The Digital Manufacturing Institute

MxD REQUEST FOR PROPOSAL

TECHNICAL SUMMARY & PROGRAM OVERVIEW

MxD-20-02:

AI-Enabled Computer Vision for Real-Time Adaptive Quality Inspection

Revision 3.0 Release Date: May 12, 2020

Contact: Emily Jerger
Project Engineer
MxD
projects@mxdusa.org

MxD
1415 North Cherry Ave
Chicago, IL 60642

TABLE OF CONTENTS

I. RECORD OF CHANGE

Revision	Date	Sections	Description
1.0	12 March 2020	N/A	Original
2.0	7 April 2020	II. Project Overview	Proposals Due Date extended from 14 May 2020 to 11 June 2020.
2.0	12 May 2020	II. Project Overview	Proposals Due Date extended from 11 June 2020 to 25 June 2020.

II. PROJECT OVERVIEW

Deadline for Joining Teaming Interest List*	26 March 2020
Deadline for Pitch Session Signup*	26 March 2020
Pitch Session*	10:00AM CT, 9 April 2020
Proposals Due	**5:00PM CT, 25 June 2020**
Anticipated MxD Funding	$500,000.00 - $700,000.00
Period of Performance	8-12 months

*Reference PPK Overview for detailed instructions

III. INTRODUCTION

MxD: The Digital Manufacturing Institute (formerly the Digital Manufacturing and Design Innovation Institute – DMDII) is where innovative manufacturers go to forge their futures. In partnership with the Department of Defense, MxD (also referred to as the Institute) equips U.S. factories with the digital tools and expertise they need to begin building every part better than the last. As a result, our nearly 300 members increase their productivity and win more business.

MxD has invested approximately $90 million in more than 60 applied research and development projects in areas including design; product development; systems engineering; future factories; agile, resilient supply chains; and cybersecurity.

MxD operates from a nearly 100,000-square-foot innovation center near downtown Chicago. Its factory floor features some of the most advanced manufacturing equipment in the world, which partners can use for experimentation and training on everything from augmented reality to advanced simulation techniques.

MxD Request for Proposals (RFP) are issued to address research and development needs in digital design and manufacturing technology that are aligned with the technical objectives of MxD and directly support the Institute's vision of developing digital manufacturing systems that make every part better than the last.

This RFP contains the following elements:

1. Request for Proposal Technical Summary & Program Overview: a description of a specific technology objective and technical and program requirements
2. Proposal Preparation Kit (PPK referenced as the Kit): includes a PPK overview document and attached proposal templates and references. The PPK Overview provides background and guidance for the preparation of required forms and instructions needed to submit to a MxD Request for Proposal. The PPK Overview offers detailed instructions on how to respond to this RFP and provides attachments with the required proposal templates. It is intended to provide the basic information necessary for assembling complete and compliant proposals and to help explain those areas that usually generate the most questions from Offerors.

NOTE: MxD recommends Offerors review the Request for Proposal Technical Summary & Program Overview prior to the PPK.

The RFP is available on the MxD website at http://mxdusa.org. Notices announcing MxD competitions and due dates will also be posted on the MxD website. Amendments to a MxD RFP may be used to extend due dates, clarify procedural requirements or modify technical requirements. An updated RFP may be issued and the previous RFP will be rescinded. Offerors should carefully monitor the MxD website subsequent to an original posting of an RFP, up to the time of the Technical Proposal and Cost Proposal submission date. Any revisions, amendments or updates will appear in the same section of the website as the original solicitation. It is the responsibility of the Offeror to monitor the MxD RFP updates and ensure their proposal meets the solicitation requirements. MxD welcomes any comments or suggestions for improving the contents of this guide. Please address them to projects@mxdusa.org.

Any questions regarding this solicitation must be provided to projects@mxdusa.org. The questions will be sent to the appropriate MxD and/or Government POC, and answers will be published on the MxD website, if appropriate. Questions submitted within one week prior to a deadline may not be answered.

IV. PURPOSE

MxD will periodically solicit proposals for applied research and technology development to meet the goals outlined in its Strategic Investment Plan (SIP) or complementary goals specified by key external stakeholders that align with MxD's core mission. The process by which this achieved is through an RFP.

An RFP is initiated when MxD desires new and creative solutions to problems and/or advances in knowledge, understanding and technology for digital manufacturing and design. The purpose of an RFP is to solicit proposals for projects in technology areas that are of interest to MxD membership and external stakeholders such as the U.S. Government. MxD will initiate and coordinate development of the RFP topics by engaging Technology Advisory Committee (TAC) members, MxD's Agile Tech Team, Department of Defense (DOD) affiliates, and other relevant stakeholders. Once the RFP topics are developed and approved the MxD RFP will be posted to the MxD website and represents the official notification to Offerors of a request to submit the required documents.

mxdusa.org
@mxdinnovates
info@mxdusa.org

1415 N. Cherry Avenue
Chicago, IL 60642
(312) 281-6900

REQUEST FOR PROPOSAL
TECHNICAL SUMMARY

V. TECHNICAL SUMMARY

PROBLEM STATEMENT

This project aims to develop and demonstrate a solution that leverages artificial intelligence (AI) and computer vision technologies to achieve real-time, in-situ adaptive quality inspection. In many cases, manufacturers still must rely on human inspection methods and non-destructive tests due to limitations of automated methods in detecting and diagnosing complex defects. To keep the competitive edge, manufacturers need to be able to mitigate quality issues in real-time to avoid defects that result in costly rework operations or scrapped parts.

While machine and computer vision have been used for years to inform and automate decision making in quality, most applications have been image analysis for simple automated choices (e.g. good/bad, object recognition). Common examples include packaging inspection, predictive maintenance, serialization (barcodes), metrology and safety applications. More complex machine vision techniques have been successful in imaging of additive manufacturing melt pools for closed loop control. With recent developments in cloud/edge computing, advanced artificial intelligence (AI), and reduced costs of data storage and processing, manufacturers are now better able to leverage the time- and cost-saving benefits of computer vision. According to Lisa Whalen, global VP at MarketsandMarkets, "The market for AI in manufacturing is expected to grow from $1.03 billion last year [2019] to $17.22 billion by 2025…Quality control and machine inspection are the major applications where machine vision in combination with AI is expected to grow at a significant rate".[1] The machine vision market "is expected to reach USD 14.0 billion by 2024 from an estimated USD 9.9 billion in 2019, at a CAGR of 7.1% from 2019 to 2024."[2] To maximize value, quality data must be collected and integrated with the digital thread and used to adaptively control and improve upstream designs and processes.

However, manufacturers often lack the infrastructure, tools, and cultural acceptance needed to handle the complexities of in-situ computer vision enabled by advanced AI techniques, such as deep learning, for near real-time quality inspection (both offline and in-line). The challenges include storage and processing of large volumes of data at production speed, linking with process meta-data and the digital thread, lack of best practices for data retention, extensibility of architectures, and high configuration costs for both computer vision systems and AI models. Moreover, adoption of these technologies requires building a culture of trust which is only realizable through validation in production settings.

This project seeks to reduce barriers to adoption of AI-enabled computer vision technologies for quality inspection. In summary, the gaps this project aims to address are as follows:

- **High Costs of Inspection Variability:** Across a network of multiple plants, and even within one plant, inconsistent inspection processes and decisions naturally arise due to subjectivity of human operators. This can cause costly, unnecessary rework and scrap.
- **Merging of AI Expertise with Manufacturing Domain Knowledge:** For successful adoption of AI-driven computer vision technology, a culture of trust must be built

[1] Morey, Bruce. “Machine Vision Technology Advances Rapidly.” *SME*, SME.org, 20 Feb. 2019, www.sme.org/technologies/articles/2019/february/machine-vision-technology-advances-rapidly/.

[2] Gupta, Sanjay. “Machine Vision Market.” *Market Research Firm*, MarketsandMarkets INC, Feb. 2020, www.marketsandmarkets.com/PressReleases/industrial-machine-vision.asp.

among engineers and operators by showing how the results can augment their capabilities. These stakeholders need to know when results are "good enough" to inform their decision making.

- **Technology Extensibility:** Current state AI-driven computer vision technology is not extensible to wide array of inspection applications (e.g. varied products, requirements, defect types), leading to expensive configuration costs for deployment at scale.

OBJECTIVES

As explained above, the problem space for quality inspection is vast. In order to encourage innovations that span the solution space, this project call is open to a wide variety of responses that will reduce the barriers to adoption of this technology. All projects must address real manufacturing problems, leverage new or existing AI and computer vision[3] technologies, and must seek to achieve the following objectives:

- **Digital Thread Benefits:** Increase manufacturers' ability to leverage inspection data in combination with the digital thread for improvements to upstream processes.
- **Collaborate:** Merge engineering and manufacturing domain knowledge with AI expertise to achieve desired manufacturing benefits.
- **Close Skills Gap:** Leverage AI and computer vision technology to close the skills gap for manufacturing engineers and operators. The project should implement or produce processes, design improvements, and metrics that encourage trust of system results in order to better enable operators to make the best inspection decisions.
- **Proof-of-value:** Measure and report key performance indicators (KPI) for system performance and return on investment to inform and justify future investments.
- **Meet Current-State Manufacturing Challenges:** Improve AI/ machine learning (ML) algorithms and implementation to better meet the current-state challenges manufacturers face with limited datasets, gaps in-house AI expertise, and concerns with extensibility and scalability.

CRITICAL REQUIREMENTS

There are a broad set of interpretations for what falls under the purview of "AI-Enabled Computer Vision for Real-Time Adaptive Quality Inspection". As such, it is required that the responding team provide their own use case and solution for this project. Proposals are required to leverage AI and computer vision technologies in order to address **at least one** of the research, development, and demonstration (RD&D) topic areas listed in Table 1 . It is required that the responding team clearly defines the connection between the qualifying topic area(s) (Table 1) and their proposed project. The following research, development, and demonstration topics qualify under this RFP:

[3] **NOTE: MxD defines vision technologies and systems broadly. Imaging techniques can include LCD camera, x-ray, laser, thermal, 2D and 3D imaging, or others. Both discrete and time-series (e.g. video) imaging are covered under the term "vision". Offers may employ vision technologies in combination with other sensing technologies as needed.**

Table 1. Qualifying RD&D Topic Areas

Topic Area	Examples
Algorithm development, enhancements, and application techniques	• Improve accuracy and confidence metrics for models with small training datasets • De-risking and enablement of deep learning models for quality inspection use cases
Vision sensor technology development and enhancements	• Improve sensor adaptability to constraints of manufacturing operations, while maintaining performance and compliance specifications
Digital thread integration with visual inspection data for enablement of real-time insights and adaptive control of upstream processes	• Interpretation/pattern recognition of inspection data in context of process metadata to enable and trigger real-time feedback to upstream design or manufacturing processes • Leverage standards-based frameworks such as those developed in MxD 15-11-08 Model Based Feature Information Network (MFIN) to connect visual inspection data • Tie visual inspection data to item-level serialization to drive real-time insights for quality assurance, compliance, and operational excellence. • Operator empowerment through UI/UX (user interface/user experience) design of human machine interfaces (HMI) • Enhancements to existing manufacturer computer vision implementation

The responding team must clearly state the use case(s) they plan to address in the scope of this project. It is suggested that use-cases be defined as user stories, framing the problem from the perspective of an end user. A user story describes the type of user, what they want and why they want it. An example format for framing problems as user stories has been included below.

As a < type of user >, I want < some goal > so that < some reason>.

While it is required that the responding team provide a single use case for the development of their solution, the technology being developed must address problems that are faced across the industrial base and must be extensible to additional industry applications. Thus, the project development should, at the very minimum, consider and comment on potential future applications.

Example use cases have been provided in Table 2. It is important to note that these have been provided as a guide and that the proposing team may offer use cases beyond those listed below.

Table 2. Example Use Cases

Description	Example Use Case
ROI study of pilot implementations at multiple factories	*As a plant or production manager, I want to pilot AI-driven computer vision systems in multiple plants to systematically inspect defects to ensure consistent reaction across all plants in order to measure reduction in scrap and rework costs.*
Digital thread integration and insights for real-time adaptive control of upstream processes	*As a manufacturing engineer, I want to intersect disparate data types such as item-level computer images, process parameters, tooling equipment maintenance history, and human interventions using advanced artificial intelligence techniques in order to identify hard-to-detect defects in order to adaptively control upstream manufacturing processes.*
Vision sensor enhancements for application in machining operations	*As a manufacturing engineering, I want to develop imaging sensors that meet spatial and performance constraints of hazardous manufacturing operations in order to expand technology extensibility to reduce safety risk to human operators.*
Demonstration and validation of timeline for return on investment for AI-enabled computer vision systems	*As a manufacturing engineer, I want to pilot AI-driven computer vision technology for magnetic particle inspection of remanufactured parts and measure the system performance and ROI in order to justify future investments and scaling.*
User Interface (UI) development for human operator feedback from AI-enabled computer vision system	*As an inspection operator, I want to interact with a user interface that identifies defects flagged by the AI-driven computer vision system, informs me of decision factors, and recommend actions, so that I can trust the system results and implement the best reaction plan.*
Data architecture development for AI-enabled computer vision system	*As a system integrator, I want a standard and flexible data science architecture for image data storage, association with metadata/digital thread, and processing that I can copy across many implementations in order to reduce configuration, maintenance, and scaling costs/timeline.*

NOTE: Both on-line inspection and off-line inspection use cases will be considered under this RFP.

RFP Scope of Work

The above objectives must be completed within the following project constraints:
Period of Performance: 8 - 12 months
Anticipated MxD Funding: $500,000.00 - $700,000.00

The scope of work for this project will vary depending on the topic areas and target manufacturing use case selected by the team. Proposals must clearly explain the scope of research, development, and/or demonstration work to be done and justify anticipated end technology readiness level (TRL).

During the period of performance, an AI-enabled computer vision solution must be implemented and tested in a production or production-relevant environment(s) to validate ROI (target return within 1-3 years) and manufacturer-defined KPI. After initial requirements are sourced directly from key stakeholders, the team should plan to take an incremental approach in the development of their solution. In this approach the team shall develop and then deploy their solution within their proposed environment, demonstrating its performance early in the solution development through tests of increasing complexity. It is necessary for the team to solicit input from key users (potentially outside of the core team) as part of their development strategy. The team should first validate any critical assumptions to showcase the feasibility of the proposed system design. Then, the team must demonstrate success on each test before continuing to more advanced development. The team should plan to design and employ at least six development and test increments during the period of performance with final testing being completed per the success metrics established by the manufacturer.

To drive value across the US industrial base, the scope must include development of a playbook(s) for system implementation including data infrastructure implementation, data retention best practices, AI/ML training, and system configuration.

Proposal Requirements

- The project team shall include one or more manufacturers who will provide the target manufacturing inspection problem(s) to be addressed by this project. The manufacturer will serve as the end user and will guide the technical direction of the project. The manufacturing participants may, but are not required to, lead the Offeror team.

- Proposals must provide a plan for demonstration and testing of the new or existing technology in a production or production-relevant environment. This plan should include, at minimum, identification of the manufacturing partner(s), a detailed description of the target quality inspection use case(s), a description of the current state process, and a high-level test plan. The demonstration should provide validation of manufacturer defined key performance indicators and cost metrics (ROI).

- This project intends to generate advancements that accelerate the screening, piloting, and adoption of AI-enabled computer vision systems for quality inspection across the US manufacturing base. Proposals must clearly justify how the proposed advancements will contribute toward this objective and other objectives listed in this RFP.

- Proposals must include a clear plan for obtaining data/images needed for training AI/ML models. Please specify if the data already exists or explain the plan to obtain and share data necessary for the project. As a rule of thumb, many machine learning models require training with at least 1000 images per defect class to reach acceptable levels of

accuracy. If your use case involves limited datasets, such as for low-frequency defects or low-volume applications, please explain your plans for mitigating this risk.

- The project scope must include design, implementation, and documentation of a data science and computing architecture for collecting, storing and associating images and meta-data; processing data through AI models; and (OPTIONAL)) feeding back data to process controls in real-time.
- This project intends to tackle industry-wide problems that cannot be solved by any entity alone. Proposals should address problems that necessitate a broad mix of capabilities and experiences to ensure successful completion and transition of the project outcomes. Moreover, this project must demonstrate the convergence of AI expertise and manufacturing domain knowledge to address the gaps outlined in the Problem Statement section of this RFP.

NOTE: Please specify any expectations for use of MxD's factory floor or MxD's existing testbeds in your proposal. Please contact MxD in advance if this is your intent.

During the period of performance, the team will produce deployable deliverables that will be shared with the MxD membership in accordance with the Membership Agreement. The recommended deliverables are listed below in Table 3, but the team is encouraged to include additional deliverables or provide value-added changes to the recommended set of deliverables.

Table 3. Technical Deliverables

Deliverable	Description
AI-Enabled Computer Vision Solution	Hardware, software and/or algorithms resulting from the solution development, necessary to run/operate the system in accordance with the requirements outlined in this RFP
Final Demonstration	All materials required to execute a final demonstration at the end of the project period of performance at manufacturer's production environment
Playbook for AI-Enabled Computer Vision Solution	Playbooks for system implementation including data architecture, installation/ implementation, data retention and security best practices, AI/ML training, and system configuration. OPTIONAL: Playbooks may target audience of small and medium manufacturers.
Technical Documentation	Documentation outlining detailed technical and business pre-requisites, requirements and constraints (hardware, software) for implementation of solution; Documentation for all software developed
Incremental System Test Plan	Test plan for each incremental evaluation that provides details for setup, test steps, success criteria and target results
End User Interviews	Record the results from a minimum of 25 end-user interviews utilizing the Customer Discovery framework
Executive Outcome Report	Report on results of KPI and ROI study for executive audience

Technical Data Package	Technical data package inclusive of engineering bill of materials, models (if applicable), integration and configuration guide, etc. necessary to procure and build the system.
User Guides	User guides for key stakeholders, such as inspection operators and manufacturing engineers

The team is expected to develop a transition plan, which is detailed in Table 2 in Section VI. MxD is focused on supporting the transition of project outcomes to its membership in the form of pilot integrations on their factory floors, follow-on research projects or commercialized products available for use. Teams are expected to tailor their deliverables to their transition goals in order to provide outcomes that have continuing impact after the period of performance is complete. **Pilot deployments and actionable transition plans are a priority for MxD to help maximize the benefits of funded research to the membership and ultimately, help increase the competitiveness of the US manufacturing base through new technological advancements. Thus, it is important that proposals emphasize not just technical merit but transition and deployment.**

mxdusa.org
@mxdinnovates
info@mxdusa.org

1415 N. Cherry Avenue
Chicago, IL 60642
(312) 281-6900

PROGRAM OVERVIEW

VI. PROGRAM REQUIREMENTS

COLLABORATION

Participation in this program requires collaboration with a team of organizations with diverse capabilities. Competitive teams should include representation from the manufacturing base, academia, solution/service providers and standards bodies. Teams are encouraged to have appropriate representation from technology providers and academic organizations to provide necessary AI expertise.

Each team must include participation by a current or potential MxD Tier 1 or Tier 2 Manufacturing Member to drive use case and operational requirements. It is encouraged that the Tier 1 or Tier 2 Manufacturing Member provide the research testbed site but this is not required if an alternative location aligns better with the team's transition plan.

Teams are encouraged to seek participation from a small/medium manufacturer (SMM) or a manufacturer within the leading manufacturer's supply chain. It is encouraged that they provide a complimentary use case for demonstration or provide requirements for an additional deliverable that is crafted to offer tangible value specifically to the SMM community.

PROGRAM MANAGEMENT

MxD will be responsible for managing the project to ensure their team will meet all the technical objectives and requirements proposed within the project's period of performance and budget. The MxD Project Engineer will coordinate with Principal Investigators (PIs) of every participant to manage the program following MxD's project processes. The Director of R&D Projects, in coordination with each project's MxD Project Engineer, will monitor technical and cost performance of the associated Enterprise Award Agreement. Project teams will submit the reports listed below to their identified Project Engineer to fulfill their reporting requirements. These reports will be internally accessed by the MxD Director of R&D Projects, the Government, the Project Engineer and other authorized MxD staff members in the course of their official duties. Technology advancements will be summarized at least annually in order to support reporting to the Executive Committee, Technical Advisory Committee, MxD Members, and the Government, when applicable.

Deliverable	Description
Project Immersion Workshop	Face to face meeting with manufacturer(s) including stakeholders from key business units to review project transition plan and define pilot requirements.
Transition Plan	Written plan for successful transition of project outcomes after period of performance including technology integration, educational distribution, and potential commercialization.
Monthly Technical and Financial Reports	Monthly report from each Project Participant including the financial and technical status of the Project
Member Technical Reviews	Presentation encompassing all technical advancements made prior to key milestone and presented to the MxD Project Engineer, members of the Technical Advisory Committee, and other interested MxD members.
Presentations at MxD	Presentation and demonstration of developed technology presented in person at MxD
Annual Patent Reports	Report of inventions and subcontracts

Intellectual Property Reports	Participants must promptly notify the MxD Project Engineer apprised of Project IP created, filing status, claims against the Project IP, and BIP licensed to other Members.
Safety Accident/Incident Report	Participants must report any major accident/incident (including fire) resulting in any one or more of the following situations: one or more fatalities or one or more disabling injuries; damage of Government property exceeding $10,000; impact to Project planning or production schedules or degradation of the safety of equipment under contract. Such report will also identify potential hazards requiring corrective action.
Draft Final Technical Report	Draft report must include a comprehensive, cumulative, and substantive summary of all technical advancements and significant accomplishments achieved during the project.
Final Technical Report	See above
Project Team Lead Release	Release by Project Team Lead confirming scope of work to be complete
Property Report	List of all MxD funded equipment and planned disposition
Final Patent Report	Report of inventions and subcontracts

Travel Requirements

Proposals should include funding for six (6) trips per year for two (2) people for each Offeror organization. These trips will be used for face to face meetings and presenting to the MxD membership. These trips may be for travel to MxD or to another location at the request of MxD (e.g., a conference, workshop, showcase, etc.). For estimation purposes, use Chicago, IL as the destination. Proposals may include additional funding for travel to pilot site for implementation and testing with proper justification.

Period of Performance Requirements

Proposed projects should be no more than twelve months in duration. Please note that projects are initiated once an Enterprise Award Agreement is signed, therefore, the project duration must include the subcontracting of all project participants between the Lead Organization and the Project Participants.

Funding Requirements

MxD anticipates awarding one or more projects for $500,000 - $700,000, not inclusive of expected cost share, under the MxD-20-02 RFP. Final award amounts will be adjusted accordingly based on Proposals received and subsequent evaluations. The most competitive proposals will offer a positive expected benefit-cost ratio relative the proposed cost and period of performance. This project requires a minimum 1-to-1 Cost Share in aggregate by each Offeror team.

VII. ELIGIBILITY

MxD Membership

All organizations selected to participate on projects must be MxD Members, in accordance with the MxD Membership Agreement, prior to project award. This RFP is open to the public; any organizations regardless of membership status may submit a Technical Proposal and Cost Proposal in response to an RFP. MxD, in its sole discretion, may make the Membership Agreement effective upon project selection and require payment of the membership dues. The Membership Agreement must be fully executed with every participant within 30 days of project selection. Any non-members Offerors are encouraged to review the Membership Agreement prior to submission and to direct questions to the MxD Director of Business Development, Tony Papke (tony.papke@mxdusa.org). For more information on how to become a MxD Member, please visit the MxD Membership page on our website.

Federally Funded Research and Development Centers (FFRDCs) and Government entities (Government/National laboratories, military educational institutions, etc.) are subject to applicable direct competition limitations and cannot propose to RFPs in any capacity unless they address the following conditions:

- FFRDCs or Government entities may not exclusively team on any specific project team.
- FFRDCs must clearly demonstrate that the proposed work is not otherwise available from the private sector and must also provide a letter on letterhead from their sponsoring organization citing the specific authority establishing their eligibility to compete with industry and propose to solicitations utilizing Government funding.
- Government entities must clearly demonstrate that the work is not otherwise available from the private sector and provide written documentation citing the specific statutory authority, as well as, where relevant, contractual authority, establishing their ability to propose to solicitations utilizing government funding.

Government agencies interested in participating in MxD RFPs as part of an Offeror team should notify MxD in advance of Proposal submission. For RFPs utilizing Government funding, special agreements and considerations may need to be implemented to enable participation.

Notification of Participation by Foreign Firms & Non-U.S. Citizens

As required by the Technology Investment Agreement, membership in MxD shall be granted only to U.S. companies, firms, organizations, institutions or other entities organized or existing under the laws of the United States, its territories, or possessions (as defined in Section 120.15 of International Traffic in Arms Regulations, 22 CFR § 120 et. seq. ("ITAR")). All proposed project participation by Non-U.S. Citizens must be disclosed to MxD at least 60 days prior to proposed participation for approval.

Membership & project participation (or participation in projects without membership status) will be granted to any agency or instrumentality of a foreign government; companies, firms, organizations, institutions, or other entities not organized or existing under the laws of the United States (as defined in Section 120.16 of the ITAR); and Non-U.S. Citizens on a case-by-case basis at the sole discretion of the Executive Committee upon approval of the U.S. Government. In such event, all Members will be notified immediately of the foreign entity's role. No project work performed outside the United States is permitted.

If a Member is a Corporation with subsidiaries or affiliates, its membership will include its wholly-owned and controlled and majority-owned and controlled U.S. subsidiaries and affiliates who qualify as a U.S. person under Section 120.15 of the ITAR.

VIII. TECHNICAL & COST PROPOSAL EVALUATION

EVALUATION PROCESS

An MxD Evaluation Board (EB) will review and evaluate each submitted Technical Proposal utilizing the evaluation criteria specified in the following section. Cost Proposals will not be provided to the Evaluation Board for the purposes of evaluation. Cost Proposals will be utilized by MxD and the Government during the cost analysis and project approval process.

The EB may consist of recognized experts from industry and academia and key government stakeholder representatives (when appropriate). MxD representatives, such as the Director of R&D Projects, and respective Project Engineers, may participate in and lead EB meetings. All members of the EB will need to meet strict standards of personal and organizational conflict of interest. The evaluators may be supported by subject matter experts to review and comment upon the proposed work.

Through its deliberations, the EB will determine “selectability” of each submission. Selectability determination incorporates average EB score, judgement of market impact, and budget availability. The EB will identify a list of all proposed Technical Proposals that are “selectable for negotiation” leading to a subagreement award, along with their associated evaluation scores, to the Project Engineer. The Director of R&D Projects, with the consultation of other MxD representatives, will determine which subset of the proposed Technical Proposals deemed “selectable for negotiation” will be down selected for negotiations. This determination will take into account the EB’s recommendation, funding availability, alignment with MxD SIP as well as external stakeholder requirements (when applicable). MxD reserves the right to fund all, some or none of the Technical Proposals received under issued RFPs.

If down selected, MxD will complete a comprehensive cost analysis (including cost reasonableness and cost realism) prior to award. In addition, the Government Agreements office may conduct a cost analysis of all submitted Cost Proposals to approve the Cost Proposals. Approval of the Cost Proposal and Technical Proposal by the Government Agreements office and the DoD Program Manager is required for all MxD projects.

Cost share is required for all MxD projects that are executed through the MxD. Cost sharing or matching relates to the portion of project or program costs supported by the Offeror and not by MxD.

Neither MxD nor the U.S. Government has any responsibility for costs associated with Technical Proposal or Cost Proposal development, submissions, or pre-award negotiations.

EVALUATION CRITERIA

MxD’s primary goal is to apply digital manufacturing technologies to solve business problems. To this end, successful proposers must demonstrate an understanding of both the business needs as well as the technology solutions. Proposals should provide a clear explanation of how the solutions address business problems and technical requirements outlined in the RFP, any assumptions, and considerations for deployment of developed solution through a pilot.

Each Proposal is evaluated by a specific set of criteria. Below are the Proposal Evaluation criteria for this RFP:

Proposal Evaluation Criteria	Order of Importance
Requirements Compliance *Clearly articulates how the team will meet all the capabilities required by the RFP; Proposed solution clearly addresses problem statement and use cases identified in RFP; Clear identification of assumptions, risks, and mitigations; proposed deliverables align with requirements; program management plan meets requirements in the RFP and is reasonable for the scope of work described in the technical proposal.*	1
Methodology *Clear and concise work effort scope targeted at problem statement; Proposed effort of direct relevance to RFP; Clear identification of barriers to implementation and explanation of how they will be overcome; Innovative methodology with high - potential for market impact; Significant and impactful use of external resources; Methodology demonstrates scientific and technical merit; SMART metrics and KPIs identified and described and demonstrate clear understanding of proposed work; Provides a maturity level assessment of both current and future state of technology with substantiation of assessed levels; Deliverables are fully described and identified.*	2
Transition Plan *Transition plan clearly articulates all project results and application into commercial and/or government products, systems and applications; Plan includes detailed descriptions of project results, risks/assumptions/mitigations, all required actions and timing, detailed funding and ROI strategy, key milestones, schedule and go/no-go decision points; Proposed team includes appropriate representation from supply chain, researchers and industrial partners; Transition tasks and partners identified and thoroughly defined, both to MxD members and the broader industry; Solution and strategy to rapidly enable the adoption of the new technologies across the US manufacturing base is presented; Clearly defined IP ownership and innovative licensing strategies designed for rapid adoption of the new technologies; Discussion of future transition and/or commercialization demonstrates a clear understanding of the industry and possible markets for the technology; benefits of technology are clearly defined and substantiated.*	3
Team Qualifications *Members of proposed team are highly qualified to accomplish project tasks with clear delineation of roles and responsibilities; Solid evidence of commitment by team members, such as letters of commitment from their companies; Team members have unique capabilities that are directly associated with the target technology; Team includes a broad mix of capabilities and experiences to ensure success along with the commitment of top-tier facilities to accomplish all project*	4
Cost Factors *Proposed cost estimates are reasonable and realistic for the proposed work effort; The minimum cost share proscribed in the RFP has been met or exceeded; Cost share is clearly defined and directly applicable to the performance and success of the project; Cost share value is readily discernable. Cost share from partners is documented with letters of commitment.*	5

IX. PROJECT AWARDS

CONTRACT

MxD projects will be funded under the MxD Tech Investment Agreement W15QKN-19-3-0003 between MxD and the Government. All contractual negotiations related to RFPs will be executed by MxD. Funds will be distributed to those offerors selected through the evaluation/selection process utilizing Enterprise Award Agreements (EAAs). EAAs are Cost Reimbursement/Cost Share agreements.

MxD has provided an EAA template within the PPK for Offerors to **review** prior to proposal submission. **The EAA should not be submitted with the proposal.** After receiving a notification of down selection, MxD will request all down selected project participants to officially begin contract review and negotiations. Once the EAA is executed the project team can begin working on the project. When applicable, it is the sole responsibility of Offeror organizations to issue sub-awards to any subcontractors and to ensure team members are abiding by the terms and conditions within the EAA.

FINAL TECHNICAL PROPOSAL & COST PROPOSAL REVISIONS

MxD reserves the right to negotiate the cost and scope of the proposed work with the project participants that have been down selected prior to award. MxD will facilitate the creation of a Statement of Work with all participants including technical scope modifications and program management aspects. All down selected organizations who intend to pursue selection are required to participate in the proposal revision process prior to award. For example, MxD may request that the organizations revise the technical scope to better align to RFP requirements. Neither MxD nor the U.S. Government has any responsibility for costs associated with pre-award negotiations.