processes offer tremendous design freedom and adaptability to generate part geometries that can’t be achieved using extant composites manufacturing approaches. These processes also offer the potential of fiber steering within a larger structure to optimize load carrying capacity as well as the ability to integrate functional elements into a structure. These and other attributes of continuous fiber printing enable integration of parts into larger unitized assemblies if desired and open the door to leveraging topology optimization and generative design to create lighter weight structures. Together, these attributes, along with reduced reliance on tooling, can unlock a completely different paradigm of materiel support for unmanned systems. A future state with a robust continuous fiber printing capability could permit distributed manufacturing and logistics as well as reinforce the responsiveness and resilience of the industrial base to ramp production rapidly.

NCDMM and AFRL are seeking responses which outline a technical approach to mature solutions that will reduce the printability gap between the part geometries we can design and the geometries that current state-of-the-art continuous fiber printers can produce. Figure 1 contains an example of a portion of a topology optimized design for an attrition-tolerant composite airframe. Advanced design tools are capable of optimizing material placement along critical load paths, yet for a myriad of reasons, those geometries cannot actually be produced as designed with current continuous fiber printers. Such designs often feature complex features oriented within the part volume that neither neatly simplify to printable features nor take advantage of exquisite fiber steering and placement to leverage advantageous anisotropic properties. As a result, significant non-recurring engineering is required to turn each design into a part, or more likely a set of assembled parts, that may ultimately bear a limited resemblance to the original design. Many of these parts are simplified to be printed in a planar configuration or onto a tooled surface. Figure 2 provides an example of the compromises necessary to fabricate organic topology optimized designs with continuous fiber reinforced printing. Such drastic design compromises that simplify printable structures to assemblies of essentially planar parts limits the utility of applying topology optimization and additive manufacturing to such structures.

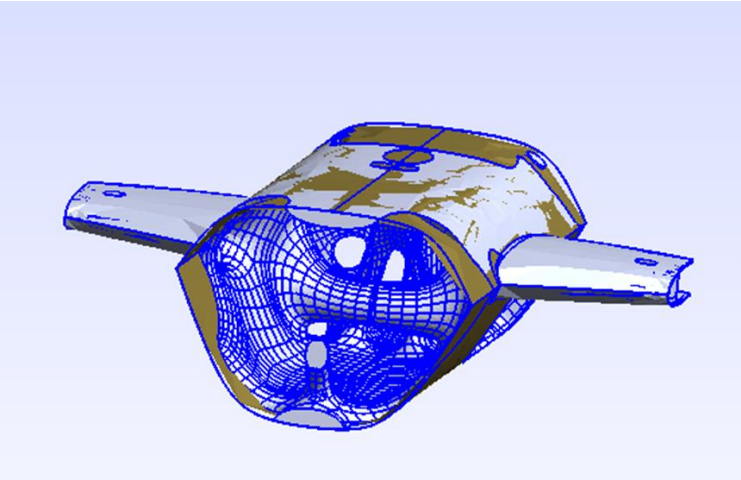

Figure 1: Topology optimized wingbox section of an attrition tolerant platform with a carry through structural member highlighted.

Figure 2: Carry-through structural member prototype taking into account manufacturing constraints of continuous fiber additive manufacturing.

Topic area 10 is seeking innovations on one of the foundational challenges limiting the realized design freedom of continuous fiber printing: robotic process planning. While there are clearly material and processing limitations that impact the ability to print complex 3 dimensional shapes with continuous fiber printing processes, maturation in those areas is beyond the scope of this effort.

For processes that generate parts in a layer-by-layer fashion, process simulation packages and slicers exist to aid the user in generating a process plan. However, generation of a process plan for any robotic AM process that would operate outside a layer-by-layer paradigm involves generation of a geometric drive curve across a tool surface or free-space in addition to integration of other key processing parameters and constraints. Some of these processing parameters are endemic to all robotic AM processes such as travel motion between stops and starts, approach motion, and retraction motion. While other parameters are more specific to continuous fiber printing such as cutting and refeeding of tows, consolidation dynamics from heating or UV cure initiation, minimum piece length, optimization of fiber orientation, and track overlap and spacing. To date, there is no software nor algorithm available that can ingest the constraints of robotic continuous fiber AM processes and generate a 3D CAD spline for

the end effector to follow, leading either to severe simplification of the parts these processes can generate or extensive manual programming that inhibits deployment of the technology.

Proposals in response to topic area 10 shall measurably close the gap between the complex designs that methods like topology optimization or generative design can create and what can actually be programmed and fabricated by emerging AM platforms. Innovations will be considered that address any aspect of the workflow between generating a CAD design and printing that design. Structural composites using continuous fiber additive manufacturing is the driving application space, but innovations in this space are anticipated to have implications for other robotic AM processes. **Solutions addressing the particular process planning constraints of continuous fiber additive manufacturing are preferred.**

There is no specific transition path nor partnering arrangement that is preferred for purposes of proposal evaluation. Proposers, however, are encouraged to articulate in detail how their solutions will impact the field in order for AFRL to assess the nature of engagement with relevant vendors and how solutions will be integrated across the community. Some potential examples include but are not limited to - Will there be an open-source solution that can be adopted by a wide range of manufacturers? Will there be a partnering arrangement to implement new or modified algorithms or software in a particular application or AM process?

Additionally, proposers shall generate Key Performance Parameters and a Data Management Plan. Proposers are required to provide key performance parameters (KPPs) which constitute an industrially relevant measure of success/acceptance and shall be aligned to the tasking, trials, experiments, or measurements within the project technical approach (scope). Responses shall propose key performance parameters using factors similar to common industry acceptance criteria. For example, tensile strength minimum, average, and/or standard deviation, maximum pore size, or other relevant quality metrics as a means of validating the outcomes of tasking in a manner conducive to technology or manufacturing readiness level assessments. For those unfamiliar with technology readiness level assessments, please see the following reference (https://www.gao.gov/assets/710/706680.pdf). Responses are required to use a threshold (minimum acceptable value) and objective (ideal or stretch goal) value approach which aligns KPPs with tasking, data, and data types as well as how the KPP will be demonstrated. For example, verification of a not to exceed a certain maximum pore size KPP may be demonstrated using metallographic sectioning, microscopy, and image analysis over a 0.5 in cross section of material.

Proposers shall maintain traceability and data management practices which facilitate dissemination and reuse of the findings in a manner which makes the proposed effort reproducible, transparent, and a well-posed and controlled technical approach. Effort and data gathering shall be conducted in a manner similar to common quality management practices standard to industry and leveraged as much as reasonably practical for ensuring data integrity and program relevancy and validity. Examples of this may include standards, specifications, certifications, calibration details, process control documentation, and verification of qualified material sources (precursors or feedstock,

etc.), processes, post processes, inspection, testing, and quality control protocols. It recognized and understood that not all AM technologies are at a readiness level where all of these factor or considerations are known or exists. Hence, quality management practices should be leveraged as much as reasonably practical. Data management not only promotes the long-term viability of America Makes research, it also facilitates trust and reuse of the data generated by our efforts. Furthermore, it diminishes concern for unknown or unrecorded sources of variance within development activities.

Proposals outside of these topic areas will not be considered at this time.

Proposals, which address the topic areas outlined in section 2 while closely considering the funding and period of performance limitations, are encouraged. Offerors are encouraged to carefully review the proposal submission and review criteria outlined in sections 3 and 4.

The America Makes membership continue to refine and expand the America Makes AM Technology Roadmap. Revision and curation of the AM Technology Roadmap is executed primarily through regular meetings of the swimlane working groups and Roadmap Advisory Group in conjunction with workshops to gather input from the broader membership. The AM Technology Roadmap not only describes the strategic interest and knowledge gaps of the technology landscape, but also serves as a history of prior efforts conducted by the membership. The merit and benefit of the roadmap arises from the collaboration of the membership which is responsible for its content. The membership is composed of small, medium, and large industry, non-profit organizations, academia, and government partners. The perspectives of the membership contained within the AM Technology Roadmap are representative of all tiers of the domestic AM supply chain. The AM Technology Roadmap offers a structure to align the interests of the AM community to within five swimlanes including: Design, Materials, Process, Value Chain, and AM Genome. Within these swimlanes are various Critical Technology Elements (CTE's) and over four hundred requirements.

Execution of funded America Makes projects and programs address roadmap requirements which foster the advancement of AM technology readiness and industrialization. Hence, the continued engagement and participation of the membership in working groups, advisory groups, and workshops is vital to the value of the roadmap and describing the impact of America Makes funded activities. The IMPACT Project Call aligns to various requirements spanning the Design, Materials, Process, Value Chain, and AM Genome swimlanes including:

- **Design**
  - REQ-000293-Implementation of AM design tools and software across industry to fully enable the unique design capabilities of AM
  - REQ-000300-Integration of material, process, and property data into design tools to improve design effectiveness
  - REQ-000304-Develop intelligent process design tools capable of determining optimal build parameters, orientations, and support structures

- REQ-000027-Develop design for manufacturability algorithms that improve cycle time required to perform CAD/CAD/CAE Analysis
- REQ-000029-Design Advisors that Recommend Rapid Qual/Cert Approaches
- REQ-000031-Design for Additive Manufacturing Criteria and Analysis Tools
- REQ-000033-Material Selection Process Design Advisors
- REQ-000071-Integrated AM and Secondary Machining Support Guidelines
- REQ-000073-CFR Polymer CAD/CAM/CAE Optimization Tools
- REQ-000078-Additive Manufacturing vs. Conventional Process Trade-Off Criteria
- REQ-000273-Implementation of AM design tools and software across industry to fully enable the unique design capabilities of AM
- REQ-000277-Develop standardized reverse engineer procedure include uniform procedures reverse engineer, include tools, software, & equipment
- REQ-000280-Development design tools for reverse engineer to reverse engineer existing part designs, include complex & multi-material parts
- REQ-000288-Establishment AM design rules & guidelines based on design for additive manufacturing (DFAM) best practices and lessons learned
- REQ-000289-Establishment of AM materials and process selection guidelines to ensure part designs meet application requirements
- REQ-000298-Develop digital design standards based on a set of comprehensive rules & standards to guide AM-focused design digital context
- REQ-000308-Development of design tools for making design decisions based on wear condition modeling
- REQ-000311-Development of design tools for DFAM using functional composite materials
- REQ-000315-Establishment of a standard characterization matrix to determine surface finish and associated "knock-down" factors for fatigue
- REQ-000318-Development of a design for repair guideline to define acceptance criteria and design requirements for repair

- **Materials**
  - REQ-000407-Populate repository with available datasets for use by the AM community
  - REQ-000412-Increase the availability of pedigreed datasets
  - REQ-000406-Establish acceptable AM feedstock material properties

- REQ-000408-Analyze the effects of feedstock material properties and process parameters on end-item performance
- REQ-000409-Develop feedstock materials specifications and standards
- REQ-000410-List Feedstock Vendors and Foster Expansion of Material Sources
- REQ-000411-Establish Vendor Qualification and Encourage Expansion of Material Sources
- REQ-000413-Identify Potential AM Materials Sources
- REQ-000414-Documentation clearly defining a domain of repairable material/microstructure based on end-use application
- REQ-000432-Development of standardized feedstock specifications for alloys for use in AM systems
- REQ-000207-Forging Tool Wear Resistant Coating Guidelines
- REQ-000430-Develop AM materials to meet industry and government needs
- REQ-000435-Geometric features including locally varying properties
- REQ-000439-Functionally graded product development - understanding multi-material interactions

- **Process**
  - REQ-000371-Development of linkages between design and simulation tool outputs integrated into AM systems for multi-material builds
  - REQ-000180-3D-Gradient Material Deposition Control
  - REQ-000371-Development of linkages between design and simulation tool outputs integrated into AM systems for multi-material builds
  - REQ-000372-Integration of knowledge base multi-material process characteristics/capabilities/post-processing into material extrusion system
  - REQ-000168-Develop optimized carbon-fiber reinforced Polymers
  - REQ-000169-Development of high-performance polymers for use in high performance structures through: Raw material Polymer/ composite develop
  - REQ-000171-Development of High Resolution / Small Featured Additive Manufacturing
  - REQ-000310-Identification of key process variables with correlation to defects for all AM processes to ensure quality control
  - REQ-000313-Development of a control framework for AM machines enabling advanced data collection and analysis techniques to manage AM processes

- REQ-000344-Development of automated material handling systems to enable a unitized production capability
- REQ-000348-Development of a common interface (hardware and software) for AM machines enabling systems integration
- REQ-000353-Development of multiscale approaches that integrate processing for a range of sizes
- REQ-000377-Development of AM systems capable of large format printing of complex parts

- **Value Chain**
  - REQ-000389-Development of AM use cases and best practices for repair, part replacement, and new part manufacture
  - REQ-000390-Development of appropriate cost models
  - REQ-000391-Development of appropriate decision tools
  - REQ-000392-Documentation of risk of AM approaches
  - REQ-000393-Documentation of relevant AM technology capabilities
  - REQ-000282-Establishment of vendor qualification processes and encourage expansion of material sources
  - REQ-000380-Development of the minimum requirements for equipment qualification enabling rapid AM equipment qualification within the supply
  - REQ-000248-Increase capability rapidly delivered to warfighter
  - REQ-000447-Establishment of AM designs/parts libraries creation AM design repositories for AM parts and ensure availability to stakeholders

- **AM Genome**
  - REQ-000043-Statistically-relevant property database data set
  - REQ-0000471-Establish a dataset to support predictive correlation between properties
  - REQ-000448-Development of a knowledge base of multi-material process characteristics, capabilities, and post-processing functions
  - REQ-000074-Develop approach for integrating the experimental processing-structure-property with process models
  - REQ-000077-Develop methodology for capturing relevant data obtained from models for rapid insertion and certification of new materials
  - REQ-000336-Determination of the linkages between AM process parameters to property predictions across length scales

- REQ-000327-Development of models that drive/ guide defect prediction and control (e.g., porosity, surface roughness, process map components)
- REQ-000333-Development and demonstration of functionally graded multi-material models and applications
- REQ-000338-Development of empirical and physics-based models to ensure AM part quality

Deliverables:

For each selected project, the selected team shall provide such deliverables as reports, data, presentations, training course materials, course content, experimental procedures, experimental hardware specifications, analytical methods, build files, CAD models, printed demonstration articles, list of relevant software, photos, video, meeting minutes, allowables, KPPs, software packages, samples, drawings, digital models, specifications and other project specific deliverables to appropriate AFRL transition partners and to America Makes for dissemination to members via the America Makes CORE.

Minimum deliverables for any project in response to Topic Areas 1 through 7 include:

Minimum Deliverable	Timeline
Written Technical Progress Reports	Quarterly
Project update calls or virtual meetings between project team, America Makes/NCDMM PM, and Government advisory	Monthly, or more as necessary
Financial and man-hour reports	Monthly
Kickoff Meeting	1 month after award or sooner
Data Management Plan including at minimum: Any commercial software packages to be used, standards or data schemas to be used, and methodology for notating and labelling data to enable linking of various sample properties and characteristics, and plans for incremental delivery of data, and key performance parameters (KPP's)	Draft at time of proposal Final no later than 4 months after award
Data Persistence Plan (how will data be stored and accessed after project conclusion) – this is meant to address data storage by the project lead by means aside from America Makes CORE	Initial at proposal Final no later than 4 months after award

Planned project deliverables list with corresponding (existing/ new) Technology Roadmap Requirements	Draft at time of proposal Final no later than 60 days after award
Experimental, qualification, material, testing and inspection data (feedstock, process, material, post-process, property, etc.) available in a static format and in a database with property meta-data (including CAD models and build files); non-destructive inspection data and meta-data	Delivered or posted to America Makes CORE database regularly as available
Schema and Data Compliance Reviews, Data shall: Be provided electronically, demonstrate pedigree and provenance, identify test apparatus/manufacturing/ fabrication equipment and calibration, testing standards or processing specifications used to include sample preparation and/or manufacturing equipment configuration, experimental/ characterization/manufacturing process conditions and procedures, raw mechanical test data, data reduction and statistical analysis procedures, and any uncertainty associated with data	Quarterly
Presentation at an America Makes Meeting (MMX/TRX)	Once per calendar year
Presentation at one major conference/event (besides America Makes hosted event) such as RAPID + TCT, ASTM ICAM, DMC, Forge Fair, Metal Casting Congress	Once per calendar year
Lead organization shall participate on at least one swimflane **working group** (Design, Materials, Process, Value Chain, or AM Genome) relevant to subject matter of the project	Quarterly (via progress reporting) Effort performed (as well as hours) via working group participation shall be documented in progress reports and regular attendance should be maintained for all working group teleconferences/meetings. Minimum of one presentation outlining all deliverables (CDIP, associated tangible artifacts, and associated roadmap requirements), KPP's, and data management plan within 4 months of project start date.

	Minimum of one presentation of milestone achievements, KPP's, and lessons learned relevant to the fulfillment or creation of roadmap requirements no later than 60 days of the period of performance end date.
Value proposition framework development and demonstration which may consider feedstock/ precursor costs, labor, depreciation, production volumes, equipment size (part size limitations), productivity factors (for AM and casting or forging) that facilitates techno-economic tools for determining when to deploy AM capabilities for certain cast or forged products	No later than 3 months prior to the end of the period of performance
Written Final Project Report (minimum one round of revision completed with PM/NCDMM prior to final submission). At a minimum report will outline: application, approach, team members and roles, potential benefits of effort, motivations and reasoning for technical approach, KPPs, summary of tasking, methods, standards and specifications used, deviations to those standards or specifications, outcomes/results, summary and observations and analysis of data gathered, how data substantiated successful outcome of this effort, lessons learned, measurable impact realized due to this effort, future opportunities for research and development realized through this effort	27 months after award Complete preliminary draft submission 24 months after award
Additional Deliverables specific to the proposed effort	"Deliver (upload to CORE) as you go" – As soon as data or deliverable is finalized for release

Minimum deliverables for any project in response to Topic Area 8 include:

Minimum Deliverable	Timeline
Written Technical Progress Reports	Quarterly
Project update calls or virtual meetings between project team, America Makes/NCDMM PM, and Government advisor	Monthly, or more as necessary

Virtual teleconference updates for advisory group	Quarterly at a minimum, more frequently as necessary
Financial and man-hour reports	Monthly
Kickoff Meeting	1 month after award or sooner
Data Management Plan, Key performance parameters (KPP's), Planned project deliverables list with corresponding (existing/ new) Technology Roadmap Requirements	Draft at time of proposal Final no later than 9 months after award
Presentation at an America Makes Meeting (MMX/TRX)	Once per calendar year
Presentation at one major conference/event (besides America Makes hosted event) such as RAPID + TCT, ASTM ICAM, DMC, Forge Fair, Metal Casting Congress	No later than 18 months after award
Lead organization shall participate on at least one swimlane **working group** (Design, Material, Process, Value Chain, or AM Genome) relevant to subject matter of the project	Quarterly (via progress reporting) Effort performed (as well as hours) via working group participation shall be documented in progress reports and regular attendance should be maintained for all working group teleconferences/meetings. Minimum of one presentation outlining all deliverables (CDIP, associated tangible artifacts, and associated roadmap requirements), KPP's, and data management plan within 9 months of project start date. Minimum of one presentation of milestone achievements, KPP's, and lessons learned relevant to the fulfillment or creation of roadmap requirements no later than 60 days of the period of performance end date.
Program Review (In-person) with virtual option as necessary to facilitate advisory group attendance/participation	No later than August 31, 2024

Draft manuscript submitted to NCDMM for publication in America Makes LAYERS	No later than August 31, 2024
Written Final Project Report (minimum one round of revision completed with PM/NCDMM prior to final submission). At a minimum report will outline: applications considered, factors influencing AM as a viable sourcing approach, current technology or manufacturing readiness levels and considerations utilized for that determination for at least (4) AM modalities, future opportunities for development, summary of program review (including feedback, discussions, minutes), time phased impact opportunities, team members and roles, potential benefits of effort, KPPs for application of component sourcing, documented gaps in AM capabilities, necessary data/evidence to advance MRL including tools, technology, and methods to accelerate realization of MRL 7 for at least (4) application/product types [2 casting and 2 forging]	21 months after award Complete draft submission 18 months after award
Additional deliverables specific to the proposed effort	"Deliver (upload to CORE) as you go" – As soon as data or deliverable is finalized for release
Value proposition framework documented which may consider feedstock/precursor costs, labor, depreciation, production volumes, equipment size (part size limitations), productivity factors (for AM and casting or forging) that facilitates techno-economic tools for determining when to deploy AM capabilities to certain cast or forged bridge sourcing applications	No later than 3 months prior to the end of the period of performance

Minimum deliverables for any project in response to Topic Area 9 include:

Minimum Deliverable	Timeline
Written Technical Progress Reports	Quarterly
Project update calls or virtual meetings between project team, America Makes/NCDMM PM, and Government advisor	Monthly, or more as necessary
Financial and man-hour reports	Monthly

Kickoff Meeting	1 month after award or sooner
Data Management Plan, Key performance parameters (KPP's), Planned project deliverables list with corresponding (existing/ new) Technology Roadmap Requirements	Draft at time of proposal Final no later than 4 months after award
Presentation at an America Makes Meeting (MMX/TRX)	Once per calendar year
Presentation at one major conference/event (besides America Makes hosted event) such as RAPID + TCT, ASTM ICAM, DMC, Forge Fair, Metal Casting Congress	No later than 9 months after award
Lead organization shall participate on at least one swimlane **working group** (Design, Material, Process, Value Chain, or AM Genome) relevant to subject matter of the project	Quarterly (via progress reporting) Effort performed (as well as hours) via working group participation shall be documented in progress reports and regular attendance should be maintained for all working group teleconferences/meetings. Minimum of one presentation outlining all deliverables (CDIP, associated tangible artifacts, and associated roadmap requirements), KPP's, and data management plan within 9 months of project start date. Minimum of one presentation of milestone achievements, KPP's, and lessons learned relevant to the fulfillment or creation of roadmap requirements no later than 60 days of the period of performance end date.
At least one interchange meeting, or more as needed	5 months after award
Interim project report	6 months after award
Written Final Project Report (minimum one round of revision completed with PM/NCDMM prior to final submission). At a minimum report will outline: summary of current demand signals, associated DoD needs, prioritized focus areas ranked according to associated impact	9 months after award Complete draft submission 12 months after award

potential, identified gaps in data and understanding, investment areas, impact of investments in various areas, insights on value statements for manufacturing technology investments, value statements from specific entities, demand signals for powder AM, notes from the interchange meeting, and quantified returns on potential investments based upon techno-economic analysis	
Additional Deliverables specific to the proposed effort	"Deliver (upload to CORE) as you go" – As soon as data or deliverable is finalized for release
Value proposition framework documented which may consider feedstock/precursor costs, labor, depreciation, production volumes, equipment size (part size limitations), productivity factors (for AM and casting or forging) that facilitates techno-economic tools for determining strategic investment return ratios (or similar metrics)	No later than 18 months after award

Minimum deliverables for any project in response to Topic Area 10 include:

Minimum Deliverable	Timeline
Written Technical Progress Reports	Quarterly
Project update calls or virtual meetings between project team, America Makes/NCDMM PM, ARM Institute, and Government advisor	Monthly, or more as necessary
Financial and man-hour reports	Monthly
Kickoff Meeting	1 month after award or sooner
Planned project deliverables list with corresponding (existing/ new) Technology Roadmap Requirements	Draft at time of proposal Final no later than 60 days after award
Data Management Plan including at minimum: Any commercial software packages to be used, standards or data schemas to be used, and methodology for notating and labelling data to enable linking of various sample properties and	Draft at time of proposal Final no later than 4 months after award

characteristics, and plans for incremental delivery of data	
Key performance parameters (KPP's)	Draft at time of proposal Final no later than 4 months after award
Schema and Data Compliance Reviews, Data shall: Be provided electronically, demonstrate pedigree and provenance, identify test apparatus/manufacturing/ fabrication equipment and calibration, testing standards or processing specifications used to include sample preparation and/or manufacturing equipment configuration, experimental/characterization/ manufacturing process conditions and procedures, raw mechanical test data, data reduction and statistical analysis procedures, and any uncertainty associated with data	Quarterly
Data Persistence Plan (how will data be stored and accessed after project conclusion) – this is meant to address data storage by the project lead by means aside from America Makes CORE	Initial at proposal Final no later than 4 months after award
Design, experimental, qualification, material, testing and inspection data (feedstock, process, material, post-process, property, etc.) available in a static format and in a database with property meta-data (including CAD models and build files); non-destructive inspection data and meta-data	Delivered or posted to America Makes CORE database regularly as available
Presentation at an America Makes Meeting (MMX/TRX)	Once per calendar year
Presentation at one major conference/event (besides America Makes hosted event) such as RAPID + TCT, ASTM ICAM, DMC, or other industry recognized conferences	No later than 18 months after award
Lead organization shall participate on at least one swimlane **working group** (Design, Material, Process, Value Chain, or AM Genome) relevant to subject matter of the project	Quarterly (via progress reporting) Effort performed (as well as hours) via working group participation shall be documented in progress reports and regular attendance should be maintained for all working group teleconferences/meetings.

	Minimum of one presentation outlining all deliverables (CDIP, associated tangible artifacts, and associated roadmap requirements), KPP's, and data management plan within 4 months of project start date. Minimum of one presentation of milestone achievements, KPP's, and lessons learned relevant to the fulfillment or creation of roadmap requirements no later than 60 days of the period of performance end date.
Written Final Project Report (minimum one round of revision completed with PM/NCDMM prior to final submission).	21 months after award Complete preliminary draft submission 18 months after award
Transition and Commercialization Plan – How will solutions be adopted or implemented by the community?	Draft at time of proposal Updated NLT 12 months after award
Additional Deliverables specific to the proposed effort	"Deliver (upload to CORE) as you go" – As soon as data or deliverable is finalized for release

3 PROPOSAL AND SUBMISSION INFORMATION

3.1 RFP Process

Project Proposal: Proposing project teams responding to topic areas 1 through 8 will develop a full project proposal and will have approximately 34 days to submit their full proposal to NCDMM. Proposals are due on Wednesday, June 28, 2023, prior to 5 p.m. eastern time.

Proposing project teams responding to topic areas 9 or 10 will develop a full project proposal and will have approximately 43 days to submit their full proposal to NCDMM. Proposals are due on Friday, July 7, 2023, prior to 5 p.m. eastern time.

Note: In previous America Makes request for proposals (RFP), a white paper was requested prior to full project proposal submission. This RFP **is not** utilizing a white paper phase and white papers **will not be accepted**.

3.2 Project Proposal Submission

Award of contract resulting from this RFP will be based upon the response to the Proposed Research Program Topic Areas under section 2 with the final decision based on the evaluation by NCDMM, OSD(R&E), and AFRL on the viability, efficiency, and value of the proposal.

NCDMM, OSD(R&E), and AFRL reserve the right to:

- Reject any or all offers and discontinue this RFP process without obligation or liability to any potential Proposer
- Accept other than the lowest priced offer
- Award a contract on the basis of initial offers received, without discussions or requests for best and final offers
- Award more or less than one contract for any topic described in section 1 under the Total Amount to be Awarded

Project Proposals shall be submitted in several parts as set forth below. The Proposer will confine its submission to those matters sufficient to define its proposal and to provide an adequate basis for NCDMM's evaluation of the proposal.

3.3 Project Proposer Eligibility:

NCDMM will recognize the integrity and validity of Proposer provided that:

- The lead proposer for responses to topic areas 1 through 8 is a current member of America Makes and in good standing by Wednesday, June 14, 2023.
- The lead proposer for responses to topic areas 9 or 10 is a current member of America Makes and in good standing by Friday, June 23, 2023.
- Information on how to join America Makes is available at www.americamakes.us/membership. Any non-America Makes members contributing to proposed effort execution are not permitted to participate in project team discussions until completing a fully executed America Makes Membership Agreement. (Note: The foreign membership approval process requires a minimum of three weeks to complete.)
- Cost share accrued in this project may also be applied towards membership, as with other project calls. However, cost-share proposed on a future project cannot be counted towards a new America Makes membership. To become a member by the deadline, organizations shall commit to a cash payment and / or complete an @Program MOU.
- A 50% cost share is required for each project submittal. Example: If $1.00 of funding is requested from America Makes, $0.50 in cost share must be committed against that $1.00 for a total scope of $1.50
- The lead Proposer is fully responsible for all project and subcontract performance
- The lead Proposer shall be registered in U.S. System for Award Management (SAM) and have a cage code and duns number before submitting a proposal
- Proposal team acknowledges that information from this project will be shared with America Makes members in accordance with the membership agreement
- Proposal team arrangements are identified and relationships are fully disclosed

- All members of proposing teams in response to topic areas 8 or 9 must submit a valid copy of their respective organization's military critical technical data agreement (DD2345)
- **No foreign national participation will be allowed for topic areas 8 or 9.**

All project team members must have a signed sub-agreement with the lead proposer, obligating them to their agreed project role, cost share, and the flow-down requirements of the overarching contract between the lead proposer and NCDMM before any funds will be made available from NCDMM to the lead proposer for the project.

Proposals in response to this RFP will be incorporated into a final agreement between NCDMM and the selected Proposer(s).

3.4 Required Forms and Documents

- **Technical Proposal.** The technical proposal (technical volume) should respond to the program description and shall contain the following information:

  1) **Executive Summary.** A concise synopsis of the Proposer's response to the Project Call **and not exceeding two (2) single-sided pages** in accordance with evaluation criterion 1 (See Section 4.1 (1) of this Project Call). All content in the executive summary shall be publicly releasable, non-proprietary, unlimited distribution information. The executive summary information will be used in the instance a proposal is selected for an award to communicate key information regarding the selected response as part of a public release or other public communication.

  2) **Technical Approach and Methodology.** A description sufficient to permit evaluation of the proposal in accordance with evaluation criterion 2 (See Section 4.1 (2) of this Project Call)

  3) **Data Management Plan.** A description sufficient to permit evaluation of the proposal in accordance with evaluation criterion 3 in (See Section 4.1 (3) of this Project call) and **not exceeding three (3) single-sided pages**

     Data management planning should be an integral part of research planning. A data management plan is a document that describes data generated through the course of the proposed research that will be shared and preserved, how it will be done, or explains why data sharing or preservation is not possible or scientifically appropriate, or why the costs of sharing or preservation are incommensurate with the value of doing so. See also: DoD Instruction 3200.12

     https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/320012p.pdf?ver=2019-04-30-073122-220

     The data management plan should conform to a format established by the relevant research discipline or a format that is similar to common industry (quality management system structures for example) data management practices and shall include at a minimum:

1. The types of data, software, and other materials to be produced.
2. How the data will be acquired
3. Time and location of data acquisition, if scientifically pertinent
4. How the data will be processed
5. The file formats and naming conventions that will be used
6. A description of the quality assurance and quality control measures during collection, analysis, and processing
7. A description of dataset origin when existing data sources are used
8. A description of the standards to be used for data and metadata format and content
9. Appropriate time frame for preservation
10. The plan may consider the balance between the relative value of data preservation and other factors such as the associated cost and administrative burden. The plan will provide a justification for such decisions

4) **Technology Dissemination to America Makes Members, Impact to OSD(R&E), AFRL, and Likelihood of Impact to DoD Broader Supply Chain Partners.** A description sufficient to permit evaluation of the proposal in accordance with evaluation criterion 4 (See Section 4.1 (4) of this Project Call)

5) **Project Management Approach.** A description sufficient to permit evaluation of the proposal in accordance with evaluation criterion 5 (See Section 4.1 (5) of this Project Call)

   Any use of assets (equipment or personnel) based outside of the United States needs to be clearly identified in your proposal. Please provide the description, location, and utilization (number of hours or percentage of total effort) for any such assets. Execution of activity outside of the U.S. in response to this project call is discouraged.

6) **Exhibit I.** Identification of Background Intellectual Property using the form included in this project call

7) **Exhibit II.** Multiple Submissions Summary using the form included in this project call

8) **Exhibit III.** Letters of Commitment, detailing the organization name, point of contact, phone, email, summary of the agreed role, dollar value and description of proposed cost share from the team member

9) **Exhibit IV.** Publication of Consortium Developed Intellectual Property agreement using the form included in this project call

10) **Exhibit V.** Identification of project Consortium Developed Intellectual Property, owning organization(s), and acknowledgement of any deliverable ITAR restrictions using the form included in this project call

11) **Exhibit VI.** Valid Copy of Military Critical Technical Data Agreement (DD2345) for each team member – **REQUIRED FOR RESPONSES TO TOPIC AREAS 8 and 9**

- **Cost Volume.** The Cost Volume shall contain the following information:
  1) Include a cost breakdown by month and by project phase and estimates of expenses. Other Federal funding (non-America makes) may be identified as leveraged funds but is ineligible to be counted as recipient cost share. The Proposer shall submit a cost proposal in a separate volume marked "Proprietary Cost Proposal," clearly identifying requested funding and cost share. NCDMM requires the Proposer to provide detailed, itemized pricing for proposals utilizing the provided cost template.
  2) **Exhibit VII.** Proposal Cost Summary

Project Team Appendix. The Project Team Appendix shall contain biographies and relevant experience of key team staff and management personnel. Describe the qualifications and relevant experience of the types of staff that would be assigned to this project by providing biographies for those staff members.

Any foreign persons conducting work on the project shall be declared within the Project Team Appendix. Any project activities occurring outside of the U.S. or by non-U.S. persons must be reported and approved in advance by the America Makes Program Management Office. Execution of activity outside of the U.S. in response to this project call is discouraged.

3.5 Project Proposal Format

1. **Cover Page:** The lead Proposer shall include their cage code and duns number on the cover page
2. **Email:** The Proposer shall submit one (1) electronic copy in response to this Project Call.
3. **Paper copies and facsimile (fax) submission.** Paper and fax submissions will not be accepted.
4. **Figures, graphs, images, and pictures.** Figures and tables must be numbered and referenced in the text by that number. They should be of a size that is easily readable and may be in landscape orientation. They must be formatted to print on an 8.5 x 11 inch paper size.
5. **Font.** Proposals are to be prepared with easy-to-read font such as Times New Roman or Arial (11 point minimum), single-spaced. Smaller font may be used in figures and tables but must be legible.
6. **Page Layout.** The Technical Volume must be in portrait orientation except for figures, graphs, images, and pictures. Pages shall be single-spaced, 8.5 by 11 inches, with at least one-inch margins on both sides, top, and bottom.

7. **Page Limit. Page limit for the Proposal shall be:**

    a. The Technical Volume is limited to 20 pages. Information beyond 20 pages will not be considered. The page limit includes a table of contents (if included) and the required sections within the technical volume. The page limit **DOES NOT** include the Cover Page, Executive Summary, or Exhibit I, Exhibit II, Exhibit III, Exhibit IV, Exhibit V, Exhibit VI, and Reference Page.

    b. The Cost Volume is limited to 5 pages. Information beyond 5 pages will not be considered. The page limit includes a table of contents (if included) and the required sections within the cost volume. The page limit does not include spreadsheets containing detailed cost information and Exhibit VII.

    c. The Project Team Appendix is limited to 10 pages. Information beyond 10 pages will not be considered. The page limit includes a table of contents (if included). Page limit does not include the Cover Page.

8. **Page Numbering.** Number pages sequentially within each section of the proposal showing proposal section and page number.

9. **Proposal Language.** English

3.6 Submission Dates

All full project proposals in response to topic areas 1 through 8 are due by **Wednesday, June 28, 2023, 5 p.m. Eastern time**. Any Project Proposal received after the time and date specified for receipt shall be considered late and non-responsive. Any late submissions will not be evaluated for award. NCDMM is not responsible for email system malfunctions or undeliverable email. Project Proposal submissions must be submitted by email marked with "America Makes IMPACT PROJECT PROPOSAL – Topic Area #"

All full project proposals in response to topic areas 9 or 10 are due by **Friday, July 7, 2023, 5 p.m. Eastern time**. Any Project Proposal received after the time and date specified for receipt shall be considered late and non-responsive. Any late submissions will not be evaluated for award. NCDMM is not responsible for email system malfunctions or undeliverable email. Project Proposal submissions must be submitted by email marked with "America Makes IMPACT PROJECT PROPOSAL – Topic Area #"

Send submissions to:

Jason Thomas
Program Coordinator, America Makes
National Center for Defense Manufacturing and Machining
projectcall@americamakes.us

Important Dates:

Event	Date
1. Project Call Announcement and Posting	5/26/2023

Event	Date
2. Webinar at America Makes Virtual TRX (**registration required**)	6/1/2023
3. Questions from Proposers about Scope or Approach Due	6/7/2023
4. Responses to Proposers about Scope or Approach Due (All questions and responses will be shared with all proposers on www.americamakes.us)	6/12/2023
5. Fully Executed NDA with NCDMM (only if proposal contains proprietary information)	6/14/2023
6. Lead Proposer required to be an America Makes Member (Topics 1 through 8)	6/14/2023
7. Lead Proposer required to be an America Makes Member (Topics 9 and 10)	6/23/2023
8. Full Project Proposal (Topic Areas 1 through 8) Submission Due Date	6/28/2023
9. Full Project Proposal (Topic Areas 9 and 10) Submission Due Date	7/7/2023
10. Anticipated Decision and Selection of Projects for Topic Areas 1 through 8	7/21/2023
11. Anticipated Decision and Selection of Projects for Topic Areas 9 and 10	8/4/2023
12. Anticipated Date to have ALL Projects on Contract	8/31/2023

4 PROJECT PROPOSAL REVIEW INFORMATION

4.1 Evaluation Criteria

The elements used in evaluating submitted proposals and assigned weights are as follows:

1. **Executive Summary (**Executive summary is not scored but will be considered as part of the overall value proposition of the proposal.**)**
    - The degree to which the proposer provides a concise synopsis of the response addressing the related topic in section 2, the team members,

merit/necessity of proposed effort, value to membership from outcomes of the proposed effort, the proposed timeline to complete said effort, a rough order magnitude of award amount requested (whole dollars) and corresponding total industry cost share, and a listing of key deliverables/outcomes.

2. Technical Approach and Methodology (40%)

- The degree to which the proposal provides a clear, concise statement of the problem(s), and identified need being addressed
- The degree to which the proposal clearly explains why funding is required, including a discussion of other sources that have been obtained or are being pursued and how this funding will provide specific benefits to the defense industrial base, OSD(R&E), AFRL, and America Makes members
- The degree to which the proposal describes in detail the project's scope of work and the approach used to achieve the results
- The degree to which the proposal describes how barriers (that have prevented the identified problem or need from being addressed and /or resolved in the past) will be overcome by the proposed effort
- The degree to which the proposal demonstrates awareness of competing and emerging technologies and identifies how the proposed concept provides significant improvements over other solutions to the USAF needs being addressed
- The degree to which the proposal identifies, quantifies, and explains Key Performance Parameters (KPPs) for demonstrating progress of the technology compared to a baseline and validating the outcomes of tasking in a manner conducive to technology or manufacturing readiness level assessments. This criterion should not be confused as a metric for project execution progress, task completion, or tracking the number of tests conducted. **Responses of such nature are highly discouraged.**
- The degree to which the proposal demonstrates alignment of tasks to KPPs and the America Makes AM Technology Roadmap and explicitly defines how progress may be significant, quantitatively demonstrated/measured, and documented for addressing KPPs and roadmap requirements
- The degree to which the proposal demonstrates how tasks will facilitate the development, discovery, and documentation of new requirements (not yet detailed within the roadmap) through research, deliverables, KPP's, presentations, reports, and working group participation
- The degree to which the project plans to obtain or leverage additional or external resources, and the credibility of that plan
- The strength of the proposal team including the capabilities, facilities, experience, and ability of the team to successfully complete the project

3. Data Management Plan (10%)

- The degree to which the proposal articulates a plan to transition the project results (including methods/procedures, decision making rationale, reports, raw data, allowable, KPP's, presentations, meeting minutes, software, samples, hardware, drawings, digital models, specifications, and other project specific deliverables) to the Air Force, OSD(R&E), and America Makes members in an organized, reusable and interoperable manner
- The degree to which the data management plan clearly and concisely describes data generation and data types in regards to proposed tasking, efforts, activities, etc.
- The degree to which the data management plan clearly outlines the minimum criteria introduced in Section 3.4
- The degree to which the data management plan demonstrates an approach which ensures data integrity, data pedigree, and provenance (traceability) is maintained and explicitly addresses team member roles and responsibilities for certain data types, sources, and a commitment to compliance reviews on a regular cadence
- The degree to which a clear plan to establish data/file storage structures which are maintained as data is gathered, analyzed, and transferred to America Makes CORE
- The degree to which the team outlines a clear plan for ensuring data integrity and reuse through quality assurance and quality control measures during collection, analysis, and processing
- The degree to which an approach is described where data is managed, curated, and regularly uploaded to CORE so a substantial level of effort in the later portion of the program is avoided, or such risks are actively mitigated

4. **Technology Dissemination to America Makes Members, Impact to OSD(R&E), AFRL, and Likelihood of Impact to DoD Broader Supply Chain Partners (40%)**

- The degree to which the proposal articulates a plan for furthering the mission of the institute through working group (Design, Material, Process, Value Chain, or AM Genome) participation including presentation of milestone achievements or lessons learned relevant to the fulfillment or creation of roadmap requirements, requesting subject matter expertise support, and consultation for project steering group purposes or as necessary
- The degree to which the proposal articulates the potential widespread usage of the transitioned technology, its impact (in a manner as outlined in section 2) on the defense industrial base, and the merits of the sources of information used to establish the validity and significance of such impact (usage)

- The degree to which the proposal articulates in detail how solutions will impact the field in order for DoD to assess the nature of engagement with relevant vendors and how solutions will be integrated across the manufacturing community.
- The degree to which the proposal clearly outlines a technology transition plan (tasks, milestones, and key decision points) as a function of time which outlines not only the proposed effort as a result of this project call, but how efforts may be conducted at the conclusion of the proposed effort
- The degree to which the proposal will likely impact the OSD(R&E), USAF, and broader DoD supply chain regarding:
    - outlining potential to increase U.S. manufacturing competitiveness;
    - ensuring transferable data exchange of project deliverables within the America Makes member community;
    - outlining the current maturity level of the technology and the target maturity needed for successful transition;
    - identifying key transition decision points; and
    - determining transition milestones and anticipated transition schedule.

5. **Program Management Approach (10%)**
    - The degree to which the proposal clearly described the project tasks in narrative form and the practicality of achieving the project goals as planned and on time
    - The degree to which the proposal provides a description of the organizational structure for the project, clearly identifying the role and responsibilities of each participant, including subcontractors
    - The degree to which the proposal describes the project work breakdown structure using a Gantt chart to show tasks, subordinate tasks, team member roles/task, detailed deliverable definition, and critical milestones / deliverables dates
    - Past cost and schedule management, and technical performance on America Makes projects
    - The degree to which the proposal describes project risks in terms of probability and consequence to delivery and corresponding plans for risk monitoring and mitigation
6. **Cost** (Cost and cost share are not scored but will be considered as part of the overall value proposition of the proposal.)
    - The reasonableness, realism, and affordability of the proposed costs
    - The quality and quantity of the project team’s cost share

- The degree to which any proposed cost share was of high value in terms of source, quality and applicability of any cost share to the performance of the project
- The degree to which letters of commitment are provided, and the value and credibility of the commitments (federal funding is not eligible to be counted as cost share, however, consideration will be provided in the evaluation regarding the extent that other Federal funding is leveraged)

4.2 Review and Selection Process

1. Initial Screening of All Proposals for Compliance with Proposal Requirements. All proposals will receive an administrative review for adherence to the RFP requirements. Ineligible and/or incomplete proposals are subject to elimination from further review.

2. Proposal Evaluation and Peer Review. Proposals determined eligible and/or complete will proceed for a full evaluation by evaluators who are independent of all teams submitting proposals. Proposals will be selected based on score, and how they contribute to the balance (technologies addressed, risk, cost, etc.) in the overall Technology Investment Portfolio.

4.3 Reporting Requirements

In addition to reporting requirements that are part of the sub-recipient agreement between NCDMM and the proposer, the following are required:

1. Technical progress reports
2. Kickoff meeting
3. Virtual teleconferences with project team
4. Virtual teleconferences with advisory groups as necessary and applicable
5. Interchange meetings as necessary and applicable
6. Financial and man-hour reports
7. Man-hour reports for attending working group meetings and supporting working group activities
8. Data management plan
9. Data persistence plan
10. Interim project reports as applicable
11. Value proposition framework documentation
12. Presentations at national meetings/conferences

13. LAYERS manuscripts as applicable
14. Transition and commercialization plan as applicable
15. Program review as applicable
16. Project briefings annually at America Makes Members Meeting (TRX or MMX)
17. Reports, presentations, or teleconferences upon request by NCDMM, OSD(R&E), or AFRL
18. Working group, advisory group, or steering committee participation shall include presentation of milestone achievements or lessons learned relevant to the fulfillment or creation of roadmap requirements, requesting subject matter expertise support, and consultation for project steering group purposes or as necessary
19. Finalized, written report (minimum one round of revision with NCDMM required before final submission)

5 ADMINISTRATIVE INFORMATION

All questions concerning this RFP must be presented by email to projectcall@americamakes.us. Questions regarding the RFP received in any other manner will not receive a response. Frequently asked questions and responses will be posted to the America Makes website at americamakes.us for clarification if received during the Question and Answers period. All responses to the questions received during the Q&A period will be posted simultaneously on the Q&A section of the Project Call website.

5.1 Contact Information

- Questions concerning technical specifications must be directed to:

Name	Jason Thomas, Portfolio Manager
Address	America Makes 236 West Boardman Street Youngstown, OH 44503
Phone	330-409-9160
Email	jason.thomas@ncdmm.org

- Questions concerning contractual terms and conditions or proposal format must be directed to:

Name	Gene Berkebile, Vice President and Chief Financial Officer

Address	National Center for Defense Manufacturing and Machining 699 Scalp Avenue Johnstown, PA 15904
Phone	724-539-5743
Email	gene.berkebile@ncdmm.org

5.2 Responsibility for Compliance with Legal Requirements

The Proposer's products, services, and facilities shall be in full compliance with all applicable federal, state, and local laws, regulations, codes, standards, and ordinances regardless of whether or not they are referred to by NCDMM.

5.3 Proposer Rights

Upon delivery, all materials submitted in response to this RFP may be appended to any formal documentation, establishing a contractual relationship between NCDMM and the Proposer.

NCDMM and potential Proposer will sign a non-disclosure agreement (NDA) to protect corporate intellectual property if contained in the proposal. Information contained in proposals shall be unclassified. If a project proposal contains export control and/or proprietary information, this must be identified on the cover page of the proposal and identified within the proposal.

5.4 Proposer Incurred Costs

The Proposer shall be responsible for all costs incurred in preparing or responding to this RFP. Materials and documents submitted in response to the RFP will not be returned.

5.5 Proposer Errors or Omissions

NCDMM is not responsible for any Proposer errors or omissions concerning the RFP process.

5.6 Modification or Withdrawal of a Proposal

The Proposer agrees in submitting a proposal that the proposal may not be modified, withdrawn, or cancelled by the Proposer, unless agreed upon with NCDMM, for 90 calendar days following the submittal date. Proposer's proposal will be valid for a period of 90 calendar days following the submittal date.

5.7 Reservation of Rights

This RFP does not commit NCDMM to award a contract, to pay any costs incurred in the preparation of a proposal to this request, or to procure or contract for services or supplies. NCDMM may require the Proposer to participate in negotiations and to submit such monetary, technical, or other revisions of its proposals that may result from preliminary review and negotiations.

5.8 Anticipated Number of Projects

The number of applied research project awards and federal funding amount allocated to this RFP will be determined based on the quality and quantity of proposals received.

5.9 Notice on the NCDMM Sub-Recipient Agreement

The purpose of this notice is to advise Lead Proposers that per the America Makes Sub-Recipient Agreement, Article 7 Intellectual Property and Article 9 Publications are non-negotiable and by submitting a proposal for this RFP you and your team agree to the language as outlined below and found in the sub-recipient agreement. Please note that Article 7 and Article 9 in the sub-recipient agreement mirrors Section 4 and Section 6 of the America Makes membership agreement. The Lead Proposer on winning proposals should be expected to sign the sub-recipient agreement within 60 days, if the Lead Proposer fails to sign the sub-recipient agreement within 120 days the NCDMM/America Makes reserves the right to cancel the award. The Lead Proposer should review the sub-recipient agreement internally and with the project team prior to proposal submission in order to assure the contract can be negotiated within the required timeline.

ARTICLE 7. INTELLECTUAL PROPERTY

7.1 Background Intellectual Property. Each Sub-Recipient/Sub-Recipient/Member shall retain all rights to its Background Intellectual Property; and the decision to make available any such Background Intellectual Property for use in a Sub-Recipient/Member's sub award project shall be at the sole discretion of each Sub-Recipient/Member and in accordance with DOD regulations with respect to identification of all such Background Intellectual Property. No license or rights are granted to a Sub-Recipient/Member's Background Intellectual Property under this Agreement.

7.1.1 In the event that one Sub-Recipient/Member may require use of another Sub-Recipient/Member's Background Intellectual Property that has been disclosed by a Sub-Recipient/Member as part of the Consortium Research in order to successfully commercialize any CDIP then the Sub-Recipient/Members agree to discuss potential licensing terms and conditions in a separate legally binding agreement between the Sub-Recipient/Members, separate from this Agreement. Sub-Recipient/Member(s) are not required to license any such originating Sub-Recipient/Member(s) Background Intellectual Property.

7.2 Consortium Developed IP shall be owned by the respective inventing or creating organizations, subject to any government rights and/or any pre-existing rights of any third party and subject to the following conditions:

7.2.1 If a Party solely or jointly creates CDIP, the Party must disclose the creation of such CDIP to its technology transfer office, licensing office or other similar department ("Party's TechTransfer Office"). A non-confidential summary of the CDIP disclosed to the Party's TechTransfer Office shall be sent to NCDMM as soon as practicable so that NCDMM can maintain a list of CDIP. Sub-Recipient/Members owning CDIP shall grant upon request to NCDMM and Sub-Recipient/Members-In-Good-Standing at the time of creation a limited, non-exclusive, royalty-free license to use the CDIP for the Sub-Recipient/Member's internal procedures, research or development purposes (but not to make, use, or sell products or external processes for commercial purposes, with the exception of licenses granted pursuant to Section 7.2.3). Such licenses shall be granted to interested Sub-Recipient/Members upon request in a separate legally binding mutually agreeable license agreement between the Sub-Recipient/Members. Payment of patent expenses may be required of Parties granted non-exclusive, royalty-free commercial licenses by universities and other non-profit institutions. Such licenses for Sub-Recipient/Members shall be without the right to grant sublicenses to third parties, except for any Sub-Recipient/Member-designated agents, contractors and non-employee students ("Permitted Third Parties") performing work for the benefit of such Sub-Recipient/Member. Under these circumstances the Sub-Recipient/Member is responsible for having any and all appropriate written agreements with such Permitted Third Parties to enable Sub-Recipient/Member's compliance with this Agreement and is responsible for such parties' use of the CDIP in the same manner Sub-Recipient/Member is responsible for its own use of such CDIP (e.g., violation of the license parameters set forth in this section by a Sub-Recipient/Member's Permitted Third Parties shall be considered a breach of this Agreement by Sub-Recipient/Member).

7.2.2 Sub-Recipient/Members are strongly encouraged to seek legal protection in the form of patents as soon as is reasonably possible following disclosure of all CDIP to NCDMM. Protection of a Sub-Recipient/Member's solely developed CDIP shall be done at Sub-Recipient/Member's own expense and through use of their respective Party's TechTransfer Office. Each Sub-Recipient/Member agrees to notify in writing NCDMM in a timely manner of all such actions in which legal protection is or has been sought so that NCDMM can enter such information in its invention disclosure database. With respect to jointly developed CDIP the relevant Sub-Recipient/Members agree to negotiate a separate legally binding agreement encompassing those terms and conditions to be used to govern the manner in which jointly developed CDIP will be owned, administered, protected, and licensed. NCDMM will be notified in writing in a timely manner of the existence of these agreements between Sub-Recipient/Members and NCDMM shall maintain pertinent information in its invention disclosure database. In the event that a single Sub-Recipient/Member for solely developed CDIP, or all Sub-Recipient/Members with an ownership right for jointly developed CDIP choose not to seek legal protection and thereby elect not to file a patent application on any CDIP, then Sub-Recipient/Member(s) agree to notify NCDMM in writing of its intent and must report any pending publication or presentation to NCDMM at the time of this notification. NCDMM may negotiate to obtain such protection at its own expense where Sub-Recipient/Member(s) choose not to seek legal protection. Ownership of CDIP shall remain with the originating Sub-Recipient/Member(s).

7.2.3 It is anticipated that one of the outcomes of an active IP licensing and commercialization plan is the generation of royalty income by a respective Sub-Recipient/Member. It is acknowledged that Sub-Recipient/Members of academic, government, and industry sectors will manage the disposition and reporting requirements of all royalties received in accordance with their institution's existing policies, through their Party's TechTransfer Office. To the extent it may legally do so, Sub-Recipient/Members owning CDIP shall grant NCDMM and Lead Sub-Recipient/Members-In-Good-Standing a limited, non-exclusive, royalty-free license to use the CDIP for commercial purposes and Full Sub-Recipient/Members-In-Good-Standing shall be granted such licenses at a fair market value royalty rate. Such licenses shall be granted to interested Sub-Recipient/Members upon request in a separate legally binding mutually agreeable agreement between the Sub-Recipient/Members. Such licenses for Sub-Recipient/Members shall be without the right to grant sublicenses to third parties, except for any Sub-Recipient/Member-designated agents, contractors and non-employee students performing work for the benefit of such Sub-Recipient/Member, provided, however, the Sub-Recipient/Member is responsible for having any and all appropriate written agreements with such parties to enable Sub-Recipient/Member's compliance with this Agreement and is responsible for such parties' use of the CDIP in the same manner Sub-Recipient/Member is responsible for its own use of such CDIP (e.g., violation of the license parameters set forth in this section by a Sub-Recipient/Member's contractor shall be considered a breach of this Agreement by Sub-Recipient/Member). In addition, sublicensing shall be permitted to the licensee's direct customers.

7.3 Licenses granted under this Section 7 shall be subject to these additional terms:

Any licenses granted to a Sub-Recipient/Member through a separate document as specified in this Section 7 shall become a royalty bearing license at fair market value for such a Sub-Recipient/Member who is designated a Withdrawn Sub-Recipient/Member.

It is understood that the United States Government (through any of its agencies or otherwise) may provide use of its facilities or equipment and / or may provide funds for Consortium Research. As a result this Agreement, any and all rights and obligations of the Sub-Recipient/Members to any CDIP resulting from use of any United States Government's facilities, equipment or funds are subject to any and all applicable rights of the United States Government.

Notwithstanding anything to the contrary in this Agreement, certain laws, regulations and/or policies may prevent and/or limit certain Sub-Recipient/Members' ability to offer royalty-bearing licenses to CDIP that has previously been licensed by such Sub-Recipient/Members on a royalty-free basis. Therefore, the ability to charge royalties to Full Sub-Recipient/Members, Supporting Sub-Recipient/Members, and/or third parties is subject to the granting Sub-Recipient/Member's ability to do so in light of then-existing contractual obligations, legal and regulatory requirements, and policies of the granting Sub-Recipient/Member.

ARTICLE 9. PUBLICATIONS

9.1 The Parties agree and expect that results of Consortium Research associated with this agreement shall be published or otherwise made publicly available and that Parties engaged in Consortium Research shall be permitted to present at symposia, national or regional professional meetings and to publish in journals, theses or dissertations, or by other means of their own choosing, the results of their research, provided that nothing will be done which could bar the availability of patent protection with respect to CDIP of a Sub-Recipient/Member or America Makes (NAMII) invention or which would disclose Proprietary Information of any Sub-Recipient/Member or of America Makes (NAMII) or disclose information in violation of the applicable U.S. laws and regulations (e.g., the International Traffic in Arms Regulations ("ITAR") and the Export Administration Regulations ("EAR") that govern the export of specific technical data and technologies, including software, prototypes and other intellectual property, to foreign countries and foreign nationals ("Export Control Laws").

9.1.1 A Party will not make a public disclosure without a review of the full text of the proposed publication, presentation or other form of public disclosure by the Sub-Recipient/Member(s) involved, the America Makes (NAMII) Director and Government PM as described below. The Sub-Recipient/Member(s) involved, the America Makes (NAMII) Director and Government PM shall be provided a copy of the proposed public disclosure at least sixty-five (65) days in advance of the submission of such proposed public disclosure and shall have two (2) weeks after receipt of said proposed disclosure to respond in writing to the submitting Party to identify Proprietary Information and/or to identify any potentially patentable CDIP and/or to identify any CDIP in which the submitting Party does not have an ownership interest. A submitting Party agrees to remove any identified Proprietary Information, potentially patentable CDIP and/or CDIP

in which the submitting Party does not have an ownership prior to public disclosure (or, for potentially patentable CDIP in which the submitting Party does have an ownership interest, delay public disclosure for a period of sixty (60) days from the date of the response).

9.1.2 Notwithstanding anything to the contrary above, student theses and dissertations shall be subject to a separate review and comment process wherein the student shall submit such student thesis or dissertation in draft form at least sixty (60) days in advance of the date of their final defense in order to afford an opportunity to identify Proprietary Information and/or identify any potentially patentable CDIP and/or any CDIP in which the Party's student does not have an ownership interest.

9.1.3 America Makes (NAMII) and/or America Makes (NAMII) Sub-Recipient/Members may negotiate and implement a more restrictive public disclosure agreement than defined in paragraphs 9.1.1 and 9.1.2 for a specific America Makes (NAMII) project based on the need for extended non-disclosure of CDIP by the project participants.

9.1.4 An acknowledgment of funding and a disclaimer shall appear in the publication of any material, whether copyrighted or not, resulting from an America Makes (NAMII) project incorporating U.S. Government funds granted in support of the America Makes (NAMII) Consortium.

The acknowledgement shall read:

"This material is based on research sponsored by Air Force Research Laboratory under agreement number FA8650-20-2-5700. The U.S. Government is authorized to reproduce and distribute reprints for Governmental purposes notwithstanding any copyright notation thereon."

The disclaimer shall read:

"The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of Air Force Research Laboratory or the U.S. Government."

6 EXHIBITS

The exhibits are required as part of the proposal submittal and do not count towards the page limit.

6.1 Exhibit I. Identification of Background Intellectual Property

Project Title	
Organization	
Principal Investigator	

List all known background intellectual property to be used in the conduct of this project or for which access may be required to implement project results:

Inventor / Owner	Title	Patent or Disclosure I.D.

☐ **If controlled by a project participant, I understand that a "good faith" commitment to enter into negotiations for a license of this background intellectual property to America Makes or the project partners may be required.**

OR

☐ **I am unaware of any background intellectual property to be used in the conduct of this project or that may be required for implementation of project results.**

Intellectual Property Rights Policy & Confidentiality Statement

As the Principal Investigator at _____ (Member) participating in this project, I agree to accept and abide by the Intellectual Property Rights Requirements of the America Makes Membership Agreement, as approved by the Governance Board, dated _____. I understand that I may be the recipient from time to time of information of a confidential and proprietary nature belonging to another America Makes participating organization. I have read and explicitly agree to abide by the provisions Section 5 of the America Makes Membership Agreement with respect to proprietary information.

I further agree to assist the project participants in their obligation of implementing America Makes' intellectual property requirements for funded projects. I will do this by encouraging the timely submission of invention disclosures by project participants to their appropriate Intellectual Property Office, clearly identifying such disclosures as relating to this project, and by providing any supporting documentation and information that may be requested from time to time for the purpose of filing patent applications under America Makes and/or the Inventing Organization(s).

Principal Investigator

Signature	
Printed Name	**DATE:**

6.2 Exhibit II. Multiple Submissions Summary

America Makes recognizes that projects may be submitted to multiple sources of funding.

America Makes must be informed if other funding is secured and will work with the Principle Investigator (PI) to modify this project scope, as appropriate.

List all planned or submitted requests for additional funding of work in this project area from sources other than America Makes.

Date Submitted or Planned Submittal Date	Organization	Decision Date

Principal Investigator

Signature	
Printed Name	
Date	

6.3 Exhibit III. Letters of Commitment

(If the sub-recipient is already involved in the Phase 1 work, then a general statement of additional commitment in terms of the funding required, the cost share contributed, and the total value to this proposal is all that is necessary.)

6.4 Exhibit IV. Acknowledgement of Consortium Developed Intellectual Property and Disclosure of Planned Publications

☐ As the Principal Investigator at _____ (Member), I agree

that results from this project will be considered consortium-developed intellectual property (CDIP) and will be shared amongst the membership according to the consortium-developed intellectual property (CDIP) structure in the Membership Agreement, with exceptions made for any ITAR/Export Control information.

☐ As the Principal Investigator at _____ (Member) participating in a funded Project, I project the following publications of the results from this project. In addition, I agree that all publications will be approved through the AFRL Technical POC 60 days prior to public dissemination.

Summary of Planned Publications from Project Team

Principal Investigator

Signature	
Printed Name	**DATE:**

6.5 Exhibit V. Identification of Consortium Developed Intellectual Property

List all Consortium Developed Intellectual Property that will be delivered at the end of this project:

List of project CDIP/Deliverable Artifacts and Completion Dates (examples including, but not limited to best practices, cost-benefit analyses, COTS Capability, benchmark datasets, demonstration study, equipment specs, hardware, material & process specs, performance evaluations, procedures/guidelines/tutorials, process windows, quality assurance methods, reference test coupons, software/algorithms, and validated models. (Add pages to the Exhibit V table as needed).

Organization Name / Responsible Party	Consortium Developed Intellectual Property	Detail Specific Tangible Artifacts to be Delivered to Membership	Expected Delivery Date to Membership	Associated Background Intellectual Property	ITAR Restricted (yes/no)

Principal Investigator

Signature	
Printed Name	
Date	

6.6 Exhibit VI. Valid Copy of Military Critical Technical Data Agreement (DD2345) for each team member

6.7 Exhibit VII. Proposal Cost Summary

Project Title	
Organization	
Address	
Principal Investigator	

Overall Requested Funding

America Makes	**$**	**Duration**	**(in months)**
Cost Share	**$**		
Project Total	**$**		

Lead Organization

Name		**Phone**	
Address		**Fax**	
Cost Share ($)		**Email**	

Partner (Please identify additional partners using the same format)

Name		**Phone**	
Address		**Fax**	
Cost Share ($)		**Email**	

Also, please include an Excel spreadsheet (not pdf) of the proposed costs in a form similar to the example shown below:

	GRAND TOTAL		Task 1	Task 2	Task 3
REQUESTED AMERICA MAKES FEDERAL FUNDING					
LABOR	$1,429,567		53,769	100,293	514,799
TRAVEL	$146,880				
SUBCONTRACT	$5,798,703		135,139	142,556	1,318,076
MATERIALS	$240,850		0	0	104,850
EQUIPMENT	$100,000		0	0	100,000
CONSULTANT	$200,000		0	0	90,000
ODC's	$84,000		0	0	0
TOTAL REQUESTED AMERICA MAKES FEDERAL FUNDING	$8,000,000		$188,908	$242,849	$2,127,725
COST SHARE					
LABOR	$101,100		0	0	35,065
TRAVEL	$0				
SUBCONTRACT	$2,609,412		218,900	6,141	726,903
MATERIALS	$50,000		0	0	20,000
EQUIPMENT	$0		0	0	0
CONSULTANT	$0		0	0	0
ODC's	$110,000		0	0	40,000
TOTAL PROPOSED COST SHARE	$2,870,512		$218,900	$6,141	$821,968
TOTAL PROJECT EFFORT	$10,870,512		$407,808	$248,990	$2,949,693

Exhibit VIII. Guidelines for America Makes Cost Proposal Budget Justification

America Makes Subrecipient Agreements will be Cost Reimbursable ***NO FEE*** agreements.

The cost proposal will include total project cost by task, by month, by government fiscal year. The offeror will also provide a detailed cost breakdown of the total project costs. Offerors are required to include costs that are in accordance with 2 CFR 200. The total cost of each major cost element and the make-up of those costs should be presented in the offeror's proposal. A statement related to the latest DCAA audit and whether the offeror's accounting system has been approved by the DCAA should be included in the cost proposal. Please provide a DCAA approval letter for currently negotiated DCAA rates and factors being used in the proposal. If approved rates are not available and do not have any other recent prior government work, NCDMM requires the use of the de minimus rate of 10% of modified total direct costs (MTDC).

Cost proposal is to be in Excel file format and show enough details to tie information to summary.

Detailed breakdown of costs by cost category by month and task include:

Direct Labor - Individual labor categories or personnel with associated labor hours and unburdened direct labor rates with support on how the rates were developed.

Indirect Costs - Fringe benefits, Overhead, G&A, Cost of Money, etc. (must show base amount and rate) If approved rates available, please provide documentation. If approved rates are not available and do not have any other recent prior government work, NCDMM requires the use of the de minimus rate of 10% of modified total direct costs (MTDC).

Travel - Number of trips, number of travelers, destinations, duration of each trip, airfare, car rental and miscellaneous travel costs. Travel is to be priced based on the GSA Per Diem Rates https://www.gsa.gov/travel/plan-book/per-diem-rates. A specific and direct relationship to the technical requirement must be documented.

Materials– An itemized listing of all items proposed with the associated direct cost is required. Items that exceed $10,000 are required to have supporting documentation supplied. The supporting documentation may be in the form of a vendor quote, prior purchase order or prior invoice (preferably no more than six months old), catalogue price, or an engineering basis of estimate.

Subcontracts - An itemized listing of all items proposed with the associated direct cost is required. Items that exceed $10,000 are required to have supporting documentation supplied. The supporting documentation may be in the form of a vendor quote, prior purchase order or prior invoice (preferably no more than six months old), catalogue price, or an engineering basis of estimate. Should the value of an individual subcontract

exceed $2M, please supply the associated cost analysis that evaluates the reasonableness and realism of the proposed subcontractor's costs.

Equipment - An itemized listing of all items proposed with the associated direct cost is required. Items that exceed $10,000 are required to have supporting documentation supplied. The supporting documentation may be in the form of a vendor quote, prior purchase order or prior invoice (preferably no more than six months old), catalogue price, or an engineering basis of estimate.

Other Direct Costs – Costs that do not fall in any of the above categories but are direct costs. An itemized listing of all items proposed with the associated direct cost is required. Items that exceed $10,000 are required to have supporting documentation supplied. The supporting documentation may be in the form of a vendor quote, prior purchase order or prior invoice (preferably no more than six months old), catalogue price, or an engineering basis of estimate.

Cost Share - Cost Share is required to be at the same level of detail as the proposed costs.

For all proposed costs, sufficient information should be provided in supporting documents to evaluate the reasonableness and realism of these proposed costs.

An example of layout of detailed cost narrative can be provided at offer's request.

Additional company overview information required:

- Official registered name (Corporate, D.B.A., Partnership, etc.),
- Address
- Unique Entity ID (UEI) number and CAGE code.
- Telephone number and Fax number (if available)
- Technical Point of Contact, title, address (if different from above address), direct telephone and fax numbers.
- Contractual Point of Contact (authorized to contractually bind the organization for any proposal regarding this RFP), title address (if different from above address), direct telephone and fax numbers.

If the subrecipient prefers not to disclose any portion of the requested proposed supporting documentation directly to the prime (NCDMM/America Makes), the subrecipient may submit directly to the US Government. A written notification of this election must be supplied with the subrecipient's proposal submission. After the prime has submitted the entire proposal to the US Government, the requisite Points of Contacts will be provided to the subrecipient and the subrecipient will be responsible for

submitting all the supporting documentation not already submitted to the prime directly to the government. The subrecipient will be responsible to respond to any questions that arise from information submitted by the subrecipient or by the prime with regard to the subrecipient's proposal.

Any questions, please ask! Were here to help!

Exhibit IX.
SUB-RECIPIENT AGREEMENT

This SUB-RECIPIENT AGREEMENT (this "Agreement") is made as of ENTER SAME DATE AS DATE OF EXECUTION by and between National Center for Defense Manufacturing and Machining having offices at 699 Scalp Avenue, Johnstown, PA 15904-1619 ("NCDMM") and XXXXXXX, having offices at ADDRESS, CITY, STATE 9 DIGIT ZIPCODE ("Sub-Recipient") with a DUNS number of XXXXXXXXX, UEI number of XXXXXXXXX and a Cage Code of XXXXX.

WITNESSETH:

WHEREAS, NCDMM is a manufacturing technology center that has entered an agreement with the United States Department of the Air Force, dated as of November 25, 2019 under cooperative agreement number FA8650-20-2-5700 with CFDA number 12.800, to act as an administrator and technical performer in the fulfilment of the "America Makes Partnership (AMP) The National Additive Manufacturing Innovation Institute" (the "Prime Agreement");

WHEREAS, NCDMM desires to engage Sub-Recipient and America Makes (NAMII) member to assist NCDMM in satisfying certain NCDMM obligations under the Prime Agreement; and

WHEREAS, the activities contemplated by this Agreement are of mutual interest and benefit to NCDMM and Sub-Recipient, and will further the fulfilment of America Makes (NAMII);

NOW, THEREFORE, in consideration of the mutual covenants and agreements contained herein, NCDMM and Sub-Recipient hereby agree as follows:

ARTICLE 1. DEFINITIONS AND SCHEDULES

a. Definitions. In addition to the terms defined elsewhere in this Agreement, the following terms shall have the meanings set forth below:

1.1.5 **"Affiliate"** means, with respect to any person or entity, any other person or entity directly or indirectly controlling, controlled by, or under common control with, such first person or entity. For purposes of this definition, the term "control" (including the correlative meanings of the terms "controlled by" and "under common control with"), as used with respect to any person or entity, shall mean the possession, directly or indirectly, of the power to direct or cause the direction of the management or policies of such person or entity, whether through the ownership of voting securities or by agreement or otherwise.

1.1.6 **"Applicable Law"** means all applicable federal, state and local laws, rules, regulations and guidelines relating to the conduct of the Parties' businesses and the performance by the Parties of their respective obligations under this Agreement.

1.1.7 **"Exploit"** means to make, have made, import, use, sell, offer for sale or otherwise dispose of, including any research, development, registration, modification, enhancement, improvement, manufacture, storage, formulation, optimization, export, transport, distribution, promotion or marketing related thereto.

1.1.8 **"Facility"** means the facility of Sub-Recipient, or any other facility used for the conduct of the activities that has been approved by NCDMM and complies with Applicable Law

1.1.9 **"Invention"** means any discovery, improvement, process, formula, invention, know-how, trade secret, procedure, device, or other intellectual property, whether or not patentable.

1.1.10 **"Materials"** means the equipment and materials supplied to Sub-Recipient by or on behalf of, or purchased at the expense of, NCDMM, reasonably necessary for Sub-Recipient to perform activities, solely as set forth in the SOW.

1.1.11 **"Party"** means either NCDMM or Sub-Recipient; **"Parties"** means both NCDMM and Sub-Recipient.

1.1.12 **"Statement of Work"** means the plan set out in Schedule A hereto.

1.1.13 "**Consortium Research"** means research supported by membership dues and / or Incorporates funds provided by the FA8650-20-2-5700 cooperative agreement. Consortium Research does not include:

1.1.10.1 Research carried out under separate contract unless specified therein, or
1.1.10.2 Research fully funded by a Member and/or without using any of the funds specified in 1.1.10 above, or
1.1.10.3 Research carried out independently by a Member using America Makes (NAMII) facilities

1.1.14 "**Consortium Developed Intellectual Property**" means individually and collectively all Intellectual Property which are conceived or made solely or jointly by Member(s) during the performance of this sub award project under Consortium Research.

1.1.15 "**Background Intellectual Property**" means technical know-how, inventions, technical data, discoveries, materials, samples, software, software programs, whether patentable or not, copyrightable programs, documentation and reports whether in existence at the time of this agreement or coming into existence subsequent to this agreement, which were not developed in the course of performance of any sub award under the America Makes (NAMII) consortium.

1.1.16 "**Intellectual Property"** means technical know-how, inventions, technical data, discoveries, materials samples, software, software programs, documentation, reports, any and all other copyrightable materials, and/or invention or discovery that is or may be patentable or otherwise protectable under title 35 of the U.S. Code.

b. Schedules. The Schedules attached hereto are incorporated in and are deemed to be an integral part of this Agreement.

ARTICLE 2. ACTIVITIES

c. . Sub-Recipient shall undertake and perform work in accordance with the Statement of Work (SOW) attached hereto as Schedule A, as the same may be amended from time to time in accordance with the terms hereof (Sub-Recipient's responsibilities as set out in the SOW being hereinafter referred to as the "Activities"). The specific objectives, scope, deliverables and estimated schedule for the Activities are set forth in the SOW. Sub-Recipient agrees that it shall implement changes to the SOW that are reasonably requested in writing by NCDMM, subject, if applicable, to NCDMM's payment of any reasonable additional fees and/or expenses incurred by Sub-Recipient as determined in accordance with Section 4.4 that arise solely from such changes to the SOW. Any material change in the SOW shall be evidenced in a written amendment of Schedule A.

d. Cooperation. The Parties shall cooperate with each other in the performance of this Agreement and shall deal honestly and in good faith with each other.

2.3 Reporting/Transfer of Results. Sub-Recipient shall comply with the monthly written progress report requirements set forth in Section 4.5.1 and, if requested by NCDMM, on an ongoing basis, Sub-Recipient shall keep NCDMM informed of progress and interim results on an informal basis, including if requested, periodic meetings to discuss Activities progress and interim results. Further specific guidance regarding programmatic requirements are found in Schedule D. Upon completion of the Activities, termination of this Agreement pursuant to Section 10.2, or expiration of this Agreement (without a further agreement related to the substance hereof entered into as contemplated in Section 10.1), Sub-Recipient will provide NCDMM with a comprehensive written report of the results that have been developed, compiled or learned during the course of the Activities, and will comply with NCDMM's reasonable requests for follow-up information

ARTICLE 3. SUPPLY OF MATERIALS AND INFORMATION

e. Supply or Purchase of Materials. If applicable, subject to the final sentence of this Section 3.1, within a commercially practicable time after written request from Sub-Recipient, NCDMM shall supply Sub-Recipient, if previously negotiated, Materials as set forth in the SOW. Sub-Recipient shall own all right, title and interest in and to any Materials, unless specifically identified to the contrary in writing. If NCDMM supplies Materials to Sub-Recipient, NCDMM shall provide Sub-Recipient with written documentation evidencing the value of such Materials (the "Valuation Price"). If the Parties disagree over the Valuation Price provided by NCDMM, after thirty (30) days of good faith discussions, either Party may request that the matter be submitted to arbitration for a binding decision in accordance with Section 4.7.

f. Information. If requested by Sub-Recipient to provide information in NCDMM's possession that is not otherwise accessible to Sub-Recipient and that is reasonable and necessary for Sub-Recipient's performance under this Agreement ("Information"), subject to the following sentence, NCDMM shall provide such Information (or an explanation of the legitimate reason for any refusal or delay, and if delay, a projected date by which such Information will be provided) within a commercially practicable period of time after receipt of Sub-Recipient's written request. Notwithstanding the foregoing, NCDMM may, in its sole discretion, refuse to provide any Information to Sub-Recipient, including Confidential Information, Inventions or any other Information NCDMM deems, in its sole discretion, to be proprietary or unnecessary for use in the Activities, provided that Sub-Recipient shall not be deemed in breach of this Agreement if the sole reason it cannot perform any Research or Development Activities is NCDMM's refusal to provide Information reasonable and necessary for the conduct of the Activities. NCDMM shall own all right, title and interest in and to any Information, unless specified to the contrary in writing.

g. Use of Materials and Information. Sub-Recipient shall (i) use the Materials and Information only for the purposes described in the SOW or such other purposes as NCDMM may approve in writing, (ii) restrict access to and use of the Materials and Information to the Principal Investigator and other researchers employed by, or who are agents of, Sub-Recipient or any permitted Sub-Recipients for whom such access and use is required to conduct the Activities

and who are bound by obligations of confidentiality at least as strict as those set forth in Section 6.

h. Supply of Other Materials by Sub-Recipient. All equipment and materials other than the Materials set forth in the SOW, required for the Activities shall be purchased and paid for by Sub-Recipient, unless otherwise agreed to in writing by NCDMM. Sub-Recipient shall own all right, title and interest in and to such equipment and materials purchased under this Section 3.4, unless specifically identified to the contrary in writing.

i. Non-Exclusive License. If, in its sole discretion, NCDMM determines that it is necessary for Sub-Recipient's conduct of the Activities, NCDMM may, by separate written agreement with Sub-Recipient, grant Sub-Recipient a non-exclusive, non-transferable and non-assignable right and license to use an Invention owned by, or licensed (with the right to sublicense) to, NCDMM, which license shall be limited in duration to the Term or such shorter period of time designated by NCDMM, limited in territory to use in a Facility, and limited in scope to use solely as needed to perform the Activities (or a part thereof as designated by NCDMM). For the avoidance of doubt, this Agreement does not grant any such license.

ARTICLE 4. BUDGET AND PAYMENT

j. Compensation and Payment Terms. NCDMM is entering into a Cost Reimbursement No Fee Agreement with the Sub-Recipient. In consideration for the satisfactory performance of the Activities by Sub-Recipient in accordance with this Agreement, subject to the provisions of this Section 4, NCDMM shall, within forty-five (45) to sixty (60) days of receipt of an invoice and any supporting documentation in accordance with Section 4.5, pay to Sub-Recipient the amounts for the invoiced incurred expenses. The Parties agree that NCDMM shall pay no Amounts or Expenses until it has been funded under the Prime Contract with respect to the Research and Development Activities. All payments hereunder shall be made in U.S. dollars, by check.

k. Reimbursement of Expenses. NCDMM shall reimburse Sub-Recipient for actual expenses incurred by Sub-Recipient for reasonable, necessary and verifiable:

4.1.5 Materials that are set forth in the SOW that NCDMM does not provide to Sub-Recipient;

4.1.6 Travel expenses incurred while performing the Activities in accordance with the Joint Travel Regulations as published by the Federal Government("Travel Expenses");

4.1.7 Other expenses expressly set forth in Schedule B (Budget) ("Other Approved Expenses");

4.1.8 Any other expenses specifically approved in advance in writing by NCDMM.

Collectively, the expenses referred to in Sections 4.2.1 through 4.2.4, are referred to herein as the "Expenses." Notwithstanding the foregoing, Sub-Recipient shall only be reimbursed for Expenses that are allowable costs under 2 Code of Federal Regulations 200, Subpart E. Sub-Recipient acknowledges and agrees that NCDMM shall not pay or reimburse Sub-Recipient for any Expenses incurred by, or purchases made by or on behalf of, Sub-Recipient other than those set forth in this Section 4.2.

l. Total Obligation. Unless otherwise agreed in writing by the Parties, the foregoing amounts represent NCDMM's total obligation for any and all Activities and any and all expenses incurred by or on behalf of Sub-Recipient. The total funds authorized by this agreement shall not exceed $XXXXXXX.

m. Expense Changes. The Expenses are based on the scope of work and assumptions stated in the SOW. If NCDMM requests a change in the SOW which the Parties agree, in good faith, would result in an increase to Sub-Recipient of its cost of conducting the Activities, the Parties shall, in good faith, evaluate and discuss revised Expenses. Based on this evaluation and discussion, the Parties shall amend the SOW and Budget by written agreement. In the event the Parties cannot agree on a price change after thirty (30) days of good faith discussions, either Party may request that the matter be submitted to arbitration for a binding decision in accordance with Section 4.7.

n. Invoicing and Progress Reports.

4.1.9 Sub-Recipient shall invoice NCDMM once each month during the Term. Each invoice shall be accompanied by a written progress report, which shall describe the Activities Sub-Recipient has performed since the date of the last invoice and provide such other information as may be required by this Agreement or reasonably requested by NCDMM. Each monthly invoice shall include expenses and cost share for expenses incurred to NCDMM's reasonable satisfaction due Sub-Recipient since the date of the last invoice. For Expenses to be reimbursed pursuant to Section 4.2, Sub-Recipient shall include in the monthly invoice a summary report of the Expenses incurred since the date of the last invoice.

4.1.10 If NCDMM disputes any portion of an invoice, it shall pay the undisputed portion and shall provide Sub-Recipient with written notice of the disputed portion and its reasons therefor, and NCDMM shall not be obligated to pay interest on such disputed portion. In the event the Parties cannot agree on an invoice after thirty (30) days of good faith discussions, either Party may request that the matter be submitted to arbitration for a binding decision in accordance with Section 4.7.

4.1.11 **Closeout, Adjustment, Continuing Responsibilities and Reimbursement** – Final payment will not be made nor can this agreement be closed out until the sub-recipient delivers to NCDMM all the final closeout paperwork, disclosure of subject inventions, and the final project report. NCDMM may adjust downward the total obligation for the effort if this information is not provided.

o. Records Retention and Audit.

4.1.12 Records Retention. Sub-Recipient shall keep or cause to be kept accurate records or books of account in accordance with applicable generally accepted accounting principles that, in reasonable detail, fairly reflect the invoiced Fees and Expenses. Such books and records shall be maintained by Sub-Recipient for at least three (3) years following the end of the calendar year to which they pertain.

4.1.13 Audit. Upon the written request of the United States Government or NCDMM, Sub-Recipient shall permit a Government auditor, or a certified public accountant or a person possessing similar professional status and associated with an independent accounting firm reasonably acceptable to the Parties, to inspect during regular business hours all or any part of Sub-Recipient's records and books necessary to verify invoices related to Expenses and Cost Share.

p. Arbitration. In the event that a Party requests a Valuation Price determination in accordance with Section 3.1, a price change determination in accordance with Section 4.4, or an invoice determination in accordance with Section 4.5.2 to be submitted to an arbitrator, such determination shall be determined by a single arbitrator in accordance with the Commercial Arbitration Rules of the American Arbitration Association. The decision of the arbitrator shall be final and conclusive, absent manifest error. The Parties shall amend this Agreement if and as appropriate to implement the decision of the arbitrator.

ARTICLE 5. REPRESENTATIONS, WARRANTIES AND COVENANTS

q. Sub-Recipient represents and warrants to, and covenants with, NCDMM that:

5.1.5 Sub-Recipient shall perform the Activities in good scientific manner and in compliance with Applicable Law and shall use reasonable efforts to perform the Activities in accordance with the SOW.

5.1.6 Neither Sub-Recipient nor any of its principal officers or employees has been debarred or suspended by any governmental entity from conducting any Activities or is subject to any such debarment and Sub-Recipient will not use in any capacity, in connection with its obligations under this Agreement, including via any permitted Sub-Recipient, any person who has been so debarred.

5.1.7 Each Facility is and shall be during the Term in material compliance with all requirements of Applicable Law. There are, and during the Term shall be, no pending or uncorrected citations or adverse conditions noted in any governmental inspection of any Facility with respect to any Activities.

5.1.8 Sub-Recipient owns or has the legal right to use all patents, know-how and other intellectual property rights required for use in its conduct of the Activities, excluding those rights obtained from NCDMM under separate written agreement of the Parties or owned by or licensed to NCDMM pursuant to this Agreement or otherwise.

5.1.9 The Principal Investigator is, and at all times during the conduct of the Activities shall be, qualified by training and experience with appropriate expertise to conduct and supervise the Activities.

5.1.10 Sub-Recipient (for itself and each Facility) and the Principal Investigator have, and at all times during the conduct of the Activities shall have, all appropriate licenses, approvals, authorizations, registrations, permits, and certifications necessary to safely, adequately and lawfully perform the Activities. Sub-Recipient shall provide copies of all such licenses, approvals, authorizations, registrations, permits or certifications upon NCDMM's request.

Sub-Recipient shall advise NCDMM immediately if any of the foregoing in this Section 5.1 ceases to be true and correct.

r. Each Party represents and warrants to, and covenants with, the other Party that:

5.1.11 It has the requisite power and authority to execute, deliver and perform its obligations under this Agreement and all governmental and third-party approvals necessary for it to enter into and perform its obligations under this Agreement have been obtained, are in full force and effect and are final and non-appealable.

5.1.12 This Agreement is its legal, valid, and binding obligation, enforceable in accordance with its terms and conditions.

5.1.13 The execution and delivery of this Agreement and the transactions contemplated in it do not violate, conflict with, or constitute a default under the terms or provisions of any agreement or other instrument to which it is a party or by which it is bound, or any order, award, judgment, or decree to which it is a party or by which it is bound.

5.1.14 It is in compliance with all Applicable Law and it will comply with all Applicable Law during the Term.

A Party shall immediately notify the other Party if any of the foregoing in this Section 5.2 with respect to such first Party ceases to be true or correct.

s. Disclaimer. EXCEPT AS EXPRESSLY SET FORTH IN THIS SECTION 5, NCDMM MAKES NO REPRESENTATIONS AND GRANTS NO WARRANTIES, EXPRESS OR IMPLIED, EITHER IN FACT OR BY OPERATION OF LAW, BY STATUTE OR

OTHERWISE, UNDER THIS AGREEMENT, AND NCDMM SPECIFICALLY DISCLAIMS ANY OTHER WARRANTIES, WHETHER WRITTEN OR ORAL, OR EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF QUALITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE WITH RESPECT TO ANY MATERIALS (AS DEFINED IN SECTION 1.1.7) OR ANY WARRANTY AS TO THE NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHTS OF THIRD PARTIES UNDER THIS AGREEMENT.

ARTICLE 6. CONFIDENTIALITY

t. In the normal and routine completion of this project, there may be some occasions where one Party discloses information that is proprietary and confidential to the disclosing Party. All such information which a disclosing Party believes to be proprietary, confidential, trade secret or the like undisclosed information shall be provided in writing or other permanent visual form (such as, for example, a physical prototype, physical sample, photograph, video or sound recording on any type of recording media) and designated as proprietary with an appropriate restrictive legend stamped or marked thereon at the time disclosure. Proprietary Information disclosed orally, must be identified as proprietary at the time of disclosure and summarized in writing as being proprietary within thirty (30) days of such disclosure.

u. The receiving Party agrees to exercise the same care and safeguards with respect to Proprietary Information disclosed by the disclosing Party as used to maintain the confidentiality of its own information of like character, but in no event less than a reasonable degree of care.

v. The obligations of confidentiality and non-disclosure set forth in this section 6 shall continue for a period of five (5) years from the termination or expiration of this Agreement or until the information ceases to fall under the definition of Proprietary Information.

ARTICLE 7. INTELLECTUAL PROPERTY

w. **Background Intellectual Property.** Each Sub-Recipient/Sub-Recipient/Member shall retain all rights to its Background Intellectual Property; and the decision to make available any such Background Intellectual Property for use in a Sub-Recipient/Member's sub award project shall be at the sole discretion of each Sub-Recipient/Member and in accordance with DOD regulations with respect to identification of all such Background Intellectual Property. No license or rights are granted to a Sub-Recipient/Member's Background Intellectual Property under this Agreement.

7.1.5 In the event that one Sub-Recipient/Member may require use of another Sub-Recipient/Member's Background Intellectual Property that has been disclosed by a Sub-Recipient/Member as part of the Consortium Research in order to successfully commercialize any CDIP then the Sub-Recipient/Members agree to discuss potential licensing terms and conditions in a separate legally binding agreement between the Sub-Recipient/Members,

separate from this Agreement. Sub-Recipient/Member(s) are not required to license any such originating Sub-Recipient/Member(s) Background Intellectual Property.

x. **Consortium Developed IP** shall be owned by the respective inventing or creating organizations, subject to any government rights and/or any pre-existing rights of any third party and subject to the following conditions:

7.1.6 If a Party solely or jointly creates CDIP, the Party must disclose the creation of such CDIP to its technology transfer office, licensing office or other similar department ("Party's TechTransfer Office"). A non-confidential summary of the CDIP disclosed to the Party's TechTransfer Office shall be sent to NCDMM as soon as practicable so that NCDMM can maintain a list of CDIP. Sub-Recipient/Members owning CDIP shall grant upon request to NCDMM and Sub-Recipient/Members-In-Good-Standing at the time of creation a limited, non-exclusive, royalty-free license to use the CDIP for the Sub-Recipient/Member's internal procedures, research or development purposes (but not to make, use, or sell products or external processes for commercial purposes, with the exception of licenses granted pursuant to Section 7.2.3). Such licenses shall be granted to interested Sub-Recipient/Members upon request in a separate legally binding mutually agreeable license agreement between the Sub-Recipient/Members. Payment of patent expenses may be required of Parties granted non-exclusive, royalty-free commercial licenses by universities and other non-profit institutions. Such licenses for Sub-Recipient/Members shall be without the right to grant sublicenses to third parties, except for any Sub-Recipient/Member-designated agents, contractors and non-employee students ("Permitted Third Parties") performing work for the benefit of such Sub-Recipient/Member. Under these circumstances the Sub-Recipient/Member is responsible for having any and all appropriate written agreements with such Permitted Third Parties to enable Sub-Recipient/Member's compliance with this Agreement and is responsible for such parties' use of the CDIP in the same manner Sub-Recipient/Member is responsible for its own use of such CDIP (e.g., violation of the license parameters set forth in this section by a Sub-Recipient/Member's Permitted Third Parties shall be considered a breach of this Agreement by Sub-Recipient/Member).

7.1.7 Sub-Recipient/Members are strongly encouraged to seek legal protection in the form of patents as soon as is reasonably possible following disclosure of all CDIP to NCDMM. Protection of a Sub-Recipient/Member's solely developed CDIP shall be done at Sub-Recipient/Member's own expense and through use of their respective Party's TechTransfer Office. Each Sub-Recipient/Member agrees to notify in writing NCDMM in a timely manner of all such actions in which legal protection is or has been sought so that NCDMM can enter such information in its invention disclosure database. With respect to jointly developed CDIP the relevant Sub-Recipient/Members agree to negotiate a separate legally binding agreement encompassing those terms and conditions to be used to govern the manner in which jointly developed CDIP will be owned, administered, protected, and licensed. NCDMM will be notified in writing in a timely manner of the existence of these agreements between Sub-Recipient/Members and NCDMM shall maintain pertinent information in its invention disclosure database. In the event that a single Sub-Recipient/Member for solely developed CDIP, or all Sub-Recipient/Members with an ownership right for jointly developed CDIP

choose not to seek legal protection and thereby elect not to file a patent application on any CDIP, then Sub-Recipient/Member(s) agree to notify NCDMM in writing of its intent and must report any pending publication or presentation to NCDMM at the time of this notification. NCDMM may negotiate to obtain such protection at its own expense where Sub-Recipient/Member(s) choose not to seek legal protection. Ownership of CDIP shall remain with the originating Sub-Recipient/Member(s).

7.1.8 It is anticipated that one of the outcomes of an active IP licensing and commercialization plan is the generation of royalty income by a respective Sub-Recipient/Member. It is acknowledged that Sub-Recipient/Members of academic, government, and industry sectors will manage the disposition and reporting requirements of all royalties received in accordance with their institution's existing policies, through their Party's TechTransfer Office. To the extent it may legally do so, Sub-Recipient/Members owning CDIP shall grant NCDMM and Lead Sub-Recipient/Members-In-Good-Standing a limited, non-exclusive, royalty-free license to use the CDIP for commercial purposes and Full Sub-Recipient/Members-In-Good-Standing shall be granted such licenses at a fair market value royalty rate. Such licenses shall be granted to interested Sub-Recipient/Members upon request in a separate legally binding mutually agreeable agreement between the Sub-Recipient/Members. Such licenses for Sub-Recipient/Members shall be without the right to grant sublicenses to third parties, except for any Sub-Recipient/Member-designated agents, contractors and non-employee students performing work for the benefit of such Sub-Recipient/Member, provided, however, the Sub-Recipient/Member is responsible for having any and all appropriate written agreements with such parties to enable Sub-Recipient/Member's compliance with this Agreement and is responsible for such parties' use of the CDIP in the same manner Sub-Recipient/Member is responsible for its own use of such CDIP (e.g., violation of the license parameters set forth in this section by a Sub-Recipient/Member's contractor shall be considered a breach of this Agreement by Sub-Recipient/Member). In addition, sublicensing shall be permitted to the licensee's direct customers.

y. Licenses granted under this Section 7 shall be subject to these additional terms:

Any licenses granted to a Sub-Recipient/Member through a separate document as specified in this Section 7 shall become a royalty bearing license at fair market value for such a Sub-Recipient/Member who is designated a Withdrawn Sub-Recipient/Member.

It is understood that the United States Government (through any of its agencies or otherwise) may provide use of its facilities or equipment and / or may provide funds for Consortium Research. As a result, this Agreement, any and all rights and obligations of the Sub-Recipient/Members to any CDIP resulting from use of any United States Government's facilities, equipment or funds are subject to any and all applicable rights of the United States Government.

Notwithstanding anything to the contrary in this Agreement, certain laws, regulations and/or policies may prevent and/or limit certain Sub-Recipient/Members' ability to offer royalty-bearing licenses to CDIP that has previously been licensed by such Sub-Recipient/Members on a royalty-free basis. Therefore, the ability to charge royalties to Full Sub-Recipient/Members,

Supporting Sub-Recipient/Members, and/or third parties is subject to the granting Sub-Recipient/Member's ability to do so in light of then-existing contractual obligations, legal and regulatory requirements, and policies of the granting Sub-Recipient/Member.

ARTICLE 8. INDEMNIFICATION AND INSURANCE

z. Indemnification by Sub-Recipient. Sub-Recipient agrees to defend, indemnify and hold harmless NCDMM and its Affiliates and their respective directors, officers, employees and agents from and against any and all costs (including reasonable legal fees), damages, expenses and losses (collectively, "Losses") arising from any third party suit, claim, demand, assessment, action or proceeding (collectively, "Claims"), in any manner caused by, resulting from or arising out of any misrepresentation, negligence or breach of this Agreement on the part of Sub-Recipient, any of Sub-Recipient's Affiliates or any permitted Sub-Recipients, or any of Sub-Recipient's or its Affiliates' or permitted Sub-Recipients' directors, officers, employees or agents, including Losses arising out of the breach or inaccuracy of any of Sub-Recipient's representations, warranties, or covenants under Section 5 of this Agreement, except to the extent any such Loss is attributable to any breach by NCDMM of this Agreement, or any negligence, wilful misconduct or unreasonable inaction by NCDMM, any of NCDMM's Affiliates, or any or NCDMM's or its Affiliates' directors, officers, employees or agents.

aa. Indemnification by NCDMM. NCDMM agrees to defend, indemnify and hold harmless Sub-Recipient and its Affiliates and their respective directors, officers, employees and agents from and against any and all Losses arising from any third party Claims, in any manner caused by, resulting from or arising out of any misrepresentation, negligence or breach of this Agreement on the part of NCDMM, or any of NCDMM's directors, officers, employees or agents, including any Losses arising out of any breach or misrepresentation made by NCDMM under Section 6, except to the extent any such Loss is attributable to any breach by Sub-Recipient of this Agreement, or any negligence, wilful misconduct or inaction by Sub-Recipient, any of Sub-Recipient's Affiliates or any permitted Sub-Recipients, or any of Sub-Recipient's or its Affiliates' or any permitted Sub-Recipients' directors, officers, employees or agents.

bb. Indemnification Procedures. In the event that either Party (an "Indemnified Party") seeks indemnification from the other Party (the "Indemnifying Party") under the terms of this Article 8 with respect to any claim made by a third party, it shall inform the Indemnifying Party of the claim as soon as reasonably practicable after it receives notice thereof, shall permit the Indemnifying Party, at the Indemnifying Party's cost, to assume direction and control of the defense of the claim, and shall co-operate as requested (at the expense of the Indemnifying Party), in the defense of the claim. After notice to the Indemnified Party of the Indemnifying Party's election to assume the defense of such claim, the Indemnifying Party shall be liable to the Indemnified Party only for such legal or other expenses subsequently incurred by the Indemnified Party in connection with the defense thereof at the request of the Indemnifying Party. The Indemnifying Party shall not settle or otherwise compromise any claim or suit without the prior written consent of the Indemnified Party, which shall not be unreasonably withheld. As to those third party claims with respect to the which the Indemnifying Party does

not elect to assume control of the defense, the Indemnified Party will afford the Indemnifying Party an opportunity to participate in such defense, at the Indemnifying Party's own cost and expense, and will not consent to the entry of any judgment, settle or otherwise dispose of any of the same without the consent of the Indemnifying Party, which shall not be unreasonably withheld.

cc. Limitation of Liability and Claims. NCDMM shall not be liable to Sub-Recipient hereunder for any indirect, incidental, special, punitive or consequential damages of any kind, including lost profits or loss of goodwill or otherwise; and in no event shall the collective, aggregate liability of NCDMM and its Affiliates and its and their respective directors, officers, employees and agents under this Agreement exceed the amount of compensation actually received by Sub-Recipient from NCDMM pursuant to this Agreement. No action, regardless of form, arising out of or in any way connected with this Agreement or the Activities, may be brought by Sub-Recipient more than one (1) year after the cause of action accrued.

ARTICLE 9. PUBLICATIONS

9.1 The Parties agree and expect that results of Consortium Research associated with this agreement shall be published or otherwise made publicly available and that Parties engaged in Consortium Research shall be permitted to present at symposia, national or regional professional meetings and to publish in journals, theses or dissertations, or by other means of their own choosing, the results of their research, provided that nothing will be done which could bar the availability of patent protection with respect to CDIP of a Sub-Recipient/Member or America Makes (NAMII) invention or which would disclose Proprietary Information of any Sub-Recipient/Member or of America Makes (NAMII) or disclose information in violation of the applicable U.S. laws and regulations (e.g., the International Traffic in Arms Regulations ("ITAR") and the Export Administration Regulations ("EAR") that govern the export of specific technical data and technologies, including software, prototypes and other intellectual property, to foreign countries and foreign nationals ("Export Control Laws").

9.1.1 A Party will not make a public disclosure without a review of the full text of the proposed publication, presentation or other form of public disclosure by the Sub-Recipient/Member(s) involved, the America Makes (NAMII) Director and Government PM as described below. The Sub-Recipient/Member(s) involved, the America Makes (NAMII) Director and Government PM shall be provided a copy of the proposed public disclosure at least sixty-five (65) days in advance of the submission of such proposed public disclosure and shall have two (2) weeks after receipt of said proposed disclosure to respond in writing to the submitting Party to identify Proprietary Information and/or to identify any potentially patentable CDIP and/or to identify any CDIP in which the submitting Party does not have an ownership interest. A submitting Party agrees to remove any identified Proprietary Information, potentially patentable CDIP and/or CDIP in which the submitting Party does not have an ownership prior to public disclosure (or, for potentially patentable CDIP in which the submitting Party does have an ownership interest, delay public disclosure for a period of sixty (60) days from the date of the response).

9.1.2 Notwithstanding anything to the contrary above, student theses and dissertations shall be subject to a separate review and comment process wherein the student shall submit such student thesis or

dissertation in draft form at least sixty (60) days in advance of the date of their final defense in order to afford an opportunity to identify Proprietary Information and/or identify any potentially patentable CDIP and/or any CDIP in which the Party's student does not have an ownership interest.

9.1.3 America Makes (NAMII) and/or America Makes (NAMII) Sub-Recipient/Members may negotiate and implement a more restrictive public disclosure agreement than defined in paragraphs 9.1.1 and 9.1.2 for a specific America Makes (NAMII) project based on the need for extended non-disclosure of CDIP by the project participants.

9.1.4 An acknowledgment of funding and a disclaimer shall appear in the publication of any material, whether copyrighted or not, resulting from an America Makes (NAMII) project incorporating U.S. Government funds granted in support of the America Makes (NAMII) Consortium. The acknowledgement shall read:

"This material is based on research sponsored by Air Force Research Laboratory under agreement number FA8650-20-2-5700. The U.S. Government is authorized to reproduce and distribute reprints for Governmental purposes notwithstanding any copyright notation thereon."

The disclaimer shall read:

"The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of Air Force Research Laboratory or the U.S. Government."

ARTICLE 10. TERM AND TERMINATION

dd. Term. The term of this Agreement shall begin on the date hereof and shall continue for ENTER # OF MONTHS (the "Term"). Subject to termination in accordance with Section 10.2, the Parties agree to discuss in good faith prior to the end of the Term amending this Agreement (including this Section 10.1 and Schedules A, B, C, and D (if applicable)) or entering into a separate agreement governing the Parties' relationship with respect to the general substance of this Agreement, subject to mutual agreement, for one or more years following the end of the Term.

ee. Termination.

10.1.1 Either Party shall have the right to terminate this Agreement, by giving written notice to the other Party, upon material breach by the other Party of any material provision of this Agreement, including any covenant, representation or warranty contained in this Agreement or failure to perform any material portion of the Activities in accordance with the SOW, provided that such breach shall have continued for a period of thirty (30) days after the non-breaching Party has delivered written notice of said breach to the breaching Party.

10.1.2 This Agreement may be terminated at any time by written agreement of the Parties.

10.1.3 NCDMM shall have the right to terminate this Agreement for any or no reason upon thirty (30) days prior written notice to Sub-Recipient.

10.1.4 NCDMM shall have the right to terminate this Agreement immediately upon termination of the Prime Agreement (in whole or part) or upon any amendment or other change to the Prime Agreement that materially affects the need for or value of (each in NCDMM's reasonable sole discretion) all or a portion of the Activities hereunder.

10.1.5 Sub-Recipient shall have the right to terminate this Agreement upon thirty (30) days written notice if circumstances beyond its reasonable control preclude continuation of the Activities as described in the SOW.

ff. Rights and Duties Upon Termination or Expiration. Upon termination or expiration (without a further agreement related to the substance hereof entered into as contemplated in Section 10.1) of this Agreement, (i) Sub-Recipient shall cease all work on the Activities and turn over to NCDMM all documentation prepared by (or on behalf of, as the case may be) Sub-Recipient for NCDMM during the Activities (whether in written or electronic form) and (ii) NCDMM shall, in accordance with Article 4 pay Sub-Recipient. Termination or expiration of this Agreement shall be without prejudice to any rights that shall have accrued to the benefit of a Party prior to such termination or expiration.

gg. Survival. The respective rights and obligations set forth in the previous Articles and any other provisions required to interpret and enforce the Parties' rights and obligations under this Agreement shall indefinitely survive the expiration or termination of this Agreement to the extent expressly set forth therein or if no survival term is expressly set forth therein to the extent necessary to preserve these rights and obligations.

ARTICLE 11. MISCELLANEOUS

hh. No Commercialization. Sub-Recipient agrees that it shall not commercialize or, except as expressly permitted under the terms of this Agreement, otherwise Exploit any Materials, Information or Inventions owned by or licensed to NCDMM.

ii. Equitable Relief. Sub-Recipient acknowledges and agrees that the restrictions set forth in Articles 6 and 7 and Sections 8.1 and 8.2 of this Agreement are reasonable and necessary to protect the legitimate interests of NCDMM and that NCDMM would not have entered into this Agreement in the absence of such restrictions, and that any violation or threatened violation of any provision of Article 6 or 7 or Section 8.1 or 8.2 will result in irreparable injury to NCDMM. Sub-Recipient also acknowledges and agrees that in the event of a violation or threatened violation of any provision of Article 6 and 7 or Section 8.1 or 8.2, NCDMM shall be entitled to preliminary and permanent injunctive relief, without the necessity of proving irreparable injury or actual damages and without the necessity of having to post a bond. The rights provided in the immediately preceding sentence shall be cumulative and in addition to any other rights or remedies that may be available to NCDMM. Nothing in this Section 11.2 is intended, or should be construed, to limit NCDMM's right to preliminary and permanent injunctive relief or any other remedy for a breach of any other provision of this Agreement.

jj. Publication. Sub-Recipient, including its Affiliates and any permitted Sub-Recipients and its or their respective employees or agents, has no right to publish the NCDMM name or logo, except as expressly consented to in writing by NCDMM.

kk. Waiver. The failure of a Party to enforce any breach or provision of this Agreement shall not constitute a continuing waiver of such breach or provision and, subject to Section 8.4, such

Party may at any time thereafter act upon or enforce such breach or provision of this Agreement. Any waiver of breach executed by either Party shall affect only the specific breach and shall not operate as a waiver of any subsequent or preceding breach. To be effective any waiver must be in writing.

ll. Assignment and Foreign Participation. Sub-Recipient shall not sell, transfer, assign, pledge or otherwise dispose of, whether voluntarily, involuntarily, by operation of law or otherwise, this Agreement or any of its rights or obligations hereunder without the prior written consent of NCDMM, provided that in the event such consent and approvals, if applicable, are granted, the proposed assignee shall agree in writing, in a form reasonably satisfactory to NCDMM, to perform all of Sub-Recipient's obligations hereunder. Any attempt to assign, transfer, subcontract or delegate any portion of this Agreement or Sub-Recipient's rights or obligations hereunder in violation of this Section 11.5 shall be null and void. Subject to the terms hereof, this Agreement shall be binding upon and inure to the benefit of the successors and permitted assigns of the respective Parties hereto.

Any foreign person or other foreign participation conducting work under this effort in or outside of the United States must be approved prior to any of the work being completed. Requests for approval should be submitted to the cognizant NCDMM project manager managing the effort. The request will be submitted to the Government program office for final review and approval. No work can be completed outside of the United States without this approval.

mm. Severability. If any provision of this Agreement is held to be illegal, invalid or unenforceable under any present or future law, and if the rights or obligations of any Party under this Agreement will not be materially and adversely affected thereby, (a) such provision shall be fully severable, (b) this Agreement shall be construed and enforced as if such illegal, invalid or unenforceable provision had never comprised a part hereof, (c) the remaining provisions of this Agreement shall remain in full force and effect and shall not be affected by the illegal, invalid or unenforceable provision or by its severance herefrom and (d) in lieu of such illegal, invalid or unenforceable provision, there shall be added automatically as a part of this Agreement, a legal, valid and enforceable provision as similar in terms to such illegal, invalid or unenforceable provision as may be possible and reasonably acceptable to the Parties.

nn. Notices. Any notice, request or other communication required to be given pursuant to the provisions of this Agreement shall be in writing and shall be deemed to be given when delivered in person, by facsimile or by courier (return receipt requested) or five (5) days after being deposited in the United States mail, postage prepaid, certified, return receipt requested to the Parties addressed as follows:

If to NCDMM, to:	If to Sub-Recipient, to:
Gary R. Fleegle, President & CEO	NAME
699 Scalp Avenue	ADDRESS
Johnstown, PA 15904-1619	CITY, STATE ZIP
Tel: (724) 539-1361	Tel: XXX-XXX-XXXX
gary.fleegle@ncdmm.org	EMAIL: XXXXXXXX

Either Party may change its contact person, address or telephone or facsimile number by giving the other Party written notice, delivered in accordance with this Section 10.7.

oo. Construction. Except where the context otherwise requires, wherever used, the singular shall include the plural, the plural the singular, the use of any gender shall be applicable to all genders and the word "or" is used in the inclusive sense ("and/or"). When this Agreement refers to a number of days, unless otherwise specified as business days, that reference is to calendar days. The captions of this Agreement are for convenience of reference only and in no way define, describe, extend or limit the scope or intent of this Agreement or the intent of any provision contained in this Agreement. The term "including" as used herein shall mean including, without limiting the generality of any description preceding such term. A reference to a Schedule, Article, Section or clause is a reference to a Schedule, Article, Section or clause of this Agreement, and the terms "hereof," "herein," and other like terms refer to this Agreement as a whole, including any attachments hereto. The language of this Agreement shall be deemed to be the language mutually chosen by the Parties and no rule of strict construction shall be applied in favor of or against either Party hereto.

pp. Governing Law. This Agreement and the rights and obligations of the Parties shall be governed by and construed under the laws of the Commonwealth of Pennsylvania, excluding any conflicts or choice of law rule or principle that might otherwise refer construction or interpretation of this Agreement to the substantive law of another jurisdiction. Code of Federal Regulation parts and clauses shall be governed by Federal law, including the Federal common law of agreements.

qq. Parties Independent. In making and performing this Agreement, the Parties act and shall act at all times as independent entities and nothing contained in this Agreement shall be construed or implied to create an agency, partnership or employer and employee relationship between NCDMM and Sub-Recipient. Except as expressly provided herein, at no time shall either Party make commitments or incur any charges or expenses for or in the name of the other Party.

rr. Conflicts. Except as otherwise required by Applicable Law, to the extent that any provision of this Agreement conflicts with a provision of a Schedule, the provision of this Agreement shall govern.

ss. Cumulative Remedies. Unless expressly set forth herein to the contrary, all remedies set forth herein are cumulative and are in addition to any and all remedies provided either Party at law or in equity.

tt. Entire Agreement; Amendment. This Agreement and the previously signed America Makes (NAMII) Sub-Recipient/Membership agreement contain the entire understanding of the Parties with respect to the subject matter hereof. Any amendment or supplement to this Agreement shall be effective only if in writing signed by each Party.

uu. Counterparts. This Agreement may be executed in any number of counterparts, each of which shall be an original as against the Party whose signature appears thereon, but all of which taken together shall constitute but one and the same instrument.

IN WITNESS WHEREOF, each Party has caused this Sub-Recipient Agreement to be signed by its duly authorized officer as of the date first above written.

NCDMM	**[Sub-Recipient]**
By: _____ (Signature)	By: _____ (Signature)
Name: _____ (Printed Name)	Name: _____ (Printed Name)
Title: _____ Date:_____	Title: _____ Date:_____

SCHEDULE A

INSERT SOW AS NEGOTIATED

SCHEDULE B

BUDGET

INSERT BUDGET AS NEGOTIATED

SCHEDULE C

APPLICABLE FEDERAL REGULATION AND PRIME AGREEMENT FLOW-DOWN

1.00 Administrative Requirements and Order of Precedence (Mar 2015)
(a) This award is governed by the guidance in 2 Code of Federal Regulations (CFR) part 200, "Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards" as modified and supplemented by the Department of Defense's (DoD) interim implementation found at 2 CFR part 1103, "Interim Grants and Cooperative Agreements Implementation of guidance in 2 CFR part 200" (79 FR 76047, December 19, 2014), all of which are incorporated herein by reference. Provisions of Chapter I, Subchapter C of Title 32, CFR, "DoD Grant and Agreement Regulations," other than part 33, continue to be in effect and are incorporated herein by reference, with applicability as stated in those provisions.

(b) In the event of a conflict between the terms of this agreement and other government documents the conflict shall be resolved by giving precedence in descending order as follows:

(1) Federal statutes
(2) Federal regulations
(3) 2 CFR part 200, as modified and supplemented by DoD's Interim implementation found in 2 CFR part 1103
(4) Award-specific terms and conditions
(5) Attachments to this award, if any
(6) In case of disagreement with any requirements of this award, the recipient shall contact the NCDMM in order to resolve the issue. The recipient shall not access any costs to the award or accept payments until the issue is resolved.

1.01 Trafficking in Persons (March 2015)
This award is subject to the requirements of section 106 (g) of the Trafficking Victims Protection Act of 2000 (22 U.S.C. 7104, as implemented by 2 CFR 175)

You as the sub-recipient and your employees may not—
(a) Engage in severe forms of trafficking in persons during the period of time that the award is in effect; or
(ii) Procure a commercial sex act during the period of time that the award is in effect; or
(iii) Use forced labor in the performance of the award or subawards under the award.

1.02 Title to Property – Identified in Budget (March 2015)
Title to personal property acquired with agreement funds shall vest in the sub-recipient upon acquisition, except that supplies shall be managed in accordance with 2 CFR 200 Section 314. Title to real property shall vest in the sub-recipient subject to conditions contained in 2 CFR 200 Section 311. The sub-recipient shall dispose of real property in accordance with 2 CFR 200 Section 311.

1.03 Property System (March 2015)
Sub-recipient's property system shall meet the standards as set forth in 2 CFR 200 Section 310-316.

1.04 Cost Principles (March 2015)
Sub-recipient(s) shall comply with the cost principles as contained in 2 CFR 200, Subpart E, Cost Principles. Cost principles for determining allowability of costs applicable to lower tier, cost type contracts or awards under this agreement shall be determined by type of entity receiving the award.

1.05 Standards for Financial Management (March 2015)
Sub-recipient(s) financial management system shall comply with the standards identified in 2 CFR 200 Section 302.

1.06 Audit Requirements/Retention and Access to Records (March 2015)
Sub-recipient shall comply with the audit requirements of 2 CFR 200, Subpart F Audit Requirements and shall comply with the requirements appropriate for the type of entity receiving the award. Sub-recipient's financial records, supporting documents, statistical records, and all other records pertinent to an award shall be retained and access to them permitted in accordance with 2 CFR 200 Section 336.

1.07 Cost Sharing (August 2001)
Sub-recipient's contributions may count as cost sharing only to the extent that they comply with 2 CFR 200(200.306)

1.08 Export Control (March 2015) (TAILORED)
(a) Access to the technology developed under this agreement by foreign firms, institutions or individuals shall be controlled by the Sub-recipient under applicable U.S. export control laws.

(b) The sub-recipient shall receive NCDMM and grants officer approval before assigning or granting access to any work, equipment, or technical data generated or delivered under this agreement to foreign persons or their representatives. The notification shall include the name and country of origin of the foreign person or representative, the specific work, equipment, or data to which the person will have access.

1.09 Inventions (March 2015)
(a) The clause entitled Standard Patent Rights, (37 CFR 401.14(a)) is hereby incorporated by reference and is modified as follows: replace the word "recipient" with "Sub-recipient"; replace the words "agency," "Federal Agency" and "funding Federal Agency" with "NCDMM"; replace the word "contract" with "agreement"; delete paragraphs (g)(2), (g)(3) and paragraph (g)(1) first sentence to read "The recipient will include this clause for experimental, developmental or research work to be performed by a Sub-recipient." Paragraph (1), Communications, point of contact on matters relating to this clause will be the servicing Staff Judge Advocate's office.

(b) Interim or final Invention Reports 1) listing subject invention(s) and stating that all subject inventions have been disclosed, or 2) stating that there are no such inventions, shall be sent to the NCDMM. Please include in the subject line of the e-mail the contract number followed by the words "Invention Reporting." The Sub-recipient shall file Invention (Patent) Reports on the DO Form 882, Report of Inventions and Subcontracts, as of the close of each performance year and at the end of the term for this agreement. Annual reports are due 60 days after the end of each year of performance and

final reports are due 60 days after the expiration of the final performance period. Negative reports are also required annually.

(c)The DD Form 882 may also be used for the notification any lower tier award for experimental, developmental or research work which contain a "Patent Rights" clause

(d) This provision also constitutes the request for the following information for any subject invention for which the recipient has retained ownership: 1) the filing date, 2) serial number and title, 3) a copy of the patent application and 4) patent number and issue date. Submittal shall be to the NCDMM.

1.10 Data Rights (March 2015)

(a) All rights and title to data, as defined in 48 CFR 27.401, generated under this agreement shall vest in the sub-recipient.

(b) The sub-recipient hereby grants to the U.S. Government a royalty free, world-wide, nonexclusive, irrevocable license to use, modify, reproduce, release, perform, display or disclose any data for Government purposes.

- "Government purpose includes competitive procurement, but not the rights to use, modify, reproduce, release, perform, display, or disclose technical data for commercial purposes or authorize others to do so"

(c) The sub-recipient is responsible for affixing appropriate markings indicating rights on all data delivered under the agreement. The Government will have unlimited rights in all data delivered without markings.

(d) The sub-recipient shall include this article, suitably modified to identify the parties, in all lower tier contracts and awards, regardless of tier, for experimental, developmental, or research work.

1.11 Publishing Project Results (March 2015)

(a) Publications. The Sub-recipient(s) is expected to publish or otherwise make publicly available the results of the work conducted under this subaward. One copy of all publications resulting from the project shall be forwarded to the NCDMM as it becomes available.

(b) An acknowledgment of awarding agency's support shall appear in the publication of any material, whether copyrighted or not. The acknowledgement shall read:

"This material is based on research sponsored by Air Force Research Laboratory under agreement number FA8650-20-2-5700. The U.S. Government is authorized to reproduce and distribute reprints for Governmental purposes notwithstanding any copyright notation thereon."

(c) The Sub-recipient is responsible for assuring that every publication of material based on or developed under this project contains the following disclaimer:

"The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of Air Force Research Laboratory or the U.S. Government."

1.12 Reporting Subawards and Executive Compensation (March 2015)
(a) Reporting of first-tier subawards.

(1) Applicability. Unless you are exempt as provided in paragraph d. of this award term, you must report each action that obligates $25,000 or more in Federal funds that does not include Recovery funds (as defined in section 1512(a)(2) of the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5) for a subaward to an entity (see definitions in paragraph e. of this award term).

(2) Where and when to report.

(i) You must report each obligating action described in paragraph a.1. of this award term to http://www.fsrs.gov.

(ii) For subaward information, report no later than the end of the month following the month in which the obligation was made. (For example, if the obligation was made on November 7, 2010, the obligation must be reported by no later than December 31, 2010.)

(3) What to report. You must report the information about each obligating action that the submission instructions posted at http://www.fsrs.gov specify.

(b) Reporting Total Compensation of Recipient Executives.

(1) Applicability and what to report. You must report total compensation for each of your five most highly compensated executives for the preceding completed fiscal year, if-

(i) the total Federal funding authorized to date under this award is $25,000 or

more; (ii) in the preceding fiscal year, you received-

(A) 80 percent or more of your annual gross revenues from Federal

procurement contracts (and subcontracts) and Federal financial assistance

subject to the Transparency Act, as defined at 2 CFR

170.320 (and subawards); and

(B) $25,000,000 or more in annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR
170.320 (and subawards); and

(iii) The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C.
78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has
access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at http://www.sec.gov/answers/execomp.htm.)

(2) Where and when to report. You must report executive total compensation described in paragraph b.1. of this award term:

(i) As part of your registration profile at http://www.ccr.gov.

(ii) By the end of the month following the month in which this award is made, and annually

thereafter. (c) Reporting of Total Compensation of Subrecipient Executives.

(1) Applicability and what to report. Unless you are exempt as provided in paragraph d. of this award term, for each first-tier subrecipient under this award, you shall report the names and total compensation of each of the subrecipient's five most highly compensated executives for the subrecipient's preceding completed fiscal year, if-

(i) in the subrecipient's preceding fiscal year, the subrecipient received

(A) 80 percent or more of its annual gross revenues from Federal procurement contracts (and subcontracts) and Federal financial assistance subject to the Transparency Act, as defined at 2 CFR
170.320 (and subawards); and

(B) $25,000,000 or more in annual gross revenues from Federal procurement contracts (and subcontracts), and Federal financial assistance subject to the Transparency Act (and subawards); and

(ii) The public does not have access to information about the compensation of the executives through periodic reports filed under section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C.
78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986. (To determine if the public has access to the compensation information, see the U.S. Security and Exchange Commission total compensation filings at http://www.sec.gov/answers/execomp.htm.)

(2) Where and when to report. You must report subrecipient executive total compensation described in paragraph c.1. of this award term:

(i) To the recipient.

(ii) By the end of the month following the month during which you make the subaward. For example, if a subaward is obligated on any date during the month of October of a given year (i.e., between October 1 and 31), you must report any required compensation information of the subrecipient by November 30 of that year.

(d) Exemptions: If, in the previous tax year, you had gross income, from all sources, under $300,000, you are exempt from the requirements to report:

(1) Subawards, and

(2) The total compensation of the five most highly compensated executives of any

subrecipient. (e) Definitions. For purposes of this award term:

(1) Entity means all of the following, as defined in 2 CFR part 25:

(i) A Governmental organization, which is a State, local government, or Indian tribe;

(ii) A foreign public entity;

(iii) A domestic or foreign nonprofit

organization; (iv) A domestic or foreign for-

profit organization;

(v) A Federal agency, but only as a subrecipient under an award or subaward to a non-Federal

entity. (2) Executive means officers, managing partners, or any other employees in

management positions. (3) Subaward:

(i) This term means a legal instrument to provide support for the performance of any portion of the substantive project or program for which you received this award and that you as the recipient award to an eligible subrecipient.

(ii) A subaward may be provided through any legal agreement, including an agreement that you or a subrecipient considers a contract.

(4) Subrecipient means an entity that:

(i) Receives a subaward from you (the recipient) under this award; and

(ii) Is accountable to you for the use of the Federal funds provided by the subaward.

(5) Total compensation means the cash and noncash dollar value earned by the executive during the recipient's or subrecipient's preceding fiscal year and includes the following (for more information see 17
CFR 229.402(c)(2)):

(i) Salary and bonus.

(ii) Awards of stock, stock options, and stock appreciation rights. Use the dollar amount recognized for financial statement reporting purposes with respect to the fiscal year in accordance with the Statement of Financial Accounting Standards No. 123 (Revised 2004) (FAS 123R), Shared Based Payments.

(iii) Earnings for services under non-equity incentive plans. This does not include group life, health, hospitalization or medical reimbursement plans that do not discriminate in favor of executives, and are available generally to all salaried employees.

(iv) Change in pension value. This is the change in present value of defined benefit and actuarial pension plans.

(v) Above-market earnings on deferred compensation which is not tax-qualified.

(vi) Other compensation, if the aggregate value of all such other compensation (e.g. severance, termination payments, value of life insurance paid on behalf of the employee, perquisites or property) for the executive exceeds $10,000.

1.13 Disclosure or Information (March 2015) (Tailored)

(a) The Sub-recipient shall not release to anyone outside the Sub-recipient's organization any unclassified information, regardless of medium (e.g., film, tape, document, media announcements, etc.), pertaining to U.S. Government Agency-Driven Projects unless-

(1) The NCDMM Agreements Officer has given prior written approval; or

(2) The information is otherwise in the public domain before the date of release.

(b) Requests for approval shall identify the specific information to be released, the medium to be used, and the purpose for the release. The Sub-recipient shall submit its request to the NCDMM Agreements Officer at least 65 days before the proposed date for release through NCDMM.

(c) The Sub-recipient agrees to include a similar requirement in each sub-agreement under this agreement. Sub-recipients shall submit requests for authorization to release through the NCDMM to the Agreements Officer.

1.14 Procurement System (March 2015)

The sub-recipient's procurement system shall comply with the standards contained in 2 CFR 200 Section 317-326.

1.15 Military Recruiting on Campus (March 2015)
As a condition for receipt of funds available to the Department of Defense (DoD) under this award, the Sub-recipient agrees that it is not an institution of higher education (as defined in 32 CFR 216) that has a policy or practice that prohibits or, in effect, prevents ROTC or military recruiting on campus, as described in DFARS 252.209-7005(b). If the Sub-recipient is determined, using the procedures in 32 CFR part 216, to be such an institution of higher education during the period of performance of this agreement, and therefore to be in breach of this clause, the NCDMM will cease all payments of DoD funds under this agreement and all other DoD grants and cooperative agreements to the sub-recipient, and it may suspend or terminate such grants and agreements unilaterally for material failure to comply with the terms and conditions of award.

1.16 Assurances (March 2015)
(a) By signing or accepting funds under the agreement, the Sub-recipient assures that it will comply with applicable provisions of the following National policies on: (1) Prohibiting discrimination:
(i) On the basis of race, color, or national origin, in Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d, et seq.), as implemented by DoD regulations at 32 CFR part 195;

(ii) On the basis of age, in the Age Discrimination Act of 1975 (42 U.S.C. 6101, et seq.) as implemented by Department of Health and Human Services regulations at 45 CFR part 90;

(iii) On the basis of handicap, in Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 794), as implemented by Department of Justice regulations at 28 CFR part 41 and DoD regulations at 32 CFR part
56;

(iv) On the basis of sex or blindness, in Title IX of the Educational Amendments of 1972 (20 U.S.C. 1681, et. seq.).

(2) The Clean Air Act (42 U.S.C. 7401, et seq.) and Clean Water Act (33 U.S.C. 1251, et seq.), as implemented by Executive Order 11738 (3 CFR, 1971-1975 Comp., p. 799).

The Sub-recipient shall obtain assurances of compliance for all subawards under this effort

1.17 Prohibition on Using Funds under Grants and Cooperative Agreement with Entities that Require Certain Internal Confidentiality Agreements (June 2015)
(a) The sub-recipient may not require its employees, contractors, or subawardees seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting them from lawfully reporting that waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.
(b) The sub-recipient must notify its employees, contractors, or subawardees that the prohibitions and restrictions of any internal confidentiality agreements inconsistent with paragraph (a) of this award provision are no longer in effect.
(c) The prohibition in paragraph (a) of this award provision does not Contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.
(d) If the NCDMM determines that the sub-recipient is not in compliance with this award provision, it:

(1) Will prohibit the sub-recipient's use of funds under this award, in accordance with section 743 of Division E of the Consolidated and Further Continuing Resolution Appropriations Act, 2015, (Pub. L. 113-235) or any successor provision of law; and
(2) May pursue other remedies available for the sub-recipient's material failure to comply with prime award terms and conditions.

Schedule D

Additional Requirements

Kickoff Meeting

The sub-recipient will schedule a kickoff meeting with the NCDMM Project Manager to be held within 30 days of contract award. At the kickoff meeting the sub-recipient will provide the following:

- A detailed Gantt chart for the entire project that includes clearly identified milestones. The milestones must include identification of the key elements of Technology Development, Education and Workforce, Technology Transition, Sustainability, and MRL/TRL status.
- A listing of project deliverables with associated delivery dates
- A Spend Plan by month for the entire project. The attached template is provided as assistance. The Spend Plan must incorporate both America Makes funding and cost share.
- Identification of team Sub-Recipient/Members and their roles and responsibilities

Project Reporting

For the duration of the project, monthly reports, invoices and cost share reports will be due by the 10th of the month for activities of the preceding month. The sub-recipient is responsible for assembling information from subcontractors to support reporting requirements. Both technical and financial reports will be required.

- Technical reports will highlight the reporting period's technical achievements, identify any unexpected technical issues that have been encountered and action plans to resolve such issues, state the current MRL/TRL level and justification for advancing in MRL/TRL, updated Gantt charts, progress on metrics and future planned activities. All technical reports must provide a brief publicly-releasable section and a section for release to America Makes Sub-Recipient/Members. Proprietary information available only to project team Sub-Recipient/Members and appropriate America Makes staff/Government representatives can also be contained in the report and marked accordingly. A template for the reporting format will be provided by NCDMM/America Makes.
- Financial reports and invoices will document expenditures of both America Makes funds and cost share. Pertinent backup documentation, such as cost share reports, will be required to support financial reports. Backup documentation to be supplied by the sub-recipient will include, but not be limited to, individual cost share reports for team Sub-Recipient/Members. Tracking of actual expenditures vs. those provided in the Spend Plan will be required. The ratio of America Makes funding vs. cost share funding is expected to be roughly 1:1 at all times throughout the project. Both the ratio of America Makes funding to cost share funding and actual expenditures to expenditures stated in the Spend Plan will be monitored by the NCDMM Project Manager. If either or both of these financial goals are not met, the sub-recipient will be required to submit a corrective action plan. Failure to correct financial shortcomings may be grounds for contract cancellation.
- America Makes will provide an online portal for reporting. All reports will be uploaded to the America Makes online portal site by the sub-recipient. Note: Microsoft SharePoint will be used initially and log-on credentials will be provided by the America Makes team.

Meeting Participation

- Sub-recipient participation in regularly scheduled conference calls, quarterly review meetings and Project Management Review (PMR) meetings will be required.