The Digital Manufacturing Institute

MxD
REQUEST FOR QUOTATION

AI-Enabled Process Tracking and Digital Twin Optimization for Advanced Energetics Manufacturing

26-12

Revision 1.0 Release Date: August 31, 2026

Contact: Joe Nichols
Sr. Project Engineer
joe.nichols@mxdusa.org

MxD
1415 North Cherry Ave
Chicago, IL 60642

TABLE OF CONTENTS

I. Record of Change 3
II. Timeline project overview 3
III. Introduction 3
IV. Technical Summary 6
Problem Statement 6
Overview and Objectives 6
Requirements 7
Base Scope, Options, and Pricing Approach 7
Phase 1 — End-to-End Process Quantification and Gap Assessment 7
Phase 2 — Targeted Sensing and Secure Data Architecture 8
Phase 3 — Predictive Digital Twin Expansion 8
Phase 4 — Reinforcement Learning Integration 8
Validation 9
Cybersecurity and Compliance 9
Deployment, Transition, and Sustainment 10
Deliverables 10
Out of scope 10
V. Program Requirements 12
Quotation 12
Period of Performance Requirements 12
Travel and Facility Access 12
Ownership of Deliverables 12
Funding Requirements 12
VI. Eligibility 13
MxD Membership & Standard Project Agreement 13
Notification of Participation Non-U.S. Citizens 13
VII. Quotation Evaluation 14
Evaluation Process 14
Evaluation Criteria 14
VIII. Submission Details 15
IX. Next Steps 15
Notification 15
Final Revisions 15
Contract 15

I. RECORD OF CHANGE

Revision	Date	Sections	Description
1.0	August 31, 2026	N/A	Original

II. TIMELINE PROJECT OVERVIEW

Deadline for submissions to be received	September 23, 2026 | 5 PM CT
Follow up clarification meetings as needed	Throughout the submission phase
Feedback to participants	October 9, 2026
Period of Performance	12 months
Anticipated MxD Funding	N/A. The respondent to this RFQ must have a detailed, itemized breakdown of all mandatory and optional items quoted.
Minimum Cost Share Contribution	Cost share is not required; However, cost share is encouraged to support the Institute's mission and quotations with proposed cost share will be viewed favorably.

III. INTRODUCTION

MxD: The Digital Manufacturing Institute strengthens U.S. economic prosperity and national security by driving digital adoption in manufacturing. In partnership with the Department of Defense, MxD (also referred to as the Institute) equips U.S. factories with the digital tools and expertise required for modernization. MxD's core mission is to strengthen U.S. manufacturing global competitiveness to advance economic prosperity and national security by accelerating digital adoption, securing supply chains, and empowering the workforce.

MxD has invested over $400 million in more than 200 applied research and development projects in areas including design, product development, systems engineering, factory modernization, agile and resilient supply chains, workforce training, and cybersecurity.

MxD is also the DoD's National Center for Cybersecurity in Manufacturing. All MxD projects must take cybersecurity into consideration.

This RFQ is publicly available on the MxD website at https://www.mxdusa.org/solicitation-opportunities/. This public posting represents the official notification of a request to submit the required documents. Amendments to an MxD RFQ may be used to extend due dates, clarify procedural requirements, or modify technical requirements. If an updated RFQ is issued, the previous RFQ will be rescinded. Those interested in responding to this RFQ should carefully monitor the MxD website after an original posting, up to the time of the quotation 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 Respondents to monitor the MxD RFQ updates and ensure that their quotation meets the solicitation requirements.

The Respondent to an RFQ is the non-Federal organization that submits a quotation in response to the RFQ. Submission to this RFQ is not a commitment for further business by either MxD or the DoD.

All responses to this RFQ are kept strictly confidential and are shared only with DoD authorized personnel in accordance with contractual requirements.

Due to the expedited nature of this RFQ schedule, Respondents are encouraged to meet with MxD project members and ask any questions for clarification purposes. Note that the responses to questions may be made public to all Respondents.

Direct all questions to both:

Joe Nichols
Sr. Project Engineer
joe.nichols@mxdusa.org

Rodrigo Perez
Sr. Systems Integration Engineer
rodrigo.perez@mxdusa.org

mxdusa.org
@mxdinnovates
info@mxdusa.org

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

TECHNICAL SUMMARY

mxdusa.org
@mxdinnovates
info@mxdusa.org

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

IV. TECHNICAL SUMMARY

PROBLEM STATEMENT

Energetics manufacturing operates as a high-variability batch process in which material state evolves continuously through mixing, heating, curing, and transfer. Variability in raw material lots, environmental conditions, equipment calibration, and operator intervention compounds across the entire batch rather than a single unit, so small early deviations escalate into scrap, rework, downtime, and safety exposure later. Monitoring is fragmented, and deviations are detected late, after material, energy, and time have been consumed.

A sensor-enabled descriptive digital twin of the batch melt-pour process, deployed on the facility's existing infrastructure, provides real-time visibility into process state. Visibility alone, however, does not prevent defects. The remaining barrier is the absence of a predictive, closed-loop capability that can anticipate variation and correct it before it propagates. This barrier is not unique to one facility; similar legacy environments across the energetics industrial base face the same gap, with no established pathway for modernizing them.

OVERVIEW AND OBJECTIVES

MxD, on behalf of a government research and development facility in the Northeast, seeks an industry partner to establish a repeatable framework for modernizing legacy, isolated energetics manufacturing environments. The facility operates, in a secure isolated on-premise environment, a descriptive digital twin supported by an on-premise sensor network and data historian. This effort builds on that foundation, advancing it from descriptive visibility into a predictive, reinforcement-learning-enabled capability for closed-loop optimization. The resulting framework is intended to support replication across additional energetics processes and facilities.

The objectives of this effort are to:

- Establish and deliver a repeatable implementation and transition framework for modernizing isolated energetics environments, supporting replication across additional processes and facilities.
- Extend the existing descriptive digital twin into a physics-informed, data-driven predictive twin that represents process state over time and correlates multi-source variation.
- Develop and train a reinforcement learning model that monitors batch state, recommends parameter adjustments, and adapts policy from historical performance to drive repeatable "Golden Batch" outcomes.
- Deliver a quantified definition of the target Golden Batch, including key process parameters, quality metrics, and measurement methods.
- Validate model performance against historical and available real batch data, supplemented by offline simulation, with defined evaluation metrics.
- Provide human-in-the-loop decision support in which the model recommends and the operator retains decision authority.

Base scope and options. The base scope builds on the existing infrastructure to deliver the objectives above. Respondents may also propose separately priced options, including enhanced three-dimensional and physics-based visualization, as further described in the Requirements section.

REQUIREMENTS

Existing environment. A descriptive digital twin of a batch melt-pour process is deployed in a secure, isolated on-premise environment, supported by an on-premise sensor network and data historian. The existing system ingests real-time and manually recorded process data, synchronizes multi-rate data streams, and visualizes process state for operators. Integration is available through standard industrial automation protocols, and historized process data is retained in an on-premise time-series data store from which the digital twin reads. Respondents should assume they will interoperate with, and build upon, this existing descriptive twin, sensor data, and historized process data, and should identify any additional data, sensing, or interfaces required to support reinforcement learning. The specific network architecture, and the boundary between development and production environments, will be confirmed with the Government and provided to the selected Respondent.

Base Scope, Options, and Pricing Approach

The base scope builds upon the existing infrastructure described above, extending it into a predictive, reinforcement-learning-enabled capability. Respondents shall address the following:

- Base Scope: Respondents shall price the base scope on a build-upon-existing approach and shall state all cost assumptions.
- Compute: Respondents assume they are responsible for providing their own development and training compute, including any GPU resources required for model training. Any Government-furnished compute resources that may be available will be shared with the selected Respondent.
- Alternative Platform (optional): A respondent proposing an alternative digital twin platform shall price it separately, describe the added scope and cost, and justify delivery within the period of performance.
- Enhanced Visualization (optional): A respondent proposing enhanced three-dimensional or physics-based visualization and simulation shall price it separately as an option layered on the base scope.

Phase 1 — End-to-End Process Quantification and Gap Assessment

- The Respondent shall enhance the existing end-to-end batch process map from incoming energetic materials to finished product, using melt-pour as the representative process.
- The Respondent shall quantify variability across the process, material, environmental, equipment, and people domains, including lag factors such as cure time, transport delay, and staging queues.
- The Respondent shall assess the existing infrastructure, hardware, and software, and shall identify the data, sensing technology, and interface gaps that must be closed to support predictive optimization and reinforcement learning model training.
- The Respondent shall catalog the existing control and automation stack, including PLCs and historian, and available edge compute, storage, and networking.
- The Respondent shall confirm the existing systems can sustain both high-throughput and low-latency data synchronization for the digital twin and sustained GPU for RL training, with attention to OT/IT segmentation protocols and closed-latency, informing the compute assumption above.

- The Respondent shall verify data availability and the fidelity and structure required for RL state observability, including sampling rates, timestamps, quality, and historization sufficient to enable digital twin calibration and offline or off-policy training.
- The Respondent shall map measured quantities against what the digital twin and reward function require, identifying insufficient resolution, drifting or uncalibrated instruments, and any missing reward signals.
- The Respondent shall treat any new instrumentation or sensors identified in this phase as an explicit Phase 1 dependency.

Phase 2 — Targeted Sensing and Secure Data Architecture

- The Respondent shall specify and, where required, integrate additional targeted sensing identified as gaps in Phase 1, for example slurry or melt state, thermal gradients, equipment performance, environmental parameters, and material traceability.
- The Respondent shall integrate data into a secure, structured architecture that supports synchronized ingestion across varying data rates and types, interoperating with the existing historian.

Phase 3 — Predictive Digital Twin Expansion

- The Respondent shall extend the existing descriptive twin into a physics-informed and data-driven predictive twin that represents process state over time, correlates multi-source variation, models delay impacts, and generates structured datasets suitable for AI training.
- The Respondent shall model the relevant process dynamics, constraints, and disturbances at a fidelity sufficient to support policy learning, such that the twin serves as a validated training and evaluation environment for reinforcement learning.
- The Respondent shall define the twin calibration methodology and the accuracy acceptance criteria against which the expanded twin will be evaluated.
- The Respondent shall document the digital twin's modeling approach and validation methodology, demonstrating fidelity against real process data.

Phase 4 — Reinforcement Learning Integration

- The Respondent shall provide a formal definition of the reinforcement learning problem, including the state space, action space, a KPI-driven reward function, and constraints.
- The Respondent shall propose and justify the policy optimization approach, specifying the RL algorithm and architecture selected and the training strategy, including use of the digital twin as the training environment.
- The Respondent shall develop and train an RL model that monitors batch state, recommends parameter adjustments, and adapts policy based on historical performance to drive Golden Batch outcomes.
- The Respondent shall implement a safety layer with defined constraints and boundary conditions on recommended actions, including safeguards to prevent unsafe exploration, and shall provide human-in-the-loop override.
- The Respondent shall document data requirements, training and validation data partitioning, and the approach to simulation-to-real-world transfer and the reality gap.

Validation

- The Respondent shall validate the model through offline validation against historical data, comparison in simulation, and performance benchmarking against defined evaluation metrics.
- The Respondent shall define the metrics and acceptance thresholds used to evaluate both the digital twin and the trained policy.
- The Respondent shall account for the facility's limited batch-run cadence in the validation plan, and shall validate against real batch data where production runs are available during the period of performance.

Cybersecurity and Compliance

Because this effort introduces substantial new software and AI models into a Government environment, cybersecurity is a firm requirement.

- The Respondent shall comply with the security requirements outlined in NIST SP 800-53 and NIST SP 800-82.
- The Respondent shall prioritize preapproved hardware and software components where possible. Security Technical Implementation Guides (STIGs) for the implementation and configuration of preapproved components are available at the STIGs Document Library, DoD Cyber Exchange. If no STIG exists for a particular component, consult the STIGs Frequently Asked Questions, DoD Cyber Exchange. Allowed networking protocols and ports for both enterprise and industrial networks are published at Enterprise Connections PPSM, DoD Cyber Exchange.
- The Respondent shall ensure all delivered software, models, and integration code support secure, isolated, on-premise operation with no external dependencies or outbound network connections, consistent with the Government's confirmed environment architecture.
- The Respondent shall disclose the provenance of all AI and machine learning models, frameworks, and pre-trained components proposed for use, including country of origin and development, and shall identify any component developed or maintained outside the United States.
- The Respondent shall describe where all project data, including training, validation, and model artifacts, will be stored and processed, and shall confirm that no project data will be transmitted to or processed by external or cloud-hosted services.
- The Respondent shall be prepared to handle Controlled Unclassified Information (CUI) in accordance with applicable Government requirements, including NIST SP 800-171. This effort involves access to CUI. Specific CUI handling requirements will be established with the selected Respondent.

Deployment, Transition, and Sustainment

- The Respondent shall deliver a staged implementation and transition framework that moves from current operations to RL-enabled control, with de-risking at each step.
- The Respondent shall provide the pipeline and architecture to package, version, validate, and promote trained policies and the digital twin from development into production.
- The Respondent shall include continuous monitoring for model drift, digital twin divergence, data quality degradation, and out-of-spec conditions, with defined triggers for retraining, fallback, or human review.
- The Respondent shall address integration with existing OT systems and workflows, and stakeholder alignment across operations, engineering, and IT/OT.

Deliverables

The Respondent shall submit the following:

- Technical Data Package and supporting technical documentation.
- Enhanced process map with quantified variability, and requirements and design documentation.
- Secure data integration strategy and technical architecture.
- Optimized predictive digital twin, with documented modeling approach and validation methodology.
- Documented RL model definition and design specifications.
- Defined set of evaluation metrics with acceptance thresholds and validation methodology.
- Quantified Golden Batch definition.
- Implementation and transition plan with staged rollout gates and rollback criteria.
- Deployment and monitoring architecture.
- Operator and human-in-the-loop decision-support and training materials.

Out of scope

Live closed-loop control of production, and connection of the AI system to live production control equipment, are out of scope. The system recommends parameter adjustments; the operator retains decision authority.

mxdusa.org
@mxdinnovates
info@mxdusa.org

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

PROGRAM OVERVIEW

V. PROGRAM REQUIREMENTS

QUOTATION

While the format of the quotation is flexible, it must clearly include requirements compliance, respondent qualifications, and cost factors. Reference section VII Quotation Evaluation for more information.

Neither MxD nor the U.S. Government has any responsibility for costs associated with development, submissions, or pre-award negotiations for this quotation and subsequent contract.

PERIOD OF PERFORMANCE REQUIREMENTS

Estimated period of performance is 12 Months from contract award. Respondents may propose a shorter period of performance with justification; however, it may not exceed 12 months.

TRAVEL AND FACILITY ACCESS

All travel requirements and associated costs needed for execution of the objectives and deliverables must be included in the quotation. Travel will be required to secure U.S. Army facilities. Access to the facilities will require U.S. citizenship and a security background check.

For quotation purposes, Respondents shall assume a minimum of two personnel per site visit and two site visits per month for the duration of the period of performance. Respondents may propose a different travel profile where justified by their proposed approach.

OWNERSHIP OF DELIVERABLES AND INTELLECTUAL PROPERTY

The contract will be structured as a work-for-hire agreement. The solution is expected to combine commercially available components with development performed under this award. Intellectual property developed under this award, if any, will be the property of MxD and the DoD. Any existing, background intellectual property (IP) remains the property of the IP owner.

FUNDING REQUIREMENTS

MxD anticipates awarding a **cost reimbursable award** resulting from this RFQ. MxD reserves the right to fund all, some, or none of the quotations received under issued RFQs. Final award amounts will be determined accordingly based on quotations received, subsequent evaluations, and final agreement between MxD and the Awardee.

Cost share is not required for this contract. However, cost share is encouraged to support the Institute's mission.

MxD recognizes the difficulty in completing a final, fixed-price quotation without additional information or site visits for certain projects. Therefore, **clearly document and explain all assumptions used to generate the quotation**.

If down selected, the Respondent will have the opportunity to gather additional details and revise the quotation. The Respondent must then submit substantiating documentation for costs (including any cost share). MxD will complete a comprehensive cost analysis (including cost reasonableness and cost realism) prior to contract award.

Neither MxD nor the U.S. Government has any responsibility for costs associated with development, submissions, or pre-award negotiations for this quotation and subsequent contract.

VI. ELIGIBILITY

MxD Membership & Standard Project Agreement

This RFQ is open to the public; any organizations regardless of membership status may submit a quotation in response to this RFQ. However, this project will require MxD membership, the MxD Membership Agreement and Standard Project Agreement (SPA) must be fully executed with the Respondent within 30 days of notification of project downselect; acknowledgment of this is required in the Quotation submission. Additionally, any organizations that are already members of MxD must ensure they are a member in good standing within 30 days of notification of project downselection.

Any non-MxD members are strongly encouraged to conduct a legal pre-review of the Membership Agreement and Standard Project Agreement (SPA) before submission, as this is a common source of delay during negotiations with proposal teams chosen during downselection. For information on MxD membership, including pricing and benefits, please contact MxD's Manager of Business Development, Chad Crump (chad.crump@mxdusa.org). For more information on becoming 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. They cannot propose to Project Calls in any capacity unless they address the following conditions:

- FFRDCs or Government entities may not exclusively team on any specific proposal team.
- FFRDCs must 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 and, where relevant, contractual authority, establishing their ability to propose to solicitations utilizing government funding.

Government agencies interested in participating in MxD RFQs as a respondent or subcontractor should notify MxD in advance of the RFQ submission. For RFQs utilizing federal funding, special agreements and considerations may need to be implemented to enable participation.

Notification of Participation Non-U.S. Citizens

The Project Award 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")).

It is a requirement that work related to the Award must be completed in the U.S. by people legally authorized to work in the U.S. All proposed participation by non-U.S. Citizens must be disclosed to MxD on Attachment 1 Non-U.S. Citizens at least 60 days prior to proposed

participation. Written approval of non-U.S. Citizens must be received by the Awardee from MxD prior to commencing work.

VII. QUOTATION EVALUATION

Evaluation Process

An MxD Evaluation Board (EB) will review and evaluate each submitted quotation. 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, the Director of Engineering, and technical subject matter experts may participate in and lead EB meetings.

All members of the EB must agree to a statement of personal and organizational conflict of interest and must agree to a non-disclosure, if not already covered by an MxD NDA.

Through its deliberations, the EB will determine "selectability" of each quotation. Selectability determination is based on quotation evaluation criteria below. Through this process, the quotations are down selected.

Evaluation Criteria

Each quotation is evaluated by a specific set of criteria. Below are the quotation evaluation criteria for this RFQ:

Quotation Evaluation Criteria
Requirements Compliance • *Quoted solution clearly addresses all objectives and tasks identified in RFQ* • *Clear identification of assumptions, risks, and mitigations* • *Complete and clear itemization of all requirements* • *Program management plan meets requirements in the RFQ*
Respondent Qualifications • *Respondent and any proposed subcontractors are highly qualified to accomplish objectives with clear delineation of roles and responsibilities* • *Respondent and any subcontractors have unique capabilities that are directly associated with the target technology and tasks* • *Respondent has the ability to travel to U.S. Army facilities, where access to the facilities will require U.S. citizenship and a security background check.*
Cost Factors • *Quoted costs are reasonable and realistic for the proposed work effort* • *Quoted costs are competitive relative to other commercial offerings* • *Value is maximized through inclusion of optional cost share and objectives*

VIII. SUBMISSION DETAILS

Each Respondent must submit their quotation (including Attachment 1) no later than 5:00PM Central Time, September 23, 2026. All submissions must be submitted electronically to MxD's submission form, LINK HERE. **Please complete the form and hit SUBMIT in order to fully submit your proposal/quote.**

Notice of Intent to Submit: If you plan to respond to this RFQ, please notify the Project Contact via email by 9/10/2026. This expression of interest helps the project team effectively manage the evaluation timeline.

IX. NEXT STEPS

NOTIFICATION

MxD will notify all Respondents of that status for their quotation by October, 2, 2026. This notification will include decision of the EB. If the quotation has been accepted for award, instructions for next steps will be reviewed with the selected Respondent.

FINAL REVISIONS

MxD reserves the right to negotiate the cost and scope of the proposed work with a Respondent that has been down selected prior to award. The selected Respondent(s) and subcontractors, if any, who intend to pursue selection may be required to participate in the revision process prior to award.

CONTRACT

Final contract vehicle and contract terms will be negotiated at the time of contracting. Down selection of a quotation does not constitute agreement to quoted terms by either MxD or the DoD.

mxdusa.org
@mxdinnovates
info@uilabs.org

1415 N. Cherry Avenue
Chicago, IL 60642
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Attachment 1

Certification of Non-U.S. Citizens

___ There is NO participation by Non-U.S. Citizens proposed for this effort.

___ The following Non-U.S. Citizen is participating in this effort.

Non-U.S. Citizen Name, Contact Info	Country of Citizenship	Primary Employment Location	Employer	US Work Authorization (Visa, Green Card, Etc)	Justification*

*The Justification section should clearly outline the rationale behind the individual's request for participation, the type of data they will have access to, and other pertinent information regarding their skill set/expertise.