

TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Iowa 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(295)		Transportation Pooled Fund Program - Report Period: Quarter 1 (January 1 – March 31, 2015) Quarter 2 (April 1 – June 30) Quarter 3 (July 1 – September 30) X Quarter 4 (October 1 – December 31)	
Project Title: Midwest Smart Work Zone Deployment Initiative			
Name of Project Manager(s): Dan Sprengeler	Phone Number: 515-239-1823	E-Mail Dan.Sprengeler@dot.iowa.gov	
Lead Agency Project ID: Keith Knapp	Other Project ID (i.e., contract #): Addendum 535	Project Start Date: July 1, 2014	
Original Project End Date: June 30, 2020	Current Project End Date: June 30, 2019	Number of Extensions: None	

Project schedule status:

On schedule
 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
\$700,000 (committed)	\$131,769.36	0

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$16,520.97		0

Project Description:

The Midwest Smart Work Zone Deployment Initiative (MwSWZDI) was initiated in 1999 as a Federal Highway Administration (FHWA) Pooled Fund Study intended to coordinate and promote research among the participating states related to safety and mobility in highway work zones.

The program is an ongoing cooperative effort between State Departments of Transportation, universities, and industry. The studies completed have consisted of evaluations of various work zone related products, various innovative topics, and several synthesis studies. Completed reports and descriptions of ongoing projects can be obtained at the Iowa State University's Institute for Transportation (InTrans) website (www.intrans.iastate.edu/smartwz/) link to the Smart Work Zone Deployment Initiative. InTrans currently operates as the program manager of the pooled fund efforts and completes administrative tasks related to request for ideas and proposals, meetings, project files, quarterly reports, and recommending reimbursement.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**Quarter Ending December 31, 2015 (Overall)**

During this quarter we communicated with a number of principal investigators as needed. Resolved some progress issues as they occurred. All of the contracts for Year 2014 and 2015 continued and are described separately below. The final draft of one report was completed, reviewed by the Board, and was posted in January 2016. Three projects were extended.

Administratively, we communicated with Board about the proposals received for the next program year (Year 2016). The proposals for the problem statements submitted were reviewed and ranked by the funding states. A two round ranking and weighting process was completed because a number of the problem statements had competitive proposals (from two to four). A meeting of the Board to discuss the final rankings was not possible this quarter but is expected to occur in January 2016. The final ranking has been completed and three to four projects should be able to be funded along with the administrative contract. The Iowa DOT agreed to the 2016 administrative contract.

The following is a summary of accomplishments from October 1 to December 31, 2015 for the Year 2014 and 2015 individual research projects under fund account TPF-5(295).

2015 Program Projects

- Evaluation of Alternative Work Zone Signing, University of Wisconsin – Madison, Madhav Chitturi as PI.

This project officially started June 1, 2015. Literature Review is now expected to be completed by 01/31/16. Survey protocol is under IRB review at both UW-Madison and University of Missouri. Purchased tablet-PCs for survey. Started the programming of survey on tablet-PCs. Identified signs to be included in the survey. This project is 15% complete. It is expected to end by August 31, 2016.

- Developing a Data Driven Traffic Impact Assessment Tool for Work Zones, University of Missouri-Columbia, Praveen Edara as PI.

This project is officially started June 1, 2015. Mining of work zone and traffic data for St. Louis was initiated. The e-alerts consisting of work zone schedule and duration information and activity information that were provided by MoDOT were processed for major freeway and arterial corridors in

the region. Travel time data for the days with and without work zone were also extracted from RITIS database for I-270 and MO-141 corridors. Delay values were then calculated. Regression and artificial intelligence models are being explored for estimated delays as a function of work zone and other factors. One challenge in developing these models is the sample size needed to identify statistically significant relationships. Requirements were also established for the prototype tool to be developed. MATLAB was used to develop a simple test user interface. The project is approximately 25% complete. It is expected to end by December 31, 2016.

- Orange Work Zone Pavement Marking Midwest Field Test, University of Wisconsin – Madison, Madhav Chitturi as PI.

This project started March 13, 2015. Literature review is expected to be completed by 02/15/2016. We have collected information on standards and specifications of different agencies and also material specifications from different vendors. Met with Wisconsin DOT again to identify potential sites for field evaluation of orange pavement markings. To assist potential test site hosts we have been attempting to obtain orange pavement marking material pricing information; this has been challenging due to the limited availability of these items. For example, although 3M sells orange pavement marking tape in several countries worldwide but their US office has shown little interest in supplying this product (3M's foreign subsidiaries are prohibited from providing price quotes to US customers). Reviewing data from the use of orange pavement markings at the Zoo Interchange in Milwaukee, WI. The project is still about 10% complete. It is expected to end by September 30, 2016.

The PI has again indicated that the identification of field test sites is behind schedule due to staff turnover at Iowa DOT and Wisconsin DOT. In addition, there continues to be a risk that Iowa DOT and/or Wisconsin DOT will not be able to identify appropriate test sites. If that occurs indicates that it is their intent is to poll the other SWZDI states for candidate locations. Another fallback option would be to conduct the research using a photorealistic simulation that presents road users with the same scene, with and without the orange-color markings.

- Setting Work Zone Speed Limits, Iowa State University, Anuj Sharma as PI.

The survey has been distributed to SWZDI states. Upon visualization and exploration of the Wavetronix data it was found that there exists following issues with the downloaded data: a. Night time speeds are often low and upon investigation it was found that the data archiving process repeats the previous speeds in absence of new data. This process is not well documented and might vary from sensor to sensor and b. There are time when Wavetronix sensor continuously report low speeds for extended periods of times. To overcome these issues data cleaning algorithms are being designed that can process massive sets of data to filter the erroneous data prior to data analytics. A simulation network will be created for one location and variable speed limit experiments will be run on this network. This project started March 15, 2015 and is approximately 70% complete. It is expected to end on May 31, 2016.

2014 Program Projects

- Work Zones in Innovative Geometric Designs Locations, University of Missouri, Henry Brown as PI.

A draft of the report was completed and sent to the TAC and sent for review on August 14, 2015. Comments were received from the TAC, and the report was revised to address these comments. The revised draft was sent to the SWZDI BOD on October 14, 2015 for review. No comments from the SWZDI BOD were received. The final report was submitted to SWZDI on November 23, 2015. The project is currently 100 percent

complete and had an original end date of June 30, 2015. An additional two month extension to November 30, 2015 was granted.

- Safety Assessment Tool for Construction Work Zone Phasing Plans, University of Missouri, Henry Brown as PI.

Survey. A survey to obtain information regarding best practices of state DOTs and other agencies for incorporating safety analysis into the process of evaluating construction phasing alternatives was developed and coded into Survey Monkey. The survey was reviewed and approved by the TAC and sent to the DOTs for all 50 states as well as the District of Columbia. To date, 22 survey responses have been received.

A separate survey for contractors was also developed and coded into Survey Monkey. After TAC review and approval, the survey was sent to 70 contractors in Missouri, Nebraska, and Wisconsin. Additional contacts for potential respondents for the contractor survey are being sought through SWZDI and other sources such as American General Contractors (AGC) of Missouri. To date, 6 survey responses have been received.

As a follow up to the online survey, 10 phone interviews were conducted with respondents from DOTs, contractors, and FHWA to learn more about their perspectives on work zone safety.

Data Collection. In order to supplement the Missouri work zone and crash data, a list of types of data regarding work zones and crashes needed for the project was developed, and a request for work zone and crash data was sent to 20 states, including all of the SWZDI states. Several states responded that they did not have the data being requested, especially since linking crash data with work zone data is very challenging. Three states indicated that they potentially have data that could be beneficial for this project: Kansas, Wisconsin, and Ohio. Data have been obtained from Kansas and Ohio.

Data Analysis. Statistical models to predict crashes based on work zone characteristics were developed for freeways, expressways, and rural two-lane highways. The models include variables such as AADT, work zone length, work zone duration, number of on and off ramps, and number of signalized intersections.

Development of Assessment Tool. A draft version of the user-friendly spreadsheet tool to implement the crash prediction models from Task 5 has been developed. The spreadsheet collects input data on crashes and work zone characteristics from the user and provides crash frequency and cost by severity as output. The spreadsheet also includes a tutorial to help the user become familiar with how to use the tool. The tool will be sent to the TAC and SWZDI Board of Directors for review.

Draft Report Preparation and Review. A draft of the final report is being prepared and will be submitted to the TAC and SWZDI Board of Directors for review.

The project currently 90 percent complete and had an original end date of December 31, 2015. An extension to April 30, 2016 was granted this quarter.

- Length of Need for Free-Standing, F-Shape, Portable 12.5' Concrete Protection Barrier, University of Nebraska, Ron Faller as PI

Currently, remaining tasks in the project include two full-scale crash tests, additional simulation of reduced length system deflections, and completion of the summary report. Funding for the project tasks remains, but a time extension was requested and received this quarter that extends the project completion date to 12/31/16.

Previously, MwRSF completed simulation of impacts on the upstream and downstream ends of the 200 ft long barrier system to determine the length of need. It was determined that three barriers would be recommended for both the beginning and the end of length-of-need for the TCB system, until the results could be further discussed with the TAC.

The next step of the simulation analysis was to conduct impacts at the selected beginning and end of length-of-need lengths for a reduced system length in order to verify that the length-of-need definitions work for shorter lengths and to examine the minimum potential length of the TCB system. Simulation models were evaluated using a seven barrier long TCB system. The results of these models found that the 2270P vehicle was successfully redirected for the seven barrier installation at both the beginning and end of the LON. In both cases, the reduced barrier system increased barrier deflections by approximately 16" over the full-length, 16 barrier system. Additionally, the impact at the end of the LON indicated a potential for the last barrier in the system to rotate rapidly towards the vehicle as it was redirected and impact the vehicle door. Thus, while the vehicle was redirected and the increases in deflections were manageable, the impact of the barrier with the driver side door was a concern.

These findings were discussed in detail at the July 21st TAC meeting in order to determine what the TAC concerns were and what was desired to be investigated through full-scale testing. The TAC indicated that the rotation and impact of the end barrier with the vehicle was a concern and wished to analyze the system with eight barriers, 3 for the beginning of LON, one in the middle, and 4 on the end of the LON. These models were simulated. Again both models successfully redirected the impacting vehicle. The addition of the fourth barrier on the end of LON mitigated the impact of the barriers on the vehicle door. Barrier deflections for impact at the beginning and end of LON for the 8 barrier installation were found to be 94.8 in. and 90 in., respectively. These results were given to the TAC in a meeting on 10-15-15. They concurred that testing should proceed on the 8 barrier installation.

Details for the full-scale crash testing of the 8 barrier installation were developed and sent to the MwRSF Outdoor Testing Facility. Barriers for both full-scale crash tests were fabricated and received. Currently, full-scale testing of the 8 barrier installation will commence as soon as possible within the current MwRSF test queue.

In the next quarter, MwRSF potential conduct the full-scale crash testing and evaluation of the reduced system lengths indicated by the simulation analysis. Two full-scale crash tests will be conducted.

1. Test designation no. 3-35 at beginning of LON
2. Test designation no. 3-37 at end of LON

Testing is anticipated for the 1st Quarter of 2015, but is dependent on other testing needs and maybe moved back.

Simulations investigating the 85% impact severity on both the standard length and reduced length systems will be performed as well as simulations of intermediate system lengths under standard TL-3 impact conditions.

This project is 47 percent complete and had an initial end date of December 31, 2015. An extension to December 31, 2016 has been granted.

- Development of a TL-3 Transition between Temporary Concrete Barrier and Guardrail, University of Nebraska, Ron Faller as PI

Due to having insufficient time to complete the summary report, MwRSF was not able to complete the research project within the original time frame. Funding for the project tasks remains, but a time extension was requested and received this quarter that extends the project completion date to 12/31/16.

Previously, MwRSF conducted all three of the full-scale crash tests for evaluation of the MASH TL-3 guardrail to PCB transition system. The test matrix is listed below.

1. MGSPCB-1 - Test no. 3-21 - Impact of the 2270P vehicle on the centerline of the fifth guardrail post upstream from the end-shoe attachment at a speed of 62 mph and an angle of 25 degrees.

2. MGSPCB-2 - Test no. 3-21R - Reverse direction impact of the 2270P vehicle 12 ft – 6 in. upstream from the end-shoe attachment at a speed of 62 mph and an angle of 25 degrees.
3. MGSPCB-3 - Test no. 3-20 - Impact of the 1100C vehicle on the critical impact point of the guardrail to PCB transition at a speed of 62 mph and an angle of 25 degrees. MASH procedures and engineering analysis will be used to determine the critical impact point.

All three of the full-scale crash tests successfully met the MASH TL-3 criteria. Thus, the system evaluation was completely successful. Currently, MwRSF is in the process of compiling the test report and recommendations for the implementation of the design. MwRSF was unable to complete the summary report prior to the original project end date of 12/31/15. Thus, a no-cost project extension was requested and granted. A TAC meeting was held on 10-15-15 to update the project status and review the full-scale crash test results.

In the upcoming quarter, MwRSF will continue efforts to complete the research report summarizing the testing and evaluation of the guardrail to PCB transition. Additionally, the project team will prepare a technical brief as well as a summary presentation of the research results for the TAC.

This project is 75 percent complete and had an original end date of December 31, 2015. An extension to December 31, 2016 has been granted.

Anticipated work next quarter:

Work will continue on contracted projects. One additional project may be finalized and the projects for Year 2016 should be finalized and contracted. We will continue to work with the principal investigators of the Program Year 2014 project and those from Program Year 2015.

Significant Results:

One report was completed and progress continued at different rates on the remaining projects from Program Year 2014 and 2015. The rankings for Program Year 2016 were completed.

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).

Currently there are no problems to report with the administrative contract. Any issues that have come up with the individual projects that may impact schedule or budget are resolved on a case by case basis.

Potential Implementation:

None at this time. However, some of the projects funded under this account number for Program Year 2014 will be completed soon and the four Program Year 2015 projects are underway.