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Jefferson City, Missouri 65102

Missouri Department of Transportation
Patrick K. McKenna, Director

1.888.ASK MODOT (275.6636)

June 26, 2019

Dear Research Partner:

The Missouri Highways and Transportation Commission requests proposals from qualified organizations—namely private consultants, universities, and research organizations—to furnish professional services as described in the following request for proposal to be coordinated by the Research Unit of the Construction and Materials Division.

Please submit a proposal for project **TR202006** entitled, “**Transportation Infrastructure Asset Monitoring through the Industrial Internet-of-Things**” Your submittal must include a work plan, the proposed project team and its background, and any related projects now active or recently completed by your firm. The project team must be led by a licensed professional engineer in the state of Missouri and the final report must be sealed, in accordance with the provisions of Chapter 327 RSMo.

The selection committee will use Qualification Based Selection. A “not to exceed” budget amount is included in the RFP to assist with the required scope, but budgets are not to be included with the proposal submissions, and will not be presented to the selection committee.

Please submit all proposals to the [Research Administrative Engineer](#) by **August 12, 2019 10:00 AM (CST)**. More information about project contracting in general can be found at <https://www.modot.org/information-researchers> under RFP documents.

Sincerely,

Jennifer Harper
Research Administrative Engineer



Our mission is to provide a world-class transportation system that is safe, innovative, reliable and dedicated to a prosperous Missouri.

www.modot.org

Background

The Missouri Department of Transportation (MoDOT) manages and maintains some 10,385 bridges and culverts, 33,859 miles of state highway and countless other assets related to the transportation system and to improving traveler safety.

Each integral part that makes up the whole of a structure, pavement, slope or other piece of infrastructure is subject to deterioration, movement and other hazards when put against the environment and time, and is therefore limited in its respective service life. Monitoring of known or perceived issues with these assets in the past has been accomplished by making trips to the respective asset, taking measurements and/or readings (i.e., tilt/angle, crack length, skew, etc.), and then logging the time component and the information gathered. Plotting the time and gathered information could give a relative idea of the behavior of an asset over that period. This process is time consuming and only provides relevant information following the moment when someone travels out to gather measurements or returns to log and compares data against past measurements. Developments in remote sensor monitoring aim to transform this once manual process into an automated one.

The Industrial Internet-of-Things (IIoT) is the name given to interconnected computing devices, sensors, instruments and other technology that collects data or information at a prescribed interval of time and transmits that information over existing communications infrastructure. The information can be used to continuously analyze and possibly predict the status of the asset being monitored. Combined with faster communications networks, anything from data collection to dissemination and analysis can be near instantaneous, providing important status alerts for critical infrastructure at a moment's notice.

The persistent data collecting nature of this technology also paints a picture of being able to visually see when certain assets are nearing their end-of-service life (after enough similar assets are monitored over a period of time). Being able to identify critical thresholds, whether they are preventative or restorative in nature, will aid in creating more effective maintenance schedules and reducing costs and downtime.

With MoDOT managed assets being so numerous and at different stages in their life-cycles, having a means of monitoring critical infrastructure assets would be highly valued. Being able to access life-cycle data for different types of construction (bridges or pavement) could aid in better understanding of proactive and cost saving maintenance schedules along with determining life-cycle cost analyses for various assets. Additionally, this technology has shown the ability to monitor traffic flow or congestion, identify potentially hazardous pavement during inclement weather and outline other valuable roadway conditions that would provide benefit in day-to-day operations within the Department.

This project consists of two independent phases. Phase 1 investigates what sensors and capabilities are currently market ready and how they could benefit the Department. If the results from Phase 1 address Department needs and demonstrate intrinsic value, Phase 2 will further explore the findings of Phase 1 and begin implementation through installation, monitoring of assets and analysis of data.

Objectives

The objectives of this project are as follows:

Phase 1:

- Generate a list, with the assistance of MoDOT personnel, of assets that would most benefit from instrumentation and monitoring.
- Gather information on available IIoT sensors and monitoring devices, communications networks, service application software/platforms; specifically those that would address monitoring of assets previously outlined.
- Report and present research findings illustrating the viability and value of current technology in monitoring MoDOT assets.

Phase 2:

- Collaborate with MoDOT personnel to finalize designation of the assets and locations for monitoring, along with what will be monitored.
- Install instrumentation/monitoring devices on selected assets.
- Evaluate communications networks for the best service, range, reliability and cost, among other factors.
- Evaluate and analyze collected data; establish notification/alarm thresholds, determine potential maintenance schedules, and use studied and relevant data to create predictive models where applicable.
- Investigate and evaluate additional applications for tested hardware or new sensors that have come to market that may benefit MoDOT in monitoring of assets.
- Provide a final report detailing the findings of the project, including the data analyzed during the duration of the project.

Project Requirements

Phase 1

Task 1: Project Management

The Contractor will facilitate a kickoff meeting with MoDOT to review the work plan, scope, and schedule; and establish a protocol for regular ongoing communication and coordination with the team. This proposal will serve as the Draft Work Plan, to be discussed in the kickoff meeting. Upon comments received during the meeting and/or in writing, the Contractor will incorporate those comments into a Final Work Plan.

The Contractor will conduct a quarterly status meeting to review progress for the previous period and anticipated work for the next period. Contractor will also develop minutes for the kickoff meeting and each of the quarterly status meetings.

Task 2: List and Define MoDOT Assets Suitable for IIoT Monitoring

Upon Notice to Proceed, MoDOT and the Contractor will collaborate to create a general list of MoDOT assets (types) that would benefit from monitoring. A draft list of specific assets and/or locations (high value or immediate need) to monitor should be generated at this time.

Task 3: Research/Literature Review

The Contractor will perform a literature search of market ready IIoT sensors and monitoring devices, communications networks, service application software/platforms and other relevant elements necessary for successfully implementing IIoT monitoring of assets. Sensors, communications networks, service platforms and other items identified in the review as viable candidates for the project will be outlined or listed as such following the review. Please note, it is of the utmost priority that long-term interoperability or standardization of sensor/network/platform combinations be sought and thoroughly reviewed in this task, to ensure the viability of continuous monitoring operations and to further promote the use of this technology by the Department after the conclusion of this project. The Contractor will propose a list of MoDOT assets for monitoring, based off the findings of the review. Finally, the Contractor will include a review of past research and/or projects related to DOT remote asset monitoring, similar in nature to this research project.

Task 4: Develop Project Summary and Presentation of Review Findings

The Contractor will prepare a final project summary (report) outlining the market ready sensors, communications networks and service platforms that would facilitate monitoring of MoDOT assets outlined in Task 2, along with viable combinations for the assets proposed by both MoDOT and the Contractor. The project summary will present the findings of the literature review from Task 3, demonstrate the feasibility of monitoring specific assets and present methods to support a successful Phase 2 implementation.

Phase 2

Based upon results from Phase 1 and the benefits and costs associated, MoDOT will make a determination of whether or not to proceed with Phase 2 within 90 days following with the delivery of the Phase 1 Final Project Summary. If MoDOT proceeds with Phase 2, a work plan and budget will be developed with the awarded Contractor for Phase 1.

Task 5: Designate Assets, Define Monitoring Effort and Select Network and Platform for Assets

The Contractor and MoDOT will collaborate to finalize a list of specific assets to monitor and the type of monitoring to be performed at each location. At this time the sensor(s), communications network and service platform for initial monitoring will be selected for each asset, per the findings of the literature review and elections made by MoDOT. Dependent on the cost, interoperability, availability and other determining factors, multiple variations of sensors, communications networks and service platforms should be chosen for testing purposes among the assets to be monitored, if more than one option is deemed to be feasible.

Task 6: Instrumentation and Monitoring

The Contractor will install the equipment/instrumentation as designated in the finalized list of assets to monitor. The Contractor will commence asset monitoring activities using the chosen communications network and service platform for each asset/location, with data collection ongoing.

Task 7a: Data Analysis and Evaluation of Thresholds, Schedules and Models

The Contractor will analyze the collected data over prescribed periods and look for potential alarm thresholds (critical assets), maintenance or restoration schedules, or other predictive models for the assets as applicable.

Task 7b: Sensor, Communications Network and Service Platform Evaluation

The Contractor will evaluate the quality, ease of use, interoperability and other aspects of the sensor, communications network and service platform variations chosen for the various assets. It is of the highest priority that long-term interoperability or standardization of sensor/network/platform combinations be sought and thoroughly tested to ensure the viability of continuous monitoring operations and to further promote the use of this technology by the Department after the conclusion of this project.

Task 7c: Emerging Sensor Technology and Asset Application Review

The Contractor will periodically, and at a minimum quarterly during the project, review literature and industry trends for new applications of currently tested sensors on MoDOT assets/scenarios, along with identifying any developing technology that could benefit or enhance monitoring of MoDOT assets.

Task 8: Develop Report and Presentation

The Contractor will develop a final report detailing the tasks completed during the project including any and all findings generated during the project's duration. A presentation for MoDOT Staff, summarizing important or significant details of the project, may also be required.

Project Deliverables

For templates and forms for reports and plans, visit <https://www.modot.org/information-researchers>

Email Communications

E-mail and phone communications between the Principal Investigator(s) and MoDOT contacts as necessary are required to provide on-going updates of progress throughout the project.

Data Management Plan

The plan is a formal document that describes the data that is acquired, created or produced during the project, specifies who owns it and who can access it as well as information on how it will be described, managed, analyzed, stored, shared and preserved during and after the project is over. Please refer to templates on the website.

Quarterly Reports

Quarterly reports should be submitted throughout the project on the last day of March, June, September and December. The quarterly reports are not intended to replace any additional correspondence between the research team and MoDOT needed to keep the project moving. Please refer to template on the website.

Draft Final Project Summary and Draft Final Report

These drafts should be final products except for revisions based on MoDOT's review. A final report must include a completed Technical Report Documentation page. Please refer to **Publication Guidelines** and summary template on the [website](#).

Final Project Summary and Final Report

After MoDOT's review is complete and documents have been edited to MoDOT's satisfaction, final documents should be submitted as Word documents (unless otherwise instructed). Please refer to **Publication Guidelines** and summary template on the [website](#).

Final Presentation

May be required. The Contractor will present the results, recommendations, and implementation ideas to MoDOT and other stakeholders. The Contractor will coordinate location, date, and meeting fees with MoDOT. For stakeholder and agency participants, any travel and lodging fees are to be covered by individual attendees or their firms. MoDOT and stakeholders will provide feedback to the Contractor, especially related to implementation.

Task-Specific Deliverables

Task	Deliverables
1	<ul style="list-style-type: none">• Schedule and conduct kickoff meeting.• Kickoff meeting minutes.• Draft and final work plans.• Quarterly project status meetings.
2	<ul style="list-style-type: none">• List of MoDOT assets where monitoring would be applicable/beneficial.• With input from MoDOT, draft a list of specific assets/asset types/locations (high value or immediate need) for monitoring.
3	<ul style="list-style-type: none">• List of candidate sensors, communications networks, service platforms, etc. for the project.• List of Contractor-proposed MoDOT assets for monitoring.
4	<ul style="list-style-type: none">• Phase 1 Project Summary on findings from Task 3 specifically related to MoDOT assets, detailing viability and setting the stage for a successful implementation of Phase 2.
5	<ul style="list-style-type: none">• Finalized list of assets to be monitored, including but not limited to the asset type, location, sensor(s) employed, communications network, service platform and any other relevant details on an asset-by-asset basis.
6	<ul style="list-style-type: none">• Monitoring data (depending on the amount of data collected, this may be limited at MoDOT's discretion).• Important and/or informative details regarding installation processes.
7	<ul style="list-style-type: none">• Data analysis findings, including any conclusions on potential alarm thresholds, maintenance schedules or predictive models if developed.• Sensor, communications network, service platform (each/compiled variations) evaluation.• Results from new/alternative sensor applications and emerging asset monitoring technology review.
8	<ul style="list-style-type: none">• Final Report• Presentation• Final Project Meeting

Project Schedule

The following is an estimate of the project timeline or information on key dates within the project, presuming the project starts **September 27, 2019**. Proposals need to include a work plan with a proposed timeline. For a sample of a work plan template, see link below. Changes to our estimated project timeline below will be considered, however, timeline extensions cannot be guaranteed. The project timeline will be discussed and finalized during the kickoff meeting.

The Offeror will provide a proposed schedule to complete the work including the following items: quarterly progress meetings, draft final report, and final report.

The draft final project summary shall be completed and provided to MoDOT within nine months of the Notice to Proceed. All work shall be completed and the final project summary provided to MoDOT within ten months of the Notice to Proceed.

For report templates and forms, visit <https://www.modot.org/information-researchers>.

Date	Milestone
On or before 10/11/2019	A kickoff meeting with MoDOT will be scheduled to discuss project requirements and deliverables. The dates of key milestones and deliverables will be determined from this meeting.
12/31/2019	Quarterly report due.
3/31/2020	Quarterly report due.
5/29/2020	Draft Final Project Summary (report) due.
6/30/2020	Final Project Summary due.
9/30/2020	Begin Phase 2 – Upon MoDOT’s decision to proceed with Tasks 5-8.
12/31/2020	Quarterly report due.
3/31/2021	Quarterly report due. Details on installation process and current monitoring status for all proposed assets due.
6/30/2021	Quarterly report due.
9/30/2021	Quarterly report due. Evaluation of sensors, communications network and service platform variations underway prior to this date.
12/31/2021	Quarterly report due.
3/31/2022	Quarterly report due.
6/30/2022	Quarterly report due.
9/30/2022	Draft final report is due.
11/30/2022	Final draft report is due.
12/31/2022	Final invoice due & Contract ends.

Special Notes

Project budget is not to exceed **\$60,000** for Phase 1. Phase 2 scope and budget will be determined following the conclusion of Phase 1, if MoDOT decides to proceed with Tasks 5 through 8 subsequent to the findings and conclusions of the Phase 1 project summary (report). A budget is not to be included in the proposal, but will be required for the contract and must be within this limit. For a sample Budget template, report templates and forms, see <https://www.modot.org/information-researchers>.

RFP Requirements

- “Contracting Documents” provide further details and links to the required forms. They are available at <https://www.modot.org/information-researchers>.
 - **Organization’s Project Experience:** The proposal must clearly identify the Organization’s experience in offering the services requested in this RFP during the past three (3) years. The description should include a list of the agencies which your organization has served during this time period or currently serves. Please highlight any work you have done with other state agencies or local governments.
 - **Team Member Experience:** Please list all team members (including subcontractors) proposed to work on the project. Attach licenses, certifications and resumes for key personnel.
 - **Organization’s Client References:** Proposals should indicate the name, title, and telephone number of at least three clients within the past three years.
- Proposals must be no more than 10 pages in length with a font size no less than 11 points. This length limit **does not include** the Proposal Submission Form, Organization’s Project Experience, Team Member Experience, Organization’s Client References and optional cover letter (if included, one page maximum).
- Proposals must be submitted as one combined PDF document. The submission should **only include the required documents** organized in the following order: 1) Proposal Submission Form; 2) Cover Letter (Optional; 1 page maximum); 3) Body of Proposal (including work plan); 4) Organization’s Project Experience; 5) Team Member Experience; and 6) Organization’s Client References.
- The Offeror must respond to this RFP by submitting all the information required herein for its proposal to be evaluated and considered for award. Failure to submit all the required information shall be deemed sufficient cause for disqualification of a proposal from consideration.
- Proposals will be evaluated by an agency and stakeholder team with knowledge and backgrounds in relevant areas for this project. Selection of the successful Offeror will be based on the Offeror’s demonstrated knowledge in the required areas, the merit of the proposed methods and approach in achieving the desired goals, the experience and qualifications of the team, the plan for ensuring implementation of results, and the adequacy and availability of team members to complete the work in a timely manner.
 - Correct proposal submission is one of the evaluation criteria. If submission instructions in this section are not followed, the **Offeror risks an automatic 10 point deduction (out of 100 total points)** when points are awarded during the Proposal Evaluation Process.

RFP Schedule

This document constitutes an RFP from qualified organizations to conduct the TR202006 - Transportation Infrastructure Asset Monitoring through the Industrial Internet-of-Things study for the MHTC and Missouri Department of Transportation (MoDOT). MHTC reserves the right to reject any and all proposals for any reason whatsoever.

The following RFP Schedule of Events represents MoDOT's best estimate of the schedule that shall be followed. The time of day for the following events shall be between 7:30 am and 4:00 pm, Central Standard Time unless otherwise noted. MoDOT reserves the right at its sole discretion to expand this schedule, as it deems necessary, without any notification except for the deadline date for submitting a proposal. Time is of the essence for responding to the RFP within the submission deadlines.

The following timeline must be met for a proposal to be accepted.

Date	Action
6/26/2019	MoDOT posts RFP to the website at https://www.modot.org/research-requests-proposal .
7/15/2019 4:00 PM (CST)	Written comments or questions must be submitted to Research Administrative Engineer .
7/24/2019	MoDOT will post written responses publicly on the website at https://www.modot.org/research-requests-proposal .
8/12/2019 10:00 AM (CST)	Written proposals must be submitted to Research Administrative Engineer .
8/30/2019	MoDOT will notify submitters about project selection, or if needed about interviews to finalize selection.

Contracting Requirements

The successful team will be required to complete additional documentation and enter into a contract such as a "Standard Research Agreement" or "Task Order." Applicants should be aware of these additional needs so contracting can proceed in a timely manner.

As part of the eAgreements process, MoDOT uses an electronic signature tool, DocuSign, for signing agreements electronically. All parties of the agreement must agree to sign electronically in order to utilize the electronic signature option. If your proposal is selected, you will be informed about how to obtain your credentials for electronic signatures (including how to become a MoDOT vendor if you are not already).

Standard contracts, forms, attachment templates and additional information are available from the [Research Administrative Engineer](#) or the website at <https://www.modot.org/information-researchers>.

Proposal Submission

Submission Deadline

Proposals must be emailed by **10:00 AM (Central Standard Time)** according to email time stamp by the submission date in the RFP Schedule to the Research Administrative Engineer's attention (Jennifer Harper) at: MoDOTResearchRFP@modot.mo.gov. Please reference the project title since more than one RFP may be due at one time. Electronic proposals are required.

Submission Confirmation

You will receive an email confirmation after your proposal has been received. If you do not receive such a confirmation by **12:00 PM (Central Standard Time)** on the day of the deadline, please contact us at MoDOTResearchRFP@modot.mo.gov as soon as possible. Your submission should not be considered received until you have received your email confirmation.