TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): **Wisconsin DOT**

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # **TPF-5(432)**	Transportation Pooled Fund Program - Report Period: ☐ Quarter 1 (January 1 – March 31) **X** Quarter 2 (April 1 – June 30) ☐ Quarter 3 (July 1 – September 30) ☐ Quarter 4 (October 1 – December 31)

Project Title:
Bridge Element Deterioration for Midwest States

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Lead Agency Project ID: 0092-19-40	Other Project ID (i.e., contract #): N/A	Project Start Date: December 3, 2019
Original Project End Date: December 2, 2021	Current Project End Date: November 3, 2022	Number of Extensions: 1

Project schedule status:

☐ On schedule   X On revised schedule   ☐ Ahead of schedule   ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$498,017	$464,264	93%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$62,943 / 13%	$62,943	93%

Project Description:

Scope

The objective of this pooled fund research is to have multiple Midwest DOTs pool resources and historic Midwest DOT bridge data related to element-level deterioration, operation practices, maintenance activities, and historic design/construction details. This data will provide the basis for research to determine bridge deterioration curves. A select number of deterioration curves will provide needed utility for the time-dependent deterioration of bridge elements to be used in making estimates of future conditions and work actions. This effort will pool data and through the analysis and research processes create results that will improve the accuracy of various bridge management and asset management applications that the member DOTs use (AASHTO BrM, Agile Assets, and others).

This study is sequenced into three tiers based on the priorities of the DOTs:

Tier 1 National Bridge Elements (NBE) & National Bridge Inventory (NBI) Components:

- Develop element-level deterioration curves for Reinforced Concrete Deck.
- Develop element-level deterioration curves for Reinforced Concrete Slab.
- Develop deterioration curves for NBI component items (i.e. bridge deck, superstructure, and substructure).
- Develop element-level deterioration curves for Reinforced Concrete Deck after a major preservation activity such as mill and overlay with the rigid concrete wearing course.
- Develop predicted improvement in the condition of Reinforced Concrete Deck element after a major preservation activity such as mill and overlay.
- In addition to probabilistic deterioration curves, also develop select deterministic deterioration curves.

Tier 2 Bridge Management Elements (BME) & Remaining NBE Elements

- Develop element-level deterioration curves for each type of wearing surface (bare concrete, sealed concrete, thin polymer overlay, Polyester Polymer Concrete (PPC) overlay, ridged concrete overlay, Polymer Modified Asphalt overlay, and asphalt overlay with membrane).
- Develop element-level deterioration curves for Strip Seal Deck Joints and Modular Deck Joints.
- Determine defect-level deterioration curves that describe defect development and progression (e.g., cracking and delamination).
- Develop deterioration curves for Paint system (protective steel) effectiveness.
- Develop defect-level deterioration curves for Steel Girder corrosion, and correlate to Paint system effectiveness; specifically, how long from new paint to 75% and 50% effective and end of life.
- Develop element-level deterioration curves for substructure elements in harsh environments (e.g., pier caps under expansion joints, pier columns in spray zone from snow plows, etc.).

Tier 3 Similar Agency Defined Elements (ADE) & Inspection Related

- Identify Agency Defined Elements (ADE) that would be of use for other Midwest DOTs to consider adopting.
- Determine what type of inspection information related to Nondestructive Evaluation (NDE) Midwest DOTs have and how it is used that translates into information on element-level defects (Ground Penetrating Radar (GPR), Infrared Thermograph, or other).
- Provide a summary of policy, guidance, and practices that Midwest DOTs employ to relate NDE results to defect reporting (to describe delamination and deterioration) and how DOTs use NDE to make quantifiable inspection and actionable work actions for concrete bridge decks.

Expected Findings and Benefits

The project will deliver the following items:

- Literature review which will detail the current state of the practice for bridge deterioration modeling and will include the literature review, a survey, and targeted interviews.
- Data screening procedure. This will allow participating States to help understand the validity of their data and its pros and opportunities for improvement.
- A populated and documented open source database and analysis engine which the States can use to explore and model their data or data from other States in an easy to use interface.
- Tier 1 models.
- Tier 2 models.
- Tier 3 information.

Overall the main thrust of this project is to produce deterioration models to fuel the analysis of bridge performance for selected items.

The activities, tools, practices, policies, or methods in partner States that would be impacted by the research findings include:

- Bridge management practices and policies.
- Deterioration modeling of bridge components.
- Deterioration modeling processes which can be applied to other element level bridge components.
- Development of defensible system performance targets.
- Development of bridge work plans.
- Performance of risk analysis to determine which bridges are more at risk from a condition standpoint.
- This project will provide participating States strengths and opportunities for improvement in their data collection policies, procedures, and methods.

The primary benefit of this project to the participating States is the ability to plug the resultant models into their asset management systems and immediately begin to use the data to make better, data-driven decisions. A secondary benefit of this project is the provision of the online database and analysis engine that will be designed for the participating States to run their own analysis at the NBI level or NBE level using their State's data, a portion of the participating States' data, national data, or some other permutation. This will empower the participating States to explore the data and come up with deterioration models as new data are available or new analysis concepts are uncovered.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

Task 1 – Project Management

A progress report was issued, and the project was managed. We held monthly status calls with the participating States and calls with the Wisconsin DOT Project Manager. Dr. Richard Boadi became the Principal Investigator for completion of the project.

This task is 95% complete. No problems have been encountered to-date.

Task 2 – Literature Review

This task is 100% complete.

Task 3 – Data Collection

This task is 100% complete.

Task 4 – Develop Data Screening Procedure

This task is 100% complete.

Task 5 – Develop Data Management Policy

The project team delivered a memorandum for discussion with the States in the previous quarter. The States decided to place a hold on this task until more was known about hosting the dataset. This task is 95% complete.

Task 6 – Develop Tier 1 Deterioration Curves

The team refined the Tier 1 models (RC Decks, RC Slabs, Deck component, RC Deck after Major Preservation). The project team conducted meetings to review the models and spreadsheets.

These models were issued to the TAC and currently under review. The States review is due on July 8, 2022.

This task is 95% complete as per the original scope.

Task 7 – Develop Tier 2 Deterioration Curves

The project team refined the 7.1 Wearing Surfaces model after beginning it in a previous quarter. The team processed the analysis dataset and developed the remainder of the Tier 2 models, including Deck Joints, Defect Development and Progression, Paint System Effectiveness, Steel Girder Corrosion, and Substructure Elements in Harsh Environment. The team also developed and issued a report documenting the process for developing these models. We held meetings to discuss the results. The models are currently under review with the TAC team until July 29, 2022.

This task is 95% complete.

Task 8 – Develop Tier 3 Inputs

The team reviewed the data submitted by DOTs and developed a summary of practices that Midwest DOTs employ to relate NDE results to defect reporting (to describe delamination and deterioration) and how DOTs use NDE to make quantifiable inspection and actionable work actions for concrete bridge decks. The team responded to several inquiries from states, participated in meetings to discuss the findings, and developed and issued a report for this task for review by the TAC until July 29, 2022.

This task is 95% complete.

Task 9 – Final Project Deliverables

We developed and issued an annotated outline for the final report to be compiled from task deliverables, and issued it for review.

This task is 15% complete.

Anticipated Work Next Quarter:

Task 1 – Project Management

We will issue a progress report and invoice. We will continue the monthly status calls with the participating States on the third Friday of every month. Keeping all States informed of progress and discussing key technical issues is a critical step in the success of this project.

Task 2 – Literature Review

The literature review task has been completed.

Task 3 – Data Collection

The data collection process has been completed.

Task 4 – Develop Data Screening Procedure

The data screening task has been completed.

Task 5 – Develop Data Management Policy

We will finalize the policy.

Task 6 – Develop Tier 1 Deterioration Curves

The project team will finalize the models based on feedback from the States and provide a final report on the Tier 1 development process.

Task 7 – Develop Tier 2 Deterioration Curves

The project team will finalize the models based on feedback from the States and provide a final report on the Tier 2 development process.

Task 8 – Develop Tier 3 Inputs

The project team will finalize the report based on feedback from the States and provide a final report on the Tier 3 inputs.

Task 9 – Final Project Deliverables

The project team will assemble the task reports into one document to produce the final project report. We will participate in one face-to-face meeting with the TAC team to present the final results.

Significant Results:

A significant result is that the project team has an improved fully populated revised data analysis database, a critical aspect of this project.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems):

The project is on schedule following the addendum in 2022. The participating states are reviewing a series of technical deliverables over the summer months, from which technical work will be complete on August 30, 2022. The balance of project time is then for compilation of the final report and delivery of data sets.

Potential Implementation:

The Tier 1 and 2 models that will be finalized within the next 6 weeks are very robust. There is a large dataset used to develop the models and results are intuitive. These models can be implemented by member and other States to enable and support bridge management functions in the DOT. In addition, the analysis matrix has been developed so that TAC members can update and run their State's data to update the models.