



The Digital Manufacturing Institute

MxD

REQUEST FOR QUOTATION

Factory Connectivity and
Performance of a 5G Network

21-18-05

Revision 1.1 Release Date: **March 9, 2023**

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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.....	6
	Requirements	7
	Scope of Work	8
V.	Program Requirements.....	10
	Program Management	10
	Period of Performance Requirements	10
	Travel, Facility Access and Insurance Requirements	11
	Ownership of Deliverables and Intellectual Property	11
	Funding Requirements.....	11
VI.	Eligibility.....	12
	MxD Membership.....	12
	Notification of Participation Non-U.S. Citizens.....	12
VII.	Quotation Evaluation.....	13
	Evaluation Process	13
	Evaluation Criteria.....	13
VIII.	Project Awards.....	14
	Contract.....	14
	Final Revisions	14
	Submission Details	14
IX.	References and Acronyms.....	14

I. RECORD OF CHANGE

Revision	Date	Sections	Description
1.0	16 February, 2023	N/A	Original
1.1	09 March, 2023	Timeline, Submission Details	Changed RFQ deadline to April 13, 2023

II. TIMELINE

Deadline for submissions to be received	April 13, 2023
Follow up clarification meetings as needed	Throughout the submission phase
Feedback to participants	May 19, 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 RFQ 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 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. The Respondent is considered the Prime sub-recipient. 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. The questions will be sent to the appropriate MxD point of contact, and answers will be published on the MxD website, if appropriate.



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TECHNICAL SUMMARY



IV. TECHNICAL SUMMARY

OVERVIEW AND BACKGROUND

This program seeks to show the demonstrability of selected 5G cellular architectures in manufacturing facilities and compare the viability and performance of these architectures to that of traditional wired ethernet setups. Verification and validation methodologies and standards will be selected towards the purpose of measuring data latency and integrity over both wired and wireless systems to form a comparison of the two network formats.

For wireless network architectures, an increased emphasis to IoT connected facilities management will be given. Potential candidates for wireless sensors within the facility such as emergency lighting, environmental conditions, door activation, etc. will require determination, and such sensors will be installed and in-use as a part of network validation efforts, as will the investigation and determination of an accompanying wireless gateway scheme for these sensors to operate on the 5G system. Both technical and business dimensions will be considered. The chosen 5G network system will act as a test platform within the MxD facilities for the exercise of specific use cases to demonstrate benefits and/or limitations of the use of digital technologies within an industrial facility setting.

Items such as wireless sensors, control systems, and related equipment will be tested within the facility over various conditions. Test results, lessons learned, and best practices will be made available for publication. The 5G system will also serve as an ongoing testbed for industry and DoD for additional use cases in the future.

PROBLEM STATEMENT

5G is often used in a singular context when talking about technology. However, 5G is made of several types of architectures and variables. These include variations in spectrum, hardware, software, and physical location of assets. When taken holistically, there are dozens of 5G configurations that provide both advantages and disadvantages depending on the use case.

These configurations then result in interdependencies between cost, complexity, availability, risk, and performance. Most literature and marketing materials are targeted at consumer use applications and are skewed toward service providers. One of the impediments to the adoption of 5G wireless technology in manufacturing is the confusion caused by this ambiguity.

MxD Project 21-18-05 will focus on the demonstration of connectivity and performance of a 5G network and its comparison to traditional wired ethernet within a complete network architecture.

OBJECTIVES

The primary goal of MxD Project 21-18-05 is to demonstrate and measure the performance of selected configurations of 5G, in a neutral and objective manner, when utilized in industrial buildings, specifically in IIoT networks where digital applications are performed, and to compare the performance of such a network to a simple wired counterpart. Finally, this information is to be made publicly available for broad industry use, including DoD.

The objective of project 21-18-05 is to verify and validate the performance of a determined “optimized” 5G network to a known wired counterpart via gathering performance diagnostics



throughout a IIoT 5G network, doing similar for a wired network, and providing a final report that details the performance of selected 5G system architectures and configuration for industrial settings to their wired counterparts.

REQUIREMENTS

Key Tasks:

- Detail the selected 5G architecture and configuration installed in MxD that is to be tested and measured.
- Determine potential candidates for wireless sensors within the facility such as emergency lighting, environmental conditions, door activation, etc.
- Investigate and determine wireless gateway scheme for these sensors to operate on the 5G system.
- Formulate a methodology for reliability, throughput, and latency testing of data to/from these devices on the networks. Data integrity should be tested in a variety of industrial conditions to be determined by the project team.
- Procure and integrate/install any sensors and related IIoT equipment intended for use in the network architecture.
- Determine equipment needed to complete testing from the formulated testing methodologies.
- Identify, quote, and procure any data analyzers and related test equipment.
- Perform and document data integrity testing of wired verse wireless 5G system.
- Perform and document latency and throughput testing of wireless sensors on the 5G system.

MxD will measure the performance of 21-18-05 as issuance of a detailed report, suitable for publication, which includes the analysis of the different performance specs. of the 5G selected configurations, a comparison of the 5G networks to a wired counterpart, a detailed summary of benefits and risks of the different selected architectures and configuration scenarios, and which makes a recommendation of top scenarios for industrial building application based on testing. A presentation of the impacts of additional technologies such as O-RAN and Next G will also be included in the report.

A response to this RFQ must have a detailed, itemized breakdown of the minimum requirements outlined above and any additional inputs if they are relevant to supporting the objectives.



SCOPE OF WORK

Deliverables:

Two reports, suitable for publication, with one summarizing test methodology, analysis, and a comparison of the wireless vs wired network performance, and the other further detailing the differences in performance between wired and cellular wireless networks and offering recommendations for 5G architecture(s) and configuration(s) in industrial buildings, including retrofitting information for such facilities that already contain significant wired infrastructure. The present and future state of O-RAN and NextG should be considered in the recommendations. This report can be used as a guideline for facilities to begin their steps towards implementing 5G today as well as to consider the up-and-coming technologies of the future.

Period of Performance: 6 months

Estimated start date: July 2023

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.



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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 quotation. 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 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
Gantt Chart	Program schedule and milestones	Quotation Response
Program Review	Summary of progress towards objectives and deliverables.	Weekly
Technical Documents	Per Technical Deliverables	Per Technical Deliverables
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 a report will also identify potential hazards requiring corrective action.	Immediately on Occurrence
Government Required Documentation	Additional reporting based on government contractual requirements.	As Needed

PERIOD OF PERFORMANCE REQUIREMENTS

Estimated period of performance is 6 months from 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 quotation. 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 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.

The Agreement between MxD and the Government **does NOT allow for any profit, fee or proceeds** for the Prime sub-recipient and the quotation must include the signed certification acknowledging the costs proposed do not include profit, fee or proceeds. If completion of the work outlined in this RFQ or submitted quotation requires commercially available goods or services to be purchased from a team member or third party, the allowance of profit, fee, or proceeds associated with that purchase will be evaluated based on the governing regulations of the agreement between MxD and the Government.

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

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

If a Respondent or Awardee wishes to promote their affiliation with MxD as a result of this RFQ 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). 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 RFQs in any capacity unless they address the following conditions:

- FFRDCs or Government entities may not exclusively respond to this RFQ.
- 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 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

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 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 the PMO, 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 quotation. Selectability determination incorporates average EB judgement of objective compliance, budget availability, and overall perceived value. The EB will identify a list of quotations 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 proposed quotations 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 quotation is evaluated by a specific set of criteria. Below are the quotation evaluation criteria for this RFQ:

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



VIII. PROJECT AWARDS

CONTRACT

The award of this contract will be subject to the requirements of the Collaboration Agreement between the Construction Engineering Research Laboratory (CERL) and MxD. All contractual negotiations related to RFQs 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 quotation to better align to RFQ requirements.

SUBMISSION DETAILS

Each Respondent must submit their quotation no later than **5:00PM Central Time, April 13th, 2023**. All submissions must be made on the MxD website. The SUBMIT button can be found on the program page at 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

References: Table 2

Document Title	Document Number
US Code of Federal Regulation	N/A

Acronyms: Table 3

DoD	Department of Defense
EB	Evaluation Board
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
RFQ	Request for Quote



Attachment 1

Certification of Foreign Firms, Travel, & Non-U.S. Citizens

Request for Quote Number: _____

Proposal Title: _____

Proposal Team Lead: _____

Date: _____

- There is NO foreign travel proposed for this effort.
- There is NO Foreign Firm or Institution participating on this effort.
- There is NO participation by Non-U.S. Citizens proposed for this effort.
- There is NO work to be performed outside of the United States 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. In providing justification for foreign participation there should be an explanation of why the proposed foreign participant is the only person available that can do the work and why you are unable to find a US citizen to do the work. Foreign participation should be unusual and limited to experts that are uniquely qualified to do the work. Requests that include work that any student or any student with a similar background could do will probably not be granted. The foreign participation requests need to state why a particular person or student is the only person that can do the work and why there is not a US citizen available.