



The Digital Manufacturing Institute

MxD REQUEST FOR SOLUTION TECHNICAL SUMMARY, PROGRAM OVERVIEW and PREPARATION INFORMATION

MxD-21-07: Secure Wireless for Factory Operations

Revision 1.0 Release Date: June 10, 2021

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I. RECORD OF CHANGE

| Revision | Date | Sections | Description |
|----------|---------------|----------|-------------|
| 1.0 | 10 June, 2021 | N/A | Original |

II. PROJECT OVERVIEW

| | |
|--|-----------------|
| RFS Released | 10 June, 2021 |
| Deadline to be included in Initial Teaming List (Optional) | 25 June, 2021 |
| Pitch Session (Optional) | 29 June, 2021 |
| Technical and Cost Proposal Due | 12 August, 2021 |
| Anticipated MxD Funding | \$350,000 |
| Period of Performance | 9 Months |

III. INTRODUCTION

MxD: The Digital Manufacturing Institute 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. MxD's core mission is to transform American manufacturing, by fully integrating the digital thread across the manufacturing enterprise to reduce overall manufacturing costs, stabilize and grow the manufacturing industrial base and improve US competitiveness through the world.

MxD has invested over \$115 million in more than 80 applied research and development projects in areas including design, product development, systems engineering, future factories, agile and resilient supply chains, and cybersecurity.

MxD operates from a nearly 75,000-square-foot innovation center near downtown Chicago. Its future 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 uses broad and collaborative processes to develop the Strategic Investment Plan (SIP) and Technology Roadmap to ensure its technology, outreach, and education investments provide U.S. manufacturing with the right skills, solutions, and tools to compete globally. A Request for Proposal (RFP) or a Request for Solution (RFS) is initiated when MxD desires new and creative solutions to problems and/or advances in knowledge, understanding and technology for digital manufacturing and design. These projects are jointly designed and implemented on MxD's factory floor to demonstrate specific digital manufacturing concepts. Once the RFS topic is developed and approved, the MxD RFS will be posted to the MxD website and represents the official notification to Proposal Teams of a request to submit the required documents.

The difference between the Request for Proposal (RFP), which has been the standard method used by MxD for soliciting proposals for specific problems, and a Request for Solution (RFS) is

that the solution objectives are focused on MxD's Factory Floor and / or are to be available for use in workshops, roadshows, or other venues for people to experience a demonstration and/or interact with solution(s). The RFS is not required to include research type elements unless they can be quickly transitioned to practical uses for the MxD Factory Floor or for education applications that are easy to use, understand, and implement.

Another key difference is that in the past, the MxD Engineering Team has developed and implemented unique and independent MxD demonstration / testbeds. These include the Discrete Cell, the Assembly Line, the Cyber Process Platform, and the Cyber Box. Meanwhile, MxD members develop and install their own demonstrations in their allocated factory floor spaces. An RFS is intended to bring MxD Engineering and members together in a joint effort to develop solutions that are demonstrated and available on the MxD Factory Floor. MxD personnel will be participating team members on the RFS Team. An RFS project will still be managed by MxD and follow standard MxD Program Management requirements.

This RFS contains the following elements:

1. Technical Summary: description of a specific technology objective
2. Program Overview: description of technical and program requirements
3. Solution Proposal Preparation Information: background and guidance for the preparation of required forms and instructions needed to submit a solution to MxD

The RFS is available on the MxD website at <https://mxdusa.org/projects/>. Amendments to a MxD RFS may be used to extend due dates, clarify procedural requirements, or modify technical requirements. If an updated RFS is issued, the previous RFS will be rescinded. Solution Teams should carefully monitor the MxD website after an original posting of an RFS, up to the time of the Technical Solution 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 Solution Team to monitor the MxD RFS updates and ensure their solution meets the solicitation requirements. MxD welcomes any comments or suggestions for improving the contents of this guide. Please address them to projects@mxdusa.org.

MxD refers to the Solution Team Lead as the non-Federal organization that submits a solution in response to a Request for Solutions. Solution Team members are other participants on the solution and are further broken down into Recipient/Subrecipient relationships, similar to a prime/subcontractor relationship in traditional contracting.

Any questions regarding this solicitation must be provided to projects@mxdusa.org. The questions will be sent to the appropriate MxD 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.



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TECHNICAL SUMMARY



IV. TECHNICAL SUMMARY

PROBLEM STATEMENT

Digital manufacturing involves many benefits that result from the use of data that include connecting factory floor sensors and other data sources to data centers or similar gathering points that can then collect, aggregate, and make the data useful for identifying trends and opportunities to improve the operation and even controlling and connecting the operation that the data is sourced from.

Traditionally, these data streams or points of data have been sent securely and with high integrity via hardwire in the factory environment. As the digital transformation advances, the use of sensors and other sources of data will be relied upon at an increasing rate. The cost and physical space to physically connect this equipment cannot be economically and efficiently done with hardwire. A wireless solution that allows flexibility, mobility and lower installation complexity and associated cost is a required substitute.

In response to this need, **PP-064: SECURE WIRELESS FOR FACTORY OPERATIONS** (page 25 of MxD's 2021 Strategic Investment Plan <https://www.mxdusa.org/sip2021/>) was identified, now **Project 21-07**, is as follows:

"Manufacturers are looking to adopt emerging wireless technologies into their facilities to benefit from communication protocols such as 5G cellular, Wi-Fi 6, Ultrawideband (UWB), and other protocols. This project will seek to provide manufacturers with information about the strengths and weaknesses of each protocol including cybersecurity related issues. Tools along with "best practices" will be identified to minimize or mitigate any risks. A testbed will be developed and installed at the MxD future factory to help visitors understand the strengths and weaknesses of the different protocols. This testbed, once completed, will be made available to members to allow testing of their hardware and software solutions."

The first part of the project (Section A) is to list all current and evolving wireless technologies, identify key attributes and requirements needed for comparison, and then provide a summary that includes strengths and weaknesses. Also required is a tool that will allow users to quickly assess the various wireless technology choices that would work best for their specific use case or application.

The second part of the project (Section B) is to develop a testbed for the MxD Factory Floor. In order to realize this aspiration, the MxD Cyber Wireless Testbed will be developed and provide practical examples of how to implement and use wireless methods to transport data. Advantages and tradeoffs with data security, integrity, speed, bandwidth, and latency with the different technologies must be highlighted and demonstrated on the testbed when practical.

Since the variation in requirements and applications for manufacturers is immeasurable, a method for members to test their own specific applications (hardware and software) is required. This will ensure that the MxD Secure Wireless testbed is truly a 'testbed' that can be used by members for their specific use case and / or equipment.



The risk of using wireless for manufacturers (or any other organization, operation, or person) is the security of the transmitted data. Intrusions or intentional modifications to the data is a major concern when using wireless transmissions. Addressing these concerns while providing best practices to eliminate or lower the risk must be included in the overview, tool and the testbed design and implementation.

Converting from a standard, reliable hardwire to a wireless method also raises concerns of data integrity when using a wireless method. The impact on data integrity must also be included in the overview, tool and the testbed design and implementation. In addition, a repeatable, reliable, and quantifiable comparison that can be used to compare different use cases and wireless technologies should be included in the solution.

In summary, MxD is funding an RFS that includes an overview, a selection tool, and a working MxD Factory Floor testbed solution for describing and demonstrating Secure Wireless for Factory Operations. The MxD Cyber Wireless Testbed objectives include:

- Explain and demystify the concepts of wireless connectivity on a factory floor while maintaining data security and integrity
- Wireless choices explained along with advantages and disadvantages of each
- A method with instructions for members to test their hardware and software solutions (reinforcing the 'testbed' concept)
- Ability to assess wireless security
- Ability to measure data integrity
- Provide the ability for project participants to include and demonstrate their technology or solutions on the MxD Factory Floor without having to have their own specific factory floor space

The purpose of this Request for Solution (RFS) is to solicit bids for "Secure Wireless for Factory Operations" that is broken into the following two sections:

Section A – Knowledge and Selection Tool

1. An overview of wireless choices that highlights best practices for use and application while also focusing on risk assessment. Decision factors should include design, cost, resources, training, maintenance, facility requirements, network implications, design, and other factors. Performance factors such as speed, bandwidth, data integrity and security should also be included.
2. A tool should be included with the overview of the wireless choices to provide an easy to view and select the optimal technology. This tool must include key factors for selection that are listed above.



Section B – Development and Installation of Testbed at MxD that includes Expansion Capabilities; “MxD Cyber Wireless Testbed”

3. A physical testbed that will be used to demonstrate the different wireless choices. This testbed should present the different options in a format and implementation that is easy to view and understand. Each demonstration should provide a summary of the setup and the results. Actual comparison of the wireless choices and with a hardwired setup is required. A description of how-to setup, configure and maintain each choice is to be included.
4. The MxD testbed must also have the capability to allow members to test their hardware and software. Requirements for how to connect the hardware and software that utilize standard methods must be detailed so that it is easy for members to utilize the testbed with minimal effort.

MxD may choose to award the solutions for the two Sections listed above to different teams to create an optimal solution. This may result in one team working on a Section A solution and a different second team working on the Section B solution. However, it would be of benefit for a solution to include both Sections and show how the Sections are linked together for a comprehensive solution.

OBJECTIVES

The following objectives outline the key activities that MxD considers applicable for a successful solution. MxD’s recommended set of requirements are included under each objective, but the team is encouraged to make value-added changes to the requirements as they see fit. MxD encourages agile development on its projects to ensure that the deliverables are shaped and validated by customers and key stakeholders throughout the period of performance.

Additionally, teams are not expected to provide all-encompassing solutions that cover all possible wireless possibilities but should consider the basic, commercially available solutions that are readily available to U.S. manufacturers of all sizes. Teams are expected to focus their solutions on a scope that is realistic, achievable, and aligned to what a typical manufacturer would consider when understanding, developing, designing, and implementing wireless capability into their production environment. For Section A, the solutions may also include future looking roadmaps that manufacturers can rely on for planning purposes. For Section B, the solutions should include commercially available hardware and software along with a roadmap of when commercial equipment will be available for future wireless technology. For both Sections, there must be an emphasis on Cybersecurity.

The key objectives are defined below:

Section A

1. **Understand the Wireless Choices:** Summarize the current and evolving wireless choices with a clear summary of each choice for comparison and decision making.

The requirements for this objective are as follows:



- Analysis and research into identifying and listing the factors that may impact the design, implementation, and maintenance of a wireless system in a manufacturing environment.
- Wireless technologies must include 5G, Wi-Fi 6, and other relevant technology
- Include all relevant standards / protocols for each technology as applicable
- Cybersecurity requirements that must be considered for the wireless choice must be included. This must include appropriate levels of security for the choices.
- Selection factors must include cost, data security, data integrity, facility impacts, implementation considerations, maintenance, training, and other key factors.
- Provide a table, matrix, or similar type methods to present the different wireless choices that are currently available and those that are still evolving.
- “Best practices” for successful design, implementation and maintenance needs to be included in the assessment.
- Include input and feedback from appropriate users in the development of this effort
- A summary of advantages and disadvantages for each of the choices to be compared against the contributing factors must be included.
- A summary of the best choice for specific applications must be included. These applications should represent typical use cases in a manufacturing environment.
- The summary must also include a risk assessment, and if possible, methods to reduce those risks.
- A method to display all of the requirements in a simple to access and understand presentation is required. This includes for an individual (reading on a PC) or in a group (classroom or factory floor environment).
- Feedback from appropriate users on the results of the analysis and summary
- List information resources for additional investigation or learning

2. **Development of Wireless Selection Tool:** Leveraging the results of the wireless choice summary in Objective 1 and convert the summary and analysis into a tool that can be used for an efficient understanding of the wireless choices. This objective is to convert the static summary in Objective 1 into an interactive tool that is easy to access and use for ‘What if’ analysis and comparisons.

The requirements for this objective are as follows:

- Provide a tool that does not require any special equipment or software for support. It would preferable that the tool is off the shelf.
- If unique software is required, it needs to be free, open-sourced software that can accessed and readily downloaded for use.
- The tool needs to be easy to be configurable for future updates, edits, and possible additions without requiring unique or advanced programming expertise.
- A method to display the tool in a simple to access and understand presentation is required. This includes for an individual (using on a PC) or in a group (classroom or factory floor environment).
- The tool must include key factors and other features that are listed in Objective 1.
- The tool must have the capability for comparing different wireless technologies and technologies across the key factors, including Cybersecurity implications.



- The tool must be able to support basic ‘What if’ options and comparisons.
- The design and development of the tool should include use and review by appropriate people outside of the team prior to completion to verify its value and usability.

The project team may provide their own specific use case, but Section A of the project is aligned with the following more general use cases:

- *As a manufacturing manager or engineer, I need to determine what are my options and best choices for connecting sensors, controller and other equipment using a secure, wireless connection.*
- *As a manufacturing manager or engineer, need to understand the effort and resources needed to implement a wireless system which includes the initial design to maintaining the system once installed.*
- *As an Operational Technology (OT), Information Technology (IT) or Business Technology (BT) professional, I need to know what considerations to understand and be compliant to in order to successfully implement a Cybersecure wireless system.*
- *As a facility engineer or manager, I need to understand the physical requirements for a wireless system and ensure the implementation aligns to those requirements.*
- *As a person interested or having a need to better understand wireless solutions in a manufacturing environment, I need a tool that will provide a summary of choice with trade-offs, risk, advantages and disadvantages for the choices available for a specific situation or use case.*
- *As a Maintenance Engineer, I need to know what it takes to manage, expand, and provide overall maintenance of different wireless technologies and systems.*
- *As an Operations Manager, I want to know what expertise and training is required to enable employees to confidently and effectively understand and utilize wireless technology and its operation.*
- *As a person interested or having a need to better understand wireless solutions in a manufacturing environment, I need a tool that will provide the factors required in understanding what factors or considerations for a secure wireless system are needed before an analysis can be made.*

Section B

3. **Development and Installation of Wireless Testbed at MxD:** Identify both the network and client side of commercially available equipment that includes the purchase and installation and then ensuring proper operation of the various wireless choices in creating a wireless testbed on the MxD Factory Floor.

The fundamental objective is to establish a testbed for wireless technologies that could be applicable to a manufacturing environment. The solution team has the freedom on what setups or use cases to utilize when demonstrating the various wireless choices.

The requirements for this objective are as follows:

- Testbed Architecture:



- Create an architecture that provides a method for integrating the following:
 - Network side (connected to a 'system')
 - Client side (connected to equipment, sensors, controller, etc.)
- Create at least two standard use cases that are typical in a manufacturing environment that can be used to test the wireless choices. More than one use case is anticipated to show the various aspects that a system may have on the data or information that is being sent. At a minimum the use case(s) must be able to provide the following mechanism for comparing the various performance attributes:
 - Data security (demonstrate the cyber security aspects)
 - Data integrity (any loss of information must be measured)
 - Bandwidth (amount of data that can be transferred without degradation)
 - Speed (how fast the information is moved; includes processing speed)
 - Latency (delay measured in milliseconds between when the data is sent and when it is received)
- The Architecture must be readily available commercial equipment that does not necessarily lock down a manufacturer into a specific solution or vendor. Options must be made available if possible.
- The Architecture must include 5G, Wi-Fi 6, and other existing wireless technologies
- Include in the Architecture the methodology for identifying and designing the system so manufacturers can understand the steps needed to get started with wireless technologies in their facility.
- The Architecture must be designed so additional equipment, test cases, etc. can be added in the future that does not require significant changes to the system; goal is for easy plug-in & play.
- The Architecture must include Cybersecurity protection which should include the basics:
 - Identify hardware and software required
 - Internal security
 - External security (connection to the web)
- Data Measurement System
 - Identify method(s) for measuring performance attributes listed above
 - These must include timing and loss of data
 - An example is BER (Bit Error Rate) that can be used for data loss/data integrity
 - This equipment must be commercially available
- Design, procure, install, and test the MxD Cyber Wireless Testbed:
 - The team is to design, procure, install, and test the system(s)
 - Define a method for selecting equipment that can be shared with MxD members. This includes a list of distributors and sources from which equipment can be purchased.
 - Installation considerations:
 - Facility requirements



- Antenna and equipment physical requirements
- Cost considerations for a typical installation for the different wireless choices.
- Access outside of the MxD Factory Floor plan; additions to existing MxD capabilities need to be budgeted for (example VPNs)
- Testing of a system
 - Special equipment that may be required
 - Contractors who may do this work; what to look for and how to select
- Staffing skill sets / expertise
 - What unique skills or expertise is needed to design, procure, install, and test a basic wireless system (such as Wi-Fi)
 - What additional skills are needed for more advanced systems or technology (such as 5G)
 - When to do the work in-house and when to contract out
 - What training resources are available for understanding, designing, implementing, operating, and maintaining wireless technologies in a factory environment
- Maintenance:
 - Awareness of system and equipment updates; where to locate and access
 - Identify and install advised updates
 - Expertise and skill set required for the maintenance of a wireless system. This should include training and education for personnel who will be assigned maintenance.
- Documentation
 - Troubleshooting guides as required
 - Define when a system is 'Production Ready' and validate those requirements using the Testbed system(s) for reference.
 - List software licenses required and how they will be managed (one time purchase or subscription)
- List of Wireless Application comparison information resources
- Proof of Concept ideally should be done at a convenient location before transfer and implementation at MxD. The project team must determine if this is the most efficient manner to identify, root cause, and resolve design and implementation issues.

4. **MxD Testbed Expansion Capability:** It is required that the MxD Cyber Wireless Testbed has the capability to add on different wireless technology, Cybersecurity hardware and/or software, and be able to “plug-in” and test different use cases across the various wireless technologies.

The requirements for this objective are as follows:

- Provide requirements and step by step instructions on how to add additional wireless technologies onto the test bed. This should include the methods used to



design and implement wireless technologies into the original testbed (lessons learned).

- Provide guidance on how to implement and utilize different Cybersecurity solutions onto the testbed. This should include the requirements, decisions, and implementation of any Cybersecurity into the original testbed.
- Provide the capability for members to assess different use cases on the testbed. This should include:
 - Requirements for hardware and software interfaces for the input, output, and controls of the new test case
 - Requirements for assessing the performance attributes; what can be measured and under what conditions
 - Knowledge or skill set required
 - How to authenticate users on the network
 - How to return the testbed to a normal state
- Proof of Concept for adding a new use case should be conducted and documented to be used as a step-by-step procedure for anyone else to follow (pending they have the appropriate skill set)

The project team may provide their own specific use case, but Section B of the project is aligned with the following more general use cases:

- *As a manufacturing manager or engineer, I need to be able to have an example or a guide for how to devise and implement a System Architecture for a Secure Wireless solution.*
- *As a manufacturing manager or engineer, need to understand the effort and resources needed to implement a wireless system which includes the initial design to maintaining the system once installed.*
- *As an Operational Technology (OT), Information Technology (IT) or Business Technology (BT) professional, I need to know what considerations to understand and be compliant to in order to successfully implement a Cybersecure wireless system.*
- *As a facility engineer or manager, I need to understand the physical requirements for a wireless system and ensure the implementation aligns to those requirements.*
- *As a member of MxD, I need to know how I can de-risk my use case by utilizing the MxD Cyber Wireless testbed for Proof of Concept.*
- *As a member of MxD, I need to understand how to utilize the Lessons Learned from the 21-07 project work*



RFS SCOPE OF WORK

The above objectives must be completed within the following project constraints:

Period of Performance: 9 months

Project Total Budget: \$350,000

Minimum Cost Share Contribution: \$350,000

Note that the funding is the total amount available for both sections. It is anticipated that the distribution of the funding is as follows:

Section A – Knowledge and Selection Tool – funding target 30%

Section B – Development and Install of Testbed at MxD that includes Expansion Capabilities– funding target 70%

To ensure an effective and efficiently executed project, the team should perform initial market, technology, case studies and other related research to gain an understanding of the needs of the industry and expectation from manufacturers. During the period of performance, periodic refinement of these identified requirements should be conducted to ensure a valuable outcome.

The team should have active engagement from design and manufacturing partners throughout the period of performance to ensure the project outcomes are headed in a value-added direction. The team should avoid developing finished deliverables and then testing them via implementation.

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 1, but **the team is encouraged to include additional deliverables or provide value-added changes to the recommended set of deliverables. As the team defines their deliverables, they should keep in mind that the outcomes should be above and beyond what any one organization can produce alone. They should fill a gap in industry and truly represent the mission of using federal funding to advance the state of US manufacturing.**

IMPORTANT: If changes are made to the deliverables, the team must provide the reasoning and detail any assumptions to provide context for the changes. Their proposed set of deliverables must align with MxD's focus on achieving deployable outcomes and enabling the transition of the research.



Table 1. Technical Deliverables

| Deliverable | Description | Deliverable Due Date |
|--|---|-----------------------------|
| Section A | | |
| Documentation of Wireless Technology and Selection Criteria | Develop requirements and criteria needed to assess wireless technologies including Cybersecurity; document current and future wireless technologies | Month 3 |
| Wireless Technology Assessment Report | Provide a report of the wireless technologies with a comparison including strengths, weaknesses, and Best Practices | Month 5 |
| Wireless Technology Assessment Summary | Provide a summary of the detailed report (key findings and information from the Assessment Report) | Month 5 |
| Selection Tool Design | Provide architecture for the Selection Tool that includes user input and feedback on the tool development | Month 5 |
| Selection Tool Demonstration | Demonstration of Selection Tool | Month 6 |
| Validation of the Selection Tool | Validation of the Selection Tool with appropriate users outside of the Project Team | Month 7 |
| Developer Documentation | Includes documentation for troubleshooting, modifications, and future expansion | Month 8 |
| User Guide | Includes requirements, how to setup, how to use, troubleshooting, and how to make changes | Month 8 |
| | | |
| Section B | | |
| System Architecture and Integration Framework | Documentation of the system architecture and framework including approach, diagrams, requirements, and expansion capability | Month 2 |
| Equipment Identification and Procurement | Detailed BOM (Bill of Material) that includes hardware and software specifics | Month 3 |
| System Test and Validation Report | Validate Proof of Concept of system design and BOM by building and validating the system | Month 4 |
| Use Cases Identified | Create two use cases | Month 5 |
| Proof of Concept | Includes wireless system and a use case at a minimum | Month 7 |
| MxD Install | Install and begin final prep at MxD | Month 8 |
| Testbed Acceptance | Testbed working per project objectives and deliverables | Month 9 |
| Documentation | All documentation completed and transferred to MxD | Month 9 |



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, open-source software release, or commercialized products available for use. Teams are expected to tailor their deliverables to their transition goals 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 solutions emphasize not just technical merit but transition and deployment.**



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PROGRAM OVERVIEW



V. PROGRAM REQUIREMENTS

COLLABORATION

Participation in this program requires collaboration with a team of organizations with diverse capabilities. Competitive teams should optimally include representation from the manufacturing base, equipment providers, and solution/service providers. While it is not necessary for a proposing team to include all such organizations in their direct performers, MxD believes that involvement of diverse stakeholders increases the strength and applicability of project outcomes while reducing unforeseen risk.

It is also expected that since the ultimate project solution could be comprised of different parts from different teams, this collaboration will need to be done openly and with considerations of how to best identify the team both in size and expertise needed to effectively execute the objectives listed.

The Solution Proposal Preparation Information section outlines the opportunities that MxD provides to facilitate solution team development:

- Teaming List: MxD will collect contact information from parties interested in teaming during the first weeks of the solution period and will then disseminate the compiled list of contacts to the responders via email.
- Pitch Session: MxD will host a Pitch Session to provide organizations and/or teams the opportunity to share a snapshot of their solution approach and allow them to identify synergies with other interested parties.

PROGRAM MANAGEMENT

MxD will be responsible for managing the project to ensure the team meets all the technical objectives and requirements proposed within the project's period of performance and budget. The MxD Project Manager will coordinate with Principal Investigators (PIs) of the Solution Team to manage the program following MxD's project processes. The Director of Cybersecurity, in coordination with the assigned MxD Project Manager, will monitor technical performance and project costs of the associated Enterprise Award Agreement (EAA), the agreement that governs a project awarded by MxD to the Solution Team Lead. Solution Teams will submit the reports listed below in Table 2 to their identified Project Manager to fulfill their reporting requirements. These reports will be internally accessed by the MxD Director of Cybersecurity, the Government, the Project Manager 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.



Table 2. Program Deliverables

| 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 the Project Team Lead 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 Manager, 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 Manager 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

Solutions should include adequate funding for the travel of the Solution Team. These trips will be used for face-to-face meetings, building and testing of the solution, 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. Solutions 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 nine months in duration. Please note that projects are initiated once an EAA is signed, therefore, the project duration must include the subcontracting of all project participants between the Solution Team Lead and each member of the Solution Team.



OWNERSHIP OF DELIVERABLES AND INTELLECTUAL PROPERTY

To accelerate digital adoption, cybersecurity, and workforce development across the U.S. manufacturing sector and to support the increased priority from our funding partners to transition project technology, MxD desires to own or co-own all the rights to intellectual property (IP) created during the project (Foreground IP or Project IP). It is the expectation that a member of the Solution Team will co-own or will have a non-exclusive, non-transferable license to use the Foreground IP it creates. MxD will negotiate in good faith to achieve this result. MxD expects that the IP Management Plan (Attachment 1b) submitted with this Solution will reflect this position. MxD will have no rights to pre-existing intellectual property (Background IP) belonging to any member of the Solution Team except as may be expressly agreed to in the Project documents. It is important to note that MxD will consider Solutions that do not meet this request; Solutions with IP Management Plans that reflect this will be favorably reviewed.

FUNDING REQUIREMENTS

MxD anticipates awarding one project for no more than \$350,000 of Federal Funding, not inclusive of required cost share, under the MxD-21-07 RFS. MxD reserves the right to fund all, some or none of the Technical Solution Proposals received under issued RFSs. Final award amounts will be adjusted accordingly based on Solutions received and subsequent evaluations.

This project requires a minimum 1-to-1 Cost Share in aggregate by the Solution Team. For every dollar of Federal funding awarded, the Solution Team must contribute at least a dollar of in-kind effort or cash. Thus, the Solution Team in aggregate will need to provide at minimum 50% of the total project cost (inclusive of labor, equipment, materials, indirect, etc.) in cost share. This cost share can be in-kind or cash and can be distributed among the members of the Solution Team however the team decides. Cost share must be accounted for and substantiated in the cost proposal, as described in the Cost Development Guide found in the Solution Proposal Preparation Kit.

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

If down selected, the Solution Team must submit substantiating documentation for all Solution Team Member costs (including cost share) and 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 project. Approval of the Cost Proposal and Technical Solution Proposal by the Government Agreements office and the DoD Program Manager is required for all MxD projects.

NOTE: Project award timelines are subject to approval of the project plan by the government and the allotment of funds from the government.



VI. ELIGIBILITY

MxD MEMBERSHIP

This RFS is open to the public; any organizations regardless of membership status may submit a Technical Solution Proposal and Cost Proposal in response to this RFS. However, the MxD Membership Agreement must be fully executed with every Solution Team member prior to project award. Any non-MxD members of the Solution Team are encouraged to review the Membership Agreement prior to submission and to direct questions to MxD's 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 RFSs in any capacity unless they address the following conditions:

- FFRDCs or Government entities may not exclusively team on any specific Solution 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 RFSs as part of Solution Team should notify MxD in advance of Solution submission. For RFSs utilizing Federal funding, special agreements and considerations may need to be implemented to enable participation.

NOTIFICATION OF PARTICIPATION BY FOREIGN FIRMS & NON-U.S. CITIZENS

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")).

Membership and project participation (or participation in projects without membership status) will be granted on a case-by-case basis at the sole discretion of the MxD Senior Leadership Team upon approval of the U.S. Government for any of the following:

- 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.

In such event, all Members will be notified immediately of the foreign entity's role.



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.

It is a requirement that work related to the project must be completed in the U.S. by people legally authorized to work in the U.S. All proposed project participation by non-U.S. Citizens must be disclosed to MxD on Attachment 2c MxD Foreign Firms, Travel, & Non-U.S. Citizens at least 60 days prior to proposed participation. Written approval of foreign firms and/or non-U.S. Citizens must be received by the member of the Solution Team from MxD prior to commencing work.

VII. TECHNICAL SOLUTION PROPOSAL & COST PROPOSAL EVALUATION

EVALUATION PROCESS

An MxD Evaluation Board (EB) will review and evaluate each submitted Technical Solution Proposal utilizing the evaluation criteria specified in the following section.

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 Managers, 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 Solutions that are “selectable for negotiation” leading to a subagreement award, along with their associated evaluation scores, to the Project Manager. The Director of R&D Projects, with the consultation of other MxD representatives, will determine which subset of the proposed Technical Solutions 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’s SIP as well as external stakeholder requirements (when applicable).

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. Solution proposals should provide a clear explanation of how the solution addresses business problems and technical requirements outlined in the RFS, any assumptions, and considerations for deployment of developed solution through a pilot.

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



| Solution Evaluation Criteria | Order of Importance |
|--|---------------------|
| Requirements Compliance <ul style="list-style-type: none">Clearly articulates how the team will meet all the capabilities required by the RFSProposed solution clearly addresses problem statement and use cases identified in RFSClear identification of assumptions, risks, and mitigations; proposed deliverables align with requirementsProgram management plan meets requirements in the RFS and is reasonable for the scope of work described in the technical solution | 1 |
| Methodology <ul style="list-style-type: none">Clear and concise work effort scope targeted at problem statementProposed effort of direct relevance to RFSClear identification of barriers to implementation and explanation of how they will be overcomeInnovative methodology with high potential for market impactSignificant and impactful use of external resourcesMethodology demonstrates scientific and technical meritSMART metrics and KPIs identified and described and demonstrate clear understanding of proposed workDeliverables are fully described and identified | 2 |
| Transition Plan <ul style="list-style-type: none">Transition plan clearly articulates all project results and application into commercial and/or government products, systems and applicationsPlan 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 pointsTransition tasks and partners identified and thoroughly defined, both to MxD members and the broader industrySolution and strategy to rapidly enable the adoption of the new technologies across the US manufacturing base is presentedClearly defined IP ownership and innovative licensing strategies designed for rapid adoption of the new technologiesDiscussion of future transition and/or commercialization demonstrates a clear understanding of the industry and possible markets for the technologyBenefits of technology are clearly defined and substantiated. | 3 |



| | |
|--|---|
| Team Qualifications <ul style="list-style-type: none">• <i>Members of proposed team are highly qualified to accomplish project tasks with clear delineation of roles and responsibilities</i>• <i>Solid evidence of commitment by team members, such as letters of commitment from their companies</i>• <i>Team members have unique capabilities that are directly associated with the target technology</i>• <i>Team includes a broad mix of capabilities and experiences to ensure success along with the commitment of top-tier facilities to accomplish all project tasks.</i> | 4 |
| Cost Factors <ul style="list-style-type: none">• <i>Proposed cost estimates are reasonable and realistic for the proposed work effort</i>• <i>The minimum cost share proscribed in the RFS has been met or exceeded</i>• <i>Cost share is clearly defined and directly applicable to the performance and success of the project</i>• <i>Cost share value is readily discernable</i>• <i>Cost share from partners is documented with letters of commitment.</i> | 5 |

VIII. PROJECT AWARDS

CONTRACT

MxD projects will be funded under the MxD Technology Investment Agreement (TIA), Contract Number W15QKN-19-3-0003 between MxD and the Government. All contractual negotiations related to RFSs will be executed by MxD. Funds will be distributed to the Solution Team Lead selected through the evaluation/selection process utilizing an Enterprise Award Agreement (EAA). EAAs are usually Cost Reimbursement/Cost Share agreements; Milestone Payment/Cost Share based EAAs will be considered upon request.

MxD has provided an EAA template within the PPK for Solution Teams to **review** prior to Solution submission. **The EAA should not be submitted with the Solution.** After receiving a notification of down selection, MxD will request the down selected Solution Team to officially begin contract review and negotiations. MxD would prefer to execute an EAA only with the Solution Team Lead. Once the EAA is executed, the Solution Team can begin working on the project. When applicable, it is the sole responsibility of the Solution Team Lead to issue contracts with applicable flow down clauses outlined in the EAA to any subcontractors, consultants, and any suppliers.

FINAL TECHNICAL SOLUTION PROPOSAL & COST PROPOSAL REVISIONS

MxD reserves the right to negotiate the cost and scope of the proposed work with the Solution Team that has been down selected prior to award. MxD will facilitate the creation of a Statement of Work with the Solution Team including technical scope modifications and program management aspects. All members of the down selected Solution Team who intend to pursue selection are required to participate in the Solution revision process prior to award. For example, MxD may request that the organizations revise the technical scope to better align to RFS requirements.



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SOLUTION PROPOSAL PREPARATION INFORMATION





IX. SOLUTION PREPARATION INFORMATION

This Solution Proposal Preparation Information section offers detailed instructions on how to respond to this RFS; the Solution Proposal Preparation Kit (PPK) includes the required Solution templates and reference documents on how to complete the templates. Together, the Solution Proposal Preparation Information and PPK are intended to provide the basic information necessary for assembling complete Solutions.

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

X. TEAMING OPPORTUNITIES

TEAMING LIST

To facilitate Solution teaming, MxD will collect contact information from parties interested in teaming during the first week of the Solution period. MxD will then disseminate the compiled list of contacts to the responders via email. If you are interested in submitting your contact info to this distributed list, please email projects@mxdusa.org by 5:00PM Central Time, June 25, 2021 with the following information:

“Subject: MxD-XX-XX RFS Teaming

[Organization Name]

[Name of Contact]

[Email address of contact]

[1 sentence description of expected contributions to Solution]

I agree to have the information herein disseminated to other organizations that have indicated interest in teaming for MxD's RFS 21-07.”

PITCH SESSION

Additionally, MxD will host a **Pitch Session** on Tuesday, June 29, 2021 to provide organizations and/or teams the opportunity to share a snapshot of their solution and receive preliminary feedback from the MxD community. It will also serve as an excellent teaming opportunity for individuals and groups to identify synergies between their pitches. Pitch Session registration information will be posted at www.mxdusa.org/projects. Participation in the Pitch Session is not required to submit a Technical Solution Proposal and Cost Proposal.

XI. SUBMISSION INSTRUCTIONS

SUBMISSION DETAILS

Each Solution Team must submit their Technical Solution Proposal and Cost Proposal no later than 5:00PM Central Time, August 12, 2021. All submissions must be made electronically to projects@mxdusa.org. Please include the RFS designation (e.g., “MxD-<XX>-<XX> – <RFS Title> - <Solution Team> - <Solution Title>”) in the subject line of the email.



REQUIRED SOLUTION DOCUMENTATION

The following section provides guidance on the necessary documentation, templates and submission formats required to submit a Technical Solution Proposal and Cost Proposal in response to this RFS. Below are the documents (organized by PPK folder) that must be completed and submitted by the due date:

| Required Solution Documentation | | | |
|---|---|--|-------------------|
| Title | Document | Template | Submission Format |
| Technical Solution Proposal ONE PER SOLUTION TEAM | Technical Solution Proposal | Attachment 1a MxD Technical Solution Proposal Template.docx | PDF |
| | Resume(s) of the Principal Investigator and Key Technical Personnel | N/A | PDF |
| | Letter(s) of Commitment | N/A | PDF |
| | Intellectual Property Management Plan (IPMP) | Attachment 1b MxD IP Management Plan.xlsx | XLS |
| Cost Proposal and Participant Certification ONE PER SOLUTION TEAM | Cost Proposal | Attachment 2a Project Cost Proposal Template.xlsm | XLS |
| | Cost Narrative | Attachment 2b Cost Narrative Template.docx | PDF |
| | Certification of Foreign Firms, Travel and Non-U.S. Citizens | Attachment 2c Foreign Firms, Travel, & Non-U.S. Citizens.docx | PDF |

- Each Solution Team must submit **one Technical Solution Proposal** (Attachment 1a). The instructions for completing the Technical Solution Proposal are in the Technical Solution Proposal template provided in the PPK folder. All questions are required, and attachments should be included.
- Each Solution Team must submit **one completed IP Management Plan** (Attachment 1b) for the entire team with the Solution. Instructions for completing the IPMP are provided in the template. The IPMP must contain Background Intellectual Property (BIP), Project (Foreground) IP, and assertions of limited rights to the Government.
- Each Solution Team must submit **one Cost Proposal** (Attachment 2a) **including the Cost Narrative** (Attachment 2b) that is a summary or “roll-up” of all Solution costs including cost share. Please reference the MxD Cost Proposal Development Guide for instructions on how to develop the Cost Proposal. An example Cost Proposal Excel Sheet and Cost Narrative are provided for reference. **Solution Teams should be prepared to**



provide substantiating documentation for all Solution Team Member costs within two weeks of down selection if the Solution is down selected.

- Each Solution Team must submit **one Certification of Foreign Firms, Travel and Non-U.S. Citizens** (Attachment 2c) with information from every Solution Team member. If there is personally identifiable information, separate certifications may be submitted
- The EAA is provided for review prior to submission. **The EAA should not be submitted with the Solution.**

Solutions that do not include the minimum requirements identified in the RFS will be deemed non-responsive and will not be evaluated.