



The Digital Manufacturing Institute

# MxD

## REQUEST FOR PROPOSAL

Automated Wireless Signal Strength  
Mapping for Industrial Facilities

21-18-09

Revision 1.0 Release Date: August 10, 2023

Contact: Michael Howard  
Technical Program Manager  
Michael.Howard@mxdusa.org

MxD  
1415 North Cherry Ave  
Chicago, IL 60642

# TABLE OF CONTENTS

---

I.	Record of Change.....	3
II.	Timeline .....	3
III.	Introduction.....	3
IV.	Technical Summary .....	6
	Overview and background .....	6
	Problem Statement .....	6
	Objectives.....	7
	Requirements .....	7
	Scope of Work .....	10
V.	Program Requirements.....	12
	Program Management .....	12
	Period of Performance Requirements .....	13
	Travel, Facility Access and Insurance Requirements .....	13
	Ownership of Deliverables and Intellectual Property .....	13
	Funding Requirements.....	13
VI.	Eligibility.....	14
	MxD Membership.....	14
	Notification of Participation Non-U.S. Citizens.....	14
VII.	Proposal Evaluation .....	15
	Evaluation Process .....	15
	Evaluation Criteria.....	15
VIII.	Project Awards.....	16
	Contract.....	16
	Final Revisions .....	16
	Submission Details .....	16
IX.	REFERENCES AND ACRONYMS .....	16

## I. RECORD OF CHANGE

---

Revision	Date	Sections	Description
1.0	09 August, 2023	N/A	Original

## II. TIMELINE

---

Deadline for submissions to be received	September 21, 2023
Follow up clarification meetings as needed	Throughout the submission phase
Feedback to participants	November 2, 2023

## 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.

MxD has invested over \$120 million in more than 85 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 is also the DoD's National Center for Cybersecurity in Manufacturing which focuses on three key areas. First, it uses its factory floor as a demonstration area for existing cybersecurity technology. Second, it works to develop new tools to address very specific pain points for manufacturers. And third, it is working with industry and government to figure out how to get these tools to small and medium-sized manufacturers. All MxD projects must take cybersecurity into consideration.

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 If an updated RFP is issued, the previous RFP will be rescinded.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

The Respondent to an RFP is the non-Federal organization that submits a proposal in response to the RFP. The Respondent is considered the Prime contractor. Any other companies involved are considered Subcontractors typical of a Prime/Subcontractor relationship. All Subcontractors are subject to flow-down clauses in the Prime contract as required by all government stipulations.

Any questions regarding this solicitation must be provided to [projects@mxdusa.org](mailto:projects@mxdusa.org). The questions will be sent to the appropriate MxD point of contact, and answers will be published on the MxD website, if appropriate.



mxdusa.org  
@mxdinnovates  
info@mxdusa.org

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

# TECHNICAL SUMMARY

## IV. TECHNICAL SUMMARY

---

### OVERVIEW AND BACKGROUND

This program seeks to develop a system to autonomously survey wireless communication signal strength in industrial facilities.

With the introduction of high speed, low latency communication protocols for wireless LAN and cellular technologies, more industrial facilities are migrating, or considering migrating, from wired to wireless networks. As performance and reliability of wireless networks approaches wired networks, the cost and flexibility of wireless drives a more viable business case.

However, a critical factor for both cost and performance of wireless networks is signal strength. Signal strength is driven by system design including transceiver power and transceiver location. Both are dependent on protocol, legal standards, and the industrial environment under consideration.

### PROBLEM STATEMENT

Industrial facilities are not friendly environments for wireless technologies. Building construction materials, building layout, and fixed and mobile equipment, are just a few examples that affect signal strength. When systems are designed, there are simulation tools used to predict signal strength based on design scenarios.

However, these scenarios are based on a preliminary, static facility condition and do not consider any potential interference from existing wireless radiation in the facility. Note that wireless radiation can be emitted from machinery, controls, and other industrial systems, not just wireless communications equipment.

Understanding wireless radiation in the facility is important both before and after system design and installation. The dynamic nature of equipment location within facilities can change signal strength due to either emissions or attenuation of wireless signals. This facilitates the need for ongoing signal strength surveys regularly.

Such signal strength surveys are typically done manually by walking the facility and taking samples versus a documented facility layout. These types of surveys will usually focus on a specific band or protocol. Many industrial facilities are large, and a survey of this type can result in significant costs. In addition, many companies lack the expertise to perform such surveys internally.

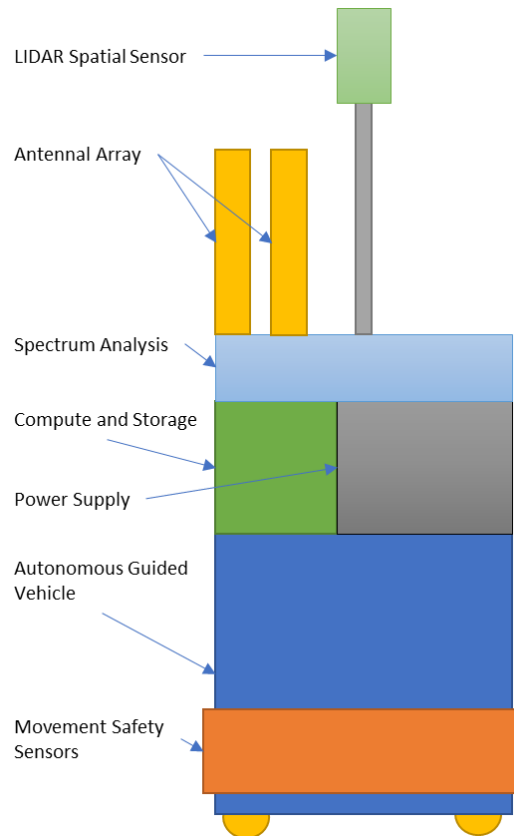
**MxD Project 21-18-09** focuses on developing a solution to map a facility and correlate wireless radiation signal strength to the facility map in an independent, autonomous manner with minimal input required from the user.

## OBJECTIVES

The primary goal of MxD Project 21-18-09 is to design, build, test, and deploy an autonomous mobile system which will survey wireless signal strength, across bands used in popular wireless communication protocols, and map the signal strength relative to a self-built, two-dimensional layout of the industrial facility.

### Concept Illustration:

The following diagram is shown only as an example to clarify the vision of the objective. Requirements are specified in the next section.



## REQUIREMENTS

### Mobile System:

- The mobile system must be agnostic to operate in any facility. The mobile system shall operate autonomously with no training or physical markers required.
- It can be assumed that the mobile system will operate indoors with suitable flooring for a mobile system.
- The size of the mobile system is to be determined by the project team. However, the footprint of the mobile system should be kept as small as practical to operate in an industrial facility.

- The mobile system shall have the necessary sensors to operate safely in an industrial environment to avoid obstacles such as equipment, stairs, transparent partitions, moving vehicles, and other moving systems.
- The mobile system shall meet all safety requirements to operate around people.
- Safety requirements are defined as all legal workplace requirements of the United States and applicable standards of ANSI / ISO.
- The mobile system shall operate under its own power without the need for a tether.
- Automated self-charging should be considered by the project team to accommodate large facilities. Manual charging is acceptable if self-charging is not feasible within the project parameters.
- The mobile system shall deploy algorithms to maximize efficiency of system movement versus coverage of an unknown facility.
- The mobile system shall remember its start point, end point, and previous path for multi session activities in large facilities.
- The mobile system must operate independent of any network or cloud connectivity. All data must be stored locally on the system.
- The mobile system must have an onboard HMI for operations including start up, shut down, basic maneuvering, go-to previously mapped waypoints, system diagnostics, and the ability to offload collected data. Remote HMI can be considered but must not rely on an external network.
- The mobile system shall have accommodation for shipment. Examples include marked lift point, marked tie downs, easy connection/removal of antennas, sensors, masts, etc.
- Location of the safety sensors, spatial sensors, and antenna array is to be determined by the project team to best meet the objectives of the project.
- Operation instructions and maintenance manual for the mobile system shall be included.
- Training intended for system operation and maintenance shall be included for up to five people.

#### **Facility Mapping:**

- The system must have the capability to autonomously map the physical, observed, environment. The final output shall be a two-dimensional representation of the observed floor layout of the facility.
- Three-dimensional or point cloud technologies may be used for mapping purposes. However, data must be converted to a two-dimensional floor layout. Suspended equipment, such as gantry cranes, which may not be part of the floor layout are considered out of scope for the purposes of this project.
- The mapping technology must have the capability to detect glass or other transparent material partitions.
- The mapping technology must have the capability to detect and filter mobile equipment, which is not stationary at the time of scanning.
- Any necessary postprocessing should be done on board the system. However, downloading data from the system and processing the data offline is acceptable if needed to meet mobile system requirements.
- The facility map must be able to be exported in a manner that does not require custom software and must use commercially available formats such as PDF, DXF, etc.
- The facility map must have common references which allow for accurate overlay of the signal strength map.
- Overlay of the facility floor layout and the signal strength maps must be automated giving the export option of floor only, signal only, or combined.



**Signal Mapping:**

- The system shall have the capability to measure signal strength in the UHF, SHF, and EHF bands.
- Measured protocols shall include Wireless LAN (5, 6, 6E), 4G and 5G cellular (within UHF, SHF, and EHF), and Bluetooth. Additional protocols, such as two-way radio, LORA, etc. can be determined and added at the discretion of the project team given project constraints.
- As signal interference is in scope for this project, signal strength of radiation within protocol bands/frequencies/channels, but not necessarily generated by a specific protocol, are to be included in measurements.
- Format of the signal strength map (heat map, topology map, etc.) shall be at the discretion of the project team provided it is easily readable with quantitative data available.
- The signal map must have the ability to be filtered by band, frequency, and protocol so that targeted analysis can be completed.
- Any necessary postprocessing should be done on board the mobile system. However, downloading data from the system and processing the data offline is acceptable if needed to meet system requirements.
- The signal strength map must be able to be exported in a manner that does not require custom software and must use commercially available formats such as PDF, DXF, etc.
- The signal strength map must have common references which allow for accurate overlay of the facility map.
- Overlay of the facility floor layout and the signal strength maps must be automated giving the export option of floor only, signal only, or combined.

**Miscellaneous Items:**

- A charger for the mobile system, either autonomous or manual, is to be included in the project.
- Any off-system equipment, such as a computer or storage if required and not able to be placed onto the mobile system, are to be included in the project.
- Any shipment packaging material required to ship the system, such as a pallet and tie downs and/or a crate, are to be included in the project.
- All components used in the system, both hardware and software, are to be DFARS and ITAR compliant.
- The system is to be delivered, tested, and validated at the MxD factory located in Chicago, IL.
- MxD will provide an industrial venue to test the system. More information about the MxD facility can be found at: <https://www.mxdusa.org/factory-floor/>

MxD will measure the performance of 21-18-09 as successful design, build, delivery, test, and validation of the autonomous system described in the above sections.

## SCOPE OF WORK

### Technical Deliverables:

The following table lists a summary of the technical deliverable requirements of the project.

<b>Deliverable</b>	<b>Type</b>
Mobile System Design	Mechanical, Electrical, and Architecture Drawings and BOM, PDF
System Software	Software and license
Mobile System	Equipment and software
Charger	Equipment and software
System Shipment Packaging	Equipment
System Operations Instruction Manual(s)	Document, PDF
System Maintenance Instruction Manual(s)	Document, PDF
System Training Document(s)	Document, PDF
Test Report including methodology and results	Document, PDF
Example facility, signal, and overlay maps from testing at the MxD facility	Document, PDF
Final Technical report including technical lessons learned	Document, PDF

**Period of Performance:** 9-12 months

**Estimated Start Date:** January 2024

**Estimated Funding Amount:** \$700,000 - \$900,000

The proposal shall include a Gantt chart detailing tasks and milestones required to achieve the project outcome.

A line-item breakdown of costs must be included in the proposal. Costs should be reasonable relative to current market rates and must adhere to any federal government guidelines.

# PROGRAM OVERVIEW



## V. PROGRAM REQUIREMENTS

### PROGRAM MANAGEMENT

The selected Respondent will be awarded a contract as the Awardee. The Awardee is responsible for managing the project to ensure the team meets all the technical objectives and requirements as contracted based on the proposal. The Awardee will coordinate with the MxD point of contact (POC) for reporting purposes and for coordinating the integration at MxD. The MxD POC will monitor technical performance and project costs relative to the associated contract. The Awardee will submit the reports listed below in Table 1 to their MxD POC to fulfill their reporting requirements. These reports will be accessed by the MxD Senior Director, PMO, MxD Senior Director of Engineering, the MxD POC and other authorized staff members in the course of their official duties.

Program Deliverables: Table 1

Deliverable	Description	Due
<b>Gantt Chart</b>	Program schedule and milestones	Proposal Response
<b>Program Review</b>	Summary of progress towards objectives and deliverables.	Weekly
<b>Technical Documents</b>	Per Technical Deliverables	Per Technical Deliverables
<b>Safety Accident/Incident Report</b>	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 a report will also identify potential hazards requiring corrective action.	Immediately on Occurrence
<b>Government Required Documentation</b>	Additional reporting based on government contractual requirements.	As Needed



### PERIOD OF PERFORMANCE REQUIREMENTS

The estimated period of performance is 9-12 months from the contract award. Time of completion is flexible dependent on the scope of objectives quoted. MxD are flexible on implementation time dependent on objectives quoted. However, there is no increase in funding beyond what was agreed to, per contract.

### TRAVEL, FACILITY ACCESS AND INSURANCE REQUIREMENTS

All travel requirements and associated costs needed for execution of the objectives and deliverables must be included in the proposal. There is no increase in funding should additional travel be required to fulfill the agreed upon requirements. Proposals must include an estimate for required travel known to be necessary to perform all work as defined above.

### OWNERSHIP OF DELIVERABLES AND INTELLECTUAL PROPERTY

The contract will be a work for hire relationship. It is expected that the solution to meet the objectives will be a commercially available solution. Any existing background intellectual property (IP) remains the property of the IP owner. Ownership and other rights in new IP produced as a result of the work performed under this contract will be determined at the time of contracting.

### FUNDING REQUIREMENTS

MxD anticipates awarding a **fixed-price contract** resulting from this RFP. MxD reserves the right to fund all, some, or none of the proposal received under issued RFPs. Final award amounts will be determined accordingly based on proposal 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 proposal without additional information or site visits for certain projects. Therefore, **clearly document and explain all assumptions used to generate the proposal.**

If down selected, the Respondent will have the opportunity to gather additional details and revise the proposal. 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 the contract award.

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



## VI. ELIGIBILITY

---

### **MxD MEMBERSHIP**

This RFP is open to the public; any organizations regardless of membership status may submit a proposal in response to this RFP. **Membership in MxD is not required to be awarded a contract as a result of this RFP.**

If a Respondent or Awardee wishes to promote their affiliation with MxD as a result of this RFP or subsequent award, MxD membership is required. This can include participation in workshops, social media promotion, and networking with other members. MxD membership does not grant rights to publish association with the project. Publication of association with the project will be subject to terms to be determined at the time of contracting.

Any Respondents who are non-MxD members 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](mailto: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 respond to this RFP.
- 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 a respondent or subcontractor should notify MxD in advance of the RFP submission. For RFPs utilizing federal funding, special agreements and considerations may need to be implemented to enable participation.

### **NOTIFICATION OF PARTICIPATION NON-U.S. CITIZENS**

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. PROPOSAL EVALUATION

### EVALUATION PROCESS

An MxD Evaluation Board (EB) will review and evaluate each submitted 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 Senior Director of the PMO, Senior Director of Engineering, MxD POC, 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 proposal. Selectability determination incorporates average EB judgement of objective compliance, budget availability, and overall perceived value. The EB will identify a list of proposals that are “selectable for negotiation” to the MxD POC. The Director of R&D Projects and the Director of Engineering, with the consultation of MxD POC, will determine which subset of the 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’s mission and strategic goals as well as external stakeholder requirements (when applicable).

### EVALUATION CRITERIA

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

<b>Proposal Evaluation Criteria</b>
<p><b>Requirements Compliance</b></p> <ul style="list-style-type: none"> <li>• <i>Quoted solution clearly addresses all mandatory objectives identified in RFP</i></li> <li>• <i>Clear identification of assumptions, risks, and mitigations</i></li> <li>• <i>Complete and clear itemization of all requirements</i></li> <li>• <i>Program management plan meets requirements in the RFP</i></li> </ul>
<p><b>Respondent Qualifications</b></p> <ul style="list-style-type: none"> <li>• <i>Respondent and any proposed subcontractors highly qualified to accomplish objectives with clear delineation of roles and responsibilities</i></li> <li>• <i>Respondent and any subcontractors have unique capabilities that are directly associated with the target technology</i></li> </ul>
<p><b>Cost Factors</b></p> <ul style="list-style-type: none"> <li>• <i>Quoted costs are reasonable and realistic for the proposed work effort</i></li> <li>• <i>Quoted costs are competitive relative to other commercial offerings</i></li> <li>• <i>Value is maximized through inclusion of optional cost share and objectives</i></li> </ul>



## VIII. PROJECT AWARDS

---

### CONTRACT

The award of this contract will be subject to the requirements of the Collaboration Agreement between ERDC’s Construction Engineering Research Laboratory (CERL) and MxD. All contractual negotiations related to RFPs will be executed by MxD. Funds will be distributed to the Awardee selected through the evaluation/selection process utilizing a fixed price contract.

### 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. MxD will facilitate the creation of a Statement of Work with the Respondent including technical scope modifications and program management aspects. The Respondent and subcontractors, if any, who intend to pursue selection are required to participate in the revision process prior to award. For example, MxD may request that the organizations revise the proposal to better align to RFP requirements.

### SUBMISSION DETAILS

Each Respondent must submit their proposal no later than **5:00PM Central Time, September 21st, 2023**. All submissions must be made on the MxD website. The SUBMIT button can be found on the program page at <https://www.mxdusa.org/projects/5g-rfq-21-18/>. By clicking the SUBMIT button, applicants will be directed to the official Submission Form.

## IX. REFERENCES AND ACRONYMS

---

DoD	Department of Defense
EB	Evaluation Board
EHF	Extremely High Frequency
FAQ	Frequently Asked Question
FFRDC	Federally Funded Research and Development Center
IP	Intellectual Property
ITAR	International Traffic in Arms Regulations
PoC/POC	Point of Contact
PoP	Period of Performance
RFP	Request for Proposal
SHF	Super High Frequency
UHF	Ultra High Frequency

Acronyms: Table 3



# 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.

