

FISCAL YEAR 2014

ANNUAL REPORT

OCTOBER 1, 2013 — SEPTEMBER 30, 2014



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State Planning and Research (SPR), Part II, Program

Fiscal Year 2014 Annual Report

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**STATE PLANNING AND RESEARCH, PART II, PROGRAM
2014 ANNUAL REPORT**

Introduction

The Michigan Department of Transportation (MDOT) Statewide Planning and Research (SPR), Part II, Program is authorized and funded through the Code of Federal Regulations, Title 23, Part 420, Subpart B. This program is administered through the Research Administration Section in the Bureau of Field Services. The program funds projects that have been initiated to address specific research needs in MDOT. SPR, Part II funding can be used to research and evaluate new technologies that relate to design, construction, maintenance and operation of all surface transportation modes. Other eligible uses include technology transfer and certain training activities.

Each year, MDOT develops a program consisting of 80 percent federally funded Projects and 100 percent federally funded projects. The program also includes funding for various national research initiatives such as American Association of State Highway and Transportation Officials (AASHTO) Technical Service Programs (TSP), Transportation Research Board (TRB), National Cooperative Highway Research Program (NCHRP) and University Transportation Centers (UTC). The program must be reviewed and approved by the Federal Highway Administration (FHWA) Michigan Division Office prior to implementation. MDOT received FHWA approval on August 26, 2013. This annual report covers the MDOT SPR Part II Program from October 1, 2013 through September 30, 2014.

Summary

Fiscal Year 2014 research was conducted in the following focus areas, representing several modes of transportation and MDOT's diverse business functions:

Multi-Modal Transportation

- Freight Rail
- Local Transit

Program & Project Development

- Bridges & Structures
- Environment & Water Sources
- Transportation Safety

Planning & Finance

- Asset Management

Delivery & Operations

- Geotechnical & Foundation Design
- Intelligent Transportation Systems
- Maintenance
- Mobility, Systems, & Signal Operations
- Pavements & Materials
- Construction

The Fiscal Year 2014 SPR, Part II, Program consisted of 67 projects. 44 were 80% federally funded and 23 were 100% federally funded, for total expenditures of \$7,398,527.18. Expenditures remained within the approved budget as follows:

<u>Program Categories</u>	<u>Expenditures</u>	<u>Budget</u>
80% Federally Funded Projects	\$5,084,277.23	\$9,683,378.00
100% Federally Funded Projects	\$2,314,249.95	\$2,408,431.00
Total	\$7,398,527.18	\$12,091,809.00

Tables 1 & 2 summarize 80% federally funded projects that were funded in Fiscal Year 2014 while the associated appendices contain one to two page project summaries with projects listed sequentially by project number. Projects in Table 1 are listed in ascending order by job number. Table 2 provides a summary of 80% federally funded projects completed in Fiscal Year 2014. Information is presented by focus area.

Table 3 summarizes 100% federally funded projects. The information is listed in ascending order by job number. The three University Transportation Center reports itemize the sources of funding in addition to the SPR II funds reported in Table 3. For additional information regarding a specific project, please contact Research Administration.

Program Milestones

Research Administration and its stakeholders achieved the following significant milestones in fiscal year 2014:

- Completed 15 80% federally funded projects with current and previous year expenditures of about \$3.1 million, as summarized in Table 2.
- Initiated 14 new 80% federally funded projects in Fiscal Year 2014, with total budgets equaling about \$7.27 million. Project managers led research advisory panels and held meetings to guide and manage the principle investigator's research.
- Authorized \$3.1 million in funding to construct a research test track evaluating technologies related to connected and automated vehicles interfacing with roadway infrastructure. The University of Michigan's Mobility Transformation Facility construction is scheduled to be completed by FY 2015.
- Published an issue of the *Research Update*, Research Administration's newsletter, focusing on research projects done in collaboration with consultants.
- Published several *Research Spotlights*, highlighting the value of individual research projects.
- Expended SPRII funds for a technology transfer session on accelerated bridge construction.
- The Research and Implementation Manual was amended to include minor changes and revisions. The Research and Implementation Manual describes the administrative processes used by Research Administration to develop and implement the MDOT research program. The Research Executive Committee (REC) approved an implementation process that will be added to the Research and Implementation Manual in fiscal year 2015. This process describes the staff, manager, and executive decision making steps to execute research implementation.
- Continued with project and program planning for the 2016, 2017, and 2018 research programs.
 - In the fall and winter of 2014, Research Administration requested the development of research ideas addressing MDOT's priorities. All stakeholders were contacted. Research Administration received about 100 response ideas addressing the research priorities.
 - In March, meetings were held with each Research Advisory Committee (RAC) to identify and prioritize the ideas that would be recommended to the REC.
 - The next program planning steps were postponed to fiscal year 2015 because of funding limitations. The intent is to hold a series of research summit meetings in the spring of fiscal year 2015 to refine the high priority research ideas for 2016, 2017, and 2018.
- Research Administration received FHWA approval of the proposed Fiscal Year 2015 SPR Part II Program on August 13, 2014.

TABLE 1 80% FEDERALLY FUNDED PROJECTS

Job No.	FY 2014 Expenditures	Expenditures to Date	Total Budget	Project Manager	Agency	Principal Investigator	Title	Start Date	End Date	Pg No
120239	\$84,670.89	\$84,670.89	\$239,613.63	McQuiston, Carissa	WMU	Van Houten	Comparison of Alternative Pedestrian Crossing Treatments	10/1/2013	4/30/2015	9
120241	\$50,833.49	\$50,833.49	\$721,223.28	Chynoweth, Matt	LTU	Grace	Evaluating Long Term Capacity and Ductility of Carbon Fiber Reinforced Polymer prestressing and post tensioning strands	10/1/2013	9/30/2017	10
120242	\$6,239.43	\$6,239.43	\$262,097.50	Kanitz, Dean	WSU	Gates	Michigan Urban Trunkline Segments Safety Performance Function (SPFs) Development and Support	3/1/2014	2/28/2016	11
120429	\$105,779.03	\$105,779.03	\$304,449.48	Lariviere, Kim	WMU	Kwigizile	Evaluation of Michigan's Engineering Improvements for Older Drivers	10/1/2013	9/30/2015	12
120482	\$96,237.41	\$96,237.41	\$257,061.16	Rogers, Corey	WMU	Aktan	Research on Evaluation and Standardization of Accelerated Bridge Construction (ABC) Techniques	10/1/2013	9/30/2015	13
120599	\$56,690.54	\$56,690.54	\$60,004.71	Nobach, Amy	URS	Winsor	Synthesis of Methods for Developing Transit Vehicle Specifications	10/1/2013	4/30/2014	14
121245	\$6,551.27	\$201,516.41	\$229,370.76	Endres, Dick	U of M	Zekkos	Effect of Pile-Driving Induced Vibrations on Nearby Structures and Other Assets	10/1/2011	10/31/2013	15
121247	\$14,776.77	\$66,756.87	\$66,756.87	Grazioli, Mark	MSU	El-gafy	Evaluating the Financial Cost and Impact on Long Term Pavement Performance of Expediting Michigan's Road Construction Work	10/1/2011	10/30/2013	17
121248	\$24,994.91	\$99,633.13	\$105,583.36	Yalda, Dan	WSU	Eamon	Side-by-Side Probability for Bridge Design and Analysis	10/1/2012	4/15/2014	18
121249	\$75,141.73	\$581,974.33	\$598,929.80	Kline, Therese	URS	Guter	Re-Examination of the 1994 and Subsequent Sewer and Culvert Installations of Various Pipe Types, Sizes and Depths	5/25/2011	7/15/2014	19
121251	\$27,200.00	\$68,000.00	\$68,000.00	Annelin, Niles	FTCH	Buckler	Greenhouse Gas Inventory for the Michigan Department of Transportation	9/16/2011	12/31/2013	20
121252	\$41,984.95	\$382,556.38	\$400,672.27	Juntunen, Dave	WMU	Aktan	Improving Bridges with Prefabricated Precast Concrete Systems	10/1/2010	12/31/2013	21
121253	\$36,539.40	\$36,539.40	\$36,541.61	Chynoweth, Matt	WMU	Aktan	Accelerated Bridge Construction and Structural move WorkShop	8/31/2013	6/30/2014	24
121254	\$32,816.98	\$202,415.45	\$206,623.86	Thompson, Deirdre	WMU	Oh	Development of Performance Measures for Non-Motorized Dynamics	10/1/2012	12/31/2013	25
121277	\$86,920.67	\$493,182.67	\$493,182.67	Croze, Tim	Dye Management	Zilay	Monitoring Highway Assets with Remote Technology	7/31/2012	1/31/2014	27
*121278	\$155,186.06	\$161,398.33	\$161,657.01	Tansil, Bill	U of M	Belzowski	Evaluating Roadway Surface Rating Technologies	8/20/2013	9/30/2014	29

TABLE 1 80% FEDERALLY FUNDED PROJECTS

Job No.	FY 2014 Expenditures	Expenditures to Date	Total Budget	Project Manager	Agency	Principal Investigator	Title	Start Date	End Date	Pg No
121279	\$256,440.83	\$281,825.88	\$308,633.26	Bott, Mark	WSU	Gates	Evaluating the Costs and Benefits of Non-differential Freeway Speed Limits for Trucks and Buses; and the Outcomes of Raising All Vehicle Speed Limits	2/26/2013	12/31/2014	30
*121281	\$103,870.23	\$402,304.42	\$415,572.26	Eacker, Michael	MSU	Buch	Preparation of Implementation of the Mechanistic-Empirical Pavement Design Guide in Michigan	10/1/2011	10/31/2014	33
121282	\$42,113.70	\$76,999.53	\$106,136.58	Endres, Dick	MSU	Baladi	Predictive Modeling of Freezing and Thawing of Frost-Susceptible Soils	10/1/2012	9/30/2014	36
121285	\$122,602.38	\$222,394.42	\$264,495.42	Curtis, Beckie	LTU	Jensen	Evaluating Prestressing Strands and Post-Tensioning Cable in Concrete Structures using Nondestructive Evaluation (NDE) methods including Joint Shear Wave Analysis	10/1/2012	12/31/2014	38
121286	\$127,741.49	\$173,017.59	\$173,017.59	Kahl, Steve	WSU	Eamon	Design and Construction Guidelines for Strengthening Bridges using Fiber Reinforced Polymers (FRP)	10/1/2012	9/30/2014	39
121287	\$135,510.24	\$329,634.04	\$329,634.04	Kulkarni, Sudhakar	WSU	Eamon	Evaluation of Prestressed Concrete Beams in Shear	10/1/2011	9/30/2014	41
121288	\$131,185.68	\$198,655.30	\$263,162.84	Kahl, Steve	WMU	Attanayake	Remote Monitoring of Fatigue Sensitive Details on Bridges	10/1/2012	3/30/2015	42
121289	\$93,452.59	\$234,058.41	\$236,435.73	Torres, Carlos	WSU	Savolainen	Study of High Tension Cable Barrier on Michigan Roadways	10/1/2011	12/31/2014	44
121347	\$154,728.50	\$209,337.09	\$256,999.90	Bramble, Mary	WSU	Datta	Evaluation of Non-Freeway Rumble Strips - Phase II	2/8/2013	3/31/2015	47
*121348	\$215,530.37	\$259,003.81	\$270,323.91	Cook, Steve	MTU	Brooks	Evaluating the use of Unmanned Aerial Vehicle (UAVs) for Transportation Purposes	5/22/2013	11/30/2014	49
121349	\$20,520.02	\$192,412.98	\$239,863.00	Polsdofer, Mark	CTC	Casey	Research Administration Section Planning and Communications	1/31/2012	3/31/2015	51
121351	\$133,954.18	\$236,754.88	\$247,819.01	Burns, Eric	MTU	Ahlborn	Evaluation of Bridge Decks using Non-Destructive Evaluation (NDE) at Near Highway Speeds for Effective Asset Management	11/1/2012	12/19/2014	52
121354	\$125,309.46	\$137,040.12	\$254,948.74	Owen, Hilary	WSU	Gates	Balancing the Costs of Mobility Investments in Work Zones	6/19/2013	5/15/2015	54
121355	\$169,318.43	\$187,069.48	\$272,649.38	Firman, Jason	WMU	Kwigizile	Evaluating Michigan Commercial Vehicle Enforcement Strategies and Facilities	5/7/2013	3/30/2015	55
121357	\$153,248.40	\$205,341.14	\$319,101.30	Kahl, Steve	U of M	El-Tawil	Development, Characterization and Applications of a Non Proprietary Ultra High Performance Concrete for Highway Bridges	3/30/2013	3/30/2015	57
121358	\$43,084.48	\$129,253.42	\$216,322.36	Cook, Steve	Alfred Benesch	Darwish	Infrastructure Monitoring Data Management	9/30/2009	4/1/2015	59

TABLE 1 80% FEDERALLY FUNDED PROJECTS

Job No.	FY 2014 Expenditures	Expenditures to Date	Total Budget	Project Manager	Agency	Principal Investigator	Title	Start Date	End Date	Pg No
121359	\$139,750.73	\$150,165.88	\$235,932.69	Castle, Collin	WMU	Oh	Cost and Benefits of MDOT Intelligent Transportation System Deployments	6/3/2013	4/30/2015	61
121361	\$41,796.65	\$41,796.65	\$260,600.20	Kanitz, Dean	WSU	Gates	Michigan Urban Trunkline Intersections Safety Performance Function (SPFs) Development and Support	9/1/2013	5/31/2015	63
121362	\$39,364.65	\$57,209.68	\$195,224.23	Croze, Tim	LTU	Bandara	Evaluating the use of Tow Plows in Michigan	3/30/2013	3/30/2015	64
121363	\$190,796.00	\$190,796.00	\$561,176.40	Guerrazzi, Sam	MTU	Colling	Bridge Design System Analysis and Modernization	11/1/2013	11/30/2015	66
121364	\$1,082,519.94	\$3,068,461.56	\$3,770,152.65	Castle, Collin	Mixon Hill	Mixon	Advanced Applications of IntelliDrive Data Use Analysis and Processing 2 (DUAP2)	8/9/2011	11/1/2015	67
121365	\$36,075.15	\$36,075.15	\$491,549.00	Chynoweth, Matt	LTU	Grace	Statewide Overall Carbon Fiber Composite Cable Bridge Monitoring	12/17/2013	9/30/2020	71
121387	\$44,482.30	\$44,482.30	\$219,692.24	Grazioli, Mark	LTU	Bandara	Performance Evaluation of Subgrade Stabilization with Recycled Materials	10/1/2013	4/30/2015	72
121388	\$139,757.69	\$139,787.69	\$184,484.09	Eacker, Mike	MTU	You	Improving of Michigan Climatic Files in Pavement ME Design	10/1/2013	4/30/2015	73
121389	\$170,562.20	\$170,562.20	\$377,437.44	Kathrens, Rich	MTU	Brooks	Wireless Data Collection and Retrieval of Bridge Inspection/Management Information	10/1/2013	9/30/2015	74
121393	\$173,083.39	\$173,083.39	\$185,118.16	Adams, Jill	Cambridge	Van Hecke	Measuring Michigan Local and Statewide Transit Levels of Service	10/1/2013	9/30/2014	75
121398	\$94,914.02	\$94,914.02	\$201,655.00	Maack, Nathan	MSU	Kutay	A Method to Access the Use of New and Recycled Materials in Pavements	10/1/2013	3/31/2015	76
122203	\$0.00	\$0.00	\$3,200,000.00	Ajegba, Paul	U of M	Sweatman	Connected/Automated Vehicle and Infrastructure Research	10/1/2013	9/30/2015	77
	\$5,084,277.23	\$9,956,639.61	\$17,740,201.35	TOTAL 80% FEDERALLY FUNDED PROJECTS						

*NOTE: Anticipated expenditures are reported showing payments that should be made once final deliverables for job numbers 121278, 121281 and 121348 are received.

TABLE 2 - COMPLETED 80% FEDERALLY FUNDED PROJECTS

PROJECT AREA	NUMBER OF PROJECTS	TOTAL EXPENDITURES	TOTAL EXPENDITURES IN PERCENTAGE
Program & Project Development			
Bridges and Structures	5	\$1,021,380.54	33%
Environment & Water Sources	1	\$68,000.00	2%
Innovative Contracting	0	\$0.00	0%
Real Estate & Permits	0	\$0.00	0%
Transportation Safety	1	\$202,415.45	7%
Rest Areas, Utilities, & Landscaping	1	\$581,974.33	19%
Surveys & Automated Design	0	\$0.00	0%
Work Force Development	0	\$0.00	0%
Subtotal	8	\$1,873,770.32	61%
Delivery & Operations			
Construction	0	\$0.00	0%
Geotechnical & Foundation Design	2	\$278,515.94	9%
Intelligent Transportation Systems	0	\$0.00	0%
Fleet/Facility Management & Operations	0	\$0.00	0%
Maintenance	1	\$493,182.67	16%
Mobility, Systems, & Signal Operations	0	\$0.00	0%
Pavements & Materials	1	\$66,756.87	2%
Worker/Facility Safety & Security Emergency Management	0	\$0.00	0%
Subtotal	4	\$838,455.48	27%
Multi-Modal Transportation			
Aviation	0	\$0.00	0%
Freight & Logistics	0	\$0.00	0%
Freight & Logistics	0	\$0.00	0%
Intercity Bus	0	\$0.00	0%
Local Transit	2	\$229,773.93	7%
Maritime	0	\$0.00	0%
Passenger Rail	0	\$0.00	0%
Private/For Hire Passenger Carriers	0	\$0.00	0%
Subtotal	2	\$229,773.93	7%
Planning & Finance			
Asset Management	1	\$161,398.33	5%
Contract Administration	0	\$0.00	0%
Finance	0	\$0.00	0%
Non-Motorized Planning & Development	0	\$0.00	0%
Program Development	0	\$0.00	0%
Transportation Policy	0	\$0.00	0%
Travel Demand Forecasting	0	\$0.00	0%
Subtotal	1	\$161,398.33	5%
TOTAL	15	\$3,103,398.06	100%

TABLE 3 - 100% FEDERALLY FUNDED PROJECTS

Project No.	FY 2014 Expenditures	Expenditures to Date	Total Budget	Agency	Project Manager	Title	Start Date	End Date	Pg No
SHR-2(014)	\$399,508.00	\$399,508.00	\$409,799.00	FHWA	Clover, Andre	SHRP 2 Implementation	10/1/2013	9/30/2014	79
SPR-2(207)	\$50,000.00	\$50,000.00	\$100,000.00	FHWA	Peplinski, Suzette	Transportation Management Center (TMC) Pooled Fund Study	10/1/2013	9/30/2015	80
TPF-5(159)	\$7,000.00	\$52,000.00	\$59,000.00	Iowa DOT	Staton, John	Technology Transfer Concrete Consortium	10/1/2008	9/30/2015	82
TPF-5(206)	\$50,000.00	\$100,000.00	\$300,000.00	Virginia DOT	Smith, Matt	Research Program to Support the Research, Development, and Deployment of System Operations Applications of Vehicle Infrastructure Integration (VII)	10/1/2012	9/30/2016	84
TPF-5(215)	\$7,000.00	\$30,500.00	\$30,500.00	Minnesota DOT	Clover, Andre	Transportation Engineering and Road Research Alliance (TERRA)	10/1/2009	9/30/2014	86
TPF-5(231)	\$35,000.00	\$175,000.00	\$175,000.00	MDOT	Nederveld, Lee	ITS Pooled Fund Program (ENTERPRISE)	10/1/2009	9/30/2014	89
TPF-5(237)	\$5,000.00	\$25,000.00	\$30,000.00	Missouri DOT	Briseno, Alexandra	Transportation Library Connectivity and Development	5/1/2011	9/30/2015	95
TPF-5(242)	\$25,000.00	\$50,000.00	\$50,000.00	Louisiana DOT	Eacker, Mike	Traffic & Data Preparation for AASHTO MEPDG Analysis and Design	6/1/2012	8/31/2014	99
TPF-5(254)	\$36,706.00	\$146,018.00	\$173,000.00	LTU	Juntunen, Dave	Evaluation and Analysis of Decked Bulb-T Beam Bridges	9/19/2011	2/28/2015	101
TPF-5(269)	\$20,000.00	\$60,000.00	\$60,000.00	Minnesota DOT	Krom, Ben	Development of an Improved Design Procedure for Unbonded Concrete Overlays	4/13/2012	9/30/2014	103
TPF-5(271)	\$10,000.00	\$20,000.00	\$30,000.00	Kansas DOT	Chynoweth, Matt	Reorganization of Section 5, Concrete Structures, of the AASHTO LRFD Bridge Design Specifications	10/1/2012	9/30/2015	105
TPF-5(285)	\$50,000.00	\$50,000.00	\$50,000.00	Maryland DOT	Endres, Richard	Standardizing Lightweight Deflectometer Measurements for Quality Assurance (QA) and Modulus Determination in Unbound Bases and Subgrades	10/1/2013	9/30/2014	107
TPF-5(286)	\$30,000.00	\$30,000.00	\$75,000.00	Iowa DOT	Staton, John	Next Generation Concrete Pavement Road Map	10/1/2012	9/30/2017	108
TPF-5(290)	\$25,000.00	\$25,000.00	\$75,000.00	Iowa DOT	Gustafson, Dawn	Aurora Program	10/1/2013	9/30/2016	110
TPF-5(297)	\$35,000.00	\$35,000.00	\$52,500.00	Oklahoma DOT	Stallard, Tim	Improving Specifications to Resist Frost Damage in Modern Concrete Mixtures	10/1/2013	9/30/2015	111
TPF-5(298)	\$181,766.00	\$181,766.00	\$190,000.00	FHWA	Clover, Andre	TRB Core Program Activities Period Covering- FFY 2014 (TRB FY 2015)	10/1/2013	9/30/2014	112
TPF-5(414)	\$1,054,701.70	\$1,054,701.70	\$1,100,000.00	FHWA	Clover, Andre	National cooperative highway research program NCHRP for FY2014	10/1/2013	9/30/2014	114
115024	\$16,000.00	\$24,000.00	\$24,000.00	AASHTO	Barondess, Margaret	Environmental Technical Assistance Program (ETAP)	10/1/2012	9/30/2015	116
115193	\$100,000.00	\$100,000.00	\$100,000.00	AASHTO / FHWA	Clover, Andre	AASHTO Engineering Technical Service Programs	10/1/2013	9/30/2014	118
116226	\$11,577.27	\$94,101.04	\$100,000.00	UDM	Edgar, Sharon	A Study of Factors that inhibit and enable effective development of sustainable regional transit systems in SE Michigan	7/1/2012	12/31/2013	120
116233	\$7,499.96	\$50,000.00	\$50,000.00	GVSU	Fandalian, Angel	A Study of the Remanufacturing, Repurposing, and Recycling of Lithium - Ion Batteries in Public Transit Vehicles	9/19/2012	12/31/2013	122
116234	\$32,491.02	\$99,469.61	\$99,470.00	MTU	D'Lamater, James	National University Rail Center for Research, Education and Technology Transfer (NURails)	10/8/2012	4/30/2014	123
121242	\$125,000.00	\$250,000.00	\$250,000.00	AASHTO / FHWA	Curtis, Beckie	Pontis 5.2 Development- AASHTOware Bridge Management Software	10/1/2012	9/30/2014	125
	\$2,314,249.95	\$3,102,064.35	\$3,583,269.00	TOTAL 100% FEDERALLY FUNDED PROJECTS					

80% FEDERALLY FUNDED PROJECTS

Sequentially Listed by Job Number

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Comparison of Alternative Pedestrian Crossing Treatments

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Dean Kanitz

CONTRACT/AUTHORIZATION NO.	2013-0069 Z2	PROJECT START DATE	10/1/2013
PROJECT NO.	120239	COMPLETION DATE (Original)	4/30/2015
OR NO.	OR14-018	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Ronald Van Houten		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$110,960.13	Vendor Budget	\$218,513.35
MDOT Budget FY 2014	\$48,000.00	Adjusted MDOT Budget	\$21,100.28
Vendor FY 2014 Expenditures	\$72,070.61	Budget	\$239,613.63
MDOT FY 2014 Expenditures	\$12,600.28	Expenditures	\$84,670.89
		Total Amount Available	\$154,942.74

PURPOSE AND SCOPE

There is a need for low cost countermeasures to increase yielding to pedestrians at crosswalks on multilane roads with moderate to high ADT. Current treatments include the Rectangular Rapid Flashing Beacon (RRFB) which costs around \$20,000 per installation and the Pedestrian Hybrid Beacon that costs \$100,000. The costs of these treatments limit their installation. The development of low cost alternatives is needed to improve pedestrian safety. Initial studies have demonstrated that in-street signs (R1-6) used as a gateway treatment (3 signs for each 2 lanes approach) can produce yielding level comparable to those produced by an RRFB or Pedestrian Hybrid Beacon. On a typical two lane road the in-street sign could be located on the centerline and near the curb on each outside lane forming a "gateway." Other configurations could be developed for three or four lane roadways. The proposed study will determine conditions that this treatment can be substituted for other treatments or used in conjunction with other devices.

FISCAL YEAR 2014 ACCOMPLISHMENTS

FY 2014 kicked off the project and discussion was generated around crossing locations to consider for the study. Different systems such as Quick Kurb and Pexco City Post have been obtained in respective colors to evaluate the potential of the systems based on different placements. Locations have been determined and some preliminary observations have been recorded and evaluations of the information are being considered. Due to the available coordination of the researcher and MDOT maintenance staff the permanent installations were not able to be performed this fall and the contract will need extension. Some of the systems were evaluated in temporary installation with promising results. Vehicle yielding rates for some of the crossing locations exceeded 90%.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Installation of the systems and evaluation of them will commence. Data will be collected and analyzed on the driver related performance response to this alternative treatment. It is recommended that these research locations be considered each year after for three years to determine maintenance needs and driver related performance.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluating Long Term Capacity and Ductility of Carbon Fiber Reinforced Polymer prestressing and post tensioning strands

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Matthew Chynoweth

CONTRACT/AUTHORIZATION NO.	2013-0065 Z2	PROJECT START DATE	10/1/2013
PROJECT NO.	120241	COMPLETION DATE (Original)	9/30/2017
OR NO.	OR14-018	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Nabil Grace		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$200,000.00	Vendor Budget	\$691,814.05
MDOT Budget FY 2014	\$9,620.00	Adjusted MDOT Budget	\$29,409.23
Vendor FY 2014 Expenditures	\$50,284.26	Budget	\$721,223.28
MDOT FY 2014 Expenditures	\$549.23	Expenditures	\$50,833.49
		Total Amount Available	\$670,389.79

PURPOSE AND SCOPE

Use of Carbon Fiber Reinforced Polymer (CFRP) as longitudinal prestressing, and transverse post tensioning is a viable alternate to the 270 ksi low relaxation steel strands currently used by MDOT is prestressed and post tensioned bridge superstructures. CFRP strands are not subject to corrosion, and have strength characteristics similar to steel. MDOT has used CFRP transverse post tensioning on two structures, and has projects planned for CFRP longitudinal prestressing. This is a material MDOT will be using on future project as well.

The current AASHTO LRFD Bridge Design Specifications do not contain guidance on the design of elements using CFRP prestressing or post tensioning. ACI 440.1R-09 provides guidance on the jacking and final stresses in CFRP strands to stay within a desired ductility range, and also provides guidance on the initial elastic losses of the CFRP fibers and resin. CFRP strands lack the ductility of steel strands, and therefore, allowable maximum stress values are recommended to ensure ductile behavior of the overall structure, so the failure mode is similar to that of a steel strand structure.

ACI 440 discusses the creep rupture characteristics of CFRP strands, but due to lack of good historical data, discussions of long term losses due to creep, concrete shrinkage, and effects of environmental factors are very general. Bond fatigue, bond lengths for splices, susceptibility to fire damage, and other severe exposure conditions are also not addressed due to the lack of long term testing data. Long term losses need to be taken into account during the initial design, as these values are subtracted from the ultimate capacity of the materials. AASHTO provides detailed methods and empirical equations for determining these losses in steel strands, however, no equivalent equations are available for CFRP strands. For current CFRP projects, detailed finite modeling has been performed to determine the performance of the materials. For CFRP strands to be used as a production design material, methodologies and empirical equations need to be developed to quantify these values, and provide the designer with the guidance on how to properly apply these methodologies.

The long term losses and other environmental effect will also need to be known for load ratings of structures with CFRP elements.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Performed laboratory testing for creep rupture, bond fatigue, bond splice length, development length, lap lengths, anchorage testing, long term relaxation testing, and long term losses and creep testing. Evaluation of worldwide design guidelines, and documentation of deficiencies when compared to AASHTO requirements.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Additional environmental testing of specimens to extreme cold and heat, and begin to develop design guide lines based on laboratory data, and data obtained from the field monitoring effort. Begin numerical simulations including finite element modeling and interpretation of results.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Michigan Urban Trunkline Segments Safety Performance Function (SPFs) Development and Support

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Dean Kanitz

CONTRACT/AUTHORIZATION NO.	2013-0070 Z3	PROJECT START DATE	3/1/2014
PROJECT NO.	120242	COMPLETION DATE (Original)	2/28/2016
OR NO.	OR14-026	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$131,021.12	Vendor Budget	\$250,000.00
MDOT Budget FY 2014	\$4,125.00	Adjusted MDOT Budget	\$12,097.50
Vendor FY 2014 Expenditures	\$6,239.43	Budget	\$262,097.50
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$6,239.43
		Total Amount Available	\$255,858.07

PURPOSE AND SCOPE

To have full functionality of the Highway Safety Manual for Michigan there is a need to develop safety performance functions (SPFs) tailored to urban segment facilities. SPFs will allow transportation professionals at all levels the ability to scientifically evaluate facilities prior to design for the expected number of crashes, crash severities, crash types and return on investment from a safety perspective. The scope of work includes the following:

1. Literature Review
2. Identification of Sites
3. Data Collection
4. Data Analysis
5. SPF Development
6. Develop Maintenance Cycle
7. Develop Maintenance Process
8. Develop Deliverables
9. Demonstration materials and meetings

Types of urban segment facilities to be evaluated are:

1. Urban Trunkline Two-Lane Arterial
2. Urban Trunkline Three-Lane Arterial (TWLTL)
3. Urban Trunkline Four-Lane Undivided
4. Urban Trunkline Four-Lane Divided
5. Urban Trunkline Five-Lane (TWLTL)
6. Urban Trunkline Greater Than Four-Lane Undivided
7. Urban Trunkline Greater Than Four-Lane Divided
8. Urban Trunkline Greater Than Five-Lane (TWLTL)

FISCAL YEAR 2014 ACCOMPLISHMENTS

The literature review and identification of sites has been completed. The data collection and analysis are underway.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

This project will see the completion of the data collection. Both the analysis and SPF development contain potential for completion during this time frame. The development of both the maintenance cycle and process should begin toward the end of the fiscal year.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluation of Michigan's Engineering Improvements for Older Drivers

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Kim Lariviere

CONTRACT/AUTHORIZATION NO.	2013-0069 Z3	PROJECT START DATE	10/1/2013
PROJECT NO.	120429	COMPLETION DATE (Original)	9/30/2015
OR NO.	OR14-013	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Valerian Kwizgile		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$206,880.00	Vendor Budget	\$295,581.91
MDOT Budget FY 2014	\$21,075.00	Adjusted MDOT Budget	\$8,867.57
Vendor FY 2014 Expenditures	\$102,386.46	Budget	\$304,449.48
MDOT FY 2014 Expenditures	\$3,392.57	Expenditures	\$105,779.03
		Total Amount Available	\$198,670.45

PURPOSE AND SCOPE

The purpose of this project is to determine the safety benefits for all drivers, but specifically drivers over the age of 65 regarding the investment MDOT is making in improving the infrastructure as it relates to the following driver countermeasures being evaluated in this project:

- Clearview Font on Guide Signs
- Box Span Signal Installation
- Pedestrian Countdown Signal Installation
- Fluorescent Yellow sign Sheeting
- Lane Use Arrows on Diagrammatic Signing

The research objectives include the following:

1. Evaluating the safety benefits of each of the studied improvements for all ages and for older drivers
2. Develop Safety Performance Functions (SPFs) and Crash Modification Factors (CMFs) for these improvements

The scope of work includes the following tasks:

- Task 1: Literature Review
- Task 2: Survey Older Drivers
- Task 3: Data Collection
- Task 4: Develop Safety Performance Functions for Reference Group
- Task 5: Empirical Bayes Analysis to Develop Crash Reduction Factors
- Task 6: Develop Safety Performance Functions for Future Implementations
- Task 7: Economic Analysis
- Task 8: Final Report and Presentation.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Literature review complete; Locations of installed countermeasures determined; Reference locations for data analysis complete; Survey and analysis of results regarding older adult opinions of countermeasures is complete; SPF's for the most reference locations developed.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Analyze data collected; develop SPF's for each countermeasure; develop CMF's for countermeasures; final report

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Research on Evaluation and Standardization of Accelerated Bridge Construction (ABC) Techniques

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Corey Rogers

CONTRACT/AUTHORIZATION NO.	2013-0069 Z4	PROJECT START DATE	10/1/2013
PROJECT NO.	120482	COMPLETION DATE (Original)	9/30/2015
OR NO.	OR14-019	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Haluk Aktan		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$131,363.16	Vendor Budget	\$249,163.14
MDOT Budget FY 2014	\$5,580.00	Adjusted MDOT Budget	\$7,898.02
Vendor FY 2014 Expenditures	\$95,779.39	Budget	\$257,061.16
MDOT FY 2014 Expenditures	\$458.02	Expenditures	\$96,237.41
		Total Amount Available	\$160,823.75

PURPOSE AND SCOPE

The primary purpose of this research is to evaluate and standardize accelerated bridge construction, by creating scoping guidelines through investigation of national best practices and implementation of a decision making matrix.

The objectives of this research include:

- 1.) Review the ABC activities in other states and monitor any current ABC projects taking place in Michigan at the time of this project.
- 2.) Evaluate methods and describe risks of substructure construction and constructability issues for utilizing deep foundations outside of existing pier/abutments and the use of precast footing elements and/or post tensioning systems for footing construction.
- 3.) Evaluate the constructability issues associated with bridge slides and Self Propelled Modular Transports (SPMTs) and what the site conditions necessary to successfully move bridges
- 4.) Evaluate the costs and describe risks associated with SPMT moves, bridge slides, and unique foundation construction compared to conventional construction. Incorporate impacts to traffic and lane rentals when determining cost to benefit ratios.
- 5.) Identify additional design requirements for moves and slides such as additional deck reinforcement, jacking stiffeners, structural stability during moves, and construction tolerances for ABC vs. conventional construction. Consider the unique loading conditions created during ABC. Also, discuss geotechnical risk management strategies for the construction of specialized geotechnical work

The scope of work includes the following tasks:

1. State-of-the-Art and State-of-the-Practice Literature Review
2. Scoping Guidelines for ABC Implementation with Focus on SPMT and Slides
3. Methodologies for Design and Construction of Foundations for Replacement of Bridges While in Service
4. Cost Analysis, Life Cycle Costs and Cost/Benefit Ratio of ABC:
5. Reporting: including quarterly progress reports, an annual interim report, and a final report.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The state of the art literature review has advanced with the review of several key documents. Draft scoping parameters have been defined to assist with a decision matrix. Preliminary cost estimating techniques have been outlined. Foundation design survey of other states has advanced and findings have been documented.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

The literature review will be completed, Scoping guidelines will be developed, foundation design methodologies will be identified, and the cost analysis will be completed. All of the methods and findings will be documented in the final research report.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Synthesis of Methods for Developing Transit Vehicle Specifications

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Amy Nobach

CONTRACT/AUTHORIZATION NO.	2013-0238	PROJECT START DATE	10/1/2013
PROJECT NO.	120599	COMPLETION DATE (Original)	4/30/2014
OR NO.	OR14-003	COMPLETION DATE (Revised)	
RESEARCH AGENCY	URS		
PRINCIPAL INVESTIGATOR	Winsor		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$60,004.71	Vendor Budget	\$60,004.71
MDOT Budget FY 2014	\$0.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$56,690.54	Budget	\$60,004.71
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$56,690.54
		Total Amount Available	\$3,314.17

PURPOSE AND SCOPE

The Michigan Department of Transportation (MDOT) has the objective to thoroughly examine and assess its vehicle procurement program for buses and vans put into service by local transit agencies. The goal of this study is to review the “best practices” of peer states and their respective vehicle specifications development and procurement processes in order to determine whether MDOT can improve its processes and provides increased opportunities for transit system members to obtain competitive pricing contracts, while increasing efficiencies to both MDOT and the local agencies.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Final report completed and provided to The Michigan Department of Transportation (MDOT) June 2014.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Specific areas of focus for recommendations to MDOT include: contracting and procurement, specification development and inspections, and local agency information and outreach. The set of recommendations are as follows:

1. Extend contract timeframes to reduce the need to re-generate the specifications-development and procurement processes for each vehicle type every three years.
2. Shorten vehicle delivery timeframes to match those of peer states, where vehicle delivery times written into the procurement contracts are generally more compressed.
3. Collaborate with third parties (universities and consultants) to get additional support for aspects of the procurement process.
4. Gather additional direct feedback from local agencies regarding the effectiveness of the state’s vehicle procurement program and any issues they are experiencing.
5. Improve online and print communications for explaining the processes and benefits of the state-administered program.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Effect of Pile-Driving Induced Vibrations on Nearby Structures and Other Assets

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Richard Endres

CONTRACT/AUTHORIZATION NO.	2010-0296 Z5	PROJECT START DATE	10/1/2011
PROJECT NO.	121245	COMPLETION DATE (Original)	6/30/2013
OR NO.	OR10-046	COMPLETION DATE (Revised)	10/31/2013
RESEARCH AGENCY	The Regents of the University of Michigan		
PRINCIPAL INVESTIGATOR	Adda Athanasopoulos-Zekkos		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$51,696.85	Vendor Budget	\$229,370.76
MDOT Budget FY 2014	\$0.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$6,551.27	Budget	\$229,370.76
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$201,516.41
		Total Amount Available	\$27,854.35

PURPOSE AND SCOPE

1. Provide screening criteria to identify sites where the magnitude of shakedown settlement could be damaging to existing bridge structures. A site class approach similar to that found in existing codes is envisioned.
2. Determine vibration characteristics of construction equipment commonly used by MDOT contractors and perform field tests as needed to calibrate analytical models, such as vibration monitoring and soil attenuation measurements.

FISCAL YEAR 2012 ACCOMPLISHMENTS

- Developed instrumentation consisting of an accelerometer embedded in a "Cone Casing" tip,. Also developed drilling rod adaptors and tooling for installing instrumentation deep below ground.
- Successfully instrumented and collected pile driving vibration data at four bridge sites
- Collected Shear Wave Velocity measurements for correlating soil stratigraphy to blow counts at four bridge sites

FISCAL YEAR 2013 ACCOMPLISHMENTS

- A final site was visited and pile driving monitored.
- Data analysis of all the four sites visited was performed in order to better understand the attenuation rate of waves from the pile to the surrounding soil materials and to develop a simplified procedure for predicting strain thresholds from pile driving operations given certain soil conditions.
- Shear wave measurements at the sites were used to refine soil properties to better understand soil conditions at the pile driving locations.
- A design aid was developed for identification of sites susceptible to shakedown settlement
- MDOT staff was trained to use the design aid.
- Project PI A. Athanasopoulos-Zekkos presented the project's preliminary findings at the 2013 Midwest Geotechnical Conference in Madison, WI, on September 24, 2013.
- University of Michigan (UM) team submitted a draft of the final report presenting the research results of the project and an excel-based tool for identifying sites susceptible to shakedown settlement.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Final report issued.
- Research Spotlight issued.
- Spreadsheet tool piloted by MDOT structures group with success.
- Copies of Spreadsheet tool distributed to select consultants

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Two revisions have been approved:

1. The extension accommodated additional field testing and data processing. Specifically, in the original proposal submitted by the research team a total of 7 sites were suggested as the optimum number of sites for testing and developing the settlement threshold criteria for pile-driving induced vibrations. During the spring and summer of 2012, only 3 sites were available for conducting this testing. Adding the data collected from an additional site improves the estimates, final report, and product submitted to MDOT.
2. UM team submitted a request for budget reallocation to allow for travel to the 2013 Midwest Geotechnical Conference in Madison, WI and a request for a no-cost time extension until October 31. Both requests were approved.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

-
- Seminar/workshop with consultants will be held on December 1, 2014
 - Presentation at Michigan Bridge Conference scheduled for March 2015
-

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE:
Evaluating the Financial Cost and Impact on Long Term Pavement Performance of Expediting Michigan's Road Construction Work

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Mark Grazioli

CONTRACT/AUTHORIZATION NO.	2010-0294 Z8	PROJECT START DATE	10/1/2011
PROJECT NO.	121247	COMPLETION DATE (Original)	9/30/2012
OR NO.	OR10-021	COMPLETION DATE (Revised)*	10/30/2013
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Mohamed El-Gafy		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$19,636.97	Vendor Budget	\$66,756.87
MDOT Budget FY 2014	\$1,400.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$14,776.77	Budget	\$66,756.87
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$66,756.87
		Total Amount Available	\$0.00

PURPOSE AND SCOPE

1. Review the 2010 MDOT document on Innovative Construction Contracting, especially the portion on Acceleration Techniques.
2. Prepare a list of all MDOT projects built via acceleration techniques using I/D methods mentioned in the Innovation Construction Contracting document.
3. Research and prepare a list of similar (work type and vintage) MDOT projects that were constructed under standard contract means.
4. Compare accelerated (I/D methods) projects to standard contract projects. The analysis should include but not be limited to;
 - Comparing user delay cost savings versus extra dollars spent on incentives, bid costs and construction oversight.
 - Comparing long term pavement or other performance differences.
5. Compare analysis results to the listed "Advantages and Disadvantages" and "Recommendations for Use" of each acceleration technique in the Innovative Construction Contracting document.

FISCAL YEAR 2012 ACCOMPLISHMENTS

The research team worked with DTMB to obtain contract data on projects with incentive and disincentive pay item codes. Due to state of Michigan employee turnover this task took more time than expected and has delayed the project completion date. The research team was successful in developing a process to obtain pavement performance data once the incentive projects and associated mile points are identified.

FISCAL YEAR 2013 ACCOMPLISHMENTS

The research team continuously assembled data, which continued to be a larger task than they first anticipated. In March a partial draft report was presented to MDOT and reviewed. Through the urging of the MDOT PM the research PI arranged for the QC of the next version of their work to go through the channels as described in their proposal. Towards the end of the fiscal year the QC effort was yielding valuable addition to the project.

FISCAL YEAR 2014 ACCOMPLISHMENTS

*After extensive MDOT review- The final report for this project was accepted in February 2014 and subsequently paid in full on February 14, 2014.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Through a meeting on October 11, 2013 with the PI, Steve Bower, Andre Clover, Curtis Bleech and the PM it was decided to allow the PI to extend the project (without additional cost) one month (October 30, 2013) to add value to the final product.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The findings of the research concluded the MDOT incentive/disincentive techniques used over the past 20 years do not have a negative impact on pavement performance. To the contrary, improved pavement performance was discovered. MDOT should continue using incentive/disincentive techniques when appropriate. The results of this research should be communicated to MDOT leadership.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Side-by-Side Probability for Bridge Design and Analysis

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Daniel Yalda

CONTRACT/AUTHORIZATION NO.	2010-0298 Z6	PROJECT START DATE	10/1/2012
PROJECT NO.	121248	COMPLETION DATE (Original)	4/15/2014
OR NO.	OR10-042	COMPLETION DATE (Revised)	7/15/2014
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Chris Eamon		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$54,849.29	Vendor Budget	\$102,239.41
MDOT Budget FY 2014	\$9,180.00	Adjusted MDOT Budget	\$3,343.95
Vendor FY 2014 Expenditures	\$21,650.96	Budget	\$105,583.36
MDOT FY 2014 Expenditures	\$3,343.95	Expenditures	\$99,633.13
		Total Amount Available	\$5,950.23

PURPOSE AND SCOPE

Using weight –in-motion (WIM) data to develop refined side by side truck multiple presence load models for Michigan structures. The objective of the study is to have an efficient and accurate procedure to clean, sort and analyze large WIM data, from that data define multiple presence factors for various MDOT vehicle classifications (Legal and Permit), and based on the side by side load effect statistics developed for different site classifications and bridge types and finally provide recommendations for vehicular loads used for design and rating of the structures.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- Task 1. Literature Review – Completed.
- Task 2. Task completed based on original and revised scrubbing criteria.
- Task 3. Define Multiple Presence – Task completed based on revised criteria.
- Task 4. Compare WIM Data to MDOT Vehicles – in progress, near completion.
- Task 5. Compare Load Effects to Design and Rating Load Effects – in progress, near completion.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Completed remaining tasks.
- Task 4. Compare WIM Data to MDOT Vehicles - Completed
- Task 5. Compare Load Effects to Design and Rating Load Effects - Completed
- Task 6, Develop Recommendations- Completed
- Final Report was posted on MDOT Research website

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

A delay occurred in Task 2 (Analyze WIM Data) due to several revisions of the data filtering criteria, as suggested by the Research Advisory Panel. However, this was time well-spent to ensure that the data used in the project best represent actual traffic loads. The extension allowed enough time to carefully complete the data analysis required in the remaining tasks and thoroughly develop well-constructed design and rating recommendations.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Load factors (LFs) were recommended.

- For design purposes, it is recommended to replace modified HL-93 loading with HL-93 loading and the application of a specific LF for structures less than 200 feet and another for longer span structures.
- For Rating/Analysis in Load and Resistance Factor (LRF) and Load & Resistance Factor Rating (LRFR) methods, most of the recommended LFs are very high relative to current MDOT practice; as such it's not feasible at this time to apply these LFs to all structures. It's recommended to optimize the rating process by taking the design variables as rating procedure variables.
 - For rating, instead of using the recommended LFs, another option would be to consider modification of the reliability targets. If the existing level of reliability on MDOT structures is assumed to be reasonable, the reliability targets could be lowered to better represent existing structures reliability level. This approach has been done in other states.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT – FISCAL YEAR 2014**

PROJECT TITLE: Re-Examination of the 1994 and Subsequent Sewer and Culvert Installations of Various Pipe Types, Sizes and Depths

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Therese Kline

CONTRACT/AUTHORIZATION NO.	2011-0282	PROJECT START DATE	05/25/2011
PROJECT NO.	121249	COMPLETION DATE (Original)	12/20/2013
OR NO.	OR10-048	COMPLETION DATE (Revised)	7/15/2014
RESEARCH AGENCY	URS Corporation Great Lakes		
PRINCIPAL INVESTIGATOR	Mike Guter		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$67,531.58	Vendor Budget	\$574,408.71
MDOT Budget FY 2014	\$13,660.00	Adjusted MDOT Budget	\$24,565.62
Vendor FY 2014 Expenditures	\$50,576.11	Budget	\$598,929.80
MDOT FY 2014 Expenditures	\$24,565.62	Expenditures	\$581,974.33
		Total Amount Available	\$16,955.47

PURPOSE AND SCOPE

In 1994, MDOT initiated a pipe study which reviewed the installed performance of flexible and rigid pipes at various locations across the state. It has been approximately 17 years since the study was completed and MDOT desires to reinspect the pipe from the original study to ascertain the current condition state of the pipe. In addition, MDOT desires to review additional pipe installations where new pipe products have been installed. The inspections will include mandrel testing where appropriate, as well as the use of a laser profiler to review pipe deformation in flexible pipes and to measure crack widths in rigid pipe. This study will be compared with the results to the 1994 study and the researcher will make recommendations to the department on pipe performance and whether corrective action is needed. Additional items in the review will be the condition of the pipe joints and end sections. The study will compare and calibrate the results of mandrel testing to the laser profiler. The pipes will be videotaped to ensure that areas of concern can be reviewed. New technology in the form of a laser profiler mounted on a track system now exists to view, record and review the current pipe status. MDOT pipe policy is based on experiences with different pipe materials. This study would assist the department in determining if its current policies need adjustment based on field performance of the various pipe products.

FISCAL YEAR 2011 ACCOMPLISHMENTS

URS set up a demonstration of four laser units for MDOT so that we could observe firsthand and in a testing situation of know pipe issues how the laser devices performed, and for the consultant to make recommendations on the unit for MDOT to purchase. Initial on site work began in July and ended in September 2011. Raw data compiled was shared with MDOT. A recommendation report with the contractor's suggested laser purchase was produced.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Three more sites were proposed by MDOT to round out the study. The contractor travel to the sites and collected data. Pipe laser profiler was delivered to MDOT and training was provided for MDOT employees. Data collected in FY 11 and 12 was analyzed. Draft final report was produced.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Pipe industry representatives were given the opportunity to review the draft final report, and provide comments. MDOT's Engineering Operations Committee (EOC) reviewed the final report and made comments.

FISCAL YEAR 2014 ACCOMPLISHMENTS

URS completed and submitted the final report and it was released to the public. The time for public comments and questions expired without input. The contract was closed and the department saved the money that the contractor would have been paid for question responses. No further presentation to MDOT was necessary with the lack of questions.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

1. Amendment 1 included all subcontractors, inadvertently left out in initial bid.
2. Amendment 2 added three more field evaluation sites. This included 10 runs of metal pipe from the second part of the 1994 Investigation, to provide a diversity of pipe materials.
3. Amendment 3 extended the contract time allowing an EOC document review. Amendment 3 also provided time and budget for URS to respond to public and industry comments.
4. Amendment 4 extended the contract time and increased the budget allowing URS to view the 1994 and 2011 pipe video footage simultaneously and make comments on changing condition.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The action plan was reviewed and implementation of further research is awaiting funds. Internal research is commencing on ways to reduce pavement/compaction issues at manholes. The use of the pipe laser profiler equipment on projects has commenced.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Greenhouse Gas Inventory for the Michigan Department of Transportation

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Niles Annelin

CONTRACT/AUTHORIZATION NO.	2011-0495	PROJECT START DATE	09/16/2011
PROJECT NO.	121251	COMPLETION DATE (Original)	12/31/2013
OR NO.	OR10-033	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Fishbeck, Thompson, Carr and Huber, Inc.		
PRINCIPAL INVESTIGATOR	Michele Buckler		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$54,400.00	Vendor Budget	\$68,000.00
MDOT Budget FY 2014	\$10,000.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$27,200.00	Budget	\$68,000.00
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$68,000.00
		Total Amount Available	\$0.00

PURPOSE AND SCOPE

The federal government is discussing the need to monitor and reduce the amount of greenhouse gas (GHG) emitted by federal agencies with the potential to expand it economy wide and create carbon price. With this in mind it is likely that state agencies will be required to monitor emissions as well. This project is intended to develop a tool to calculate emissions in all MDOT's business areas. It is also intended to establish an annual baseline emission level for the facilities, maintenance, and operations (not construction activities) of the Michigan Department of Transportation (MDOT) and to develop recommendations on how to reduce emissions.

FISCAL YEAR 2011 ACCOMPLISHMENTS

The project kickoff meeting was held to establish expectations and begin the research.

FISCAL YEAR 2012 ACCOMPLISHMENTS

1. Literature Review: Review the literature to determine techniques for estimating greenhouse gas emissions, techniques for reducing greenhouse gas emissions from operations and facilities.
2. Data Collection: Determine the average amount of GHG emissions created by travel of the department's vehicle fleet, direct maintenance activities, statewide crews, the operation (electricity and fuel use) of MDOT owned facilities and other activities mentioned above.
3. Analysis: Determine how the greatest GHG reductions can be achieved per dollar spent and how we can estimate greenhouse gas emissions in the future based on data that is readily available.

FISCAL YEAR 2013 ACCOMPLISHMENTS

A draft of the study was reviewed and commented on by MDOT staff. Data was supplied to consultant relevant to the study.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The project was satisfactory completed in FY14.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

At this time there are no plans to implement the results of the study.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Improving Bridges With Prefabricated Precast Concrete Systems

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Dave Juntunen

CONTRACT/AUTHORIZATION NO.	2010-0297 / Z2	PROJECT START DATE	10/01/2010
PROJECT NO.	121252	COMPLETION DATE (Original)	09/30/2012
OR NO.	OR09-153	COMPLETION DATE (Revised)	12/31/2013
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Dr. Haluk Aktan		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$90,262.80	Vendor Budget	\$400,672.27
MDOT Budget FY 2014	\$10,000.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$41,984.95	Budget	\$400,672.27
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$382,556.38
		Total Amount Available	\$18,115.89

PURPOSE AND SCOPE

The objectives of this project include the following:

- 1) Determine the state of practice related to prefabricated precast concrete bridge systems.
- 2) Determine appropriate steps for evaluating and implementing possible systems in Michigan.
- 3) Identify systems with the greatest potential for use in Michigan.
- 4) Evaluate identified systems for Michigan conditions and provide implementation recommendations.

The objectives of this project include the following:

- 1) Literature search -- Review literature on existing practices and proposed techniques for using prefabricated, precast concrete bridge systems.
- 2) Specify evaluation criteria -- Determine the design, construction, and performance-related factors against which possible prefabricated precast concrete bridge systems will be measured. Define evaluation methodologies (modeling, lab testing, field testing or otherwise).
- 3) Propose feasible system -- Based on current practice and anticipated needs in Michigan, propose one or more specific prefabricated precast concrete bridge systems for evaluation.
- 4) Investigate proposed system(s) -- Use the methodologies, revised as needed, to evaluate the proposed system.
- 5) Findings and Recommendations -- Report on the findings, including their implications for possible implementation. Provide specific recommendations on possible further research or testing, pilot studies, small-scale implementation or large-scale implementation.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Literature Review: ongoing

-continue to document precast concrete bridge configurations/components currently being used in accelerated bridge construction (ABC) or the systems and components that are being developed;

-continue to document construction procedures, equipment, and implementation constraints. Several construction projects (case studies) are being reviewed to identify the technologies used for bridge construction. Some exemplars that are of interest to the research team are given below.

San Francisco Yerba Buena Island Viaduct
Mill Street Bridge, New Hampshire
Bridge over Keg Creek in Pottawattamie County, Iowa
Route 99/120 separation bridge in city of Manteca, California
Skyline Drive Bridge over West Dodge Road in Nebraska
I-215 East Bridge over 3760 South in Utah
MD Route 24 Bridge over Deer Creek in Maryland
I-40 Bridge in southeastern California

-continue identifying strengths and weaknesses of precast concrete bridge structural systems that are already built. Information is gathered as new ABC projects are being implemented.

-performance evaluation of precast full-depth deck panel systems is complete.

-custom development of the decision-making framework developed by the FHWA for selection of prefabricated bridge elements and systems is complete.

-FY 11 annual report completed.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Literature Review

- Continued with deconstruction and construction case studies
- Continued identifying precast system configurations with attention to reparability and maintainability. Performance of other ABC systems is being evaluated as the literature being published.
- Continued reviewing literature on prefabricated component connection details, grout materials, and grout application procedures, equipment, and specifications
- continuing to identify details, materials, and performance of precast concrete component joints.

Identification of Precast Concrete Bridge Configurations

- Continued work on task
- Test plan and testing of decision making framework based on Analytical Hierarchy Process
- Identify potential sites for implementation using Michigan 5-year plan and research advisory panel (RAP) recommendations,
- Identify precast concrete bridge structural systems using Michigan specific decision making framework,

Performance Assessment of Precast Concrete Bridge Structural Systems

- Continued to evaluate performance and associated design, construction, and deconstruction challenges of the currently available systems through literature and literature from associated DOTs, and
- Continued to evaluate construction and deconstruction procedures as well as the joint details and load transfer mechanisms through advanced simulations.

Reporting – Continued with quarterly and annual reports and a draft final report was provided

ABC decision-making framework

- Michigan specific ABC decision-making framework was provided in the draft final report. This procedure is being reviewed by MDOT.
- An example using Stadium Road bridge (1-94 Business S03 of 39014) is being developed to demonstrate its application procedure and superiority over existing ABC decision-making models

FISCAL YEAR 2013 ACCOMPLISHMENTS

Work on the following tasks continue to be updated:

- Literature Review,
- Identification of Precast Concrete Bridge Configurations
- Performance Assessment of Precast Concrete Bridge Structural Systems
- Reporting

Additionally activities included the following:

- Modify and update the Michigan specific ABC decision-making framework.
- Demonstrate the ABC decision making model on Stadium Road bridge (1-94 Business S03 of 39014).
- Form a subgroup of MDOT stakeholders and users of the ABC decision making framework and work with the research team to finalize a simple and intuitive spreadsheet based procedure based on the high level factors and methodology included in the research report.
- Evaluate precast pier caps for implementation and standardization within MDOT's bridge program.
- Develop design examples and details for bridge elements order to standardize and implement these technologies within MDOT's bridge program.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Michigan specific ABC decision-making framework and final Excel spreadsheet; MiABCD with user's instructions has been completed,
- Lightweight options for ABC precast pier cap configurations were identified and presented in the report,
- Examples and details for bulb-T beams, decked prestressed box beams, and full depth deck panels, and recommendations are provided in the final report.
- Standardized design details for longitudinal connections between decked box and bulb T beams were developed and included in the final report,
- A comprehensive list of PBES, connection details suitable for Michigan exposure, constructability checklist for PBES and further research needs were provided in the final report.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

An extension of time and increase in budget was approved for the following activities:

- Complete decision making example on the Stadium Road bridge (1-94 Business S03 of 39014).
- MDOT needs to form a subgroup of MDOT stakeholders and users of the ABC decision making framework and work with the research team to finalize a simple and intuitive spreadsheet based procedure based on the high level factors and methodology included in the research report.
- The research report identified construction difficulties associated with building precast pier caps due to weight and size of the components. Several pier cap configurations were recommended, however, these methods need to be further evaluated for implementation and standardization within MDOT's bridge program.
- Concurrent with this research, MDOT has identified decked bulb-T beams, decked prestressed spread box beams, and full depth deck panels as prefabricated bridge elements and systems (PBES) components that have potential as standard MDOT components. However, design examples and details for these methods, including connection details, need to be further developed in order to

standardize and implement these technologies within MDOT's bridge program.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

- The Michigan Accelerated Bridge Construction Decision-Making (Mi-ABCD) software platform is ready for implementation. The Mi-ABCD can be introduced in Section 7.01.19 A of the BDM as well as in Chapter 6 of the Scoping Manual. Further, a link can be provided in both documents to access the Mi-ABCD user's manual as well describe the process of accessing the software.
 - Recommended prefabricated bridge elements and systems (PBES) can be used to revise the information presented in the BDM Section 7.01.19 B. Further, typical cross-section geometry of each element or system can be included in the Bridge Design Guide (BDG.) Also these pages can be linked to the associated titles in BDM Section 7.01.19 B.
 - Three prefabricated girder types are recommended for implementation but requiring additional studies. MDOT needs to initiate projects to address the research needs listed under each girder type. The list of girders and research needs are: precast adjacent box-beams for sites with underclearance limitations, inverted-T precast slab for sites with underclearance limitations, and Northeast Extreme Tee (NEXT) D beam for sites up to 90 ft span and underclearance limitations.
 - Recommendations of connection and continuity details for PBES and formwork to assure constructability, durability, and dimensions and tolerances for grout or special mix placement can be included in the BDM Section 7.01.19 B. These recommendations can be presented in the Bridge Design Guide (BDG) and the pages can be linked to BDM Section 7.01.19 B. Also, a standard detail developed for the longitudinal connections of decked bulb-tee and decked box-beam systems can be included in BDG.
 - The ABC constructability checklist can be introduced in the MDOT bridge design manual section 7.01.19 B 1. The checklist will need to be revisited periodically to account for changing and evolving ABC practices.
 - A template of special provisions presented for material selection for connections between PBES and their application procedures can be a part of the project special provisions. Also, the special provision can be used to qualify a material and/or application procedure for a specific connection detail.
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**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Accelerated Bridge Construction and Structural move Workshop

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Matthew Chynoweth

CONTRACT/AUTHORIZATION NO.	2013-0069 Z7	PROJECT START DATE	8/31/2013
PROJECT NO.	121253	COMPLETION DATE (Original)	6/30/2014
OR NO.	OR14-031	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Haluk Aktan		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$36,298.22	Vendor Budget	\$36,541.61
MDOT Budget FY 2014	\$3,458.39	Adjusted MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$36,539.40	Budget	\$36,541.61
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$36,539.40
		Total Amount Available	\$2.21

PURPOSE AND SCOPE

MDOT currently has multiple bridge move and prefabricated elements & systems projects proposed for the 2014 construction season, and would like to prepare the construction and fabrication industry to understand, bid on, and successfully complete these types of projects.

The goal of this workshop is to provide a large audience of Michigan contractors, fabricators, and consultants with the knowledge and resources necessary to perform the unique items of work for accelerated bridge construction, such as setting of prefabricated elements, grouted spliced connections, temporary substructure design and construction, jacking systems for lateral slides, and moving prefabricated bridge elements, or complete superstructures into place. It is important that Michigan contractors understand the typical accelerated bridge construction requirements and operational changes, to ensure competitive bidding, while implementing Every Day Counts 2 (EDC 2) initiatives.

Providing this information to Michigan contractors will allow local firms to participate in the work, resulting in potential bid savings on otherwise standard work, and knowledge gained and retained for the Michigan contracting and consulting industry.

FISCAL YEAR 2013 ACCOMPLISHMENTS

WMU developed a draft agenda and scheduled speakers from industry. They also selected the venue, and have engaged the Michigan Local Technical Assistance Program to develop the workshop announcement, and registration. The workshop was held on December 9, 2013 with a very large and diverse audience covering MDOT, local agencies, consultants and contractors.

FISCAL YEAR 2014 ACCOMPLISHMENTS

A final workshop report with copies of all presentations and summaries of discussions and recommendations was produced by the PI. After review and comment by MDOT, the report was accepted as final.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Recommendations included MDOT continuing to explore options for accelerated bridge construction (ABC) and use of prefabricated bridge elements and systems (PBES). MDOT has implemented these recommendations by including ABC/PBES project evaluations as part of the annual Call for Projects process, along with providing technical support, and emerging technology funding to assist in offsetting some higher initial costs of structural moves, or other equipment required for accelerated bridge construction.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Development of Performance Measures for Non-Motorized Dynamics

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Deirdre Thompson

CONTRACT/AUTHORIZATION NO.	2010-0297 Z5	PROJECT START DATE	10/1/2012
PROJECT NO.	121254	COMPLETION DATE (Original)	12/31/2013
OR NO.	OR10-035	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Jun Seok Oh		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$105,217.56	Vendor Budget	\$201,851.00
MDOT Budget FY 2014	\$10,000.00	Adjusted MDOT Budget	\$4,772.86
Vendor FY 2014 Expenditures	\$28,044.12	Budget	\$206,623.86
MDOT FY 2014 Expenditures	\$4,772.86	Expenditures	\$202,415.45
		Total Amount Available	\$4,208.41

PURPOSE AND SCOPE

The random nature of pedestrian and bicycle crashes make it difficult to apply crash countermeasures when scoping transportation projects. Therefore, the Michigan Department of Transportation (MDOT) needs a systematic approach to determine performance measures for non-motorized safety and to identify the need for countermeasures when designing facilities.

This research has six specific objectives:

1. Building an inventory database for non-motorized safety analysis and providing guidelines for data collection, storage, and management;
2. Conducting detailed analysis of high crash and low crash communities to identify factors affecting crashes involving pedestrians and bicyclists and to develop applicable performance measures;
3. Evaluating performances of recent pedestrian and bicycle improvement projects through before and after studies and cost-benefit analyses to quantify their effectiveness;
4. Identifying cultural issues associated with pedestrian incidents, and determining what issues can and cannot be addressed by engineering solutions;
5. Developing systematic guidance for adjusting performance measurements by comparing the nationwide non-motorized performance measurements and analysis results; and
6. Developing a user guide for using performance measures and determining the need for non-motorized countermeasures and providing recommendations for Michigan's Complete Streets policy.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 3. Data Analysis

- Completed analyzing on-motorized crash patterns
- Completed performance evaluation by three level (corridor, census tract, and city)
- Developed safety performance functions

Task 4. Analyze Performance Measures by Others

- Reviewed performance measures by others

Task 5. Develop Goals and Performance Measures

- Developed performance measures for non-motorized safety

Task 6. Develop Guidance

- Developed guidance for analysis process

Task 7. Prepare final report

- Developed a draft report

FISCAL YEAR 2014 ACCOMPLISHMENTS

Completed Task 6, Developed guidance for analysis process and an implementation plan.

Completed Task 7, Prepared final report.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The non-motorized volume models can be used in estimating pedestrian and bicycle volumes at intersections where field data are not available. However additional calibration is necessary because data was very limited in the development of the models. Non-motorized safety performance functions are applicable to any city in Michigan, but additional calibration efforts are needed for higher accuracy in other areas. Non-motorized performance measures were developed for infrastructure, exposure, education and safety. The challenge in implementing the safety performance functions and measures is the immense amount of data that is needed to develop and analyze them.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE Monitoring Highway Assets with Remote Technology

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER Tim Croze

CONTRACT/AUTHORIZATION NO.	2012-0636	PROJECT START DATE	7/31/2012
PROJECT NO.	121277	COMPLETION DATE (Original)	12/31/2013
OR NO.	OR10-030	COMPLETION DATE (Revised)	1/31/2014
RESEARCH AGENCY	Dye Management Group, Inc.		
PRINCIPAL INVESTIGATOR	Robert Zilay		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$137,500.00	Vendor Budget	\$489,997.00
MDOT Budget FY 2014	\$7,200.00	Adjusted MDOT Budget	\$3,185.67
Vendor FY 2014 Expenditures	\$83,735.00	Budget	\$493,182.67
MDOT FY 2014 Expenditures	\$3,185.67	Expenditures	\$493,182.67
		Total Amount Available	\$0.00

PURPOSE AND SCOPE

1. Reduce MDOT reliance on field staff to monitor roadway hardware/asset data.
2. Develop a uniform methodology ensuring all data significant to maintenance operations and budgets are considered.
3. Prioritize categories for collection based on budgeting and maintenance needs.
4. Identify tools and establish processes for collecting, storing, analyzing, sharing and updating roadway hardware data.

FISCAL YEAR 2012 ACCOMPLISHMENTS

A project kick-off meeting was held on July 31, 2012 to discuss the research plan, deliverables, and expectations of the consultant, research advisory panel, and project manager. The consultant conducted a literature search and submitted a document summarizing the findings of their literature search. The research advisory panel reviewed the document and met with the consultant to review suggested changes. The document was updated by the consultant and resubmitted to the RAP for approval. The consultant has also begun researching remote technologies and costs of these technologies for monitoring MDOT assets.

FISCAL YEAR 2013 ACCOMPLISHMENTS

The consultant finalized their research of remote technologies and costs and developed a plan for validating the recommended technologies on a 150-mile pilot section in southwest Michigan. The consultant conducted and completed the pilot and documented the results. The results were submitted to the RAP for review and the consultant conducted a review workshop to validate the results with the RAP. The consultant also integrated the pilot data with the MDOT enterprise GIS. Finally, the consultant researched possible data storage and distribution technologies for a statewide application of the pilot findings.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Final report and implementation recommendations were completed

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Additional time was needed to complete the final report.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

1. **Develop a request for proposal (RFP) for statewide data collection:** MDOT will develop the requirements for a statewide data acquisition and extraction RFP that focuses on collecting inventory for prioritized assets using mobile imagery or video technology, possibly with LiDAR supplementation, and supported by a manual quality assurance (QA) process. Suggested RFP requirements are presented in the final report. Also, the suitability of using various technologies and frequency of asset inventory updates is included in the recommendations section of the final report.
2. **Review proposals:** MDOT will review the vendors and develop a shortlist of potential vendors to invite to demonstrate their proposed approaches. Suggested criteria for selecting the short list are presented in the final report
3. **Conduct demonstration of approach with vendors:** MDOT will provide the opportunity for the shortlisted vendors to demonstrate their approaches on a designated route, as specified in the RFP.

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4. **Review vendor demonstration results:** MDOT will review and conduct QA on the vendor demonstration results, including the vendor-provided geodatabase, for the following:
- Accuracy of asset location is within allowable tolerance
 - Precision of defined assets (e.g., is guardrail identified as guardrail, not curb?)
 - The structure of the geodatabase accommodates complete integration into the enterprise GIS
5. **Select vendor for contract:** Based on a blend of RFP responses, demonstrated capabilities, and cost, MDOT will select a vendor for contract award. Suggested criteria and rating points for vendor selection are presented in the final report.
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**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluating Roadway Surface Rating Technologies

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: William Tansil

CONTRACT/AUTHORIZATION NO.	2013-0068 Z2	PROJECT START DATE	8/20/2013
PROJECT NO.	121278	COMPLETION DATE (Original)	7/8/2014
OR NO.	OR14-030	COMPLETION DATE (Revised)**	9/30/2014
RESEARCH AGENCY	University of Michigan		
PRINCIPAL INVESTIGATOR	Bruce Belzowski		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$161,657.01	Vendor Budget	\$161,657.01
MDOT Budget FY 2014	\$7,300.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$155,186.06	Budget	\$161,657.01
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$161,398.33
		Total Amount Available	\$258.68

PURPOSE AND SCOPE

The proposed study would compare accelerometer movements from a smart phone collected by DataProbe and stored on a server with PASER ratings measured on the same portion of the state's roadway system between May 2012 and October 2012 and additional PASER data to be collected statewide from June 2013 to October 2013 (data provided by MDOT Planning Division). Evaluate and correlate the data and where possible compare data with IRI values (where they exist) for the same roadway sections (data provided by MDOT Asset Management Division). Make recommendations regarding any necessary adjustments and/or improvements to the smartphone program software and application to improve the comparability of the results. In addition, the study should assess and report on the repeatability of the comparison results.

FISCAL YEAR 2013 ACCOMPLISHMENTS

1. Gather data collected from the smart phone accelerometer via DataProbe and the PASER study group's (MDOT statewide) ratings that were collected during the period May 2012 through October 2012 and PASER data collection from June 2013 through October 2013. Gather data from MDOT for IRI values for the same sections of roadway (where DataProbe application and PASER collection methods were used) measured in 2012 & 2013.
2. Analyze, evaluate, correlate, and document data collected from a smartphone; using a DataProbe application, to that of the expert subjective PASER ratings and IRI for the evaluation period from May 2012 through October 2012 and June 2013 through October 2013.

FISCAL YEAR 2014 ACCOMPLISHMENTS

1. Use Matlab subroutines to generate DataProbe PASER ratings based on the revised algorithm and compare them to PASER ratings for the same road segments statewide. Correlate the PASER ratings and roughness measure from the smart phone to better calibrate the data collection software by developing a curve fitting algorithm to more accurately represent the expert-based PASER ratings and IRI results. Modify the data collection software as needed to more accurately represent PASER ratings and IRI collection system.
2. Prepare a draft presentation and draft final report for review and comment six months after notice to proceed.
3. Refine draft presentation and draft final report for review and comment one month prior to project completion.
4. Provide final presentation and report and refine the data collection smart phone software for future use as data collection device for roadway surface condition state.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Final Report, Executive Summary, and an Implementation Action Plan. During the first quarter of FY2015 PI is to complete 100% of project tasks and submit to MDOT for review/approval all project required reports, products and other deliverables (if applicable).

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

More time needed for additional experiments. Based upon the principal investigator's (PI's) analyses of the 2012 and 2013 data collected; multiple factors were found that affect the ability of the DataProbe data collected to predict IRI road segment ratings. Therefore, the PI proposed and the PM/RAP accepted additional experiments to further study the found factors. The researchers first estimated that they would be able to complete this additional work by the end of the contract (July 8, 2014). But after beginning the experiments they found that it was going to take longer than expected; therefore, this request for a no cost time extension.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**The MDOT project manager anticipates the project will extend into FY2015. More time is needed before MDOT will receive the project final deliverables. Project Manager is still waiting on Principal Investigator to submit final report for review and acceptance by the project Research Advisory Panel. The PI's Implementation Action Plan (IAP) and the final report are under development. We now expect sometime in December 2014 this will be accomplished.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluating the Costs and Benefits of Non-differential Freeway Speed Limits for Trucks and Buses; and the Outcomes of Raising All Vehicle Speed Limits

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Mark Bott

CONTRACT/AUTHORIZATION NO.	2013-0070 Z2	PROJECT START DATE	2/26/2013
PROJECT NO.	121279	COMPLETION DATE (Original)	5/1/2014
OR NO.	OR13-009	COMPLETION DATE (Revised)	12/31/2014
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$297,720.26	Vendor Budget	\$300,060.61
MDOT Budget FY 2014	\$18,200.00	Adjusted MDOT Budget	\$8,572.65
Vendor FY 2014 Expenditures	\$247,868.18	Budget	\$308,633.26
MDOT FY 2014 Expenditures	\$8,572.65	Expenditures	\$281,825.88
		Total Amount Available	\$26,807.38

PURPOSE AND SCOPE

The purpose of the research is to determine the impacts of raising freeway truck and bus speed limits from the present 60 mph to 65 mph or 70 mph. This includes what safety and speed impacts could occur if the speed limits were raised for truck/buses, what impacts occurred when other states raised their speed limits and those states that have a differential speed limit. This research is also to determine the economic impacts to the state and the trucking industry.

The following table shows SPR II and ITS funding for this project:

Funding Source	FY 14 Expenditures	Total Expenditures	Total Budget
SPR II - JN 121279	\$ 256,440.83	\$281,825.88	\$300,060.61
Traffic JN 124729	\$840.20	\$840.20	\$75,000.00

FISCAL YEAR 2013 ACCOMPLISHMENTS

The following tasks progressed in fiscal year 2013:

- **Task 1: Literature Review**
A state-of-the-art literature review has been conducted. Relevant research literature was identified, summarized, and critically reviewed by graduate students under the supervision of the Principal Investigators (PIs). These summaries are being compiled into a comprehensive topical summary, which will be included as a part of the final report.
- **Task 2: Survey of State Agencies**
Draft survey tools were developed and reviewed by the Research Advisory Panel (RAP). These surveys have been implemented and the results are being used to determine available state-level data, as well as to identify state DOT-sponsored research for inclusion in the literature review.
- **Task 3: Collect Historical Data: Michigan and Other States**
Data collection activities have begun. Historical fatal crash data have been obtained and support data is being requested from various state departments of transportation.
- **Task 4: Collect Field Speed Data**
Preliminary field speed data was collected. Full scale data collection is currently under way in Michigan, Indiana, and Ohio.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The following tasks progressed in fiscal year 2014:

- **Task 1: Literature Review**
The revised literature review has been included as a part of the final report.
- **Task 2: Survey of State Agencies**
A survey was implemented to obtain feedback from the trucking industry. The results of these surveys have been summarized in the project report.

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- **Task 3: Collect Historical Data: Michigan and Other States**
Data collection activities have been completed. Historical fatal crash data have been obtained and support data was requested from the FMCSA and various state departments of transportation. This includes vehicle miles of travel, speed limit information, and any other pertinent information. The scope was expanded from truck-involved fatality data to more broadly cover fatalities for all vehicle types. The results have been described in the project report.
 - **Task 4: Collect Field Speed Data**
Data were ultimately collected at a total of 160 locations for trucks, buses, and passenger vehicles. The methods have been described in the final report.
 - **Task 5: Analyze Speed Data**
Preliminary analyses were conducted to determine aggregate statistics (e.g., mean, 85th percentile, variance). More detailed analyses were subsequently conducted to ascertain the impacts of speed limit policies on these speed measures. The results have been described in the project report.
 - **Task 6: Analyze Crash Data**
An analysis of national fatalities has been completed. This analysis considered data for all vehicle crashes (passenger vehicle and truck-involved). Separate analyses were conducted for urban and rural interstates in order to ascertain trends between states with different speed limit policies while controlling for other factors, such as vehicle miles traveled. A before-and-after study was performed for crashes on select urban freeways where the speed limit was recently increased from 55 to 65 or 70 mph. The effects of speed limits on non-freeway fatal crashes were assessed based on prior research findings. The methods and results have been described in the project report.
 - **Task 7: Conduct Economic Analysis of Policy Alternatives**
The WSU team worked with MDOT to obtain infrastructure costs in order to estimate the potential economic impacts associated with speed limit increases (e.g., alignment and other geometric issues, signage, etc.). Additional economic costs and benefits, including increased fuel consumption costs, travel time benefits, and crash costs (or benefits) were also estimated. Using these estimated economic costs and benefits, the research team estimated the benefit/cost ratio for several potential speed limit increase scenarios at the statewide level. The methods and results have been described in the project report.
 - **Task 8: Present Findings to Leadership**
WSU presented the preliminary results to the MDOT Engineering Operation Committee on May 1, 2014. A follow-up presentation of the revised research findings by WSU to the Engineering Operation Committee occurred on July 10, 2014.
 - **Task 9: Final Report**
The draft final report was prepared and submitted to MDOT on April 2, 2014. After receiving comments from MDOT, WSU subsequently revised the final report and resubmitted on May 16, 2014. After receiving further comments from MDOT, WSU again revised and resubmitted the report on June 2, 2014. Final comments were received from MDOT and the finalized final report was submitted to MDOT for final acceptance on July 21, 2014.

The following three tasks progressed during fiscal year 14 and were documented in the final report identified in task 9:

- **Task 10: Identify the Environmental Costs and Benefits**
Michigan-specific calibration data has been obtained by MDOT for use in MOVES in order to estimate potential air quality impacts of speed limit policy changes. The University of Akron is assisting in conducting this analysis. MDOT has also assisted in conducting preliminary analyses to estimate potential pavement impacts. The methods and results have been described in the final report.
- **Task 11: Survey County and Local Road Officials and Police**
Draft survey questions were developed and this content was used as part of a focus group activity facilitated by WSU on March 20, 2014.
- **Task 12: Survey ACEC members and MDOT engineers**
Draft survey questions were developed and this content was used as part of a focus group activity facilitated by WSU on March 20, 2014.

The following tasks have been approved within scope revision #3 and will provide expanded assessment of non-freeway roadway speed limit policies.

- **Task 13. Literature Review for Two-Lane Highways**
The research team has identified and reviewed documents pertaining to operations, safety, and policy related to speed limits for non-freeway roadways. A written literature review is in progress and will be included within the final report.
 - **Task 14. Data Collection**
WSU has created a comprehensive crash database by merging the Michigan crash databases from 2004 - 2013 with the
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statewide sufficiency files from the same period. Additional data from outside the sufficiency file are also being added, including horizontal curvature information, school locations, speed reduction zones, and MDOT's driveway count file. Crash prediction models have been developed to determine the significance of the various infrastructure related factors.

- **Task 15. Field Speed Data Collection**
Speed data for passenger vehicles and heavy vehicles were collected using RADAR and LIDAR at 100 locations on MDOT non-freeway roadways during July of 2014. The locations included 26 different roadways spread across 34 counties from all seven MDOT regions. Roadway segments were identified from possible candidate locations for speed limit increases provided to WSU by the PM and RAP. Several speed reduction zone locations were included in addition to the standard locations with posted speed limits of 55 and 65 mph. The data have been compiled into a series of spreadsheets for analysis. Prediction models have been estimated. Preliminary results were presented to MDOT at the RAP meetings on July 28, 2014 and September 16, 2014. This task is complete.
- **Task 16. Develop Prioritization Process**
A process for prioritization of segments to be considered for speed limit increase is under development. This process is based on consideration of numerous safety, operational, and infrastructure performance measures for all MDOT statewide non-freeway roadway segments. The process relies on the data found within the comprehensive crash database referenced in Task 14 and uses performance measure criteria recommended by the MDOT EOC and the MDOT RAP.
- **Task 17. Review Geometric Features of Select Segments**
Segments have been identified and design plans are being collected for review.
- **Task 18. Assess Need for Infrastructure Investment**
No progress to report during the quarter. Prioritization of infrastructure investments will be a primary topic of discussion at the October 14 RAP meeting.
- **Task 19. Benefit-Cost Analysis of Investment Scenarios**
No progress to report during the quarter.
- **Task 20. Prepare Final Project Report**
Literature review is in progress. No additional progress to report.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Progress on tasks 13 through 20 identified above are scheduled to progress so that a final report documenting findings can be completed by December 31, 2014.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Additional time was required to allow the RAP team to complete a thorough review of the draft final report and to allow for any necessary revisions to be made for the presentation to MDOT executives. No additional cost was necessary for that extension. Under a separate revision, additional scope and funding was approved for an expanded assessment of non-freeway roadway speed limit policies outlined in tasks 13 to 20. The timeline for the expanded scope is July 1, 2014 - December 31, 2014.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Preparation of Implementation of the Mechanistic-Empirical Pavement Design Guide in Michigan

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Michael Eacker

CONTRACT/AUTHORIZATION NO.	2010-0294 Z5	PROJECT START DATE	10/1/2011
PROJECT NO.	121281	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-022	COMPLETION DATE (Revised)	10/31/2014
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Neeraj Buch		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$138,710.05	Vendor Budget	\$400,000.00
MDOT Budget FY 2014	\$14,700.00	Adjusted MDOT Budget	\$15,572.26
Vendor FY 2014 Expenditures	\$89,297.97	Budget	\$415,572.26
MDOT FY 2014 Expenditures	\$14,572.26	Expenditures	\$402,304.42
		Total Amount Available	\$13,267.84

PURPOSE AND SCOPE

Part 1: HMA Mixture Characterization

1. Review what HMA properties are currently being tested by MDOT and which ones need to be considered for future testing in order to appropriately characterize MDOT HMA mixes for the M-E PDG.
2. Test HMA samples collected from MDOT construction projects for the inputs necessary in the M-E PDG. The principal investigator should provide a statistically based test matrix that will cover all of Michigan's geographic regions as well as a majority of the mixes identified in the HMA Mixture Selection Guidelines (Section 6.03.09 of the Road Design Manual available on the MDOT Web site). A number of mixes have already been tested under the MDOT research project "Development of Specification for the Superpave Simple Performance Tests (SPT)". The researcher is expected to utilize information from this recently completed project.
3. Provide recommendations on the appropriate values and input levels for HMA mixtures for use in the M-E PDG pavement designs.
4. Identify future needs, such as necessary design model calibrations, possible focus of other research, methods for verification of as-built properties, etc., that would be beneficial to MDOT in improving its design practice for new, reconstruct, and rehabilitation pavements.
5. Recommend what types of changes in the HMA should trigger new characterization testing.

Part 2: Evaluation of Rehabilitation Fixes

1. Review the sensitivity analysis completed under MDOT research project "Evaluation of the 1-37A Design Process for New and Rehabilitated JPCP and HMA Pavements". Identify the most critical/sensitive input parameters for use in the M-E PDG for pavement rehabilitation designs. Recommend any currently available methods (such as tests, procedures, or equipment) to more accurately determine input values for those inputs that are highly sensitive.
2. Provide technical criteria for selecting pavement sections to consider for predicted/observed performance comparisons. This should be a statistically based matrix based on geographic regions, traffic levels, pavement type, fix type, etc.
3. Perform comparisons between the M-EPDG predicted pavement performance and the observed performance of selected pavement sections.
4. Analyze the performance comparisons and provide recommendations as to whether or not M-E PDG should be used by MDOT for rehabilitation designs. Include, if applicable, any limitations of use for rehabilitation that the research results would suggest.
5. Provide recommendations on the appropriate values and input levels for all critical/sensitive parameters for use in M-E PDG pavement rehabilitation designs.
6. Identify future needs, such as necessary design model calibrations, possible focus of other research, etc., that would be beneficial to MDOT in improving its design practice for pavement rehabilitation.

Part 3: Calibration and Validation

1. Determine the best method for calibration.
2. Evaluate the readiness of Michigan's Pavement Management System (PMS) to provide the necessary data for M-E PDG calibration and validation. Identify deficiencies and recommend course of action to remedy.
3. Design a statistically based matrix for comparison of predicted with observed performance. The matrix should be statistically based on geographic regions, traffic levels, pavement type, fix type, etc.
4. Compare predicted performance from M-E PDG to observed performance of in-service pavements.
5. Adjust performance models so that predicted performance more closely matches observed, thereby reducing error and bias.
6. Validate the model adjustments on an independent set of in-service pavements.
7. Recommend a plan for future calibration and validation to ensure that the performance models are continuously improved, including any database needs.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Part1, HMA Mixture Characterization:

64 HMA mixtures from MDOT construction projects were delivered to MSU. Dynamic modulus testing was conducted on 57 of them and Indirect Tensile Strength testing was conducted on 18. In addition, samples of 55 asphalt cement binders from those mixes were also delivered to MSU. Dynamic shear modulus has been conducted on 40 of them using the 25 mm plate and 19 using the 8 mm plate.

Using the test data from the HMA mixes and binder samples, the Witczak equation for predicting dynamic modulus that is in the MEPDG pavement design software, was calibrated so that there is better agreement between actual test data and predicted results. This will improve predicted values for HMA mixes that were not tested.

MSU began developing a software package that will allow pavement designers to select the appropriate inputs for HMA layers when designing an asphalt pavement. The software will allow the user to select the HMA mix according to the appropriate Region and mix type. They can then export the input files and then import them into MEPDG or DARWin-ME. The results in the export files are based on the test results of the mixes and binders sampled from MDOT projects.

Part 2, Evaluation of Rehabilitation Fixes:

A sensitivity analysis of inputs specific to rehabilitation fixes was conducted. This builds on the sensitivity study conducted for new/reconstruct designs under a previous research project. Inputs were changed one at a time to determine which ones affect the output the most. These sensitive inputs were then subjected to a more detailed sensitivity analysis that looked at interactions between multiple inputs. Last, a global sensitivity analysis was started which will look at changing all of the sensitive inputs over the entire range of potential values. 3-dimensional surfaces can be plotted from this analysis that allow a visual analysis of how much these inputs affect the output and over what range this occurs.

A validation of predictions from the MEPDG software was also started. This involves comparing distresses observed from in-service pavements with predicted distresses from MEPDG. 6 to 10 projects from for each of the following fixes were identified to be used in this work:

- Unbonded concrete overlays
- Rubblized concrete with HMA resurfacing
- HMA over existing concrete
- HMA over existing composite
- ASCRL overlays
- Crush and shape with HMA resurfacing

HMA over existing HMA projects have not been chosen yet.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Part1, HMA Mixture Characterization:

The final report for Part 1 was accepted and published by MDOT.

An updated version of the DynaMod software (developed as a part of this research project) was provided by Michigan State University (MSU) and has been under evaluation by MDOT.

Part 2, Evaluation of Rehabilitation Fixes:

The global sensitivity analysis was completed and the results were summarized into a useable set of charts and tables for pavement designers. This completed the full range of sensitivity analyses. The verification of the predictive models for rehabilitation designs was completed. The conclusion from the verification was that the models require local calibration to improve the accuracy of the

predictions for Michigan pavements.

The final report for Part 2 was accepted and published by MDOT.

Part 3, Calibration and Validation:

Part 3 was started with a literature search of on-going or completed calibration work by other states. 145 new and reconstruct projects currently in-service in Michigan were identified to be included in the calibration process. The 32 rehabilitation projects from Part 2 of the study will also be included in the calibration. Project records for many of these identified new/reconstruct projects were searched to look for materials inputs required by the ME software. Because the project records for the rehabilitation projects were searched during Part 2 of the study, the calibration process was started with those project types. It is intended that rehabilitation and new/reconstruct projects will be calibrated separately and will result in a separate set of calibration coefficients for each.

Michigan State University requested transverse laser profiles that are taken by MDOT's Pavement Management data vendor. These profiles were requested to help calibrate the rutting predictions of the ME software.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Calibration of the predictive models in the ME software was completed. The calibration was conducted for both reconstruct designs as well as rehabilitation designs. Overall, the local calibration using Michigan pavement management data improved the predictive capabilities over the default (national) calibration. In addition, standard error for each model (which is used for reliability calculations) was established. The draft final report was delivered on July 31, 2014. An agenda for a technology transfer class was drafted.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

The following final deliverables are expected in fiscal year 2015:

- Final report
- One-day technology transfer class

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Revision 1: The due dates for the draft and final report for part 1 were moved back by 3 months to December 31, 2012 and March 31, 2013 respectively. The Research Advisory Panel (RAP) felt this was a good idea so that additional HMA mixes and binders could be sampled and tested. This will make the data set stronger as well as allow the software MSU is developing to output more actual test data for pavement design versus outputting predicted values. This was approved by the RAP at a July 26, 2012 meeting. The Scope Change form was submitted on September 24, 2012.

The overall completion date of the project was moved back 6 months from March 31, 2014 to September 30, 2014. MDOT was providing project records slower than anticipated. Additionally, the use of the transverse laser profiles was not in the original work plan, but was added because it was felt this would significantly improve the calibration of the asphalt rutting models. This date change was approved October 9, 2013.

Revision 2: PI requested a one-month extension to deliver the draft final report. A one-month extension to the project completion date is being requested by the PM to allow adequate time to review/edit the draft final report.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Predictive Modeling of Freezing and Thawing of Frost-Susceptible Soils

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Richard Endres

CONTRACT/AUTHORIZATION NO.	2010-0294 Z9	PROJECT START DATE	10/1/2012
PROJECT NO.	121282	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-047	COMPLETION DATE (Revised)	12/31/2014
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Gilbert Baladi		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$75,837.78	Vendor Budget	\$99,453.00
MDOT Budget FY 2014	\$21,000.00	Adjusted MDOT Budget	\$6,683.58
Vendor FY 2014 Expenditures	\$40,430.12	Budget	\$106,136.58
MDOT FY 2014 Expenditures	\$1,683.58	Expenditures	\$76,999.53
		Total Amount Available	\$29,137.05

PURPOSE AND SCOPE

MDOT has a large investment in retaining walls, many of which are located in the metro Detroit area. Poor quality backfill soils have caused drainage problems behind many wall sections. In addition to the increased hydrostatic pressure on the wall, freezing and thawing of frost susceptible soils may impose additional forces on these structures.

Furthermore, many grade separation bridges are founded on spread footings where under clearance requirements have increased since initial construction. Design engineers often ask to remove a portion of the soil cover over the spread footings to facilitate lowering the pavement grade beneath the structure. Removing soil cover results in less protection against frost heave.

Design engineers lack tools for prediction of frost depth and design of insulation countermeasures. Under-prediction of frost impacts could cause failure of retaining walls and spread footings. Over prediction could cause unnecessary removal and replacement of existing bridge foundations when lower under clearance is needed. Better methods are needed to predict frost depth and design countermeasures.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- Literature Review- 100% complete.
- Developed heat transfer frost depth model- 100% complete.
- Completed validation of the frost depth model.
- Begin the development of a heave and earth pressure model.
- Soil samples from the U.P. were delivered to MSU during the 2013 summer.
- Second batch of soil samples at MDOT's soil laboratory. To be delivered to MSU next quarter.
- Held a project progress meeting on February 5, 2013. 1) Discussed literature review performed; preliminary validation of numerical model UNSAT-H; soils thermal properties measurements, using the thermal conductivity apparatus; review of MDOT field data collected at instrumented sites. 2) Demonstrated soil thermal measurements and instrumentation associated with soil thermal testing (temperature chamber, data loggers, hydraulic sensors, etc.).
- May 3, 2013 presented draft results from heat flow simulation model.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Complete development of the heave and earth pressure model.
- Complete validation of the heave and earth pressure model.
- Couple the heat transfer model with prediction of earth pressure from frost heave.
- Validate models by applying to MDOT field data from selective sites.
- Training workshop.
- Spotlight issue

FISCAL YEAR 2015 PROPOSED ACTIVITIES

- Perform training to MDOT technical staff and complete the Final Report.; including an executive summary and implementation action plan.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluating Prestressing Strands and Post-Tensioning Cable in Concrete Structures using Nondestructive Evaluation (NDE) methods including Joint Shear Wave Analysis

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Rebecca Curtis

CONTRACT/AUTHORIZATION NO.	2010-0293 Z4	PROJECT START DATE	10/1/2012
PROJECT NO.	121285	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-038	COMPLETION DATE (Revised)	12/31/2014
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Elin Jensen		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$154,961.45	Vendor Budget	\$249,999.97
MDOT Budget FY 2014	\$11,440.00	Adjusted MDOT Budget	\$14,495.45
Vendor FY 2014 Expenditures	\$109,066.93	Budget	\$264,495.42
MDOT FY 2014 Expenditures	\$13,535.45	Expenditures	\$222,394.42
		Total Amount Available	\$42,101.00

PURPOSE AND SCOPE

Prestressed beams are commonly used in highway bridge construction, and segmental post-tensioned bridges are becoming more widely used for medium and long span bridge construction. These types of structures rely heavily on steel prestressing strands and post tensioning strands for strength and durability. Additionally, it is very important during the construction of these bridges to implement a good quality control plan to ensure the proper placement of the strands and ensure ducts are fully grouted in accordance with the design. Methods to determine the overall condition of these strands are critical to verify the overall integrity and safety of these structures. Because the strands are embedded in concrete and often the area is complex and congested, non-destructive evaluation methods are needed to evaluate the condition and proper placement of the strands.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- Literature Report was completed
- Salvaged box beams were obtained
- Preliminary analysis of MIRA results for Group I laboratory box beams and MDOT salvaged beam
- Testing of MDOT salvaged beam using the canin (corrosion monitoring device), profometer and hammer
- Preparation of specimen II

FISCAL YEAR 2014 ACCOMPLISHMENTS

Field testing has been completed on Bridge carrying I-131 SB over Muskegon river and I-96 EB over Canal Rd in Dimondale. The final laboratory specimens have been constructed. Data analysis progressed concurrently with field and laboratory work.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

The final lab testing will be performed in October. Analysis and reporting will be completed in FY2015.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The project work plan has been delayed and an extension granted. First, the testing of the field beams was delayed as the access to load testing frame was limited due to activities in other testing programs/projects at LTU. Secondly, the duration of laboratory testing and evaluation programs were underestimated. This is in part due to (1) delay in the delivery and integration of a hardware piece to collect accurate distance measurements as the magnetic flux leakage (MFL) device traverses a test surface; (2) MFL data validation; (3) in-warranty maintenance and repair of battery pack in the ultrasonic testing equipment was conducted outside of LTU (in 2013); and (4) the final selection and design of the laboratory specimens to demonstrate the NDE methods' effectiveness in determining un-grouted and/or poorly grouted areas in longitudinal and transverse post-tensioned ducts.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Design and Construction Guidelines for Strengthening Bridges using Fiber Reinforced Polymers (FRP)

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Steve Kahl

CONTRACT/AUTHORIZATION NO.	2010-0298 Z7	PROJECT START DATE	10/1/2012
PROJECT NO.	121286	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-039	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Chris Eamon		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$135,693.73	Vendor Budget	\$163,854.14
MDOT Budget FY 2014	\$17,011.94	Adjusted MDOT Budget	\$9,163.45
Vendor FY 2014 Expenditures	\$118,578.04	Budget	\$173,017.59
MDOT FY 2014 Expenditures	\$9,163.45	Expenditures	\$173,017.59
		Total Amount Available	\$0.00

PURPOSE AND SCOPE

Although various design and construction guidelines exist for externally bonded FRP systems, FRP materials and their technologies are relatively new to the Michigan construction industry, and hence a knowledge gap exists for best practices and implementation. A significant concern is long-term performance in the relatively harsh Michigan environment. Although FRP guidelines from organizations such as the American Concrete Institute, such as ACI 440.2R (2008), have been validated for short-term structural performance, long term behavior is much less known. By providing a design and use guide based on experimentally and numerically validated parameters specifically developed for Michigan, the completion of this research will allow MDOT bridges to be strengthened with FRP in a cost-effective manner with long-term performance durability.

This project aims to provide refined design, construction, maintenance, and inspection guidelines for strengthening deteriorated Michigan bridge elements with FRP composites. The project scope encompasses the following tasks:

1. Develop a synthesis report that identifies primary factors in the selection, design, and use of FRP for strengthening, with application to specific bridge components such as pier caps, concrete beam flanges, webs, and bearing surfaces.
2. Identify special design, maintenance, and inspection issues of FRP strengthening specific to MDOT bridges.
3. Identify specific cases of potential FRP application on actual MDOT bridges, and assess the expected increase in capacity once the FRP repair is applied, using AASHTO LRFD requirements.
4. Develop a user-friendly design procedure for FRP strengthening, a guide for construction, maintenance, and inspection, a decision matrix for FRP use, and an accompanying booklet of example design calculations and details that demonstrates the methodology of FRP flexural and shear strengthening and its application to Michigan bridge components.
5. Validate the recommended procedures by conducting selected laboratory and field tests of FRP strengthened components.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1. Literature Review – Completed. Task completion memo with report previously sent.

Task 2. Address Deficiencies in Existing Guidelines -- In progress, near completion.

Task 3. Conduct Durability Tests -- In progress. All specimens have been completed. Accelerated and outdoor testing has begun.

Task 4. Development of Design & Evaluation Procedures – In progress. Guideline development for flexure, shear, and confinement analysis, design, and evaluation is in progress and near completion.

FISCAL YEAR 2014 ACCOMPLISHMENTS

All tasks started in fiscal year 13 were completed along with the following tasks:

- Task 5. Development of Use, Construction, Inspection, and Maintenance Guide
- Task 6. Field Implementation and Testing for Validation and Demonstration of Proposed Guidelines

A final report was developed and submitted for MDOT review.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Implement design and construction recommendations into special provisions for upcoming projects. For future design projects of strengthening existing structures, update design aids used in shear, flexural, and confinement upgrades with FRP. Use AASHTO Guide specifications for design of bonded FRP systems with the following exceptions:

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- Waiver of minimum confinement pressure of 0.6 ksi for shear and confinement strengthening;
 - Use Michigan specific environmental reduction factors as stipulated in the report;
 - For flexural design, use a FRP strain limit of 0.005;
 - For prestressed sections, use ACI equation for initial strain of FRP/concrete interface, and use the recommended strain limit equations in the report.

For construction and maintenance of FRP strengthening projects, incorporate the installation, QC, and maintenance recommendations in the report. Update special provisions to incorporate the changes. Expand the acceptance testing requirements.

All the above recommendations can be incorporated within a reasonable timeframe.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluation of Prestressed Concrete Beams in Shear

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Sudhakar Kulkarni

CONTRACT/AUTHORIZATION NO.	2010-0298 Z5	PROJECT START DATE	10/1/2011
PROJECT NO.	121287	COMPLETION DATE (Original)	9/30/2013
OR NO.	OR10-040	COMPLETION DATE (Revised)	9/30/2014
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Christopher Eamon		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$87,935.04	Vendor Budget	\$277,774.10
MDOT Budget FY 2014	\$46,000.00	Adjusted MDOT Budget	\$51,859.94
Vendor FY 2014 Expenditures	\$83,650.30	Budget	\$329,634.04
MDOT FY 2014 Expenditures	\$51,859.94	Expenditures	\$329,634.04
		Total Amount Available	\$0.00

PURPOSE AND SCOPE

1. Review existing structures in the MDOT inventory designed under the multiple methods. Review existing structures that have evidence of shear cracks and identify any issues stemming from construction or design.
2. Determine the most appropriate method of evaluating the structures, and provide calibration to apply modified compression field theory to Load Factor Design or Rating. Consider the use of automated software such as AASHTO VIRTIS, so that recommendations or changes can be seamlessly integrated into current MDOT practice.
3. Develop recommended procedures to the bridge design manual to avoid shear distress in new structures.
4. Identify a prestressed beam with shear cracks and load test to predict the load capacity at failure and also capacity at the point damage has occurred and the beam would need to be rehabilitated or replaced in service.

FISCAL YEAR 2012 ACCOMPLISHMENTS

During FY2012 the following tasks were completed.

- 1) Literature review
- 2) Identify a sufficient sample of prestressed concrete bridges with shear cracks at the ends of the PC beams for the study
- 3) Determine causes of shear cracks.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Tasks included

- 1) Laboratory testing of one full size PC beam and field load testing of two bridges was completed
- 2) Finite element analysis progressed, but was not completed
- 3) Modified compression field theory / load factor design (MCFT/LFD) based shear design and evaluation method development continued but was not completed

FISCAL YEAR 2014 ACCOMPLISHMENTS

Continue work on finite element analysis, MCFT/LFD based shear design and evaluation method development, and prepare final report. This work is completed and a report has been developed documenting findings.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The extension provided time to thoroughly evaluate test results and validate finite element analysis models after the delayed beam test occurred. A significant beam casting and testing delay occurred, as a result of the co-PI's changing employment positions from the proposed test institution (University of Michigan) to out-of-state. This unfortunately resulted in significant logistical delays in managing the testing portion of the project.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Develop MCFT/LFD based shear design method that will be used in bridge analysis and rating processes. This work is completed.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Remote Monitoring of Fatigue Sensitive Details on Bridges

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Steve Kahl

CONTRACT/AUTHORIZATION NO.	2010-0297 Z7	PROJECT START DATE	10/1/2012
PROJECT NO.	121288	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-041	COMPLETION DATE (Revised)	3/30/2015
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Upul Attanayake		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$232,931.31	Vendor Budget	\$249,997.83
MDOT Budget FY 2014	\$40,020.00	Adjusted MDOT Budget	\$13,165.01
Vendor FY 2014 Expenditures	\$123,800.67	Budget	\$263,162.84
MDOT FY 2014 Expenditures	\$7,385.01	Expenditures	\$198,655.30
		Total Amount Available	\$64,507.54

PURPOSE AND SCOPE

MDOT performs inspections of over 200 bridges with fatigue sensitive details. AASHTO LRFD (2010) classifies fatigue sensitive details into two groups: (1) load-induced fatigue and (b) distortion-induced fatigue. Identification of details that are prone to load-induced fatigue is straight forward. The distortion-induced fatigue can result from many different causes; hence, these details need to be identified through inspection and analysis. Further, the distortion-induced fatigue details need to be inspected in detail or monitored to gather real-time data. Hence, MDOT's needs are twofold. The first is to monitor the stress state of such details to calculate the remaining fatigue life so that the inspection, monitoring, or maintenance can be scheduled as needed. The second is to detect fatigue crack initiation and monitor fatigue crack growth to schedule maintenance activities. Both these needs require monitoring the structures as needed. Hence, a portable data logger is required. This process involves installing sensors at multiple bridges and moving the data logger from bridge to bridge, as needed, to monitor stresses, detect cracks, and monitor crack growth. Therefore, the structural health monitoring (SHM) system should be simple enough for an inspector with a minimal training to operate and maintain, while it is robust enough to provide necessary data, data processing capability, and include other tools needed for bridge management personnel.

The SHM system that will be developed through this research will help remote monitoring of fatigue sensitive details in steel bridges to (1) alert the bridge managers when a crack is initiated so that the crack growth is monitored to schedule maintenance activities, (2) monitor stress flow to calculate remaining fatigue life, evaluate maintenance effectiveness, improve design details, and understand the structural response under permit loads or during maintenance activities.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1: State-of-the-Art Literature Review

Structural modeling techniques for distortion-induced fatigue modeling were reviewed.
Fatigue life calculation models are being reviewed.

Task 2: Bridge Structural Analysis

Bridge model was updated using data collected during field inspection.
Studies are being conducted to identify the best modeling options for distortion-induced fatigue details as part of the global structure.

Task 3: SHM System Development

A SHM system was developed, purchased, and installed.

Task 4: SHM System Installation, Calibration, and Data Analysis

The SHM system was installed.
Acoustic emission (AE) sensor configuration was calibrated using the standard procedures for the detail.

Task 6: Reporting

1st quarterly report was submitted.
A synthesis report was submitted.
2nd quarterly report was submitted.
3rd quarterly report was submitted.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 1: State-of-the-Art Literature Review

Reviewed literature on the latest fatigue life calculation models.
Reviewed literature on acoustic emission data processing techniques.

Task 2: Bridge Structural Analysis

Evaluated different finite element modeling and data processing techniques for hot spot and/or notch stress calculation.
Implemented the concepts on a full bridge model that represents the I-94 EB over Puetz road bridge.
Hot spot stress under a fatigue truck was calculated in order to determine the fatigue life of a welded detail.

Task 4: SHM System Installation, Calibration, and Data Analysis

Strain, acoustic emission, and power supply data were recorded.
Data analysis techniques were evaluated to develop meaningful results for bridge management decision-making.

Task 6: Reporting

Interim annual report for FY13 was completed. 8th quarterly report submitted.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Task 2: Bridge Structural Analysis

Perform as needed analysis to complete the final report.

Task 4: SHM System Installation, Calibration, and Data Analysis

Data analysis to develop meaningful results for bridge management decision-making.

Task5: Technology Integration and Training:

SHM system capabilities will be demonstrated.
MDOT staff will be trained on the use of equipment.

Task 6: Reporting

9th quarterly report.
Draft final report and other deliverables to meet end date of 3/30/15.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Revision 1: A budget increase was needed to fund MDOT traffic control and support.

Revision 2: Coordination and design issues with solar power hookup and cold temperatures resulted in power demand exceeding capacity of system to recharge. This power issue at a remote location delayed operation of the system such that one of year monitoring was not possible, but with the extension several months of data collection can be realized and incorporated into project results.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Study of High Tension Cable Barrier on Michigan Roadways

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Carlos Torres

CONTRACT/AUTHORIZATION NO.	2010-0298 Z3	PROJECT START DATE	10/1/2011
PROJECT NO.	121289	COMPLETION DATE (Original)	12/31/2014
OR NO.	OR10-036	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Peter Savolainen		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$91,529.28	Vendor Budget	\$223,895.17
MDOT Budget FY 2014	\$22,080.00	Adjusted MDOT Budget	\$12,540.56
Vendor FY 2014 Expenditures	\$80,912.03	Budget	\$236,435.73
MDOT FY 2014 Expenditures	\$12,540.56	Expenditures	\$234,058.41
		Total Amount Available	\$2,377.32

PURPOSE AND SCOPE

The purpose and scope of this project includes the following:

- Determine the average level of effectiveness of high tension cable barrier in reducing median crossover crashes (e.g., 95% effective at capturing/redirecting impacting vehicles) for all cable barrier installations in Michigan.
- Estimate the overall life-cycle cost of high tension cable barrier in Michigan.
- Perform a cost-benefit analysis for each high tension cable barrier installation in Michigan and determine if the benefits of the installation outweigh the costs.
- Propose guidelines for installing high tension cable barrier. Cable barrier guidelines should be based on specific characteristics, such as crash frequency, traffic volumes, roadway location, etc. Cable barrier guidelines recommended as part of this study must be clearly defined and must specify which characteristic(s) they are based on.
- Explore the effects of cable barrier placement. Specifically, compare the crash history of cable barrier installations in Michigan and determine if there is a relationship between the number of cable barrier impacts and the lateral offset between the cable barrier and the nearest traveled lane.
- Explore the effects of regional weather patterns in Michigan and the frequency of cable barrier impacts. Specifically, identify cable barrier installations in areas that traditionally have specific weather patterns (e.g., "snow belt" areas), compare the frequency of cable barrier impacts in areas with specific patterns to cable barrier installations in other regions of Michigan, and determine if there is a relationship between the frequency of cable barrier impacts and regional weather patterns.
- Explore the effects of traffic volumes and the frequency of cable barrier impacts. Specifically, compare the crash history of cable barrier installations in Michigan based on roadway traffic volumes and determine if there is a relationship between the number of cable barrier impacts and traffic volume.
- Compare the level of effectiveness of comparable four-cable and three-cable systems. MDOT has at least two cable barrier installations where the barrier has four individual cables. Both of these four-cable systems meet National Cooperative Highway Research Program Report 350, Test Level 3 (NCHRP 350, TL-3) and are approved for use on 1:4 slopes. MDOT also has several cable barrier installations which only have three cables, and these cable systems also meet NCHRP 350, TL-3 and are approved for use on 1:4 slopes. Determine the number of cable barrier impacts on similar installations (i.e., three-cable versus four-cable), determine the number of crashes where the impacting vehicle breached the cable system, and determine if four-cable systems have resulted in fewer breaches compared to three-cable systems.
- Determine the percentage of cable barrier impacts on Michigan roadways involving motorcycles, and determine the crash severity of motorcyclists impacting cable barrier. Determine the percentage of motorcycle crashes on Michigan roadways where the motorcyclist impacted other barrier types (i.e., traditional guardrail, concrete barrier) and compare the frequency and severity of those crashes to motorcycle crashes involving high tension cable barrier.
- Estimate the number of vehicular impacts involving traditional beam guardrail and permanent concrete barrier installations in Michigan and compare this to the number of impacts involving high tension cable barrier. Determine if high tension cable barrier is more susceptible to vehicular impacts compared to other barrier types (i.e., traditional beam guardrail and concrete barrier).

11. Create marketing tools and techniques that could be used to promote the use of high tension cable barrier to the general public, and help give cable barrier a positive image.

12. Explore the relationship between cable barrier installation and the ability of official vehicles to cross the freeway median. Median barrier installation closes all unofficial median crossovers and forces all official vehicles (e.g., emergency first responders, law enforcement, maintenance vehicles, etc.) to use official median crossovers or interchanges to change bounds. Therefore, determine what effects cable barrier installation has had on the day-to-day operations of emergency first responders, law enforcement, and maintenance. Also, determine if cable barrier installation has had an adverse impact on the day-to-day operations of emergency first responders, law enforcement, and maintenance. Examine MDOT's current median crossover guidelines as it pertains to crossover spacing. If deemed appropriate, suggest modifications to the median crossover spacing guidelines.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Task 1: High Tension Cable Barrier Literature Review

A detailed state-of-the-art literature review has been conducted. Relevant research literature has been identified and each document has been summarized and critically reviewed by Wayne State University graduate student staff under the supervision of the Principal Investigators (PIs). These summaries have been compiled into a comprehensive topical summary, which will be included as a part of the final report.

Task 2: Crash Data Collection

Details of all completed and planned cable barrier installations have been obtained from MDOT. The associated plans and proposals have been used by graduate student staff to determine the limits of each installation. This information has been entered into a database that was used to construct a geographic information system (GIS) map. This map provides details of the installation limits for each cable barrier section, the side(s) of the road on which the barriers are located, and the locations where turnarounds are provided. The Project Manager (PM) has also provided details of recent cable barrier installations that have occurred, as well as sites where installation is scheduled in the near future. Using this location information, data for crashes along such segments have been obtained under the direction of the PIs. MDOT has also provided the research team with location information for all turnaround locations, including non-cable barrier locations.

Task 3: Crash Data Analysis

The research team has reviewed UD-10 crash report forms for crashes resulting in K and A injuries at select locations over the period from 2002 to 2006 in order to ensure consistency between WSU's methods and those utilized by MDOT during a prior analysis. Subsequently, the UD-10 crash report forms were collected for all crashes that occurred on the freeway segments where cable barrier has been installed. As a part of this review, the research team is identifying all target (i.e., median-related) crashes that occurred up to five years prior to cable barrier installation. In addition to the crashes along the cable barrier sections, other non-cable barrier sections along the same freeways are being identified in order to compare crash trends between types of median treatments.

Task 4: In-Depth Crash Investigation

The research team has met with the Michigan State Police (MSP) to discuss a proposed methodology for in-depth crash investigations to be conducted by traffic crash reconstructionists. Given current resource constraints within MSP, the research team is currently collecting more detailed data from crash report forms, as well as supplementary information that is available through design plans, aerial photography, and other data sources. The data that is being collected includes cross-slope information, details of the horizontal and vertical alignment, and information related to the damage sustained during specific crashes as can be determined by available maintenance and repair data.

Task 5: Collection of Maintenance, Repair, and Cost Data

Construction cost data has been obtained and contact with MDOT has been established with respect to obtaining maintenance, repair, and other data. The research team will bring review of these data in coordination with MDOT.

Task 6: Conduct Survey of Emergency Service Personnel

A draft survey tool was developed to obtain feedback as to the impacts of cable median barriers on emergency response. MDOT reviewed and approved the proposed survey tool. The survey was implemented and completed during fiscal year 2013.

FISCAL YEAR 2013 ACCOMPLISHMENTS

1. Continued crash data collection, review, and analysis.
2. Continued collection of additional supplementary data for the purposes of the crash analysis.
3. Continued collecting maintenance and repair cost data.
4. Implemented and completed survey tool for emergency response personnel.
5. Conducted survey of emergency response personnel.

FISCAL YEAR 2014 ACCOMPLISHMENTS

1. Completed crash data collection, review, and analysis.
2. Completed collection of maintenance and repair cost data.
3. Analyzed all data collected and completed the objectives of the research study.
4. Created marketing tools and techniques that could be used to promote the use of high tension cable barrier to the general public, and help give cable barrier a positive image.
5. Prepared a draft report and draft versions of the other deliverables for this research study and submitted the report and deliverables to MDOT (RAP members) for review and approval.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Submit a final report and other deliverables for this research study addressing all of the objectives of the study by December 31, 2014.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluation of Non-Freeway Rumble Strips - Phase II

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Mary Bramble

CONTRACT/AUTHORIZATION NO.	2013-0070 Z1	PROJECT START DATE	2/8/2013
PROJECT NO.	121347	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR13-007	COMPLETION DATE (Revised)	3/31/2015
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Tapan Datta		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$231,995.91	Vendor Budget	\$249,999.90
MDOT Budget FY 2014	\$18,720.00	Adjusted MDOT Budget	\$7,000.00
Vendor FY 2014 Expenditures	\$154,728.50	Budget	\$256,999.90
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$209,337.09
		Total Amount Available	\$47,662.81

PURPOSE AND SCOPE

There were 1084 fatalities, 7,485 severe injuries and a total of 324,174 reported crashes in Michigan in 2007. Lane departure crashes play a large role in the number of crashes and fatalities in Michigan as well as nationwide. To combat this, MDOT has taken on a new, innovative approach to safety by installing centerline and shoulder non-freeway rumble strips across the state in fiscal year 2008, 2009, and 2010 in order to lower fatalities and crashes caused by drivers leaving their lane.

MDOT's centerline and shoulder non-freeway rumble strip implementation will cost approximately 9 million dollars over the 3 years 2010.

This is Phase II of a research project related to this rumble strip installation. Three years of 'after' crash data will be collected and analyzed, drivers and residents will be surveyed as to their acceptance of the rumble strips, MDOT pavement and maintenance personnel will be surveyed as to their experiences and opinions about the installation and finally information from Phase I and Phase II will be used to develop 'How-To' for use by other agencies, both state and local, that are interested in a similar safety initiative.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1: Literature Review

A detailed literature review was completed as a part of the Phase I study. New literature is being reviewed and will be incorporated into an updated state of the art literature review, as well as any subsequent literature made available in the duration of the project.

Task 2: Three Years of "After" Crash Data Collection

Candidate "after" period crash data has been identified through the year 2012. This process matched that of the Phase I study "before" period data. The "after" period crash data identification will continue when 2013 crash data becomes available.

Task 3: Pavement Design and Maintenance Personnel's Impression Survey

A survey was prepared and distributed to MDOT personnel. Responses by November 15, 2013 were requested.

Task 4: Identify and Review "After" Target Crashes

Based on the candidate crashes identified as a part of task 2, "after" period target crashes are currently being identified by the criteria developed as part of the Phase I study. This process will continue once year 2013 crash data becomes available.

Task 5: Identify Focus Group and Conduct Meeting

MDOT has provided a list of potential candidates for the focus group.

Task 6: Perform Crash Analysis

No progress reported this year.

Task 7: Develop and Perform Public Impression/Opinion Survey

A survey was prepared and distributed on MDOT social media. The survey is open until November 15, 2013.

Task 8: Development of Centerline Rumble Strip System-wide Implementation Guideline

No progress reported this year.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 1: Literature Review

New literature has been reviewed and will be incorporated into an updated state-of-the-art literature review.

Task 2: Three Years of "After" Crash Data Collection

All candidate "after" period crash data has been identified, through 2013. This process matched that of the Phase I study "before" period data.

Task 3: Pavement Design and Maintenance Personnel's Impression Survey

A survey was distributed to MDOT personnel. Survey results were presented in the focus group meeting.

Task 4: Identify and Review "After" Target Crashes

Based on the candidate crashes identified as a part of Task 2, "after" period target crashes have been identified via the criteria developed as part of the Phase I study.

Task 5: Identify Focus Group and Conduct Meeting

Focus group meeting was conducted on 9/11/2014.

Task 6: Perform Crash Analysis

In-depth analysis of the crash data is currently being performed now that crash data collection and identification is complete. Preliminary results were provided in a draft technical memo at the end of August.

Task 7: Develop and Perform Public Impression/Opinion Survey

A survey was distributed via MDOT's public relations department. Survey results were presented in the focus group meeting.

Task 8: Development of Centerline Rumble Strip System-wide Implementation Guideline

Initial input from several local agencies was received at the focus group meeting. Guideline development is continuing.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

1. Continue to review new and forthcoming literature relevant to centerline rumble strips.
2. Summarization of the results of the focus group meeting.
3. Development of the implementation guideline.
4. Preparation of final report.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Additional time is needed to review crash data from the most recent year. There was also a delay in receiving the traffic volume data needed, which now needs to be analyzed. A focus group meeting needed to be delayed until more attendees are available.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluating the use of Unmanned Aerial Vehicle (UAVs) for Transportation Purposes

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Steve Cook

CONTRACT/AUTHORIZATION NO.	2013-0067 Z1	PROJECT START DATE	5/22/2013
PROJECT NO.	121348	COMPLETION DATE (Original)	11/30/2014
OR NO.	OR13-008	COMPLETION DATE (Revised)	03/31/2015
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Colin Brooks		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$214,902.99	Vendor Budget	\$269,123.91
MDOT Budget FY 2014	\$10,800.00	Adjusted MDOT Budget	\$1,200.00
Vendor FY 2014 Expenditures	\$215,530.37	Budget	\$270,323.91
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$259,003.81
		Total Amount Available	\$11,320.10

PURPOSE AND SCOPE

- Develop UAV technology that will provide visual inspection capabilities for pump stations, roadway lighting fixtures, sewers and culverts from an aerial platform. The technology must be capable of collecting visual images of equal quality to existing ground based inspection (tracked vehicles and human based) techniques. The technology must be capable of flying within confined spaces as small as a 24 inch diameter pipe.
- Develop UAV technology that will provide aerial monitoring of traffic conditions. Image quality must be equivalent to that provided by publicly available web based mapping services such as Google Earth and Bing Maps.
- Develop UAV technology that will provide bridge condition data from an aerial platform to supplement routine and in-depth inspections. Condition data includes both surface condition and non-destructive structural assessment data of bridge element integrity. These evaluation techniques typically require ultrasonic, infrared, thermo graphic, radar and visual inspection technologies.
- Develop UAV technology that can collect LiDAR (Light Detection and Ranging) based surveying information.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- Conduct literature search
- Develop prototype vehicles that meet the requirements of objectives 1, 2, 3 & 4.
- Demonstrated UAV technology in confined spaces of an MDOT large pump station
- Task 1-4; approximately 30% complete.
- State of Practice/Literature Review document (task #5); approximately 95% complete.
- Determine steps to obtain the required approvals from federal and state government to conduct needed unmanned aerial operations required for research and implementation.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Collect condition data from multiple sites as determined by MDOT. Conduct field trials of the prototype equipment.
- Analyze collected data for accuracy. Compare UAV collected data to comparable data obtained from existing collection methods.
- Provide final data to MDOT in a format specified by MDOT.
- Produce and deliver a final report that summarizes the results of the data analysis. This includes information that summarizes the quality and effectiveness of UAV collected data.
- Provide an implementation plan for utilizing the new UAV technology in MDOT operations.
- Deliver operating UAV equipment and provide user training to MDOT personnel.
- Provide demonstration at ITS World Congress – Detroit
- Provide demonstration to MDOT RAP and EOC

FISCAL YEAR 2015 PROPOSED ACTIVITIES

- Provide time extension to March 2015 for review and comment on draft final report.
- Submit Final Report.
- Provide training and delivery of equipment purchased.
- Proposed project extension (to May 1, 2016) and funding of \$150,000 to further develop sensor data collection, storage, usage, and application development in the following areas:
 - Operations and Maintenance uses for traffic monitoring for a TOC.
 - A formal demonstration of crash scene reconstruction imaging.
 - A demonstration of slope stability assessment (for example, for retaining walls).
 - A demonstration of the capabilities to complete aerial imaging to meet MDOT mapping and construction monitoring needs.
 - A report that describes and recommends optimal methods to store and distribute potentially large imaging and 3-D surface datasets create through UAV-based data collection.
 - Enhanced testing of UAV-based thermal imaging for bridge structural integrity and geotechnical assets.
 - A demonstration of high-accuracy simultaneous thermal/video/LiDAR measurement using a high-fidelity sensor-fused UAV positioning

approach.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Vendor plans to submit a request for a no cost time extension into Spring 2015. Verbal approval was given by the project manager. A formal 5306 Form (Project Change Request) will be processed during the first quarter of FY 2015.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Research Administration Section Planning and Communications

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Mark Polsdofer

CONTRACT/AUTHORIZATION NO.	2012-0298	PROJECT START DATE	1/31/2012
PROJECT NO.	121349	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR12-021	COMPLETION DATE (Revised)	3/31/2015
RESEARCH AGENCY	CTC & Associates, LLC		
PRINCIPAL INVESTIGATOR	Patrick Casey		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$91,893.98	Vendor Budget	\$239,863.00
MDOT Budget FY 2014	\$0.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$20,520.02	Budget	\$239,863.00
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$192,412.98
		Total Amount Available	\$47,450.02

PURPOSE AND SCOPE

1. Assist Research Administration with developing, designing, writing and editing of new or updated manuals, assorted newsletters and other communication materials.
2. Plan Research Summit Materials for interaction with Universities and private consultants.
3. Produce newsletters outlining the results of research projects.
4. Provide support as-needed for additional documentation, such as the development of the new Innovations Report.

FISCAL YEAR 2013 ACCOMPLISHMENTS

1. Develop Communications of documents such as At-A-Glance, Research Spotlights and other newsletters: Partially fulfilled and ongoing.
2. Research and Implementation Manual: Completed.
3. Innovations Report: Partially fulfilled and ongoing.
4. Annual Report: Completed.

FISCAL YEAR 2014 ACCOMPLISHMENTS

1. Annual Report cover document preparation.
2. Continued work on and completed the new Innovations Report.
3. Developed communications of documents such as At-A-Glance, Research Spotlights and other newsletters as directed by Research Administration.
4. Research posters for RAC meeting and TRB meeting.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Develop communications of documents such as At-A-Glance, Research Spotlights and other newsletters as directed by Research Administration. Assist in the production of documents for the DUAP 2 Project (Data Use Analysis and Processing 2).

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Additional time is needed to complete services. Approved revision date: May 27, 2014.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluation of Bridge Decks using Non-Destructive Evaluation (NDE) at Near Highway Speeds for Effective Asset Management

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Eric Burns

CONTRACT/AUTHORIZATION NO.	2010-0295 Z7	PROJECT START DATE	11/1/2012
PROJECT NO.	121351	COMPLETION DATE (Original)	10/31/2014
OR NO.	OR10-043	COMPLETION DATE (Revised)	12/19/2014
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Theresa Ahlborn		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$167,919.31	Vendor Budget	\$243,251.57
MDOT Budget FY 2014	\$6,300.00	Adjusted MDOT Budget	\$4,567.44
Vendor FY 2014 Expenditures	\$130,406.74	Budget	\$247,819.01
MDOT FY 2014 Expenditures	\$3,547.44	Expenditures	\$236,754.88
		Total Amount Available	\$11,064.13

PURPOSE AND SCOPE

The objectives of this project include the following:

1. Research commercially available or deployment ready non-destructive evaluation (NDE) methods to evaluate bridge decks top surface area for delaminations, spalling, and cracking at near highway speeds.
2. Research NDE methods to evaluate bridge deck bottom surfaces and fascia's for delaminations without hands on contact.
3. Identify, review, or develop post processing methods to efficiently view, analyze, and report bridge deck spalling, cracking, and delamination consistent with MDOT's bridge management systems.

The scope of work for this project includes the following tasks:

1. Literature Review and a state of the practice review of Transportation agencies in the US and internationally to determine what NDE methods are being used.
2. Research Design and Planning - Plan studies of NDE methods and deck condition indicators. Understand MDOT's current bridge deck condition indicators and how they are used.
3. Data Collection - 1) Collect data on and/or experiment with NDE methods to evaluate bridge deck bottom surfaces and fascia's for delaminations without hands on contact. 2) Collect data on and/or experiment with commercially available or deployment ready NDE methods to evaluate bridge decks top surface for delaminations, spalling, and cracking at near highway speeds. Coordinate a portion of the deck testing prior to a series of deck rehabilitation projects so that chain drag testing, non-destructive testing, and destructive testing can be used to compare and validate the techniques. NDE methods should have data on ease of use, availability, reliability, ease of interpreting results collected among other issues. Collect information on current bridge inspection processes.
4. Analysis: Analyze data to make statistically sound recommendations on NDE method as they relate to current MDOT's bridge management systems, including cost, ease of use, availability, reliability, ease of interpreting results and other important factors.
5. Reporting: Develop deliverables.
6. Demonstration: Demonstrate NDE techniques recommended for use and educate MDOT staff about thier use.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Selected and completed 4 fall bridge field reviews. Began analyzing field data.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Completed field reviews of bridges. Reviewed and analyzed field data. Began the final report.

FISCAL YEAR 2015 PROPOSED ACTIVITES

Present report to bridge committee. Summarize findings and prepare the final report.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Revision 1: A budget increase was needed to fund additional hours for evaluating and improving nondestructive evaluation techniques.

Revision 2: More time is needed to provide a more comprehensive final report following the workshop, and allow adequate time for MDOT's review and approval.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Implementation to be determined after final report.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Balancing the Costs of Mobility Investments in Work Zones

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Hilary Owen

CONTRACT/AUTHORIZATION NO.	2013-0070 Z5	PROJECT START DATE	6/19/2013
PROJECT NO.	121354	COMPLETION DATE (Original)	5/15/2015
OR NO.	OR13-004	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$140,180.05	Vendor Budget	\$250,000.00
MDOT Budget FY 2014	\$20,000.00	Adjusted MDOT Budget	\$4,948.74
Vendor FY 2014 Expenditures	\$120,360.72	Budget	\$254,948.74
MDOT FY 2014 Expenditures	\$4,948.74	Expenditures	\$137,040.12
		Total Amount Available	\$117,908.62

PURPOSE AND SCOPE

Part 1:

- The objective of this study is to establish guidance on the appropriate level of investment in temporary measures to maintain mobility in work zones.

Part 2:

- Analyze how the type of work being performed and the equipment usage and placement affects driver behavior, traveler and worker safety, highway capacity and contractor efficiency.
- Use this information to develop a decision support tool to determine the appropriate mobility strategy for various pavement types and work types for use in the life-cycle cost analysis process.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- Task 1: Conduct state-of-the-practice survey. All State DOTs have been sent the survey, and responses are being compiled.
 Task 2: Conduct State-of-the-art literature review. This task has begun and remains ongoing.
 Task 3: Implement public survey on work zone delay. This task has begun and remains ongoing.
 Task 4: Collect Mobility, safety and cost data. This task has begun and remains ongoing.

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Task 1: Complete state-of-the-practice survey
 Task 2: Complete state-of-the-art literature review
 Task 3: Complete public survey on work zone delay
 Task 4: Continue to collect mobility safety and cost data for ongoing and past projects
 Task 5: Begin working on operational, safety, and economic analysis of selected work zone mobility strategies
 Task 6: Prepare Part 1 report

FISCAL YEAR 2015 PROPOSED ACTIVITIES

- Incorporate comments from RAP team into final report for Part 1
 Complete all tasks associated with Task 2 (if RAP team approves to move forward with Part 2)

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluating Michigan Commercial Vehicle Enforcement Strategies and Facilities

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Jason Firman

CONTRACT/AUTHORIZATION NO.	2013-0069 Z1	PROJECT START DATE	5/7/2013
PROJECT NO.	121355	COMPLETION DATE (Original)	3/30/2015
OR NO.	OR13-005	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Valerian Kwizgile		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$237,982.60	Vendor Budget	\$268,560.45
MDOT Budget FY 2014	\$8,000.00	Adjusted MDOT Budget	\$4,088.93
Vendor FY 2014 Expenditures	\$167,229.50	Budget	\$272,649.38
MDOT FY 2014 Expenditures	\$2,088.93	Expenditures	\$187,069.48
		Total Amount Available	\$85,579.90

PURPOSE AND SCOPE

The primary goals of this study is to define the benefits of each of the 14 fixed weigh stations in Michigan, the cost of upgrading and maintaining these weigh stations and the cost of using alternative solutions (Wireless Weigh in Motion (WWIM), safe enforcement sites, permanent intermittent truck weigh stations (PITWS) etc.) in place of the fixed weigh station or as an enhancement to it. This will include a benefit/cost analysis to help MDOT and MSP in decision making on future commercial vehicle enforcement strategies.

The project will identify the value of each fixed weigh stations as currently they are the only legal place to weigh a vehicle if the operator objects to using a PITWS site. The stations are also used for administrative and training purposes. Other factors to consider will be the significance of the corridor, border weigh stations, commercial volume, percent overweight, safety and redundancy. This project will also be able to quantify the damage of overweight vehicles to the state highway system.

Detailed information on the advantages and disadvantages of each enforcement treatment will also be included.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1: Literature Review:

- Gathering and reviewing literature about commercial vehicle enforcement strategies in other states and other countries
- Reviewing MDOT documents related to commercial vehicle enforcement in Michigan
- Creating GIS databases for WIM sites, fixed weigh stations, and safe enforcement sites

Task 2: Surveying other states and Canada:

- Establishing contact list for conducting the survey
- Designing questionnaire for a survey of other states and Canada to identify CVE strategies implemented and determine the effectiveness of these strategies. Study technologies used to conduct commercial vehicle enforcement

Site Visits to select Michigan fixed weigh stations and other CVE sites:

- Monday July 29, 2013 - Cambridge Weigh Station and Monroe Weigh Station.
- Wednesday July 31, 2013 - Ionia Weigh Station
- Monday August 5, 2013 – New Buffalo Weigh Station
- Wednesday August 14, 2013 – Grass Lake Weigh Station and Safe Enforcement Site at Oshtemo Rest Area
- Tuesday August 20, 2013 - Check-Lane Operation at Zeeland Rest Area

Progress meeting with the RAP on Thursday August 22, 2013.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 2: Surveying other states and Canada:

- Completed the survey of other states and Canada

Task 3: Detailed all potential enforcement strategies identified in the literature review and survey of other states and Canada

Task 4: Developed criteria to evaluate virtual weigh station spacing distribution

- Examined the usability of WIM data for identifying locations with higher overweight problems
- Acquired Michigan Truck Flow Model from MDOT

Task 5: Summarized conditions of each existing fixed weigh station and the costs to update each fixed weigh station.

Task 6: Collected Crash Data

Task 7: Obtained costs associated with each enforcement strategy.

Research progress meeting with the RAP on 9/22/14

FISCAL YEAR 2015 PROPOSED ACTIVITES

Task 6: Identify crash patterns at fixed stations and evaluate safety impact of strategies

Task 7: Identifying factors associated with costs and benefits of each enforcement strategy – quantification of benefits will be completed and cost/benefit analysis will be done.

Task 8: Reviewing all enforcement strategies and summarizing effectiveness – review of benefits and effectiveness of each enforcement strategy will continue and be concluded.

Task 9: Preparing the Final Report – draft final report will be finalized and submitted to MDOT.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Development, Characterization and Applications of a Non Proprietary Ultra High Performance Concrete for Highway Bridges

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Steve Kahl

CONTRACT/AUTHORIZATION NO.	2013-0068 Z1	PROJECT START DATE	3/30/2013
PROJECT NO.	121357	COMPLETION DATE (Original)	3/30/2015
OR NO.	OR14-020	COMPLETION DATE (Revised)	
RESEARCH AGENCY	University of Michigan		
PRINCIPAL INVESTIGATOR	Sherif El-Tawil		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$215,442.21	Vendor Budget	\$311,125.21
MDOT Budget FY 2014	\$3,490.00	Adjusted MDOT Budget	\$7,976.09
Vendor FY 2014 Expenditures	\$146,932.31	Budget	\$319,101.30
MDOT FY 2014 Expenditures	\$6,316.09	Expenditures	\$205,341.14
		Total Amount Available	\$113,760.16

PURPOSE AND SCOPE

UHPC is a specially formulated concrete that is capable of achieving extremely high performance. When properly reinforced with steel fibers, the material is capable of achieving the following properties:

1. High compressive strength, approaching that of mild steel.
2. High tensile strength, several times that of regular concrete.
3. Pseudo-ductility, with tensile softening strains of up to an order of magnitude greater than that of regular concrete.
4. Exceptional energy absorption prior to fracture.
5. Extremely small crack widths, small enough to practically eliminate ingress of chlorides.
6. Exceptional durability, primarily enabled by the very small crack widths and the extremely high packing density of the material at the microstructure level.
7. Self-consolidating properties, which simplify construction.
8. Autogenous self-healing properties, enabled by small crack widths under service loads.

As of recently, the primary commercially available UHPC on the US market was available through LaFarge and marketed as Ductal®. Ductal is a proprietary material that is much more expensive than regular concretes. Construction using Ductal and other similar materials available through European suppliers requires specially certified contractors and costly construction processes, such as pressure or heat treatment, which are impractical to achieve in the field. High material cost coupled with complicated and costly construction procedures have seriously delayed widespread adoption of UHPC in the US. An alternative UHPC developed at the University of Michigan, here termed np-UHPC for non-proprietary-UHPC, has the potential for removing all obstacles preventing widespread use of UHPC in the State of Michigan and in the US.

The study has 7 research objectives, each of which will be achieved in a specific project task as detailed in the next section:

Objective 1: Survey and identify potential applications for np-UHPC, particularly for Accelerated Bridge Construction (ABC) and Precast Bridge Element Systems (PBES)

Objective 2: Investigate whether a family of new np-UHPC materials, with a range of compressive strengths ranging from 15 ksi to 30+ ksi, can be made using locally available components. Can the cost be made commensurate with performance and minimized through optimization? What classification scheme should be used?

Objective 3: Characterize the properties of the new family of np-UHPCs developed in this project, focusing on tensile strength, compressive strength, modulus of elasticity, and durability by laboratory testing.

Objective 4: Selecting: 1) continuous bridge decks and 2) deck overlays as two promising applications of np-UHPC, conduct finite element simulations to evaluate potential, quantify the effect of using np-UHPC, and prepare for field demonstrations and proof-of concept testing.

Objective 5: Conduct limited field demonstration and lab tests to show proof-of-concept for the selected applications. Provide for a batch scale up test for MDOT staff to observe the batching, mixing, placement, curing, and sampling characteristics.

Objective 6: Develop design, operational, and maintenance guidance for the chosen applications.

Objective 7: Develop use guidance on np-UHPC with cost/benefit analysis procedures.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1 – Completed. Applications of UHPC: This task surveyed applications of np-UHPC, focusing in particular on Precast Bridge Element Systems (PBES).

Task 2 – Completed. Identified Sources of Materials for np-UHPC: UofM identified both local and national suppliers, in that order of priority, making a concerted effort to avoid international suppliers. We anticipate that steel fiber suppliers may be the most problematic; however, we have already identified US companies that have the potential for supplying suitable fibers. As part of this task, a systematic optimization process that relies on feedback from test results was developed to change the amount of the various material components with the objective of reducing costs while maintaining a performance characteristic, e.g. either strength or ductility.

Task 3 – About 30% complete. Material Performance and Characterization: UofM proposed classifying the performance of the new np-UHPC using a categorization scheme. The proposed limits can be adjusted depending on the test results and in conjunction with the MDOT project manager. For all classes, UofM is striving to ensure that the strain at peak tensile stress is greater than 0.3%. Such a value is important since steel bars yield at about 0.21% and implies that the new material is effective not only in service but up to and after yielding of the bars. Based on determinations made in Task 2, test results, in conjunction with other published results, are evaluated as they become available and used to direct our effort to reduce mix cost. The criteria UofM is using for performance evaluation are compressive strength, tensile strength and tensile strain at peak stress.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Tasks 1, 2, 3, listed above have been completed along with the following tasks:

Task 4 - Simulation Studies of np UHPC

Task 6 - Synthesis: develop design, operational, and maintenance guidance

The following tasks are partially completed:

Task 5 - Field and Structural Testing is about 75% complete

Task 7 - Cost Benefit Guidance has just started.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Complete task 5 and 7, and submit final report. Participate in the pilot construction project 115777A using mi-UHPC for precast segmental closure joints. The project is scheduled for a December 2014 bid letting.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Infrastructure Monitoring Data Management

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Steve Cook

CONTRACT/AUTHORIZATION NO.	2009-0642 Z1	PROJECT START DATE	9/30/2009
PROJECT NO.	121358	COMPLETION DATE	9/30/2011
OR NO.	OR09-148	COMPLETION DATE (Revised)	4/1/2015
RESEARCH AGENCY	Alfred Benesch and Company		
PRINCIPAL INVESTIGATOR	Ihab Darwish		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$76,298.00	Vendor Budget	\$215,422.36
MDOT Budget FY 2014	\$1,500.00	Adjusted MDOT Budget	\$900.00
Vendor FY 2014 Expenditures	\$43,084.48	Budget	\$216,322.36
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$129,253.42
		Total Amount Available	\$87,068.94

PURPOSE AND SCOPE

To evaluate the ability to collect vehicle probe data from specially equipped vehicles. Also, to use a telecommunication backhaul that allows the collection of the data to be analyzed and evaluated for road surface and road quality conditions.

FISCAL YEAR 2010 ACCOMPLISHMENTS

Worked on Milestone 1, which includes design and coordination of hardware/software needs.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Completed Milestone 1

FISCAL YEAR 2012 ACCOMPLISHMENTS

Completed Milestone 2, which include commencing data collection to the server.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Performed tasks under Milestones 3 through 6.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Activities under project tasks 3-6; including a Project summary Report that was provided at the ITS World Congress held in Detroit, MI.

- Continue data collection.
- Analyze and organize data.
- Complete a white paper for presentation and distribution.
- Provide live feed demonstration display of video and data from Cut River Bridge site for 2014 - ITS World congress in Detroit (September 7-14, 2014).
- Provide summary project report.

Continued tasks under Milestones 3, 4, 5, 6, and 2014 - ITS World Congress demonstration.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

1. Vendor plans to collect a full winter cycle (Winter 2014/2015) for the first time since this project began.
2. Complete draft final report for RAP review and comment.
3. Complete Final Report by March 31, 2015.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

This project depends solely on the instrumentation of the Cut River and Mackinaw Bridge and the communication systems that link the two together. Data collection delays have been caused by both a two-month contract award delay (start date October 1, 2010) and several networking issues and equipment related failures at the site. Now because of weather related issues, we can't complete some sensor connectivity until spring (five months delay). It is anticipated that the system will be fully operational by June 1, 2010. That's when data retrieval will commence. We then need two years of data collection for analysis and processing.

This project's method of payment is by milestone. There were no expenditures to bill (based on milestone method) for fiscal year 2013.

In fiscal year 2015 we anticipate the Final report will be completed.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Costs and Benefits of MDOT Intelligent Transportation System Deployments

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Collin Castle

CONTRACT/AUTHORIZATION NO.	2013-0069 Z5	PROJECT START DATE	6/3/2013
PROJECT NO.	121359	COMPLETION DATE (Original)	4/30/2015
OR NO.	OR14-004	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Jun-Seok Oh		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$223,697.45	Vendor Budget	\$233,394.69
MDOT Budget FY 2014	\$8,550.00	Adjusted MDOT Budget	\$2,538.00
Vendor FY 2014 Expenditures	\$139,512.73	Budget	\$235,932.69
MDOT FY 2014 Expenditures	\$238.00	Expenditures	\$150,165.88
		Total Amount Available	\$85,766.81

PURPOSE AND SCOPE

The purpose of this project is to quantify costs and benefits of individual ITS devices and systems in Michigan. This research compiles all ITS devices deployed in Michigan and classifies them into geographical areas and device types. Costs and benefits are quantified by its type using data from Traffic Operation Centers as well we traffic simulation analysis in selected corridors.

FISCAL YEAR 2013 ACCOMPLISHMENTS

During FY 2013, literature reviews on TOCs in other states and existing cost and benefit studies were completed. Other tasks in progress include the following:

Task 1: Literature Review

- Reviewed other TOCs
- Reviewed cost and benefit of other ITS

Task 2: Reviewing MDOT's ITS Deployments

- Visited WMTOC (7/8/2013), STOC (8/12), and SEMTOC (8/14/2013)
- Collected MDOT ITS Inventory
- Built GIS Database for MDOT ITS Deployment
- Collecting ITS cost data
- Reviewed sites (corridors) for detailed analysis

Task 3: User Perception Survey

- Began designing user perception survey

Task 4: Collecting Performance Data

- Began collecting ITS performance data
- Received an access to NAVTEQ database
- Received a list of TOC data users

Meetings: Progress meeting (October 2, 2013) at MDOT

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 3: User Perception Survey

- Collected additional survey data and completed data analysis

Task 5: Selection of Analysis Tool and Modeling

- Selected Paramics simulation model as an analysis tool
- Collected data for modeling
- Developed corridor models for selected sites
- Analyzed data for selected corridors
- Began processing data for the TMC areas
- Developed simulation models and began quantifying benefits

Task 6: Cost and Benefit of ITS System

-
- Analyzed cost and benefit factors
 - Started processing ITS benefits
 - Collected cost data and began analyzing cost data
 - Began processing data and estimating ITS benefits

Task 7: Cost and Benefit of Individual ITS Devices

- Started reviewing benefits by individual ITS devices

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Task 5: Selection of Analysis Tool and Modeling ITS Corridors

- Complete simulation analysis
- Analyze simulation models for estimating benefits

Task 6: Cost and Benefit of ITS System

- Develop models for costs and benefits
- Complete data processing for ITS benefits
- Perform cost and benefit analysis

Task 7: Cost and Benefit of Individual ITS Devices

- Estimate benefits by individual ITS devices

Task 8: Recommendations and Final Report

- Develop Recommendations and Final Report

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Michigan Urban Trunkline Intersections Safety Performance Function (SPFs) Development and Support

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Dean Kanitz

CONTRACT/AUTHORIZATION NO.	2013-0070 Z4	PROJECT START DATE	9/1/2013
PROJECT NO.	121361	COMPLETION DATE (Original)	5/31/2015
OR NO.	OR14-015	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$160,490.09	Vendor Budget	\$250,100.20
MDOT Budget FY 2014	\$4,312.50	Adjusted MDOT Budget	\$10,500.00
Vendor FY 2014 Expenditures	\$41,796.65	Budget	\$260,600.20
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$41,796.65
		Total Amount Available	\$218,803.55

PURPOSE AND SCOPE

To have full functionality of the Highway Safety Manual for Michigan there is a need to develop safety performance functions (SPFs) tailored to urban intersection facilities. SPFs will allow transportation professionals at all levels the ability to scientifically evaluate facilities prior to design for expected number of crashes, crash severities, crash types and return on investment from a safety perspective. The scope of work includes the following:

1. Literature Review
2. Identification of Sites
3. Data Collection
4. Data Analysis
5. SPF Development
6. Develop Maintenance Cycle
7. Develop Maintenance Process
8. Develop Deliverables
9. Demonstration materials and meetings

Types of urban intersection facilities to be evaluated are:

1. Urban Trunkline Three-Leg Minor Road Stop Control
2. Urban Trunkline Three-Leg Signalized
3. Urban Trunkline Four-Leg Minor Road Stop Control
4. Urban Trunkline Four-Leg Signalized

FISCAL YEAR 2013 ACCOMPLISHMENTS

Literature review and identification of sites are currently underway.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Literature review identification of sites, data collection, data analysis, and SPF development

FISCAL YEAR 2015 PROPOSED ACTIVITES

Development of Maintenance cycle and process, development of deliverables and demonstration materials and meetings.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Findings from the research will be integrated in the Michigan Highway Safety Manual spreadsheet, published on the web along with utilization into Safety Analyst.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Evaluating the Use of Tow Plows in Michigan

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Tim Croze

CONTRACT/AUTHORIZATION NO.	2013-0065 Z1	PROJECT START DATE	3/30/2013
PROJECT NO.	121362	COMPLETION DATE (Original)	3/30/2015
OR NO.	OR14-006	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Nishantha Bandara		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$139,452.85	Vendor Budget	\$186,661.15
MDOT Budget FY 2014	\$6,000.00	Adjusted MDOT Budget	\$8,563.08
Vendor FY 2014 Expenditures	\$38,083.11	Budget	\$195,224.23
MDOT FY 2014 Expenditures	\$1,281.54	Expenditures	\$57,209.68
		Total Amount Available	\$138,014.55

PURPOSE AND SCOPE

Due to the rising costs of winter maintenance and the environmental concerns related to usage of salt, Michigan Department of Transportation (MDOT) has embarked a number of innovative approaches to enhance winter maintenance operations. These include, pre-wetting, alternative de-icing and anti-icing products and Road Weather Information Systems (RWIS) etc. One of the new pieces of equipment evaluated for the same purpose by other State DOT's and Canadian provinces includes the Tow Plow. A Tow plow is a trailer mounted snow plow with 26' blade. When attached to a traditional snow plow with 12' front plow, the combination can clear a 25' path. MDOT has purchased one Tow Plow and is in the process of purchasing more units and there is a need for assessing the effectiveness of the Tow Plow in terms of efficiency, cost-effectiveness and safety.

The scope of the project includes the following primary tasks:

1. Understand the current state of practice for Tow Plows across the nation
2. Learn the benefits/draw backs of utilizing Tow Plow
3. Understand the most efficient use of Tow Plows in Michigan
4. Development of training materials for operators on safe and effective use of Tow Plows

In order to fulfil the above, the following tasks will be completed at the conclusion of this project:

1. Conduct Comprehensive Literature Review
2. Perform a Survey of Winter Weather States
3. Compare the Effectiveness of Tow Plow to Traditional Truck/wing Plow Setup
4. Perform Benefit/Cost Analysis for Tow Plow to Truck/wing Plow Setup
5. Develop Recommendations for MDOT Management as to the Safest and Most Effective Areas to Utilize Tow Plows
6. Develop Training Materials for Operators and Recommendation for Changes to the Current Winter Maintenance Truck Specifications
7. Develop a Final Report describing major research results and implementation recommendations

FISCAL YEAR 2013 ACCOMPLISHMENTS

The following tasks were completed during Fiscal Year 2013:

1. Task 1: Conduct a comprehensive Literature Review
90% of this task has been completed during the first quarter and details were included in the Quarterly Report 1 (QR 1). This task will continue until the completion of the project.
2. Task 2: Perform a Survey of Winter Weather States
 - a. The creation of survey distribution database has been completed.
 - b. The survey was finalized and deployed through "Survey Monkey". A reminder e-mail was sent on 10/11/2013 and survey is closed on 10/31/2013. At the end of the survey period, there were 53 respondents. Analysis of survey responses is currently underway
Approximately 80% of this task is completed at this time.
3. Task 3: Compare the Effectiveness of Tow Plow to Traditional Plow
 - a. A meeting was held on 9/4/2013 at Brighton Garage to finalize snow routes for the comparison study. It was determined that the I-96 Snow Route will be divided into two sections (M-59 to US-23 and US-23 to Oakland County line) for the comparison study and few more comparison sites are to be determined from the Lansing TSC area.
 - b. Configuring Dynatest "Survey" program to measure the condition of the roadway behind the Tow Plow/Traditional Plow is underway.

- c. Comparison sites and pavement condition measuring technique will be presented to MDOT PM and RAP members during the progress meeting on November 20, 2013.
Approximately 15% of this task is completed at this time.
- 4. Task 4: Perform Benefit-Cost Analysis for Tow Plow to Truck/Wing Plow Setup
 - a. Development of a benefit-cost analysis methodology is currently underway. The developed method will be presented to MDOT PM and RAP members during the progress meeting on November 20, 2013.
 - b. Winter weather related accident database for the Livingston County has been completed. Assigning each accident to different snow routes in the county is underway.
 - c. Creation of winter storm database for the Livingston County is currently underway.
 - d. Update to the MDOT Winter Maintenance Activities Record Sheet was proposed by PI. Currently MDOT is considering the PI's request.
Approximately 15% of this task is completed at this time.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Task 1: Literature Review

This task was completed during the First Quarter. However, this task will continue throughout the project to include any new information related to Tow Plow research

Task 2: Survey of Winter Weather States

This task was completed during the second quarter.

Task 3: Compare the effectiveness of Tow Plow to traditional truck/wing plow

This task was performed during three winter storms. Following types of data were collected during three winter storms

- Friction Data behind Tow Plow and Regular Plow
- Surface Condition behind Tow Plow and Regular Plow
- Operating Speed of the Tow Plow/Regular Plow
- Traffic condition behind Tow Plow/Regular Plow
- Pictures of the pavement

Further analysis of collected data is in progress.

Task 4: Perform Benefit-Cost Analysis for Tow Plow to Truck/Wing Plow Setup

- a. Previously created winter storm database for Livingston County was checked for errors and updates were made.
- b. Winter weather related accident database for the Livingston County for year 2012-2013 has been completed and QA/QC was completed during the last quarter.
- c. MDOT Form 14100 data was used to get winter maintenance data for each snow route in Livingston County. Both 2012-2013 year data and 2013-2014 data were compiled and sorted for different maintenance segments for each winter storm.
- d. MDOT granted access to RITIS database to analyze traffic speed during winter storms and time to regain normal speed during winter storms. Analysis were completed for winter seasons 2012-2013 and 2013-2014.
- e. Currently developing a cost model to determine the benefit-cost of tow-plow to truck/wing plow setup.
- f. Approximately 60% of this task is completed at this time.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

1. Task 1 – Finalize the literature search
2. Task 3 - Continue with field data collection during 2014-2015 winter season.
3. Task 4 – Continue with Benefit cost analysis methodology
4. Finalize winter weather related accident database for 2014
5. Finalize the cost model for benefit cost analysis and perform sensitivity analysis
6. Prepare final report and provide recommendations to MDOT executive management

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Bridge Design System Analysis and Modernization

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Sam Guerrazzi

CONTRACT/AUTHORIZATION NO.	2013-0506	PROJECT START DATE	11/1/2013
PROJECT NO.	121363	COMPLETION DATE (Original)	11/30/2015
OR NO.	OR14-029	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Tim Colling		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$336,380.94	Vendor Budget	\$551,176.40
MDOT Budget FY 2014	\$10,000.00	Adjusted MDOT Budget	\$10,000.00
Vendor FY 2014 Expenditures	\$190,796.00	Budget	\$561,176.40
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$190,796.00
		Total Amount Available	\$370,380.40

PURPOSE AND SCOPE

MDOT currently designs between 50 to 80 bridges a year using an in-house software tool called the Bridge Design System. The initial software was developed over 30 years ago in the Fortran programming language and it has been updated and improved to adapt to MDOT's design process changes and AASHTO standards. However, the evolutionary nature of desk top operating systems and accompanying programming languages has put MDOT's primary design tool at some risk. The bridge design calculations, procedures and methodology contained in the Bridge Design System must be documented and preserved, and the program must be modernized as needed to assure it will function on new operating systems and work integrally with third party programs. At the same time, existing bridge design calculations, processes, and procedures must be updated to meet AASHTO bridge design standards. The first steps in improving the software is an in depth analysis of the existing system to better understand its function followed by an alternative analysis evaluating various improvements.

Tasks include:

- Reviewing and documenting the bridge design calculations, procedures, and methodology contained in the MDOT Bridge Design System.
- Performing a risk assessment of the current system,
- Providing recommendations to modernize the system incorporating new efficiencies and/or other programming improvements.
- Executing appropriate recommendations

FISCAL YEAR 2014 ACCOMPLISHMENTS

The first year's proposed activities include reviewing and documenting the bridge design calculations, procedures, and methodology contained in the MDOT Bridge Design System. The reviewing and documentation activities progressed throughout the year such that draft documentation formats were presented.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

The second year's proposed activities include a software risk assessment, recommendation for modernization and optimization, along with finalizing software documentation and delivery of training material and training.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Advanced Applications of IntelliDrive Data Use Analysis and Processing 2 (DUAP 2)

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Collin Castle

CONTRACT/AUTHORIZATION NO.	2011-0316	PROJECT START DATE	08/09/2011
PROJECT NO.	121364,111941, 122184	COMPLETION DATE (Original)	06/30/2014
OR NO.	OR10-044	COMPLETION DATE (Revised)	11/1/2015
RESEARCH AGENCY	Mixon Hill of Michigan, Inc.		
PRINCIPAL INVESTIGATOR	Lee Mixon		

BUDGET STATUS

MDOT SPR-II FY 2014 Budget		MDOT SPR-II Total Budget	
Vendor Budget FY 2014	\$1,903,000.00	Vendor Budget	\$3,687,062.65
MDOT Budget FY 2014	\$76,650.00	Adjusted MDOT Budget	\$83,090.00
Vendor FY 2014 Expenditures	\$1,082,519.94	Budget	\$3,770,152.65
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$2,688,240.38
		Total Amount Available	\$1,081,912.27

PURPOSE AND SCOPE

To support MDOT and its partners in the evaluation of the uses and benefits of vehicle-related data. Evaluate and determine how the connected vehicle program will impact how state and local departments of transportation, specifically MDOT, do business as a result of the significant quantity of additional data collected on all major (and eventually minor) roads. This information is anticipated to permit MDOT and MDOT's partners to more efficiently and effectively manage traffic on all facilities in the region, manage assets and road conditions, and respond to safety concerns.

The following table shows SPR II and ITS funding for this project:

Funding Source	FY 14 Expenditures	Total Expenditures	Total Budget
SPR II - JN 121364	\$1,082,519.94	\$2,688,240.38	\$3,770,152.65
ITS - JN 111941	\$47,206.02	\$91,404.11	\$194,191.51
Wx-TINFO - JN 122184	\$289,017.06	\$289,017.06	\$403,504.29

FISCAL YEAR 2013 ACCOMPLISHMENTS

Task 1: Concept Review and Refinement

- Conducted ongoing research for development of white papers on applications
 - Discussed with Subject Matter Expert (SME) areas where data sharing can bring the most benefit to MDOT
 - Created modular-based domain diagrams based on SME input to communicate application ideas with SMEs
- Evaluated tentative application white papers

Task 2: User Needs Development

- Developed process to normalize the functions across regions and central office
- Conducted user meetings in Lansing, MI with SME; prepared meeting minutes for the meetings
 - Dec. 12 – SMEs from Asset Management/Planning
 - Dec. 12 – SMEs from Maintenance
 - Dec. 13 – SMEs from Construction
 - Dec. 13 – SMEs from Operations
 - Feb. 28 – SMEs from Design
 - Feb. 28 – SMEs from Asset Management
 - Mar. 1 – SMEs from Metro Region to discuss Performance Management and MAP-21
 - Jul. 11 – Meeting with Bob Miller
 - Jul. 11 – Meeting with E-Construction
 - Jul. 12 – Meeting with MDOT's Metro Region engineers
 - Jul. 12 – Meeting with Tony Kratofil regarding Performance Based Operating System (PBOS)
 - Jul. 12 – Meeting with OPUS regarding PBOS
 - Aug. 29 – Meeting with University of Michigan – Transportation Research Institute (UMTRI) in Ann Arbor, MI
- Began documenting user needs that will supplement application white papers

Task 3: Design and Development

- System Requirements Specification (SRS)
 - Developed first draft DUAP system requirements
 - Began drafting requirements for user interface of the DUAP system
 - Drafted requirements for USDOT Safety Pilot Model Deployment data ingestion
 - Drafted requirements for USDOT Integrated Mobile Observation (IMO 2.0) data ingestion

- Drafted DUAP system ingestion requirements
 - System Architecture Description (SAD)
 - Developed first draft of system architecture description
 - Drafted generic ingestion architecture for DUAP system
 - Drafted generic data management architecture for DUAP system
 - Drafted generic consumption architecture for DUAP system
 - Drafted hardware architecture for DUAP system
 - System Design Description (SDD)
 - Developed first draft SDD document
 - Began drafting the ingestion operation under software design
 - Designed Safety Pilot data ingestion
 - Designed IMO 2.0 data ingestion
 - Designed generic data ingestion
 - Draft the hardware design
 - Designed and developed ingestion for data sources
 - Designed and developed ingestion for USDOT Safety Pilot Model Deployment (Safety Pilot) data
 - Developed preliminary design for ingestion of IMO 2.0 data and vehicle tracking
 - Designed and developed map-based application for displaying Safety Pilot and IMO 2.0 data
- Task 4 – Implementation, Testing and Evaluation
 - Implemented ingestion of data sources for the DUAP system
 - Implemented ingestion of Safety Pilot data
 - Implemented ingestion of IMO 2.0 data
 - Implemented map-based application for displaying Safety Pilot and IMO 2.0 data
 - Tested map-based application for displaying Safety Pilot and IMO data
 - Evaluated performance of maps for use in map-based application
 - Evaluated currently available hardware, software, operating systems and database systems for the DUAP system
 - Evaluated telecommunications requirements for DUAP system
 - Evaluated current state of the practice for computing platform
 - Evaluated currently available mapping software for supporting DUAP applications
 - Evaluated mapping tools, frameworks, and projections used for displaying data
- Task 5 – Procure and Deploy Data Sources
 - Began integrating existing MDOT maps and data sources into DUAP system
 - Discussed integrating Advanced Traffic Management System (ATMS) Software data
 - Discussed integrating MiDrive data
 - Collected and processed Safety Pilot data
 - Collected and processed IMO data
 - Collected and processed original Chrysler fleet data
- Task 6 – Data Management and Distributions Design
 - Monitored and maintained data from Safety Pilot Model Deployment
 - Monitored and maintained data from IMO 2.0
 - Monitored and maintained data from Original Equipment Manufacturer (OEM) fleet
- Task 7 – Data Collection Method, Comparison and Exploration
 - Evaluated and analyzed Safety Pilot data
 - Evaluated and analyzed IMO 2.0 data
- Task 8 – Application Convergence and Sustained Operations
 - No activity in this reporting period
- Task 9: Outreach and Awareness
 - Prepared for 2014 ITS World Congress in Detroit, MI
 - Developed concepts for socializing project data among potential user groups
 - Encouraged SMEs to collaborate with other MDOT personnel to identify areas to share data
 - Prepared outreach and awareness materials as needed

FISCAL YEAR 2014 ACCOMPLISHMENTS

- Task 1: Concept Review and Refinement
 - Conduct ongoing research for development of white papers on applications
 - Discuss with SMEs areas where data sharing can bring the most benefit to MDOT
 - Evaluate tentative application white papers
 - Pavement application
 - Data capture through mobile device
 - Work flow development
 - Traffic application
 - Complete Application White Paper #1
 - Complete Application White Paper #2
 - Complete Application White Paper #3
 - Complete Application White Paper #4
- Task 2: User Needs Development
 - Conduct user meetings with SMEs as necessary for gathering user needs
 - Concept of Operations
 - Publish DUAP 2 Concept of Operations
- Task 3: Design and Development
 - System Requirements Specification (SRS)
 - Complete DUAP system requirements

- Complete System Architecture Description (SAD)
 - System Design Description
 - Design functional operation for the DUAP system
 - Design hardware needs and hardware integration for the DUAP system
 - Design monitoring operations for the DUAP system
 - Develop DUAP system applications as identified
 - Developed user interface for interfacing with the DUAP system and the system applications
- Task 4 – Implementation, Testing and Evaluation
- Implement components of the DUAP system
 - Implement DUAP system applications as identified
 - Implement user interface capabilities for enabling users to interfacing with the DUAP system and the system applications
 - Test components of the DUAP system
 - Test DUAP system applications for satisfying user needs
 - Test user interface capabilities for displaying the correct information to system users
 - Evaluate DUAP system components for correct operation
 - Evaluate DUAP system applications, as determined necessary
 - Evaluate user interface capabilities for displaying the correct information to system users
 - Create System Test Plan (STP)
 - Develop Final DUAP STP document
 - Create Field Operational Test Plan (FOTP)
 - Develop Final DUAP FOTP document
- Task 5 – Procure and Deploy Data Sources
- Continue to procure data sources for integration into the DUAP system
 - Integrate existing MDOT data sources into the DUAP system, as identified
 - Integrate other data sources into the DUAP system, as identified
 - Create Data Collection Plan (DCP)
 - Develop final DUAP DCP document
 - Create DUAP system Procurement Specification
 - Develop final DUAP Procurement Specification document
 - Create Configuration Management Plan (CMP)
 - Develop final DUAP CMP document
- Task 6 – Data Management and Distributions Design
- Deploy prototype system
 - Continue collecting data for the DUAP system
 - Continue collecting Safety Pilot data for the DUAP system
 - Continue collecting IMO data for the DUAP system
- Task 7 – Data Collection Method Comparison and Exploration
- Develop Application Data Needs and Evaluation Criteria
 - Develop White Paper on Comparison of DUAP 2 and Current Data Collection Practices
- Task 8 – Application Convergence and Sustained Operations
- Develop Operational Policies and Procedures
 - Develop Application User Manual
 - Develop Application Training Material
- Task 9: Outreach and Awareness
- Prepare for 2014 ITS World Congress in Detroit, MI
 - Develop concepts for socializing project data among potential user groups
 - Prepare outreach and awareness materials as needed

FISCAL YEAR 2015 PROPOSED ACTIVITIES

- Task 0 - Project Management Activities
- Continue to perform ongoing activities in support of project management and reporting
- Task 1 - Concept Review and Refinement
- Nothing in this period
- Task 2 - User Needs Development
- Nothing in this period
- Task 2.5 - (Wx-TINFO Concept Review and Refinement, and Requirements Development)
- Nothing in this period
- Task 3 - Design and Development
- Continue to develop map application for use in DUAP consumption
 - Continue work on data analysis for use in reports
 - Develop mobile application for use in DUAP consumption
 - Continue efforts of design and documentation for base VIDAS system integration
- Task 3.5 - (Wx-TINFO Data Collection and System Design, and Development)
- Nothing in this period
- Task 4 - Implementation, Testing and Evaluation
- Continue to implement, test, and evaluate data ingestion, management and consumptions operations as necessary
 - IMO
 - Weather
 - MVDS
 - Safety Pilot
 - VIDAS
-

- Continue work to build interface to integrate with VIDAS system
 - Continue to participate in weekly IMO and Wx-TINFO meetings to identify issues and provide status updates
- Task 4.5 - (Wx-TINFO System Testing)
- Nothing in this period
- Task 5 - Procure and Deploy Data Sources
- Continue collecting and processing data from data sources
 - Safety Pilot for inclusion in DUAP
 - IMO
 - Weather data
 - MVDS
 - VIDAS
 - Continue efforts to secure interface and data for GPS/AVL
 - Continue efforts to secure interface and data for LCAR data
 - Continue to collect data from new sources as identified
 - Work with USDOT's Southeast Michigan Test Bed and data sources
- Task 6 - Data Management and Distributions Design
- Continue to monitor and maintain Safety Pilot, IMO, weather, MVDS and VIDAS on DUAP backend servers
 - Continue to work with USDOT's Southeast Michigan Test Bed and data sources
- Task 7 - Data Collection Method Comparison and Exploration
- Continue to evaluate and analyze Safety Pilot, MVDS, VIDAS, IMO, and weather data
 - Evaluate and analyze other data sources as identified
 - Continue to work with USDOT's Southeast Michigan Test Bed and data sources
- Task 8 - Application Convergence and Sustained Operations
- Continue to capture and analyze user needs and requirements for application development
- Task 9 - Outreach and Awareness
- Prepare outreach materials as needed

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The contract extension is in order to support two initiatives; 1) 2014 ITS World Congress in Detroit and 2) Wx-TINFO initiatives. The first component of the extension to June 30, 2015 is to the original DUAP II scope, to support of the 2014 ITS World Congress in Detroit as well as project delays related to a change in MDOT Project Management staff, and unforeseen issues with accessing MDOT data. The second component of the time extension to November 1, 2015, is the proposed time line to deliver the additional Wx-TINFO scope per MDOT proposal to FHWA, and will not affect other components of delivery of the DUAP II project beyond the outlined date of June 30, 2015.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Statewide Overall Carbon Fiber Composite Cable Bridge Monitoring

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Matthew Chynoweth

CONTRACT/AUTHORIZATION NO.	2014-0043	PROJECT START DATE	12/17/2013
PROJECT NO.	121365	COMPLETION DATE (Original)	9/30/2020
OR NO.	OR14-039	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Nabil Grace		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$34,000.00	Vendor Budget	\$395,549.00
MDOT Budget FY 2014	\$16,000.00	Adjusted MDOT Budget	\$96,000.00
Vendor FY 2014 Expenditures	\$36,075.15	Budget	\$491,549.00
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$36,075.15
		Total Amount Available	\$455,473.85

PURPOSE AND SCOPE

Carbon Fiber Composite Cable (CFCC), and other Carbon Fiber Reinforced Polymer (CFRP) materials are being used for prestressing applications in Michigan bridge rehabilitation and replacement projects. As this is still considered an innovative material, understanding and quantification of the long term behavior based on stress/strain gage readings of previous field deployments is essential for future design and construction considerations. Continued monitoring of the CFCC elements in already constructed bridges will provide information on the long term behavior, and allow for recommendations to be made for future designs, taking into account the behavior of current field deployments.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Completed the setup of the monitoring website and data are now available for review and download. The research team at LTU was successful at downloading data from the website and recordings from Bridge Street bridge, M-50 bridge, M-39 bridge have been checked. Readings from M-50 and M-39 bridges had minor issues that were corrected later on. The system is currently working properly in both bridges and the readings so far conform to the theoretical calculations. Still working on connecting M-102 bridge to the website and making the data available. As part of the nearly completed construction project, a power system to be installed on-site. Scheduled maintenance visits to Bridge Street bridge and M-50 bridge were postponed until the necessary power system for M-102 is available.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Performing maintenance activities at all site, and ensure consistent data. Research PI will be further evaluating data, and comparing actual data to theoretical calculations to assist in developing design methodology.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Performance Evaluation of Subgrade Stabilization with Recycled Materials

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Mark Grazioli

CONTRACT/AUTHORIZATION NO.	2013-0065 Z3	PROJECT START DATE	10/1/2013
PROJECT NO.	121387	COMPLETION DATE (Original)	4/30/2015
OR NO.	OR14-009	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Nishantha Bandara		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$111,543.82	Vendor Budget	\$213,535.18
MDOT Budget FY 2014	\$15,300.00	Adjusted MDOT Budget	\$6,157.30
Vendor FY 2014 Expenditures	\$43,625.24	Budget	\$219,692.24
MDOT FY 2014 Expenditures	\$857.06	Expenditures	\$44,482.30
		Total Amount Available	\$175,209.94

PURPOSE AND SCOPE

Perform thorough review of recycled materials available for potential soils stabilization in Michigan. Obtain representative soil samples throughout Michigan for laboratory testing after the recycled materials are mixed with the soils. Assess the long term performance of projects that have used soil stabilization techniques to date, make recommendations relative to pavement design support values. Develop a guidance matrix for MDOT Engineers to assist with the potential selection of soils stabilization techniques and materials on future projects.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The project started at the beginning of the FY. Soil samples were obtained at three locations throughout the state; two in Metro Detroit and one in the upper peninsula. Laboratory testing began on the collected soils mixing the stabilization materials determined through literature and industry practice review. Field testing occurred on MDOT roadways that were stabilized in 2005, 2008 and 2010.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Finish the laboratory testing. Analyze the laboratory and field testing results, draw conclusions and make recommendations. Write the final report including a decision matrix tool for MDOT Engineers.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Improving of Michigan Climatic Files in Pavement ME Design

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Michael Eacker

CONTRACT/AUTHORIZATION NO.	2013-0067 Z3	PROJECT START DATE	10/1/2013
PROJECT NO.	121388	COMPLETION DATE (Original)	4/30/2015
OR NO.	OR14-010	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Zhanping You		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$136,633.31	Vendor Budget	\$177,159.40
MDOT Budget FY 2014	\$7,200.00	Adjusted MDOT Budget	\$7,324.69
Vendor FY 2014 Expenditures	\$136,633.00	Budget	\$184,484.09
MDOT FY 2014 Expenditures	\$3,124.69	Expenditures	\$139,787.69
		Total Amount Available	\$44,696.40

PURPOSE AND SCOPE

The purpose of this project is:

1. Review existing Michigan climatic data in the Pavement ME Design software for errors and missing data. Correct any errors and fill in missing data when found.
2. Conduct sensitivity analysis of pavement designs to individual weather data items.
3. Search for alternative sources of weather data to add to existing weather stations in the software or create new ones.
4. Develop a procedure for obtaining weather data for new stations and putting it in the correct format.
5. Determine where it would be beneficial to have additional weather stations for pavement design.
6. Provide additional weather data and new stations in the proper format for use in the Pavement ME Design software.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The project was started in fiscal year 2014. The following were accomplished this fiscal year:

- Literature review to see what other states are doing to improve on weather data used for pavement design.
- Created algorithms in Microsoft Excel that found errors and missing data in the weather station files currently in the Pavement ME Design software for Michigan. Decisions were made on how to replace errors and how to fill-in missing data.
- Conducted sensitivity analysis of pavement designs to changes in each of the five items of weather data used in Pavement ME Design. Each weather item was changed individually by small increments to see how each one affects the distress predictions in the software.
- A search was conducted to find additional sources of data for adding to existing stations and to add new stations. The review of sources included Road Weather Information System (RWIS) operated by MDOT.
- Started work on the procedure for obtaining new data and putting it in the correct format.

In addition to the above, quarterly meetings between MDOT and MTU were held to discuss work progress, make sure expected work was being accomplished, and provide guidance on future work.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

In fiscal year 2015, it is expected that the procedure for obtaining new data and putting it in the correct format, will be fully developed and tested. A methodology for determining whether or not additional stations are needed in current gap areas of the state will be developed. If additional stations are recommended, sources of additional data that were discovered in an earlier task will be utilized to create those stations in a useable format in the Pavement ME Design software. All edited and new weather station files will be delivered to MDOT to be utilized for future designs. These same files may be delivered to AASHTO so they can be included in the larger weather station zip file that contains default stations to be included in the ME software. A final report will be drafted by MTU and will be reviewed by MDOT.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Wireless Data Collection and Retrieval of Bridge Inspection/Management Information

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Rich Kathrens

CONTRACT/AUTHORIZATION NO.	2013-0067 Z2	PROJECT START DATE	10/1/2013
PROJECT NO.	121389	COMPLETION DATE (Original)	9/30/2015
OR NO.	OR14-021	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Collin Brooks		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$183,014.76	Vendor Budget	\$356,497.90
MDOT Budget FY 2014	\$11,088.00	Adjusted MDOT Budget	\$20,939.54
Vendor FY 2014 Expenditures	\$168,762.66	Budget	\$377,437.44
MDOT FY 2014 Expenditures	\$1,799.54	Expenditures	\$170,562.20
		Total Amount Available	\$206,875.24

PURPOSE AND SCOPE

The overall goal is to help MDOT take advantage of the advances in portable data entry technologies, reduce the need for field staff time to collect bridge inspection data and thereby help have a safer bridge inspection program, and help provide a compatible path forward to a more efficient bridge inspection process that is available to all appropriate levels of MDOT.

Develop a wireless web/tables based bridge inspection data collection system. This system will use 2D and/or 3D models to help collect data and integrate with MDOT Michigan Bridge Reporting System and other current MDOT bridge inspection process and web applications.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The following tasks were completed during 2014:

- Task 1: Literature Search for ongoing and recently completed research (state-of-the-practice) which included a state-of-the-practice report will focus on identifying and evaluating existing commercial applications as well as still-developing research techniques. (Delivered to MDOT 2/15/2014)
- Task 2: Review MDOT's existing (National Bridge Inventory) NBI and AASHTO Element data collection process which included coordination with MDOT bridge inspection management and field personnel to arrange for selected research staff to review the existing National and MDOT bridge inspection methods. Several meetings and workshops were completed on 12/17/2013, 2/25/2014, and 5/29/2014.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

The following tasks are anticipated for completion in 2015:

- Task 3: Develop and test a wireless data collection and display system that meets the needs of MDOT's bridge inspection and management personnel.
- Task 4: Development of a user-interface for wireless data collection which includes designing a user-friendly web application, which will be compatible with mobile devices (mobile phones and tablets), for inspectors to collect, review, and submit on-site bridge inspection information.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Measuring Michigan Local and Statewide Transit Levels of Service

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Jill Adams

CONTRACT/AUTHORIZATION NO.	2011-0477 Z2	PROJECT START DATE	10/1/2013
PROJECT NO.	121393	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR13-002	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Cambridge Systematics, Inc.		
PRINCIPAL INVESTIGATOR	Samuel Van Hecke		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$185,151.36	Vendor Budget	\$185,118.16
MDOT Budget FY 2014	\$4,800.00	Adjusted MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$173,083.39	Budget	\$185,118.16
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$173,083.39
		Total Amount Available	\$12,034.77

PURPOSE AND SCOPE

Research the feasibility of developing a statewide transit level of service (LOS) measure. MDOT wanted to determine if it was feasible to have a LOS measure for the state as a whole (and perhaps regions within the state) that was more informative than the current methods used (total passengers, revenue miles, and revenue hours). Also, MDOT wanted to determine if a simple, reliable set of transit LOS measures could be accurately captured with a minimal burden of data collection and complex analysis on transit agencies.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Cambridge Systematics, Inc. completed the required research and presented several recommendations for MDOT's consideration.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Cambridge concluded that it was feasible to develop a transit LOS measurement tool with minimal data collection. They recommended linking service data to socioeconomic statistics (service area population, transit dependent population, jobs) and offered these possible LOS measures:

- Passenger trips per capita (indicative of how well transit is utilized relative to the population served);
- Vehicle revenue hours per capita (indicative of service frequency and transit availability within a service area);
- Passenger trips per transit dependent population (indicative of service demand for mobility-challenged individuals); and
- Safety incidents per 100k vehicle miles (indicative of safe service).

Cambridge Systematics laid out a vision for how these recommended measures could be developed into a web-based application that would allow data to be viewed at the region/county or transit agency level.

MDOT is evaluating the practicality of adding these measures to the existing measures MDOT uses for transit LOS. As part of that process evaluation process MDOT is getting input from the research advisory panel and other transit stakeholders. Adding these measures will require an additional ongoing commitment of MDOT financial and staff resources and MDOT has not yet determined if the value added by these measures warrants the additional effort.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: A Method to Access the Use of New and Recycled Materials in Pavements

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Nathan Maack

CONTRACT/AUTHORIZATION NO.	2013-0066 Z1	PROJECT START DATE	10/1/2013
PROJECT NO.	121398	COMPLETION DATE (Original)	3/31/2015
OR NO.	OR14-008	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Emin Kutay		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$141,556.00	Vendor Budget	\$198,655.00
MDOT Budget FY 2014	\$3,000.00	Adjusted MDOT Budget	\$3,000.00
Vendor FY 2014 Expenditures	\$94,914.02	Budget	\$201,655.00
MDOT FY 2014 Expenditures	\$0.00	Expenditures	\$94,914.02
		Total Amount Available	\$106,740.98

PURPOSE AND SCOPE

To develop a methodology to evaluate new and recycled materials for use in pavements.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The research team completed a literature review of how other states evaluate new and recycled materials and what testing is performed. A framework was developed to evaluate any new and recycled materials for use in pavements. The team began to develop software incorporating the framework developed and started validation of the software using existing materials used by MDOT. The research team met twice with the advisory panel. The final report was started.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

The research team will complete work on the software and validation of the software. A training session using the new software will be held for MDOT technical staff in 2015. The final report will be completed.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: Connected/Automated Vehicle and Infrastructure Research

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Paul Ajegba

CONTRACT/AUTHORIZATION NO.	2014-0006	PROJECT START DATE	10/1/2013
PROJECT NO.	122203	COMPLETION DATE (Original)	9/30/2015
OR NO.	OR14-053	COMPLETION DATE (Revised)	
RESEARCH AGENCY	University of Michigan		
PRINCIPAL INVESTIGATOR	Peter Sweatman		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$1,000,000.00	Vendor Budget	\$3,000,000.00
MDOT Budget FY 2014	\$100,000.00	Adjusted MDOT Budget	\$200,000.00
Vendor FY 2014 Expenditures	\$0.00	Budget	\$3,200,000.00
MDOT FY 2014 Expenditures*	\$0.00	Expenditures*	\$0.00
		Total Amount Available	\$3,200,000.00

PURPOSE AND SCOPE

To construct a research test bed to investigate and evaluate technologies related to the interfacing of roadway infrastructure (including smart and connected technologies) and roadway vehicles (connected and automated vehicles). The safe operation of connected and automated vehicles requires technological advances in roadway infrastructure including, but not limited to, roadside communication equipment for connected vehicles, road weather information system (RWIS) technologies, Intelligent Transportation System (ITS) infrastructure, pavement delineation devices (reflectors, pavement markings, freeway lighting), sign supports, signs (dynamic and static) and intersection treatments (traffic signals, pedestrian signals/signing). Knowledge gained from research performed at this newly constructed UM Mobility Transformation Facility (Test Track) will help MDOT improve safety, mobility and efficiency of the public roadway system by accommodating and implementing connected and automated vehicle technologies.

FISCAL YEAR 2014 ACCOMPLISHMENTS

A construction project was awarded to Angelo Iafate Construction Company. The anticipated completion of construction is on November 14, 2014.

Progress- To- Date:

- 1) UMTRI tours of the construction site were performed on September 10-12 for the 21st ITS World Congress held in Detroit, Michigan.
- 2) Detention Ponds 100% complete.
- 3) 95% completion of the storm sewer installations.
- 4) Approximately 95% completion of the mass earthwork balancing.
- 5) Began installation of the MSE wall along the creek on the south end of the job site.
- 6) Began electrical power supply installation with DTE coordination.

*Project payments are based on Milestones.

Since no milestone was 100% complete by September 30, 2014- No payments were made during FY2014.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Complete construction performed by Iafate. Delivery of as constructed plans. Work to be performed by MTC; which was deferred from the original bid in order to lower the bid price to within the planned budget amount. A final report of project accomplishments is due on September 30, 2015.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

MTC will perform remainder of the MTF site installations to fulfill the original project construction scope.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

100% FEDERALLY FUNDED PROJECTS

Sequentially Listed by Job Number

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: SHRP 2 Implementation

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	SHR-2(014)	MDOT START DATE (FUNDING)	10/1/2013
PROJECT NO.		MDOT COMPLETION DATE (FUNDING)	9/30/2014
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Steve Bower		
LEAD AGENCY	FHWA		
PROJECT MANAGER	Andre Clover		
CONTRACTOR			

BUDGET STATUS

SPR- II Portion of FY 2014 MDOT Budget			FY 2014 MDOT Total Budget		
FY FUNDS	(Original)	\$409,799.00	BUDGETED AMT.	(Original)	\$409,799.00
	(Revised)		ACTUAL COST	(Revised)	\$399,508.00
TOTAL FY 2014 EXPENDITURES		\$399,508.00	Total Committed Funds Available		\$0.00*

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

PURPOSE AND SCOPE

MDOT is very interested in continuing to support the development of SHRP2 products through the implementation phase of the program. As such, it's SPR-I Planning Program contributes 50% of the annual commitment and the SPR-II Research Program contributes the remaining 50%.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013?

MDOT is interested in the following SHRP 2 products targeted for implementation over the next three years:

- (L01/L06) Fostering Faster Travel-Time Reliability through Smarter Operations
- (L02/L05/L08) Accurately Forecasting Travel Times on Heavily Traveled Roads
- (L12) Improving Traffic Incident Scene Management
- (L36) Regional Operations Forums for Advancing Systems Operations, Management, and Reliability
- (R04) Bridge Designs for Rapid Renewal
- (R09/R10) Managing Strategies for Challenging Projects
- (R15B) Identification of Utility Conflicts and Solutions
- (C01) Collaborative Decision-Making Framework
- (C06) An Ecological Approach to Highway Planning

For 2013 MDOT participated in the following SHRP 2 activities:

- An Ecological Approach to Highway Planning (Project C06). Margaret Barondess (MDOT)
- Fostering Faster Travel-Time Reliability through Smarter Operations (Project L01/L06) - Jason Firman (MDOT)
- Modular Pavement Technology (Project R05)
- Real-Time Smoothness Measurements on Portland Cement Concrete Pavements During construction (Project R06E)
- Innovative Strategies for Managing Complex Projects (Project R10)- Sue Datta (MDOT)

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

1. MDOT continues to support the above list of SHRP 2 products.
2. * MDOT funding commitment covers two (2) fiscal year periods, 2013 and 2014.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Transportation Management Center (TMC) Pooled Fund Study

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	SPR-2(207)	MDOT START DATE (FUNDING)	10/1/2013
OR NO.	OR14-040	MDOT COMPL. DATE (FUNDING)	9/30/2017
		PROJ. COMPL. DATE (Revised)	9/30/2017
TECHNICAL CONTACT	Jimmy Chu email: jimmy.chu@dot.gov Phone: 202-366-3379		
LEAD AGENCY	Federal Highway Administration		
PROJECT MANAGER	Suzette Peplinski		
CONTRACTOR			

BUDGET STATUS

FY 2014 Budget			Total Budget		
FY FUNDS	(Original)	\$50,000.00	BUDGETED AMT.	(Original)	\$100,000.00
	(Revised)		BUDGETED AMT.	(Revised)	\$175,000.00
TOTAL FY 2014 EXPENDITURES		\$50,000.00	Total Committed Funds Available*		\$75,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

NA

PURPOSE AND SCOPE

The Transportation Management Center PFS is to assemble regional, state, and local transportation management agencies and the Federal Highway Administration (FHWA) to (1) identify human-centered and operational issues; (2) suggest approaches to addressing identified issues; (3) initiate and monitor projects intended to address identified issues; (4) provide guidance and recommendations and disseminate results; (5) provide leadership and coordinate with others with TMC interests; and (6) promote and facilitate technology transfer related to TMC issues nationally.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

A conference call with the members is scheduled to be held in early October to discuss the plan for initiating projects that were selected at the annual meeting in May 2013. Members would review the scopes of the projects and discuss additional issues and topics to be included, and determine the priority for moving them forward.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Studies included: Best Practice for Road Condition Reporting Systems, Guidebook for Developing Virtual TMCs, Effectiveness of Safety and PSA messages on DMS, Roles of Transportation Management Centers in Incident Management on Managed Lanes, Travel Time Displays prior to Freeway Entrances.

Webinar held: Effectiveness of Disseminating Traffic Messages on Dynamic Message Signs

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Study topics to include: Next Generate Travel Information: 5 year Outlook, Traffic Video Recording and Archiving, Freeway Service Patrol Prioritization, Synthesis of Variable Speed Limit Signing, Addressing MAP-21 Performance Measures for Highway Operations, Considerations of Current and Emerging TMC Data. Also plan to do 2-3 group webinars on topics TBD.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

*MDOT anticipates the lead agency will solicit the existing partnering states to continue their contribution to this pooled fund project. The amount of committed funds available represents a revised total funding commitment of \$175,000.00 through September 30, 2017.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

- Note implementation recommendations resulting from 2013 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).
 - Travel Time Displays prior to Freeway Entrances reports are being used for current project being implemented in west Michigan and for planning other operations throughout the state.
 - MDOT staff attended the PFS webinar on July 16, and will use information from this and the related study for developing statewide messaging guidelines.

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- Roles of Transportation Management Centers in Incident Management on Managed Lanes reports are being used for planning process for managed corridors statewide.
2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
-

**RESEARCH ADMINISTRATION
TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Technology Transfer Concrete Consortium (TTCC)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(159)	MDOT START DATE	10/01/2008
OR NO.	OR08-020	MDOT COMPLETION DATE (Original)	09/30/2015
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Linda Narigon Linda.Narigon@dot.iowa.gov Phone: 515-239-1471		
LEAD AGENCY	Iowa Department of Transportation		
PROJECT MANAGER	John Staton		
CONTRACTOR	Iowa State University (PI-Tom Cackler)		

BUDGET STATUS

FY 2014 Budget			Total Budget		
FY FUNDS	(Original)	\$7,000.00	TOTAL COST	(Original)*	\$38,000.00
	(Revised)			(Revised)**	\$52,000.00
TOTAL FY 2014 EXPENDITURES		\$7,000.00	Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

AL, CA, GA, IA, IL, IN, KS, LA, MI, MN, MO, ND, NE, NY, OH, OK, PA, SD, TX, WI, CO, NC, UT, WA

PURPOSE AND SCOPE

The purpose of this pooled fund project is to identify, support, facilitate and fund concrete research and technology transfer initiatives.

FISCAL YEAR 2010 ACCOMPLISHMENTS

The fall 2009 meeting of the NCC was held in St Louis, Missouri. The theme for this meeting was Cement Standards and Technology for Sustainable Concrete Paving and included a tour of the new Holcim cement plant. Approximately 80 participants from government agencies, industry and academia, including 20 different state DOT representatives. The Spring 2010 workshop was held in Savannah, GA with 85 participants. The theme for this meeting was overlays, including state reports on overlays and the new roller compacted concrete guide.

FISCAL YEAR 2011 ACCOMPLISHMENTS

The Spring 2011 workshop will be held in April 2011 in Indianapolis, IN. Approximately 80 participants from government agencies, industry and academia, including 20 different state DOT representatives. The Fall 2011 workshop was held in Rapid City, SD with approx. 85 participants. The theme for this meeting was MEPDG, including state reports.

FISCAL YEAR 2012 ACCOMPLISHMENTS

The Spring 2012 NCC meeting was held in Oklahoma City, OK. The theme for this meeting was non-destructive testing of concrete. The fall meeting was held in Seattle, WA in conjunction with the International Conference on Concrete Pavements. The NCC meeting provided updates on several pooled fund projects related to Task 1 of the current CP Roadmap. There were also discussions relative to a proposed future pooled fund project focused on development of new protocol for durability-based testing and acceptance of concrete. This initiative will be further discussed in the Spring 2013 meeting.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

The Spring 2013 NCC meeting was held in Philadelphia, PA. The theme for this meeting was pavement smoothness and ride quality. The fall meeting was held in Asheville, NC. Its theme was life-cycle cost and pavement type selection. The NCC meeting provided updates on several pooled fund projects related to Task 1 of the current CP Roadmap. There were also discussions relative to a proposed future pooled fund project focused on development of new protocol for durability-based testing and acceptance of concrete. This initiative will be further discussed in the Spring 2014 meeting. The total number of participating state agencies was recently increased from 24 to 27.

*\$7,000 was approved in FY13 amended program and \$3,000 was approved in amendment 5 of FY12 for a synthesis report. FY12 and FY13 budgeted funds were expended in FY13.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

The Spring 2014 NCC meeting will be held in Jacksonville, FL. The theme for this meeting is yet to be determined.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

The Spring 2014 meeting was held in Jacksonville, FL on April 21-24. Topics included state reports, rethinking concrete delivery, SHRP2 update, sustainability, bridge deck cracking, and others.

The Fall 2014 meeting will be held in Omaha, Nebraska on September 9-11. Topics include state report on aggregate quality, MnRoad update, Microspheres, Quality paving, FHWA Update, pavement repairs, and others.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

The Spring and Fall 2015 meetings date and location are to be determined.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

* The original budgeted amount of \$38,000 covered FY's 2008- 2012; each at \$7,000.00, plus \$3,000.00 in FY2012 via program amendment # 5 for Michigan's cost share of a Durability Synthesis Study approved by the study's TAC.

**The revised budgeted amount increased MDOT's study commitment level to \$59,000.00; originally (for FY's 2013-2015 @ \$7,000.00 each year.), however, at the request of the lead agency on May 21, 2014 MDOT moved its FY 2015 fund commitment from TPF-5(159) to the new Solicitation No. 1363.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

This forum serves to transfer technology and current state of practice amongst participating state DOT's, industry, and academia. Discussions and dialogue presented at this forum often serve as a springboard for further in depth studies and pooled efforts.

This is a continuing pooled fund study focused on being an ongoing forum to identify, support, facilitate and fund concrete research and technology transfer initiatives.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Research Program to Support the Research, Development, and Deployment of System Operations Applications of Vehicle Infrastructure Integration (VII)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(206)	MDOT START DATE	10/1/2012
OR NO.	OR09-146	MDOT COMPLETION DATE (Original)	9/30/2014
		COMPLETION DATE (Revised)	9/30/2016
TECHNICAL CONTACT	Catherine McGhee Cathy.McGhee@VDOT.Virginia.gov Phone: 434-293-1973		
LEAD AGENCY	Virginia Department of Transportation		
PROJECT MANAGER	Matt Smith		
CONTRACTOR			

BUDGET STATUS

FY 2014 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$50,000.00	TOTAL BUDGET	(Original)*	\$100,000.00
	(Revised)			(Revised)**	\$300,000.00
TOTAL FY 2014 EXPENDITURES		\$50,000.00	Total Committed Funds Available		\$200,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

Maricopa County , AZ , CA , FHWA , FL , MI , MN , NJ , NY , PA , TX , UT , VA , WA , WisDOT

PURPOSE AND SCOPE

Scope:

- Development and evaluation of connected transportation system large scale systems level operations applications
- Support AASHTO's Strategic & Deployment Plans
- Support USDOT's connected vehicles programs and initiatives

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013?

The Pooled Fund Study embarked upon the following four defined initiatives in FY2013:

- the development and review of the AASHTO Connected Vehicle Footprint and Deployment Analysis
- the development of the study "Connected Vehicle Impacts on Traffic Management Center Operations"
- the development of the "Use of DSRC for Road Weather Management" study
- the second phase of the Multi-Modal Intelligent Traffic Signal System deployment.

2. Please list those deliverables that will benefit MDOT if implemented.

Deliverables from the above four initiatives will include guidelines, operational changes, and deployment lessons learned. All deliverables will directly benefit MDOT with implementation.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Finalize the products/services listed above. Selection of additional proposed activities through the Pooled Fund Study will be completed in December, 2013.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

FY2014 accomplished several initiatives for the Pooled Fund Study. The following accomplishments were achieved:

1. Completion of the development and review of the AASHTO Connected Vehicle Footprint and Deployment Analysis. MDOT is using this Analysis as the framework for our Connected Vehicle deployment.
2. Completion of the study "Connected Vehicle Impacts on Traffic Management Center Operations". This report can be used as a guideline for MDOT Traffic Operations Centers in handling and addressing the influx of data from a connected vehicle environment.
3. Continued development of the "Use of DSRC for Road Weather Management" study
4. Continued development of the second phase of the Multi-Modal Intelligent Traffic Signal System program. When completed, MDOT can use this program as a basis for Vehicle-to-Infrastructure applications in a connected vehicle environment. Initiated a project to research accuracy requirements for GPS and mapping in a connected vehicle environment.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

The following activities are proposed for FY 2015:

1. Completion of the "Use of DSRC for Road Weather Management" study
2. Completion of the second phase of the Multi-Modal intelligent Traffic Signal System program.
3. Completion of the research project on GPS and mapping accuracy requirements in a connected vehicle environment.
4. Initiate the project "Tracking of Member States Connected Vehicle Testbeds".
5. Provide review and direction to the USDOT on the development of their "Connected Vehicle Deployment Guidance Document".

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

*The original budgeted amount of \$100,000.00 was for FY's 2009-2010; at \$50,000.00 each fiscal year.

** The revised budgeted amount increased to \$300,000.00 to cover FY's 2013-2016 at \$50,000.00 each fiscal year.

Revising the timeframe and MDOT contribution to this Pooled Fund Study will help ensure that MDOT maintains our leadership position in the development and deployment of connected vehicle technologies. Continued participation with this Pooled Fund Study will also provide continued regular interaction with the USDOT in the development of Connected Vehicle policies and programs. With the Department's goal of implementing a connected vehicle environment in the state, it is imperative that MDOT continues to partake in the activities associated with this Pooled Fund Study.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2013 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).

The Footprint Analysis is being used directly for the planning and programming of money to support Connected Vehicle Deployment. This deliverable is being used directly by the ITS Program Office, and subsequently shared and used by each region with active ITS deployments. The results of the Connected Vehicle Impacts on Traffic Management Center Operations have been shared with all Traffic Operations Centers in Michigan in order to prepare for Connected Vehicle deployments.

2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.

We believe that the Pooled Fund Study will be extended by an additional 2 years, and we'd like to continue to actively participate.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Transportation Engineering and Road Research Alliance (TERRA)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(215)	MDOT START DATE (FUNDING)	10/01/2009
OR NO.	OR10-012	MDOT COMPL. DATE (FUNDING)	09/30/2014
		PROJ.COMPL. DATE (Revised)	09/30/2018
TECHNICAL CONTACT	Maureen Jensen maureen.jensen@dot.state.mn.us , 651-366-5507		
LEAD AGENCY	Minnesota Department of Transportation		
PROJECT MANAGER	Andre Clover		
CONTRACTOR			

BUDGET STATUS

FY 2014 Budget			Total Budget		
FY FUNDS	(Original)	\$7,000.00	BUDGETED AMT.	(Original)	\$25,000.00
	(Revised)		BUDGETED AMT.	(Revised)**	\$30,500.00
TOTAL FY 2014 EXPENDITURES		\$7,000.00	Total Committed Funds Available***		\$28,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

MI, MN, ND, NY, WI, and IA

PURPOSE AND SCOPE

TERRA exists to:

- Guide future pavement research investments and activities
- Exchange information, share ideas, and learn research results
- Develop relationships, and provide a network for expanded collaboration and development of proposals
- Attract key public, industry, academic and other program partners to contribute resources
- Expand entrepreneurial use of the capacity and capabilities of the MnROAD facility by pursuing opportunities to serve a broader research community

TERRA was formed in 2004 by a task force of government, industry, and academic representatives. TERRA's mission is to develop, sustain, and communicate a comprehensive program of research on pavement, materials, and related transportation engineering challenges, including issues related to cold climates. TERRA does not fund research, but its members have helped secure funding for a \$10M program of TERRA-initiated research.

All project funds are utilized to implement the strategic directions and action plans of TERRA, as defined and approved by the full TERRA board. Currently, a majority of TERRA's operating funds are being utilized to disseminate research results and help put these results into practice. Project funds will not be used for research projects. Tasks to be supported by these project funds include, but are not limited to:

- Plan and conduct three board meetings and multiple committee meetings per year to establish research priorities, share research findings, exchange information, and define direction of the organization. Up to two representatives from each member organization can participate on the board.
- Discuss and screen potential research projects and seek partners from the public, academic, and private sectors to collaborate on these projects. Utilize available resources to ensure research is not duplicative.
- Communicate and disseminate TERRA research results and innovations through the use of communication products such as the Web site (www.TerraRoadAlliance.org), quarterly electronic newsletter, and fact sheets.
- Put research results into practice through technology transfer events such as the TERRA Innovation Series.
- Communicate impacts of the organization's activities to national leaders in transportation. Organizational support to staff and manage these activities is outsourced.

Comments: \$5,000 per year requested from each organization for five years. In addition, organizations can cover travel to board meetings by adding \$2,500 per person per year for up to two people.

FISCAL YEAR 2010 ACCOMPLISHMENTS

TERRA board meetings were held on November 12, 2009, March 11, and August 19, 2010. Multiple meetings were held by the various TERRA committees throughout FY 2010.

A TERRA Innovation Series Event was held on August 20, 2010, in Madison, WI. This TERRA Innovation Series event highlighted sustainability in transportation. The event was held in conjunction with the 2010 Mid-Continent Transportation Research Forum. Topics included; Sustainability and Environmental Quality Improvements: Environmental review process, best management practices, and construction practices used in Wisconsin; Sustainability and Beneficial Reuse: Of Construction Materials used by Wisconsin DOT; A Hot-Mix-Asphalt Plant Tour: Incorporation of post-consumer shingles and recycled asphalt pavement (RAP) into hot-mix asphalt (HMA) pavement.

Following the General TERRA Project Selection Process, a solicitation for research project ideas from partners and friends was

conducted in April and May 2010. Twenty-two (22) projects were submitted in response to this solicitation. Nine project submissions are moving forward in the TERRA project selection process.

TERRA accomplishments in marketing new members resulted in the addition of three (3) new DOT members; Wisconsin, N. Dakota, and NY DOT; and 1 new association; American Traffic Safety Services Association (ATSSA).

TERRA was represented (by MI: A. Clover) at the July 2010 Research Advisory Committee meeting in Kansas City. The meeting brought together 120 representatives of state DOT's, federal agencies, universities, and private consultants to see research results and discuss key issues facing the national transportation research community. TERRA presentation was given at the session on *Breaking Out of the Silos: Coordinating and Collaborating Research Activities to Achieve Greater Strategic Benefits*.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Host a TERRA Open House at the MnROAD facility in July 2011. TERRA plans to sponsor the Minnesota Pavement Conference in February 2011. The Research and Implementation committee will provide topic ideas to the Marketing and Communications Committee for Fact Sheet topics and E-News articles. Develop three (3) research fact sheets by May 2011. Develop a one-pager highlight FY 2011 accomplishments.

FISCAL YEAR 2012 ACCOMPLISHMENTS

TERRA board meetings were held on February 8, 2012 (2012 Winter Meeting); August 13, 2012 (2012 Summer Meeting); and a November 1, 2012 (2012 Fall Meeting) is scheduled. Multiple meetings (see below) were held by the various TERRA committees throughout FY 2012.

At the 2012 February winter meeting; Wisconsin DOT (Steve Krebs) gave a presentation on the Performance and Cost Effectiveness of Warranted HMA Pavements. The Board approved the FY 2012 Performance Measures and FY 2013 Business Plan. More discussion and work is necessary on the FY 2013 Strategic Plan. The Board devoted most of the summer meeting developing a new strategic plan for TERRA. At the 2012 summer meeting; the Board held a full day session on Strategic and Operational Planning. This work will continue at the 2012 fall meeting

- The Marketing and Communications Committee met on August 2, 2012.
- The Member and Partner Engagement Committee meeting met on August 21, 2012.
- The Research and Implementation Committee that was scheduled for September was rescheduled for October 17, 2012.
- The August 2012 E-News (Vol. 6, No. 3) was distributed on August 1, 2012 (<http://www.terraroadalliance.org/publications/enews/2012/03/>).
- Ideas were collected through the call for project ideas to partners and friends. A total of 15 project ideas were submitted. The ideas went through an initial review with the MPE Committee at their meeting in August.
- Work began on the next TERRA fact sheet on the topic of innovative diamond grinding and board members were asked for their suggestions of innovative diamond grinding projects to highlight in the fact sheet. The fact sheet will be completed in fall FY13.
- The August 14 TERRA Innovation Series event in partnership with Michigan Tech was held in Houghton, MI.
- The Pavement Conference Planning Committee met twice to develop the agenda.
- Completed the low temperature cracking project.
- Hosted a webinar on Chip Seals. Over 100 attended.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013?

- Complete the fact sheet on innovative diamond grinding
- A fact sheet on white topping and is expected to be completed in FY13
- Completed the strategic plan and committee realignments
- Board and subcommittee meetings
- 2013 Annual Pavement Conference was held on Feb 14 2013
- Published E-News articles and technical summaries
- Conduct webinar on chip seals

2. Please list those deliverables that will benefit MDOT if implemented.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

The 2013 November TERRA Meeting will develop and final proposed activities for 2014.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

TERRA Board Meetings.

Winter 2014- February 5, 2014. (Held)

Summer 2014- August 20, 2014. (Held)

Fall 2014- November 19, 2014 (Planned)

February 5/6, 2014, the 18th Annual Pavement Conference was held in conjunction with the Road Dust Institute (RDI) 3rd Road Dust Best Management Practices Conference.

TERRA Innovation Series to feature University-DOT collaborations, Aug. 20- A half-day TERRA Innovation Series event on

August 20 will highlight some of the current pavement-related research topics in the Wisconsin transportation community and showcase the collaboration between the University of Wisconsin–Madison and the Wisconsin Department of Transportation

SHRP2 workshop for the preservation of high-traffic roads, Sept. 2–5- The SHRP2 R26 Workshop for the Preservation of High-Traffic-Volume Roadways with on-site inspection of preservation test cells at MnROAD will be held September 2–5, 2014, in conjunction with the AASHTO Midwestern Pavement Preservation Partnership (MPPP) meeting at The Depot Renaissance in Minneapolis.

MnROAD to celebrate 20th anniversary with open house, Aug. 6- MnROAD celebrates its 20th anniversary this summer and is welcoming research partners, supporters, and friends from 10 a.m. until 2 p.m. on August 6, 2014, to an open house. MnROAD staff will be conducting tours of the mainline and low-volume road (LVR) during the day along with equipment demos in the parking lot.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

** On June 11, 2012 FHWA- Michigan Division approved a budget increase in the amount of \$5,500. This increase provide travel funds for MDOT representatives during FY 2012 (\$1500.) and FY 2013 & FY 2014 at \$2,000 each year.

***MDOT anticipates the lead agency will solicit the existing partnering states to continue their contribution to this pooled fund project. The amount of committed funds available represents a revised total funding commitment of \$58,500.00 through September 30, 2018.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2013 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).

 2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
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**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: ITS Pooled Fund Program (ENTERPRISE)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(231)	MDOT START DATE	10/01/2009
PROJECT NO.	111159	MDOT COMPLETION DATE (Original)	09/30/2014
		COMPLETION DATE (Revised)	09/30/2019
TECHNICAL CONTACT	Lee Nederveld nederveld@michigan.gov 517-335-5317		
LEAD AGENCY	Michigan Department of Transportation		
PROJECT MANAGER	Lee Nederveld		
CONTRACTOR	Athey Creek Consultants		

BUDGET STATUS

FY 2014 Budget			Total Budget		
FY FUNDS	(Original)	\$35,000	TOTAL COST	(Original)*	\$175,000.00
	(Revised)			(Revised)**	\$300,000.00
TOTAL FY 2014 EXPENDITURES		\$35,000	Total Committed Funds Available		\$175,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

GA (5.5%), ID (6.9%), IL (6.9%), IA (5.5%), KS (9.1%), MI (8.0%), MN (6.9%), MS (4.1%), Netherlands (5.7%), OK (5.5%), ON (23.7%)

PA (1.4%), TX (6.9%), VA (1.4%), WA (2.7%)

PURPOSE AND SCOPE

The objectives of the project include the following:

- Investigate and promote ITS approaches and technologies that are compatible with other national and international ITS initiatives.
- Support the individual ITS program plans of ENTERPRISE participants.
- Provide a mechanism to support multi-state and international project cooperation and technical information interchange.
- Facilitate the formation of public-private partnerships for appropriate program activities.
- Pursue emerging ITS project opportunities in areas of interest to the group.
- Provide test beds in a variety of environments and locations for emerging ITS technologies.
- Identify common needs within the group and proceed with appropriate technical activities.

Scope of Work

- The tasks to be completed as part of the program vary from year to year, and are decided through an annual project selection process, as established by the ENTERPRISE member agencies. As a direct result of this selection process, a work plan is developed annually for the ENTERPRISE program, detailing the projects that will be pursued in the upcoming year.

Program Management and Administration

- Michigan DOT received official approval from FHWA and a TPF number to accept SP&R funds for the ENTERPRISE Pooled Fund to complete the transition of the administration of the program from the Iowa DOT to the Michigan DOT. Michigan DOT began to receive funds from member states for FY2010.
- A Request for Proposal (RFP) was distributed from Michigan to solicit a program management consultant for the ENTERPRISE Program. Athey Creek Consultants was selected to provide administrative and technical project support and authorized to start work on September 10, 2010.

FISCAL YEAR 2011 ACCOMPLISHMENTS TO DATE

New Members

- Two new members joined the ENTERPRISE Program (Georgia and Mississippi) in FY 2011.

Program Management and Administration

- Michigan DOT received funds from the ENTERPRISE member states for financial contribution to FY 2011.

Meetings

The ENTERPRISE Executive Board held nine meetings during FY 2011.

- November 8 and 9, 2010 in Phoenix, Arizona – The group discussed the background and accomplishments of the
- ENTERPRISE Program, discussed program communications (program website, Wikipedia and brochures), discussed in detail the 2011 projects and provided updates on the 2010 projects.

- January 6, 2011 Conference Call – The group reviewed the management structure of ENTERPRISE, launched a new program website, and discussed the administrative details for Michigan DOT to authorize projects.
- February 3, 2011 Conference Call – The group reviewed the ENTERPRISE budget and provided comments to update the ENTERPRISE management plan, charter and operating rules.
- March 3 and 4, 2011 in Austin, Texas - The group approved the revised management plan, charter and operating rules for ENTERPRISE, discussed coordination with other pooled fund efforts, toured the Austin, Texas Combined Transportation and Emergency Management Center (CTECC) and discussed the process of developing future work plans.
- April 7, 2011 Conference Call – A summary of a Connected Vehicle Workshop in Toronto, Canada was given and the group discussed the process and documentation needed to submit 2012 projects ideas.
- May 5, 2011 Conference Call – The group reviewed the submitted 2012 project ideas and discussed support for Non-ENTERPRISE business trips. Project 1: Developing Consistency in ITS Safety Solutions: Intersection Warning Systems was authorized to begin work on May 13, 2011.
- June 2, 2011 Conference Call – The group approved a document stating how ENTERPRISE would support non-ENTERPRISE business trips.
- July 7, 2011 Conference Call – The group discussed the detailed project scopes for the 2012 projects and a project update was provided on Project 1: Developing Consistency in ITS Safety Solutions: Intersection Warning Systems.
- August 28, 2011 in Coeur d' Alene, Idaho – The group reviewed the goals and objectives of the ENTERPRISE program, finalized the proposed 2012 project proposals, voted on the projects and approved the 2012 Work Plan. The group also voted on and determined the order of starting the approved 2010, 2011 and 2012 projects and developed a 2010 – 2012 Work Plan that shows the priority.

Project Updates

Project 1: Developing Consistency in ITS Safety Solutions: Intersection Warnings Systems

- Project 1 was authorized by ENTERPRISE on May 13, 2011. FHWA agreed to provide further funding in late May to support non-ENTERPRISE states to attend project workshops.
- Webinar 1 was held on June 23 to compile and assess lessons learned from systems that have been developed and field-tested, and then identify challenges with deploying such systems more permanently.
- Workshop 1 was held on July 28-29 to discuss the content of a preliminary standard building off the challenges identified during Webinar 1 and to develop a roadmap for reaching standardization.
- Participants have included ENTERPRISE states (ID, IA, KS, MI, MN and WA), other states that have deployed systems (MO, NC, PA, ME and WI), FHWA, NCUTCD, AASHTO and NACE.
- Workshop 2 was held on September 15-16 to review the preliminary standards (guidance) proposed for MUTCD consideration, develop an evaluation framework that may be used in future deployments for experimentation and discuss plans for future experimentation and coordination.

FISCAL YEAR 2012 ACCOMPLISHMENTS TO DATE

Administrative/Management:

Nine conference calls were held in FY 2012. Two in person meetings were also held in FY 2012, one in Kansas City, Missouri in conjunction with the ITS Heartland Annual Meeting, and one in Biloxi, Mississippi in conjunction with the National Rural ITS Conference. Due to MFOS system FYE process FY fund obligations for FY 2012 were not performed; FY2012 and FY2013 transfers will be made during FY 2013.

Projects:

Low-Cost ITS Safety Solution System: Intersection Conflict Warning Systems

Project Goal: Develop a consistent approach for accelerated, uniform deployment and further evaluation of intersection warning systems, and to recommend preliminary standards for MUTCD consideration

- Final Design and Evaluation Guidance for Intersection Conflict Warning System was distributed on December 16, 2011.
- Contacts have been made with several organizations (FHWA MUTCD, 2012 ATSA Convention and Expo, Evaluation of Low Cost Safety Improvements pooled fund, Traffic Control devices pooled fund) in the roadmap for standardization of ICWS.
- Project completed. The final report is available at: <http://enterprise.prog.org/projects.html>

Impacts of Travel Information on the Overall Network

Project Goal: To understand the impacts of travel information dissemination (at what thresholds of travel times do more travelers begin to divert) on the overall operations of an urban transportation network.

- Project was authorized by ENTERPRISE on October 20, 2011.
- A project kick-off meeting was held during the November 3, 2011 monthly ENTERPRISE conference call. The group discussed the project concept: compare volume and travel times at selected locations in Minneapolis/St. Paul and Seattle and survey travelers to learn how they use travel time displays and how and why they divert.
- A draft of the data collection plan was completed.
- A draft traveler survey was developed and reviewed by the ENTERPRISE Board at the January 2012 monthly board meeting. The survey will be modified for each ENTERPRISE state that would like to distribute the survey.
- Surveys were developed and links to the Minnesota and Washington website. The purpose of the surveys is to learn how travelers use travel time displays and how often they divert and why they divert.
- Project completed. The final report is available at: <http://enterprise.prog.org/projects.html>

Understanding Utilization of 3rd Party Data and Information

Project Goal: Document the experiences of public agencies with using 3rd party data and learn from the 3rd party providers.

- Project was authorized by ENTERPRISE on October 20, 2011.
- A project kick-off meeting was held during the November 3, 2011 monthly ENTERPRISE conference call. The group discussed the project which includes identifying public agencies with 3rd party data experience, identifying 3rd party data

-
- providers and then identifying what the ENTERPRISE members would like to learn from each other and from the providers. This will be accomplished through webinars and/or in-person discussions.
- A survey was developed and distributed on January 9, 2012 to the ENTERPRISE states to gather interests and focus of the project. The feedback from the ENTERPRISE members was used to develop a Data Collection Plan for presenting the 3rd party data as part of this project. The Data Collection Plan was distributed on 1/23/12.
 - Each ENTERPRISE state with 3rd Party Data experience shared information at the March 28 and 29, 2012 ENTERPRISE in person meeting.
 - 3rd Party vendors were contacted in order to gain an understanding of the private sector perspective in providing data. A summary of 3rd Party vendor information was shared at the March 28 and 29, 2012 ENTERPRISE in person meeting.
 - Project completed. The final report is available at: <http://enterprise.prog.org/projects.html>

The Next Era of Traveler Information

Project Goal: understand how real-time traveler information technology and use is changing and how the changes are impacted by current and emerging trends with dissemination mechanisms and data management practices.

- Project was authorized by ENTERPRISE on March 2, 2012.
- A survey was developed and distributed to the 511 Deployment Coalition contacts to gather high-level information about the current state of practice with real-time traveler information programs around the country. The information was summarized and shared, along with a detailed project schedule, during the ENTERPRISE annual meeting on March 28-29.
- Highlights of the survey and an overview of the project was presented during the ITS Heartland conference on March 27, 2012
- Continued the information exchange of the project by scheduling webinar speakers on the following topics: dissemination tools, cost management, customer needs and wants, data management, and performance targets.
- Webinar 1 was held on 8.16.12. Over 20 states participated in the first webinar featuring trends in dissemination tools and practices in the states of Washington and Wisconsin.
- Webinar 2 was held on 9.13.12. It featured cost management practices – specifically sponsorship –in the states of Georgia and Missouri. It also featured a brief update on USDOT's effort to define a data exchange format for Real-Time System Management Information Programs.

ICWS Coordination and Systems Engineering – Phase 2

Project Goal: An extension of Project 1, this project will further support the standardization of ICWS by coordinating among the various national standards and association groups, and by developing a concept of operations and system requirements for the four types of ICWS identified in the Design and Evaluation Guidance for Intersection Conflict Warning Systems.

- AASHTO SCOTE passed a resolution to recommend NCUTCD establish a task force, to assess ICWS work by the three pooled funds, and to endorse "Design and Evaluation Guidance for Intersection Conflict Warning Systems." The resolution will proceed on to the Standing Committee on Highways and AASHTO Board of Directors for final approval in November.
- Following the recommendation from AASHSTO SCOTE, the NCUTCD Regulatory/Warning Sign Technical Committee created a task force on ICWS. The task force will determine what may be needed for ICWS in the MUTCD.
- An email update was distributed to the group of ICWS stakeholders on 7.13.12 highlighting SCOTE and NCUTCD meeting outcomes and ENTERPRISE plans to develop a draft concept of operations in July.
- Draft concept of operations was developed and reviewed with stakeholders by webinar on 9.11.12. An overview of the draft and comments was shared with the ENTERPRISE board on 9.19.12.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

Administrative/Management:

Eight conference calls were held in FY 2013. Two in person meetings were also held in FY 2013, one in Phoenix, Arizona in conjunction with an AASHTO-sponsored meeting to evaluate the re-establishment of the 511 coalition, and one in Saint Cloud, Minnesota in conjunction with the National Rural ITS Conference.

Projects:

All remaining projects from the 2010-12 Work Plan were started during FY 2013. Two additional projects were completed:

The Next Era of Traveler Information

Over the last decade, 511 telephone and web services have been deployed in many states and provinces. Some agencies have already deployed 'second-generation' 511 systems with the intent of adding functionality, improving content or reducing operating costs. Agencies are also expanding their dissemination of real-time traveler information using push services like Constant Contact and social media tools like Twitter. Many agencies have also developed partnerships to reduce operating costs through sponsorship or outsourcing. It is increasingly challenging to plan, evaluate, operate and enhance real-time traveler information services because of limited resources, overwhelming information and rapidly changing dynamics.

The ENTERPRISE Transportation Pooled Fund sponsored this project – Next Era of Traveler Information – to help agencies understand how real-time traveler information technology and use is changing and how the changes are impacted by current and emerging trends. Emphasis was placed on sharing lessons learned by agencies that have experience related to current trends. The areas of interest that were explored during this project are described as follows.

- Dissemination tools. The project facilitated an exchange of experiences with push information services and social media to help agencies understand new options for delivering information without relying on incoming phone calls. In addition to describing the tools being used, agencies described their philosophy and goals for traveler information to provide a context for how their dissemination tools support them.

- Data management. Managing the availability, variety and formatting of a growing number of data sources creates a complex environment for delivering traveler information. The project explored data requirements outlined in the Code of Federal Regulations, Title 23: Highways, Part 511—Real-Time System Management Information Program (23 CFR 511) and the data format specifications being developed by USDOT to support the exchange of information from highway and transit monitoring systems.
- Cost management. Managing traveler information program costs continues to be challenging, particularly with increasing demands for information to be timely, accurate and delivered in a variety of formats. The project supported a peer exchange of alternative funding approaches, specifically sponsorships, to manage and optimize the costs of operating traveler information services.
- Customer needs. Understanding and meeting customer needs in an era when information is a premium commodity is especially problematic in government culture where market research is still rarely used to understand customer needs. The project facilitated a discussion of how agency approaches to understanding customer needs and presented findings from a nation-wide study conducted by the National Cooperative Highway Research Program to understand what information and services travelers find most useful.
- Performance targets. A key feature of the 2012 legislation, Moving Ahead for Progress in the 21st Century (MAP-21), is the establishment of a performance- and outcome-based program that will encourage states to invest resources in projects that will make progress toward national goals. The project facilitated an exchange of information about states' approaches to establishing practical performance measures and targets for traveler information programs, particularly as they relate to meeting requirements in 23 CFR 511

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Use and Impacts of Camera Images and Other Displays of Traveler Information

The overall objective of this project was to understand the use and impacts of camera images and other “unverified” displays of information that can be interpreted by travelers, especially when compared to the use of “verified” reports such as traffic maps, incident reports, and other information that is formulated and/or verified by agencies. Results from this project could be used by agencies to help make decisions about what types of information to display and whether or not to increase/decrease current displays (e.g. add more cameras for display to the public). The focus of the project was on traveler information websites hosted by transportation agencies. A public survey, analysis of web usage statistics, and interviews with agency staff were used to inform project findings.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Administrative/Management:

Ten conference calls and two in-person meetings are scheduled for FY 2014. The project will continue to receive funds from the ENTERPRISE member states and start new projects as funds are available.

Projects:

All current projects will be completed in FY 2014. All projects in the ENTERPRISE 2013 Work Plan will be started, and projects in the 2014 Work Plan may begin as funds are available. A approved work plans will be posted on the ENTERPRISE website at: <http://enterprise.prog.org>

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

Administrative/Management:

Nine conference calls were held in FY 2014. Two in person meetings were also held in FY 2014, one in San Antonio, Texas and one in Branson, Missouri in conjunction with the National Rural ITS Conference.

Projects:

All remaining projects from the 2010-12 Work Plans were completed during FY 2014.

ICWS Coordination and Systems Engineering

In the previous ICWS ENTERPRISE effort, [Developing Consistency in ITS Safety Solutions – Intersection Conflict Warning Systems](#), the project concluded with a preliminary design guidance and an evaluation framework for intersection conflict warning system (ICWS) deployments. The project engaged several national standards groups and industry associations including the National Committee on Uniform Traffic Control Devices, AASHTO Subcommittee on Traffic Engineering, and the Traffic Control Devices and Evaluation of Low Cost Safety Improvements pooled funds.

This project furthered supported the standardization of intersection conflict warning systems by coordinating among the various national standards and association groups, and by developing a concept of operations and system requirements for the four types of ICWS identified in the Design and Evaluation Guidance for Intersection Conflict Warning Systems.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Next Generation Traffic data and Incident Detection from Video (Video Analytics Evaluation)

The objective of this project was to conduct “proof of concept” evaluation to document the potential for Video Analytics as a tool for traffic operations centers (TOCs) and for traffic data collection. The project reported results from testing of several Video Analytics Systems in the United States (Iowa, Missouri) and in Ontario, Canada, under real-world environments. Components of the project

evaluation included:

- Traffic Data Collection - Compared Video Analytics outputs to trusted agency detectors, for traffic volumes, speeds, and vehicle classifications.
- Incident Detection – Compared Video Analytics alerts to still images, video clips, and agency-reported incidents, to validate accuracy for detection of incidents including stopped vehicles, debris in the road, and slow traffic/congestion.
- Wrong-Way Vehicle Controlled Test – Conducted a controlled test to test the ability of Video Analytics systems to detect wrong-way movements on freeway ramps.
- Observations from Agency Staff: Representatives from participating agencies provided feedback on the value and usefulness of the Video Analytics systems to assist with managing road networks.

Results indicate that Video Analytics is ready to support a number of operational uses in its current state of practice. The final report includes several use case scenarios, along with procurement guidance and readiness of the state of practice to support each scenario tested as a part of this project. Lastly, a number of lessons learned are documented, which agencies can use as they plan for and procure Video Analytics systems.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Transitioning ITS Warrants to a Permanent Home

This project builds off a series of projects ([ITS Warrants - Phase 1 and Phase 2](#)) that have been conducted by the ENTERPRISE Pooled Fund Study to develop preliminary warrants for ITS devices. The warrants were designed to assist agencies with deployment decisions and site selection. ENTERPRISE continues to test and refine the warrants while exploring industry acceptance for the concept. The overall approach to developing the ITS warrants was modeled after the Manual on Uniform Traffic Control Devices (MUTCD) warrants for traffic signal installations.

Ideally, the ENTERPRISE Program envisioned that a National or International agency would embrace the concept of technology device warrants and carry the concept forward in order to support traffic engineers for years to come. In order to move towards this vision, ENTERPRISE approved this project “Supporting the Transition of ENTERPRISE ITS Warrants to a Permanent Home”. The objective of this project was to document activities ENTERPRISE had conducted as owner and maintainer of the warrants to assist in identifying potential organizations for transitioning the warrants to a new owner.

As ENTERPRISE documented the details of each task that was involved with owning the warrants, a number of options were suggested as potential organizations to transition the ownership and maintenance of the warrants. However after the ENTERPRISE Board reviewed the different options for one organization to maintain the warrants, it was agreed that ENTERPRISE should continue to own and maintain the warrants and partner with organizations to review the warrants. This approach was based on the understanding that it would be easier to find agencies willing to review and comment on one or more warrants periodically than it would be to find an organization willing to accept the entire workload of all the warrants. Given this, ENTERPRISE as part of this project developed a warrants review process to assist with review and modifications of the warrants.

A copy of the final project summary is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Crashworthiness and Protection of ITS Field Devices

Many Intelligent Transportation System (ITS) deployments include signs and other traffic control device displays that require locating them and other ITS components within the roadway clear zone. The [Manual on Uniform Traffic Control Devices](#) (MUTCD) requires these devices to be crashworthy.

Agencies wishing to deploy ITS devices within the clear zone are responsible for ensuring that the device is either protected by a longitudinal barrier or mounted on a breakaway support in a configuration that is crashworthy. The ENTERPRISE Pooled Fund Program completed a research project to document available resources to assist state, provincial, and local agencies in the process of designing and deploying ITS devices in the clear zone. The final report summarizes the large number of resources available from federal and state agencies.

A copy of the final project summary is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

HAR – Best Practices and Future Direction

Highway Advisory Radio (HAR) is a communication tool that has been used since the late 1970s by government organizations to deliver public information over short ranges by radio. Systems typically consist of a transmitter, antenna, recording device and power. Most modern systems use control software and wireless communication options that allow messages to be recorded or activated remotely. HAR is often used by departments of transportation, in particular, to deliver information about road conditions, construction and other traffic conditions.

The overall intent of this project was to provide ENTERPRISE member states with guidance to help them better understand how they should pursue HAR technologies and approaches in the future. To accomplish this, the project goals of the project were defined as follows:

- Goal #1: To help members understand how HAR is being used by transportation agencies today;
- Goal #2: To help members understand the potential value of HAR; and
- Goal #3: To help members understand the current and potential future state of HAR technology practices.

The final document for this project presents a general background of HAR, a summary of HAR uses and value, as well as the state of HAR technology and operational practices. Information for this project was gathered through literature reviews and interviews with transportation agencies operating HAR and manufacturers of HAR systems.

A copy of the final project summary is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Intelligent Work Zones – Synthesis of Best Practices

The ENTERPRISE Pooled Fund Program initiated a project to document the resources available as well as uses and benefits regarding the following Intelligent Work Zone (IWZ) technologies: queue warning systems, dynamic merge systems, alternate routes and variable speed limits in work zones. A detailed literature search was conducted to summarize work zone materials available related to the four work zone technologies. In addition, intelligent work zone representatives from transportation agencies were contacted to provide details on recent related deployments and provide input to the project.

The purpose of the final report is to understand the current status of work on IWZ activities by combining the resources gathered through a literature search with the information collected from the transportation agencies on recent deployments. Also included is a summary of the four IWZ technologies including examples of successes, any guidance possible when technologies are most effective, and the configurations that demonstrated the best results. Separate documents were then created from the final report highlighting the summary of uses and benefits for each IWZ technology as a quick reference for the specific technology of interest.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Connected Vehicles Data Element Concept of Operations

This effort examined the opportunities for state DOT’s to improve highway operations and safety through the use of Connected Vehicles sourced data. This included the following:

- Compiling a list of data elements
- Surveying state DOTs to determine which of these data elements could be useful for incident detection, incident management, traffic management, winter maintenance, special events management, EMS dispatch, and 511 entry. Also the surveying w state DOT representatives on preferred locations for IntelliDrive roadside equipment.
- Prepared a high level Concept of Operations that describes the data elements available from Connected Vehicles, the acquisition of the data from network servers, and the options for integrating the relevant vehicle sourced data into existing ITS software applications.

A copy of the final report is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

Assessment of Emergency Service Providers Data Feeds

ENTERPRISE established a working relationship with [General Motors’ OnStar](#) during the [Multi-Jurisdictional Mayday \(MJM\)](#) project in the late 1990s to explore how automatic collision notification (ACN) technology could enhance roadway safety and traveler information if data from such systems were available to emergency medical staff and transportation agencies. In the years since, OnStar has worked diligently with the [Association of Public Safety Communications Officials](#) (APCO) and the [National Emergency Number Association](#) (NENA) to establish parameters around the crash data that they can provide. Using those parameters, OnStar has published a data stream for emergency services and transportation agencies to use.

In addition to the safety and convenience services offered by OnStar, similar services are being offered by other automobile manufacturers. For example, Ford provides a service called [SYNC](#) that literally syncs your mobile phone with your vehicle to provide various safety functions, and Hyundai offers [Assurance Connected Care](#) as a standard feature for three years on most of their new vehicles. Insurance companies are also providing similar safety and rate reduction services such as [In-Drive](#) offered by State Farm.

Given the evolution and potential value of crash notification technology, this project researched the current data available from OnStar and similar telematics service providers, suggested the value of such data for transportation operations, and worked with ENTERPRISE member agencies to understand how they could use this type of data. This summary report provides information about the data currently available from telematics service providers and suggests the potential value of such data for transportation agency operations.

A copy of the final project summary is available from the ENTERPRISE website at: <http://enterprise.prog.org/projects.html>

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

- *The original budgeted amount of \$175,000.00 was for FY’s 2010-2014; at \$35,000.00 each fiscal year.
- ** The revised budgeted amount increased to \$350,000.00 to cover FY’s 2015-2019 at \$35,000.00 each fiscal year.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. There are many lessons to be learned from these research projects that could be used by MDOT, now and in the future. Specifically, there are several recommendations from the Next Era of Traveler Information project that could influence the direction MDOT takes with new enhancements to the Mi Drive website, the possible development of a Mi Drive app, and other traveler information initiatives.
2. MDOT committed to participating in ENTERPRISE for 5 years when taking over as the administrative agency in FY 2010. Although this is final year of the initial 5-year commitment, it is strongly recommended that MDOT continue to be an active part of the ENTERPRISE program, contribute to the program at current levels, and continue to serve as lead agency.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Transportation Library Connectivity and Development

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(237)	MDOT START DATE (FUNDING)	05/01/2011
OR NO.	OR13-017	MDOT COMPLETION DATE (FUNDING)	09/30/2015
		PROJECT COMPLETION DATE (Revised)	9/30/2015
TECHNICAL CONTACT	Renee McHenry renee.mchenry@sos.mo.gov Phone: 573-522-1948		
LEAD AGENCY	Missouri Department of Transportation		
PROJECT MANAGER	Alexandra Briseno		
CONTRACTOR			

BUDGET STATUS

FY 2014 MDOT Budget			Total MDOT Budget		
FY FUNDS	(Original)	\$5,000.00	TOTAL BUDGET	(Original)	\$25,000.00
	(Revised)			(Revised)	
TOTAL FY 2014 EXPENDITURES		\$5,000.00	Total Committed Funds Available		\$5,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

University of Wisconsin-Madison , Center for Transportation Studies (University of Minnesota) , AUTC , AZ , CA , CT , IA , ID , IL , KS , LA , MI , MN , MO , MS , NC , NJ , NM , NV , NY , OH , OR , PA , TN , WA , WisDOT, University of Alaska Transportation Research Center

PURPOSE AND SCOPE

Traditionally, a small group of libraries have been responsible for providing information service within the transportation community. They have managed collections while supporting practitioners and decision-makers. Yet, today a vast amount of industry information is not collected or posted to the internet without a management plan. User research habits are also changing. Recognizing this, a national effort has been made over the past five years to advocate for the development of improved library and information centers.

Unfortunately, stakeholders have been hampered by time and funding constraints. To overcome these constraints, this Transportation Pooled Fund (TPF) supports and evaluates collaborative library development. It also enhances existing efforts to develop a national transportation information infrastructure using Transportation Knowledge Networks (TKNs).

While facilitating coordination among federal, state, academic and private sector libraries, this study provides technical and promotional support. Moreover, it capitalizes on previously developed networking initiatives to implement research tools and analyzes their effectiveness. Library services can be supported locally, but collaboration allows for shared problem solving, resources as well as potential time and cost savings through best practices, defrayed costs and collective purchasing power. All of these things are critical in an era of real-time communication.

FISCAL YEAR 2011 ACCOMPLISHMENTS

The Transportation Pooled Fund started on April 1, 2011 and the Fiscal Year ends December 31, 2011. Special projects are underway for individual member libraries in New Mexico, Illinois, and North Carolina to catalog important transportation information and research resources so that they are accessible to researchers and decision makers. The pooled fund lead consultant has coordinated all phases of the project planning and subcontracting.

Group special projects were selected. Through these projects, members will pursue the development of an return on investment assessment strategy for transportation information services, develop a unified web presence for the regional Transportation Knowledge Networks (TKN's) and host email lists for Eastern TKN and Western TKN, develop a new acquisitions awareness tool to help librarians share resources and plan collection development more effectively and finally, a project has been selected to investigate and acquire a multisite license to a research tool of the TAC's choice. Using pooled funds to pursue these projects will benefit the study partners and the wider transportation information and research community by increasing access to research tools and materials, improving communication and collaboration and enabling librarians to allocate resources more effectively for their departments.

Web site development has been ongoing to provide members and the transportation library community a central place to access important project information and monitor happenings in the on the TKN landscape. All members and partners are registered users of the WordPress site and many are participating in the collaborative features of the site.

Essential subscription access was maintained by pooled fund payments to On-Line Computer Library Catalog (OCLC), Inc. These subscriptions are indispensable tools for librarians in providing services to department researchers and decision makers.

The FFY2011 annual meeting was planned and took place on October 19, 2011 as a four-hour Web meeting with featured speakers and a business meeting.

FISCAL YEAR 2012 ACCOMPLISHMENTS

- Create and implement an National TKN marketing plan that coordinates National Transportation Library (NTL), NTKN, regional TKNs and the pooled fund;
- Investigate and coordinate special project for subscription access for Oregon DOT (individual member project) and group access to

- selected resource. Evaluation of resources within budget will begin at the FFY2011 annual meeting;
- Continue developing and updating the Web site, develop project resources and librarian resources page, develop statistical reporting tool;
 - Continue facilitating subcontracting process and managing selected individual member and group projects,
 - Coordinate development of partnership and project scope with NTL on selected project, RFP and subcontract;
 - Facilitate development of ROI project with project team, develop RFP and subcontract,
 - Implement cataloging subscription tools at agreed upon consortium pricing with the Library of Congress;
 - Begin planning FFY2012 annual meeting on location;
 - Continue management of OCLC subscriptions and payment of invoices;
 - Schedule and plan FFY2012 quarterly TAC teleconferences with continuing education and networking opportunities

FISCAL YEAR 2013 PROPOSED ACTIVITIES

- Projects that will benefit transportation research were selected for implementation in FFY2013.
- A group subscription was approved, discount secured and will be enacted ASCE Library with access to all staff at member agencies.
- Valuation Toolkit will assist librarians and managers leverage the organization's information assets and plan for sustainable library services in our member departments.
- Coordinated regional TKN sites and integration of NTKN web sites and projects will assist with branding and access to transportation information.
- Professional development opportunities at TRB will be highlighted and shared by attendees with study partners.
- Further collaborative applications and tools will be added to the project Web site.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

- Added the University of Alaska Transportation Research Center as a new member.
- Manage marketing campaign of ASCE Library with materials and other promotions. Run quarterly usage reports and distribute to TAC, post in Members Only section of website.
- Completed a special project – Proving Your Library's Value: a Toolkit for Transportation Librarians was published in January. 2013.125 print copies were disseminated among members, partner organizations and other transportation libraries and information centers. An announcement / press release was sent to TRANLIB-L and the AASHTO RAC list with a link to the web version (PDF), which is prominently displayed on the project website at: <http://libraryconnectivity.org/files/Proving-Your-Librarys-Value.pdf>
- Continued developing website, new content includes more licensed content behind the password on the Members Only page (trials, workshop registrations, ALA materials, presentations), new pages for Outreach and Marketing and Administration resources and project and librarian resources pages; promoted RSS feed and technical support with feed readers.
- Conducted a free 45-day trial of EBSCO Ebooks for Engineering.
- Continued facilitating and managing selected individual member and group projects, including subcontracts and vendor relations.
- Provided travel support documentation for requests for out of state travel and expenses to 75% of the membership.
- Set up subscription and paid invoice for the RDA Toolkit, an essential cataloging tool to work within new RDA guidelines for bibliographic records. The subscription is a companion to existing subscriptions to Cataloger's Desktop and Classification Web, also provided through the pooled fund. (Vendor: American Library Association)
- Held quarterly TAC meeting on March 21, 2013. Provided professional development session: EBSCO Ebooks for Engineering – product demonstration and Q&A session. The regular business meeting also took place.
- Attend regional TKN meetings, chairs meetings and TLCat committee meetings.
- Developed collaborative opportunities with new members and partner agencies. Continuing project with NTL for New Acquisitions list with assistance from WisDOT staff and lead team member AZDOT.
- Consulted with TAC on pooled fund hosting of the NTKN Cataloging Workgroup's wiki and NTKN web site. TAC voted and approved. The wiki data has been moved to the UW-Madison server. It has not gone live, per a pending decision by the Workgroup.
- Special Projects: New projects for FY13 team meetings held.
- Cataloging: NM, IL, NC – all contracts renewed by HS InFocus LLC
- Multistate Cataloging – conducting a search for a professional cataloger for subcontract;
- Report Documentation – discussing best avenue to desired result (this may entail another subcontract);
- Report Distribution - discussing best avenue to desired result (this may entail another subcontract);
- Marketing Toolkit – scoped, outline complete, shu shu design retained for layout and graphics;
- Reference Tracking Tool – began investigating software/subscription products currently on the market.
- TKN Web Project – KKL Info contract was renewed, new KM calendar project scoped.
- Continued development of the Marketing and Outreach toolkit. Sections were sketched out and team members were assigned responsibility for development.
- Purchased group access to the ALA Web seminar The DIY Patron: Library Instruction at the Point of Need as a professional development opportunity for members. The recorded session and materials are permanently available behind the password on the Members Only page on the project website.
- Selected host sites for FY2013 annual meeting – the pooled fund meeting will take place at The Commons Hotel on the University of Minnesota campus. A draft agenda has been distributed to members and we have secured a block of rooms at the Missouri state rate at The Commons Hotel.
- Continued managing selected individual member and group projects, including subcontracts and vendor relations.
- All registration, travel and reimbursements for the Special Libraries Association annual meeting in San Diego was completed. The conference was June 9-11, 2013. • Provided travel support documentation for requests for out of state travel and expenses to 75% of the membership. A pooled fund meeting was held on June 10 to discuss the annual meeting agenda in the Twin Cities.
- Continued website enhancements, including project documents, updates and librarian resources and other resources.
- Held a June quarterly TAC meeting on 6/19/13. *Special topic: SLA takeaways to help us do serve our customers better and help our departments fulfill their missions.*
- Held the Annual Meeting on September 18-19th in the Twin Cities, MN

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Five proposed activities are currently being voted on by Pooled Fund members:

- Subscription to Springshare for hosting for the Eastern Transportation Knowledge Network (ETKN) LibGuide and Other LibGuides
- Website and listserv hosting for the WTKN and ETKN
- Development of a Knowledge Management Calendar Website
- Creating a generic brochure that could be edited and used for marketing purposes by each of the regional transportation knowledge networks (TKNs).
- Library Valuation Paper and Presentation – “The Continuing Value of Transportation Libraries in Digital Age”.

Other goals include:

- Getting the pooled fund benefits discussed at the RAC agenda during the TRB meetings in January 2014
- Continuation of the ASCE journal subscription for members
- Continuation of the contract cataloging project for several DOT members

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

Meetings & Professional Development

- Quarterly TAC meeting, 3/20/14. Special topic: Data curation and the libraries’ role in compliance with the OSTP data policy.
- Quarterly TAC meeting, 6/19/14. Special topic: 2014 Special Libraries Association Conference.
- Quarterly TAC meeting, 12/19/14. Special Topic: MnDOT Library Valuation Study
- Members attended the Special Libraries Association Annual Meeting and Conference in Vancouver, BC. June 8-10, 2014.
- Annual Meeting, Ann Arbor, MI, September 8-9, 2014. Special Topics: LibGuides Workshop, Data Curation, Connected Vehicle Technology.

Library/Research Resources

- Product trials for standards with vendors IHS, Techstreet and ASTM to provide engineers with optimal access to standards in their work at a significant negotiated discount by leveraging the size of our group.
- LibGuides subscription was purchased for the membership. <http://guides.libraryconnectivity.org/index.php>
- NTKN working group wikis are being hosted on our domain, www.libraryconnectivity.org, at the request of the National Transportation Knowledge Network, regional TKNs and approval by the NTKN Steering Committee and the TPF-5(237) TAC. Two wikis have been developed.
 1. Data Management: http://libraryconnectivity.org/datamgt/index.php/Main_Page (live, public)
 2. Cataloging: http://libraryconnectivity.org/catwiki/index.php/Main_Page (live, not public yet)
- Cataloging Resources
 1. Cataloger’s Desktop, Classification Web (Library of Congress) – subscriptions renewed, paid with pooled funds.
 2. RDA Toolkit (American Library Association) subscription renewed with pooled funds. These tools assist librarians in creating standards compliant bibliographic records for increased access to library resources (print and digital) and as part of the collection management aspects of running a library.
- Continued ASCE Library product marketing and renewals for participating members receiving consortium discount.
- Continued CMS website development, including project documents, updates and librarian tools and other resources. <http://www.libraryconnectivity.org>

Special Projects

- Improvement of research report distribution and access and promotion of more effective use of Technical Report Documentation page, USDOT Form 1700.7 will be complete by 30 September, 2014 by subcontractor, Transanalytics.
- KM Calendar project: Phase I – design, build – complete. <http://clients.robotkittendesigns.com/events> (temporary URL). The calendar will be deployed in Phase I with a video tutorial and accompanying user guide.
- Connecticut DOT Library website – built with pooled funds. <http://ctdotlibrary.org/>
- Cataloging Projects:
 1. Illinois – 2,190 TRB Highway Research Records series and Transportation Research Records.
 2. North Carolina - 292 total: Original = 49; Copy = 243
- Multistate Cataloging – Complete.
 - Michigan – 106 total: Original = 49; Copy = 57
 - Minnesota – 103 total: Original = 103; Copy = 5
 - California – 404 total: Original = 304; Copy = 100
 - Idaho – 300 subject headings into Excel.
 - New York – 11 total: Original = 11; Copy = 0
- TKN Brochures were completed and will be distributed among members for marketing the value of library services. Links:
 1. MTKN - <http://www.mtkn.org/sites/default/files/MTKNBrochure.pdf>
 2. ETKN – Not published on website.
 3. WTKN- Not published on website.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

FFY2015 Highlights

- Develop and disseminate beneficial products and best practices through projects;
- Demonstrate proof-of-concept value of strong, sustainable transportation library networks as a vital component of effective TKNs;
- Expand access to resources by leveraging pooled funds for more group subscriptions to valuable transportation information resources for researchers;
- Increase outreach and marketing to advocate for sustainable libraries and TKNs.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Updated the information in the Fiscal Year 2014 Accomplishments and the Fiscal Year 2015 Proposed Activities on September 29, 2014.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2013 accomplishments that MDOT may consider for implementation

immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).

- As part of the contract cataloging project, MDOT was the first state to submit and complete the cataloging of 100 research reports. These reports are now available on the OCLC (Online Computer Library Catalog) for any available library to search and request use of.
 - The availability of the ASCE journal subscription has helped complete numerous research requests for journal information for MDOT employees
2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
-

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Traffic and Data Preparation for AASHTO MEPDG Analysis and Design

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(242)	MDOT START DATE	6/1/2012
OR NO.	OR14-035	MDOT COMPLETION DATE (Original)	9/30/2013
		COMPLETION DATE (Revised)	8/31/2014
TECHNICAL CONTACT	Doc Zhang doc.zhang@la.gov Phone: 225-767-9162		
LEAD AGENCY	Louisiana Department of Transportation		
PROJECT MANAGER	Michael Eacker		
CONTRACTOR	Kelvin Wang, Oklahoma State University		

BUDGET STATUS

*FY 2014 Budget			Total Budget		
FY FUNDS	(Original)	\$0.00	TOTAL COST	(Original)	\$50,000.00
	(Revised)			(Revised)	
TOTAL FY 2014 EXPENDITURES		\$25,000.00	Total Committed Funds Available		\$0.00

*FY 2014 funds were expended to cover program costs approved in FY 2013.

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

HI , KY , LA , MD , MI , NC , NH , WisDOT

PURPOSE AND SCOPE

This project was initiated to further develop the Prep-ME software.

Prep-ME is designed to assist states with data preparation and storage for mechanistic-empirical (ME) pavement design.

The scope of the project is:

1. Estimate the axle load spectra from weigh-in-motion (WIM) data
2. Create algorithms to check WIM data for errors or inconsistencies and to repair the data where possible
3. Add functions as directed by the participating states
4. Customize the software for each of the participating states
5. Training for the participating states
6. Technical support for the participating states

FISCAL YEAR 2012 ACCOMPLISHMENTS

Project began September 2011. Contractor (Oklahoma State University) purchased two DARWin-ME licenses.

The previous version of Prep-ME was developed for the previous version of the ME software (pre-commercial version called MEPDG). Contractor began working with DARWin-ME (commercial version of ME) to learn the differences between MEPDG and DARWin-ME. One of the differences is the formats of files for importing into and exporting from DARWin-ME. The contractor began working on changes that will allow importing and exporting in these new file formats.

DARWin-ME was designed to work with SQL or Oracle databases. The contractor began developing tools to allow software users to utilize data and files stored in these two database formats.

An update meeting was held on September 5 & 6, 2012 in Romulus, Michigan. Most of the participating states were in attendance as well as FHWA representatives. The Oklahoma State University (OSU) team provided a working version of the Prep-ME software to the participating states for their review. Training was provided at the meeting by OSU.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

The contractor plans to work on the following:

- Customize the software to accept the file formats of the WIM data for each participating State of Michigan
- Continue to work on tools for working with both SQL and Oracle databases
- Add function to allow quality checks of WIM data using the Traffic Monitoring Guide protocol or the state's own protocol
- Add functionality that will allow grouping and clustering of WIM sites with similar data. This will allow selection of ME inputs for areas that do not have a WIM
- Improve mapping function currently in the software (showing WIM site locations) to allow customization
- Begin work on allowing storage of geospatial soil data

- Begin work on tools to summarize and create climatic inputs for ME
- Begin work on tools to import, analyze, and prepare inputs for ME, of falling weight deflectometer data
- Begin work on database to store 2-dimensional and 3-dimensional automated distress surveys

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013?

Version 3.0 of the PrepME software was delivered for the participating states to review. An updated user manual was provided with the new version.

2. Please list those deliverables that will benefit MDOT if implemented.

With the new version, the Michigan DOT's process for clustering weigh-in-motion sites was incorporated. If the software is producing the correct results using MDOT's process, it will allow MDOT personnel to perform the clustering process rather than using a consultant to do it through a research project.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Once feedback is received from the participating states, the vendor will continue to refine the software. They will also work on software functions that have not been included yet.

A workshop based upon the activities of this pooled fund has been proposed for the 2014 TRB conference.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

A workshop was held at the 2014 TRB meeting in Washington DC this past January. The workshop successfully demonstrated the PrepME software to several other states who were in attendance.

A new version of PrepME was delivered with the following enhancements:

- Functionality for quality control checks on truck classification data was enabled
- A materials database module was added. This module will allow storage of pavement material test data that can be utilized as inputs for the mechanistic-empirical (ME) pavement design software.
- A climate module was added. This module will allow for storage and retrieval of climate data outside the data already embedded in the ME software.

With this new version of the software, MDOT will be able to begin utilizing PrepME for the traffic inputs necessary to do ME designs.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

This pooled fund study start date was delayed by the lead agency. MDOT original plan was to transfer funds in 2012 and 2013. However, the actual fund transfers occurred in July 2013 and November 2013.

The partner state Dots will continue to actively participate on the TAC until all required deliverables are completed.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Implementation of the PrepME software has already begun with the following tasks:

- Raw permanent traffic recorder data was requested and received from the Asset Management Division
- The raw data was imported in to PrepME
- A team was assembled to help make decisions on the acceptance/rejection of data flagged by the software as not passing quality control checks. The team has met three times and completed analysis of truck weight and classification data from 2011 to 2013.

Next, the Pavement Management Section will begin utilizing PrepME to prepare traffic inputs that will be utilized by MDOT pavement designers for ME designs. They will also review the capabilities of the materials and climate modules. Because of existing software already in place, it is expected that these two modules will not be needed.

It is recommended that MDOT fully implement the use of PrepME in the following manner:

- After the end of each calendar year, the permanent traffic recorder truck weight and classification data from the previous year should be assembled and imported in to PrepME.
- The PrepME QA team will meet after the latest year's data has been loaded and the quality control checks have been run. The QA Team will review all the data that did not pass the quality control checks to see if it can be accepted.
- After the QA Team has completed its work, the Pavement Management Section will use the export function of PrepME to update the ME traffic files used for pavement designs.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Evaluation and Analysis of Decked Bulb T Beam Bridge

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(254)	MDOT START DATE	09/19/2011
PROJECT NO.	114419	MDOT COMPLETION DATE (Original)	09/30/2014
		PROJ. COMPLETION DATE (Rev.)	2/28/2015***
TECHNICAL CONTACTS	Dr. Nabil Grace, (LTU- PI) Phone: 248-204-2400 Benjamin Graybeal (FHWA) Phone: 202-493-3122		
LEAD AGENCY	Michigan Department of Transportation		
PROJECT MANAGER	Dave Juntunen and Matthew Chynoweth		
CONTRACTOR	Lawrence Technological University		

TOTAL PROJECT BUDGET STATUS

* MDOT Budget			Project Total Budget		
FY 2014 BUDGET	(Original)	\$27,000.00	TOTAL COST	(Original)	\$ 349,000.00
	(Revised)			(Revised)	\$ 367,200.00
TOTAL FY 2014 EXPENDITURES		\$36,706.37	Project Total Committed Funds Available		\$ 18,612.59

Year	** MDOT Total Expenditures	Project Total Expenditures
2012	\$55,500.72	\$132,495.94
2013	\$53,811.36	\$128,462.96
2014	\$36,706.37	\$ 87,628.51

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

IA , MI , MN , OR , WisDOT

PURPOSE AND SCOPE

To analyze and evaluate the decked bulb-T beam (or decked I- beam) as a viable replacement for the side-by-side box-beam bridge. The project's description uses the term bulb- T beam as a general description of an I-beam shape, with a wide top flange that can serve as a deck surface. For this type of beam to be a viable replacement to a box beam, it must have a very robust cross-section designed to have a shallow depth-to-span ratio; which makes it very different than the standard AASHTO section used by some states. The use of a bulb- T beam cross section would eliminate inherent problems associated with the ability to inspect and repair box-beam type structures. The Bulb-T beam cross-section will provide enough space at the section bottom for ease of periodical inspections and maintenance of critical elements; such as beam web and the suffit of the bridge deck slab.

The purpose of this proposed study is to collaborate and share common interests with State DOT's in the Midwest area, and other research stakeholders, regarding alternative/innovative solution(s)to environmental and structural challenges in building and maintaining a sustainable transportation infrastructure. In correlation with analyzing the bulb- T beam this study includes comparing alternative non-corrosive materials, including, but not limited to carbon fiber, stainless steel and stainless clad reinforcement materials. The study's analysis and evaluation will include the evaluation of top flange connection details including the use of ultra high performance concrete (UHPC) to fill the joint between the adjacent decked bulb-t beams (as used in New York).

FISCAL YEAR 2011 ACCOMPLISHMENTS

Project started 9/19/2011.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Theoretical analysis, construction of decked bulb T beams.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

Continued theoretical analysis, construction and testing of decked bulb-T beams.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013?
 - Completed construction of ½ scale bridge model with CFRP materials.
 - Completed instrumentation and testing of control beam.
 - Completed pre-stressing of decked bulb-T beams.

2. Please list those deliverables that will benefit MDOT if implemented.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

- Perform ultimate load test on the ½ scale Bulb-T Bridge Model with CFRP materials.
- RAP meeting in the spring of 2014.
- Final Report

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

- 1- Completed analysis and testing of one-half-scale decked bulb-T beam bridge
- 2- RAP meeting in the spring 2014
- 3- Assembling laboratory test results and completed analysis of the experimental and numerical investigations for reporting in the final report .

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Finalizing the results and conclusions from the entire investigations. Finalizing and submitting the final comprehensive report.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

* MDOT, as lead agency initially budgeted/obligated project funds using MDOT's SPR-II research funds. Early project invoice billings were paid using these obligated funds to cover the initial cost of the research while waiting to receive the partner state's transfer of funds. After the other partner state's funds were transferred; MDOT decreased its FY 2012 obligation amount to \$146,000 and subsequently increased its total budgeted/obligated amounts to \$173,000 in FY 2014 to cover its share of the anticipated total project cost.

** The project's fiscal year 2011 incurred expenditures were \$1,041.75; these expenditures were paid in fiscal year 2012 and are included in the fiscal year 2012 total invoices paid amount of \$132,495.94. The MDOT's 2012-2014 expenditures shown above represent its actual pro-rata share of the project cost reimbursements made in each respective year.

*** Since the FEA analysis and results of the parametric study, and the results of the conducted extensive experimental work; the PI requested additional project time for careful documentation and clear presentation. The project manager approved a no cost time extension through February 28, 2015 to will allow the PI to finalize and submit a comprehensive final report.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2014 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (I.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).
 2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
-

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Development of an Improved Design Procedure for Unbonded Concrete Overlays

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(269)	MDOT START DATE (FUNDING)	4/13/2012
OR NO.	OR14-036	MDOT COMPLETION DATE (FUNDING)	9/30/2014
		PROJECT COMPLETION DATE (Revised)	5/31/2016*
TECHNICAL CONTACT	Debra Fick deb.fick@dot.state.mn.us Phone: 651-366-3759		
LEAD AGENCY	Minnesota Department of Transportation		
PROJECT MANAGER	Benjamin Krom, P.E		
CONTRACTOR	University of Minnesota		

BUDGET STATUS

MDOT FY 2014 Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$20,000.00	TOTAL COST	(Original)	\$60,000.00
	(Revised)			(Revised)	
TOTAL FY 2014 EXPENDITURES		\$20,000.00	Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

GA , IA , KS , MI , MN , MO , NC , OK

PURPOSE AND SCOPE

It is the goal of this project to develop a stand-alone national design procedure that will result in improved performance and life-span prediction of unbonded concrete overlays constructed over existing concrete or composite pavements. The procedure should be based on mechanistic-empirical principals, and developed in a way such that it could be easily adopted into future versions of the MEPDG or DARWin-ME design procedures. The new procedure must incorporate the best features from existing UCOCPP designs, as well as develop improved structural and fatigue models that consider the effects from the environment and the behavior of the wide range of interlayer systems currently in use.

FISCAL YEAR 2012 ACCOMPLISHMENTS

The participating states met via conference call and web conference on 6/28/2012 to discuss the contents of the Request for Proposals (RFP). Based on that input, the Lead Agency developed the final RFP, and posted it on 9/4/2012, with proposals due by 10/2/2012.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

First, the participating states will review, discuss, and score the proposals that are received, ultimately selecting the contractor who will perform this work. Once a contract is in place, work on the following tasks is expected:

Task 1 – Literature review and summary of existing UCOCPP design procedures, and survey of performance of experimental and in-service UCOCPP projects.

Task 2 – Develop separator layer (interlayer) design parameters and performance model(s) for various materials based on field testing results and limited laboratory testing (if needed).

Task 3 – Develop new, or improve existing UCOCPP pavement response and performance prediction models that incorporate slab thickness, panel size, joint load transfer mechanisms, axle load configuration, condition of the existing pavement, climate (nation-wide), and performance of a separator layer over time. Existing national climate models should be adopted and updated as needed.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013?

The contract with the University of Minnesota was not executed until June 17, 2013. Therefore, the project has just started, beginning with a literature review and the creation of a database of existing unbonded concrete overlay projects.

2. Please list those deliverables that will benefit MDOT if implemented.

N/A

FISCAL YEAR 2014 PROPOSED ACTIVITIES

The project started later in the 2013 fiscal year than originally expected; FY 2013 proposed activities are carried into FY 2014.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

Two Technical Advisory Panel meetings occurred via web-conference this FY (December 16, 2013 and May 27, 2014), to keep all member states informed on the progress with this project. Task 1 was completed this FY, which included a literature review of existing unbonded concrete overlay design procedures, and a survey to states was also sent out. MDOT provided a lot of detailed information on our existing unbonded overlay projects as part of the survey. The research team also met with Minnesota DOT pavement experts to

gather information about the historical performance of unbonded concrete overlays in Minnesota. Extensive pavement management system records and personal knowledge/ experience with unbonded overlays were transferred to the research team. The University of Minnesota's subcontract with the University of Pittsburgh was not executed until May of 2014, so the Task 2 work is behind schedule. For the laboratory testing in Task 2, the University of Pittsburgh requested that member states provide material samples for testing (concrete specimens with open-graded & dense-graded interlayer asphalt attached). MDOT has acquired concrete samples with both asphalt interlayer types, and is in the process to delivering them to the University of Pittsburgh. MDOT staff has also hosted some members of the research team (U of Pitt), touring the Michigan unbonded concrete overlay projects that were of interest to them.

Website Updates:

- Work continued on the development of a longitudinal cracking model, which will be used in the UBOL design procedure being developed.
- Task 2 was the major focus during July-September 2014; the TAC members began securing/sending material samples for testing characterization of the interlayer.
- Selection of projects for supplementary non-destructive testing is underway. Some of the selected sites were visited by the research team in 2014.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

* Due to the late start in fiscal year 2013 the project's proposed completion date has been revised to May 31, 2016. MDOT and other active members will actively participate in the project's progress.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2014 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).
None.
 2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
N/A
-

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Reorganization of Section 5, Concrete Structures, of the AASHTO LRFD Bridge Design Specifications

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(271)	MDOT START DATE	10/1/2012
OR NO.	OR14-033	MDOT COMPLETION DATE (Original)	9/30/2015
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Susan Barker Email: SusanB@ksdot.org Phone: 785-291-3847		
LEAD AGENCY	Kansas Department of Transportation		
PROJECT MANAGER	Matt Chynoweth		
CONTRACTOR			

BUDGET STATUS

FY 2014 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$10,000.00	TOTAL BUDGET	(Original)	\$30,000.00
	(Revised)			(Revised)	
TOTAL FY 2014 EXPENDITURES		\$10,000.00	Total Committed Funds Available		\$10,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

FHWA , FL , IA , ID , KS , LA , MI , MN , NE , NJ , OH , OR , PA , TX , UT , VA , WA

PURPOSE AND SCOPE

Since the adoption of the AASHTO LRFD Bridge Design Specifications; 1st Edition in 1992, yearly interim revisions have been written to Section 5, Concrete Structures. These revisions were made by members of the AASHTO technical committee T-10; Concrete Design researchers or other friends of the committee.

Much care was taken by the original National Cooperative Highway Research Program (NCHRP) project 12-33 team to maintain organizational, philosophical, and technical consistency throughout the specifications. The yearly interim revisions since 1992; while well meaning, have not always maintained the desired consistency. However; this situation is not unique to Section 5, AASHTO technical committee T-14, Structural Steel Design, had the opportunity to reorganize Section 6, Steel Structures, during the recent integration of straight and horizontally curved steel girders. In addition, Section 5 is ready to be re-organized, after the many years of interim revisions.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

1. Survey stakeholders - Stakeholders will be identified and surveyed via conference calls and in-person meetings (for example, during the various T-10 meetings throughout the year) to identify the needs for returning Section 5 to its original organizational, philosophical, and technical consistency. Stakeholders will include AASHTO technical committee T-10, practicing bridge-design engineers, and bridge-design researchers, among others.
2. Develop annotated revised table of contents – From the results of Task 1 an annotated revised table of contents will be developed for Section 5.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013?
Nothing thus far, as they are still reviewing survey monkey results and putting together a revised annotated table of contents.
2. Please list those deliverables that will benefit MDOT if implemented.
The eventual re-organization and re-write of Section 5, into a more concise, easier to use document.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

1. Critically review all interim changes for technical and philosophical consistency - All interim changes since the original first edition of the LRFD Specifications will be reviewed for technical and philosophical consistency.

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2. Write interim report - An interim report will be written proposing the revised table of contents and changes to the specifications to restore its philosophical and technical consistency.
 3. After review and approval of the interim report by T-10, begin developing the new revised and reorganized draft Section 5, Concrete Structures
 4. From comments and direction of the T-10 committee, based upon the reviews of the interim report, a new revised and reorganized draft Section 5 will be developed.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

Task 5, *Develop new revised and reorganized draft Section 5, Concrete Structures*, continues with periodic revisions (10 to date) with the seventh revision, the latest to be submitted for review by the panel. On April 27 during PCI Committee Days and on June 24 during the annual meeting of the AASHTO Subcommittee on Bridges and Structures, the research team met with the panel to review drafts of Section 5.

Work will continue on Task 5 based upon review comments. Early in the next quarter, the tenth draft of Section 5 will be submitted to the panel.

A panel meeting is scheduled on September 7, to review the tenth draft.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Good progress continues to be made, but no significant results can yet be cited.

Work will continue on refining the reorganized draft Section 5, with at least 3 meetings anticipated.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2013 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).

Nothing has been implemented to date.

2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
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**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Standardizing Lightweight Deflectometer Measurements for QA and Modulus Determination in Unbound Bases and Subgrades

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(285)	MDOT START DATE	10/01/2013
OR NO.	OR14-037	MDOT COMPLETION DATE (Original)	9/30/2014
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Allison Hardt Email: ahardt@sha.state.md.us Phone: 410-545-2916		
LEAD AGENCY	Maryland State Highway Administration		
PROJECT MANAGER	Richard Endres Email: endresr@michigan.gov Phone: 517 322-1207		
CONTRACTOR			

BUDGET STATUS

FY 2014 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$50,000.00	TOTAL BUDGET	(Original)	\$50,000.00
	(Revised)			(Revised)	
TOTAL FY 2014 EXPENDITURES		\$50,000.00	TOTAL COMMITTED FUNDS AVAILABLE		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

FL , MD , MI , MO , NC , NY , SC , VA

PURPOSE AND SCOPE

The primary purpose of this study is to provide state DOT and local government engineers with a practical and theoretically sound methodology for the evaluation of in-place elastic modulus of unbound layers, subgrades, and other earthwork from LWD field test data

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Funding requested and approved in FY2013, however project will not begin until FY2014.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

Project is in early stages and approximately 15% complete. Two states, Indiana and Minnesota, have implemented LWD into their specifications. Methodology from those states has been documented during literature review phase. In addition to the Literature Review phase which continues, work has begun on Equipment Evaluation. Three devices were selected for further study including the Zorn ZFG 3000 which MDOT tested as part of the Intelligent Compaction pilot project last summer in Iron River. Further study of this device was a key goal from MDOT's perspective.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

MDOT Geotechnical will stay current on progress and findings from this pooled fund study. When standardized, straightforward procedures for using LWD for modulus/stiffness-based compaction control is available, we will develop specifications and pilot for use beginning with recycled materials. Expanded use beyond recycled materials may be possible but will depend on a successful pilot project, and widely accepted procedures that are suitable for practical implementation by field inspection personnel

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Next Generation Concrete Pavement Road Map

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(286)	MDOT START DATE	10/1/2012
OR NO.	OR09-144	MDOT COMPLETION DATE (Original)	9/30/2017
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Linda Narigon Linda.Narigon@dot.iowa.gov Phone: 515-239-1471		
LEAD AGENCY	Iowa Department of Transportation		
PROJECT MANAGER	John Staton		
CONTRACTOR			

BUDGET STATUS

*FY 2014 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$15,000.00	TOTAL BUDGET	(Original)	\$75,000.00
	(Revised)*	\$30,000.00		(Revised)	
TOTAL FY 2014 EXPENDITURES		\$30,000.00	Total Committed Funds Available		\$45,000.00

*FY 2014 funds were expended to cover program costs approved in FY 2013.

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

GA , IA , MI , OK , PA

PURPOSE AND SCOPE

This problem statement is for the establishment of a Next Generation Concrete Pavement Road Map (Next Gen CP Road Map) Pooled Fund to carry on the work started by FHWA's initial Concrete Pavement Roadmap Pooled Fund, TPF-5(185), which ended June 2012. This initial pooled fund was developed to guide concrete pavement research investments identified as critical for accomplishing customer-driven goals. This Next Gen CP Road Map pooled fund will continue the effort to identify needed research to help the concrete pavement community meet today's paving needs and tomorrow's pavement challenges.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

What products or services were delivered from study activities performed in 2013?

On a bimonthly basis, the Next Gen CP Road Map E-newsletter was developed, featuring national highlights on research, including a specific state PCC pavement updates.

A continuation of the PCC pavement project database, monitoring the TAC's progress towards the CP Road Map research priorities is moving forward from the previous CP Roadmap pooled fund project.

A Next Gen CP Road Map website with general information on the road map, the 12 tracks and a library of the pooled fund deliverables is being transferred from the previous CP Roadmap pooled fun project.

The pooled fund is continuing facilitation of the Next Gen CP Road Map Track Leadership Committees, comprised of leading national experts, organized around the specific research tracks.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

The FY 2013 tasks will be carried forward into FY 2014.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

- Contacted states to determine dates and topics for training.
- Developed outline for PCC overlay specification.
- FHWA's contribution was added to the pooled fund. Scope was expanded to include E-new and MAP Briefs.
- First e-news and MAP Brief were distributed. MAP brief topic was "Mix Design and Proportioning for Concrete Pavements".
- Updated research database with information gathered from state interviews.
- A TAC meeting was held January 7th.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

- Finalize dates, locations, and topics for training events.
- Issue new e-news and MAP Brief. MAP brief will focus on PCC joint performance.
- Finalize PCC overlay outline and begin writing new specifications.
- Continue to update research database as further state interviews are completed.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

- The FY 2013 budget was expensed in FY 2014. Also, the FY 2014 budgeted amount was expensed in the same year as well.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2013 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).

The year to year tasks associated with this pooled fund project (Next Gen CP Road Map E-newsletter, PCC pavement project database, Next Gen CP Road Map website, Next Gen CP Road Map Track Leadership Committees) are continuing and implementation of deliverables will be disseminated accordingly. This is the first fiscal year quarter of the Next Gen CP Roadmap pooled fund project. Additional Deliverables to be prioritized by the TAC as funding allows.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE:
Aurora Program

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(290)	MDOT START DATE	10/1/2013
OR NO.	OR14-057	MDOT COMPLETION DATE (Original)	9/30/2016
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Linda A. Narigon, P.E.		
LEAD AGENCY	Iowa Department of Transportation		
PROJECT MANAGER	Dawn Gustafson		
CONTRACTOR			

BUDGET STATUS

FY 2014 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$25,000.00	TOTAL BUDGET	(Original)	\$75,000.00
	(Revised)			(Revised)	
TOTAL FY 2014 EXPENDITURES		\$25,000.00	TOTAL COMMITTED FUNDS AVAILABLE		\$50,000.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

AK, IA, IL, IN, KS, MI, MN, NY, ND, OH, PA, UT VA, WI, Ontario MOT,

PURPOSE AND SCOPE

1. To improve dissemination of road weather information to transportation providers and end users, ultimately increasing safety by reducing potential weather-related incidents and improving transportation safety, reliability, and mobility in both urban and rural areas.
2. To improve the efficiency of maintenance operations.
3. To aid in the development of technologies that seamlessly integrate to facilitate the formation of partnerships between maintenance and operations and facilitate the dissemination of road weather information.
4. To develop initiatives that assist public agencies in deploying RWIS technologies and methodologies.
5. To encourage greater cooperation and information exchange between transportation agencies and the other agencies and groups.
6. To support development of expanded uses of RWIS technologies.

The program's mission is to support cooperative research, evaluation, and deployment of innovative technologies that advance road weather monitoring and forecasting in highway design, construction, maintenance and operations and to serve as an international advocate for expanded uses of these technologies

FISCAL YEAR 2014 ACCOMPLISHMENTS

Completion of project 2009-01 Summary and Comparison of Agency Experience with Sensors. This project was funded to compile a summary of various environmental sensors and the experience agencies have had with each sensor. This information will be utilized by MDOT when selecting sensor types and models.

Completion of project 2007-05 Multiple Use ITS Data Collection Practices. This project was funded to summarize previous experience of other states when combining ITS/Traffic/etc. devices at one location. MDOT participated in the survey. MDOT also continues to strive to combine as many of these devices at one location as possible.

Completion of project 2013-01 National Winter Maintenance Peer Exchange. This project was completed and finalized a gathering to allow agencies to network and share ideas and innovations. MDOT is an active participant in this meeting.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Project 2012-05 Seasonal Weight Restrictions Demonstration, Phase 1. MDOT will be an active partner in this project. An evaluation will be completed at one of our environmental sensor stations. This information will help guide MDOT with future decisions on frost tube installation and implementation of weight restrictions.

Project 2014-00 National Winter Maintenance Peer Exchange 2015. This project will continue the peer exchange meeting for states to partner.

Project 2011-02 RWIS Training Tool. This project is working to create a training tool to assist agencies in implementing their RWIS training.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE:

Improving Specifications to Resist Frost Damage in Modern Concrete Mixtures

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(297)	MDOT START DATE	10/1/2013
OR NO.	OR14-038	MDOT COMPLETION DATE (Original)	9/30/2015
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Ron Curb Email: rcurb@odot.org Phone: 405.522.3795		
LEAD AGENCY	Oklahoma Department of Transportation		
PROJECT MANAGER	Tim Stallard Email: stallardt@michigan.gov Phone: 517 - 322-6448		
CONTRACTOR			

BUDGET STATUS

FY 2014 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$35,000.00	TOTAL BUDGET	(Original)	\$52,500.00
	(Revised)			(Revised)	
TOTAL FY 2014 EXPENDITURES		\$35,000.00	TOTAL COMMITTED FUNDS AVAILABLE		\$17,500.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

CT , IA , ID , IL , IN , KS , MI , MN , ND , NE , OK , PA , WisDOT

PURPOSE AND SCOPE

To establish new test methods and specifications for fresh and hardened concrete to determine frost durability and field performance. Task 1: Literature Review and Development of the Testing Matrix ; Task 2: Sample Preparation; Task 3: Validation of the Super Air Meter; Task 4: Use of X-Ray Tomography of Air Voids and Frost Damage; Task 5: ASTM C 666; Task 6: Absorption and Desorption; Task 7: Degree of Saturation and Damage Development; Task 8: Rate of Damage Analysis; Task 9: Technology Transfer; Task 10: Final Report

FISCAL YEAR 2014 ACCOMPLISHMENTS

Literature Review and Development of the Testing Matrix, 50% complete.
 Samples will be prepared at OSU and a subset of these mixtures will be prepared at a local ready mix plant to replicate these mixtures in the field, 10% complete.
 Validation of the Super Air Meter, 20% complete.
 Creation of an AASHTO Test Method and Specification for the SAM, 35% complete.
 Degree of Saturation and Damage Development, 10% complete.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Continue to produce concrete mixtures with different air contents and air void qualities for more in-depth testing.
 Begin examining the rate of absorption and desorption, rate of damage, and degree of saturation level on the damage with the concrete provided by OSU.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: TRB Core Program Activities Period Covering FFY 2014 (TRB FY 2015)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5 (298)	MDOT START DATE	10/01/2013
PROJECT NO.	n/a	MDOT COMPLETION DATE (Original)	09/30/2014
		PROJECT COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Jean Landolt Jean.Landolt@dot.gov Phone: 202-493-3146		
LEAD AGENCY	FHWA		
PROJECT MANAGER	André Clover		
CONTRACTOR			

BUDGET STATUS

FY 2014 Budget			Total Budget		
FY FUNDS	(Original)	\$190,000.00	BUDGETED AMT.	(Original)	\$190,000.00
	(Revised)		ACTUAL COST	(Revised)	\$181,766.00
TOTAL FY 2013 EXPENDITURES		\$181,766.00	Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

AK, AR, CA, CT, FL, IA, ID, IL, IN, ME, MI, MN, MS, MT, NC, ND, NJ, NM, OR, PA, SC, SD, TX, WV

PURPOSE AND SCOPE

The Michigan Department of Transportation provides annual financial support for TRB's Core Program technical activities. This support helps to operate TRB annual meetings, the committee structure, State visits by TRB, and the TRB publication program.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

MDOT Benefit:

MDOT has a representative on the TRB Executive Committee, an official representative to provide liaison with the Board, and negotiates the fees and services that best serve its particular needs and provide support for the Board's programs and activities of interest to the entire transportation community.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

- **TR News** - TRBs bimonthly news magazine features timely articles and state-of-the-art research and practice in all modes of transportation.
- **Transportation Research Record: Journal of the Transportation Research Board (TRR Journal)** – TRB publishes approximately 70 volumes of the TRR Journal per year, containing more than 900 papers grouped by subject. TRR Journals are available in print format and are also available through an online service.
- **TRR Journal Online** - TRB's [TRR Journal Online website](#) provides 24/7 electronic access to the full text of more than 13,900 peer-reviewed papers that have been published as part of the Transportation Research Record: Journal of the Transportation Research Board (TRR Journal) series since 1996. The site includes the latest in search and analysis technology, and is updated as new TRR Journal papers become available.
- **TRB Full Collection**- Includes all of the regular serial publications of TRB in print format. TRB books and reports covering 36 transportation functions and modes. Annually, TRB produces approximately 200 titles in its [serial publications \(pdf\)](#) that include the TRR Journal; TR News; Special Reports; Conference Proceedings; Transportation Research Circulars; National Cooperative Highway Research Program (NCHRP), Transit Cooperative Research Program (TCRP) Reports, Airport Cooperative Research Program (ACRP) Reports, National Cooperative Freight Research Program (NCFRP), Hazardous Material Cooperative Research Program (HMCRP), Research Results Digests, Legal Research Digests, and Syntheses; Commercial Truck and Bus Safety Synthesis Program (CTBSSP) Syntheses and Research Results Digests; and SHRP 2 Reports.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2014 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.). NA
 2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business. NA
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**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: National Cooperative Highway Research Program (NCHRP) for FY 2014

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(414)	MDOT START DATE	10/01/2013
PROJECT NO.		MDOT COMPLETION DATE (Original)	09/30/2014
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT			
LEAD AGENCY	Federal Highway Administration		
PROJECT MANAGER	Andre Clover		
CONTRACTOR			

BUDGET STATUS

FY 2014 Budget			Total Budget		
FY FUNDS	(Original)	\$1,100,000.00	BUDGETED AMT.	(Original)	\$1,100,000.00
	(Revised)		ACTUAL COST	(Revised)	\$1,054,701.70
TOTAL FY 2014 EXPENDITURES		\$1,054,701.70	Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

PURPOSE AND SCOPE

Every federal fiscal year State Departments of Transportations are solicited to contribute 5.5 percent of their State Planning and Research (SP&R) Program federal funds to NCHRP to ensure its continued successful operation. The NCHRP is a federal program in place to develop and fund national transportation research in acute problem areas that affect highway planning, design, construction, operation, and maintenance nationwide.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

The NCHRP disseminates information throughout the transportation community and conducts independent research that benefits various transportation agencies throughout the country.

Accomplishment:

A Michigan University; Lawrence Technological University, was awarded NCHRP Project 12-97 to investigate a full-depth CFRP deck panel system that greatly simplifies the construction process. The developed design system will need to be fully investigated before being implemented on a bridge project.

Project 12-97: Design Guidelines for Field Deployment of CFRP Prestressed Beams in Bridge Construction

Funding: Allocation: \$500,000

Benefit to MDOT:

A successful implementation for CFRP reinforcement in bridge industry calls for the development of standards that address all design and construction aspects such as flexural strength, shear strength, bond strength, development length, creep, shrink-age, durability, handling, and erection. With such standards in hand, it is expected that the construction of CFRP reinforced/prestressed concrete bridges will grow to be a general practice rather than a demonstration practice.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

As of October 17, 2014:

- Thirty-two (32) new NCHRP Research Project Reports (January - October 2014) were published in 2014.
- Fourteen (14) new NCHRP Synthesis Reports (March - July 2014) were published.
- Four (4) new NCHRP Research Results Digests (January – July 2014) were published.
- NCHRP [announces its FY 2015 projects](#); requests for proposals are expected to be released starting in August 2014.
- NCHRP's [2013 Summary of Progress](#) highlights the more than 161 projects completed in 2013 and includes a listing of the more than 2,800 other projects undertaken by the program since 1962.

-
- Information on all projects initiated under the NCHRP from its inception in 1962 through 1988 is included in [NCHRP Web Document 7: Special Edition of Summary of Progress through 1988](#).

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Research findings are published in the NCHRP Reports series and the NCHRP Synthesis of Highway Practices series.

1. Note implementation recommendations resulting from 2013 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).

Recommended research tasks include the following:

- Conduct a literature search.
- Develop 3-D refined analysis model(s) of proposed precast deck system.
- Develop and test a full-scale mock-up that evaluates the structural behavior and constructability of the system.
- Investigate and test a continuous deck slab option assuming simple span beams.
- Develop criteria and restrictions for proposed system.
- Develop simplified design procedures and give examples for various beam spacing.
- Develop recommendations for the LRFD AASHTO design code.

2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
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**RESEARCH ADMINISTRATION
TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Environmental Technical Assistance Program (ETAP)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

OR NO.	OR11-009	MDOT START DATE	10/1/2013
PROJECT NO.	115024	MDOT COMPLETION DATE (Original)	9/30/2014
		COMPLETION DATE (Revised)	9/30/2015
TECHNICAL CONTACT			
LEAD AGENCY	FHWA/ AASHTO		
PROJECT MANAGER	Margaret Barondess		
CONTRACTOR			

BUDGET STATUS

FY 2014 Budget			Total Budget		
FY FUNDS	(Original)	\$8,000.00	TOTAL COST	(Original)	\$24,000.00
	(Revised)*	\$16,000.00		(Revised)	
TOTAL FY 2014 EXPENDITURES *		\$16,000.00	Total Committed Funds Available		\$0.00

*The FY 2014 and 2015 invoices were paid using FY 2014 SPR-II funds.

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

NA

PURPOSE AND SCOPE

The ETAP program helps optimize the value of transportation investments by promoting sustainable solutions reducing congestion, energy use, emissions & life cycle costs. For the Efficiency and Effectiveness goal, it identifies streamlining measures, and supports faster, more efficient product delivery. FY2014 annual membership fee for AASHTO's Environmental Technical Assistance Program

FISCAL YEAR 2012 ACCOMPLISHMENTS

MDOT supported the Environmental Technical Assistance Program which supplied weekly newsletters distributed to 58 people, mostly MDOT employees. The newsletters provide current information on environmental research, policy and procedure. This is a one-of-a-kind resource that would be difficult to replace.

FISCAL YEAR 2013 ACCOMPLISHMENTS

1. What products or services were delivered from study activities performed in 2014?

MDOT received a weekly newsletter with recent information on environmental research, regulation, guidance, and laws as they related to transportation.

- This product is shared via email to a list of 58 individuals within MDOT, FHWA, local agency officials, and regulatory agency staff.
- The newsletter is a high quality product that enables staff to act quickly on new information along with facilitating discussions with outside entities.

2. Please list those deliverables that will benefit MDOT if implemented. Continued delivery of the newsletter throughout the next fiscal year.

FISCAL YEAR 2014 ACCOMPLISHMENTS

The weekly newsletter was successfully delivered via email to staff at MDOT, FHWA, local agencies, and regulatory agencies.

FISCAL YEAR 2015 PROPOSED ACTIVITIES

Continue to distribute the newsletter via email on a weekly basis.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

The original \$24,000.00 budgeted amount was for FY's 2013, 2014 and 2015.

The ETAP FY 2014 and 2015 invoices were paid using FY 2014 SPR-II funds.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2014 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).

There are no direct implementation recommendations.

2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
-

**RESEARCH ADMINISTRATION
TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: AASHTO Engineering Technical Service Programs

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	Not applicable	MDOT START DATE	10/1/2013
PROJECT NO.	115193	MDOT COMPLETION DATE (Original)	9/30/2014
OR NO.	OR12-016	COMPLETION DATE (Revised)	
TECHNICAL CONTACT			
LEAD AGENCY	AASHTO		
PROJECT MANAGER	Andre Clover		
CONTRACTOR			

BUDGET STATUS

FY 2014 Budget			Total Budget		
FY FUNDS	(Original)	\$85,000.00	TOTAL COST	(Original)	\$85,000.00
	(Revised)	\$100,000.00		(Revised)	\$100,000.00
TOTAL FY 2014 EXPENDITURES		\$100,000.00	Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.
Not applicable

PURPOSE AND SCOPE

The programs provide benefits to the member departments through the pooling of resources and expertise from across the country.

MDOT has the opportunity to support the development and continued operation of each of the following critical programs:

- AASHTO Innovation Initiative/Technology Implementation Group (TIG) - \$6,000
- Transportation Curriculum Coordination Council (TC3) - \$20,000
- Snow and Ice Cooperative Program (SICOP) - \$4,000
- Transportation System Preservation (TSP2) - \$20,000
- Equipment Management Technical Services Program (EMTSP) - \$3,000
- National Transportation Product Evaluation Program (NTPEP) - \$12,000
- Highway Safety Policy and Management Technical Service Program - \$10,000
- Load and Resistance Factor Design (LRFD) Bridges and Structures Specification Maintenance (LRFDSM) - \$10,000
- Operations Technical Service Program - \$15,000

FISCAL YEAR 2014 ACCOMPLISHMENTS

MDOT's financial support of the Technical Service Programs.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

1. What products or services were delivered from study activities performed in 2013?

- TIG- Identify and champion the implementation or deployment of a select few proven technologies, products, or processes.
- TC3- Develop national level training courses for the construction maintenance and materials technical work force.
- SICOP- Maintains a useful website and listserv where a lot of information on winter operations is located. Coordinates testing of winter maintenance technologies and disseminates results nationwide.
- TSP2- Supports the research, technical, and program needs of the member states in the development and implementation of their respective pavement and bridge programs.
- EMTSP- A MDOT representative is able to attend AASHTO EMTSP conferences at no cost. Two (2) significant recommendations were identified & subsequently placed into resolution and approved by AASHTO. 1) Recommendation to hold a national AASHTO Fleet Conference every two years and the presentation of four (4) key fleet metrics at AASHTO's Subcommittee on Maintenance; adopted by Resolution 12-03). Starting in July 2013 all states will start reporting out on all 4 metrics.
- NTPEP- Combines the professional and physical resources of the AASHTO member departments to evaluate materials, products and devices of common interest for use in highway and bridge construction.
- SAFETY- Emergency operations peer exchanges, technical transfer/exchange, and providing more than 50 technical documents and workshops to promote safety operations, emergency management, and security.

- LRFDSM- MDOT bridge engineers use these manuals to design all Michigan bridges.
- Operations Technical Service Program/National Operations Center of Excellence (NOCoE) - The NOCoE will provide the state DOTs with a wide range of resources related to best practices , training and skills development, technical assistance, communities of practice, and other opportunities related to transportation systems management and operation.

2. Please list those deliverables that will benefit MDOT if implemented.

FISCAL YEAR 2014 ACCOMPLISHMENTS (Benefits to MDOT)

See AASHTO TSP's Benefit Documentation (email)

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

Director Kirk Steudle approved all of the above nine (9) TSP programs for payment by the end of FY 2014. The Operations Technical Service Program/NOCoE was added to the original approved list of TSP Programs to be paid with FY 2014 funds.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Each fiscal year MDOT will review and assess the return on its investment in the above list of AASHTO TSP programs. If value is served in a particular program, MDOT will continue its contribution to that program. If value is not being served from a particular program; MDOT may choose to discontinue its contribution to that program.

1. Note implementation recommendations resulting from 2013 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).
 2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
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**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: A Study of Factors that Inhibit and Enable Effective Development of Sustainable Regional Transit Systems in Southeastern Michigan

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Sharon Edgar

CONTRACT/AUTHORIZATION NO.	2010-0299 Z1	PROJECT START DATE	7/1/2012
PROJECT NO.	116226	COMPLETION DATE (Original)	12/31/2013
OR NO.	N/A	COMPLETION DATE (Revised)	
RESEARCH AGENCY	University of Detroit Mercy		
PRINCIPAL INVESTIGATOR	Leo Hanifin		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$25,882.50	Total Vendor Budget	\$100,000.00
MDOT Budget FY 2014	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$11,577.26	Total Budget	\$100,000.00
MDOT FY 2014 Expenditures	\$0.00	Total Expenditures	\$94,101.04
		Total Contract Amount Available	\$ 5,898.96

PURPOSE AND SCOPE

Investigate factors that have prevented regional transit from evolving in the Detroit Metro area, including a review and analysis of historical and current context as well as the experiences in other states. Develop recommendations for moving forward.

The following table shows RITA, UDM, and MDOT funding for this project:

	Totals
RITA Sponsor	\$ 200,000
UDM Match to RITA	\$ 84,073
UDM Match to SPRII	\$ 25,000
MDOT Match to SPRII	\$ 100,000
Total:	\$ 409,073

FISCAL YEAR 2012 ACCOMPLISHMENTS

- Formed and met with Advisory Committee
- Hired Students
- Four regions were identified for study: Atlanta, Cleveland, Denver and St. Louis.
- Assembled over 50 documents describing transit development, governance and operation in the four target cities
- Visited Cleveland, St. Louis, Atlanta and Denver and conducted in-depth interviews with local officials and policymakers
- Interviewed key transit leaders in Detroit
- Assembled over 35 documents and reviewed extensive literature regarding Detroit transit history
- Assembled and reviewed regional plans and proposed legislation (over 40 documents)

FISCAL YEAR 2013 ACCOMPLISHMENTS

- Complete study of four comparison cities and write full report on other region, including follow-up visits/interviews as needed
- Complete study of Detroit history and write full report on Detroit transit history
- Complete Study of Detroit Current Regional Transit
- Define and conduct survey
- Monitor and analyze proposed and enacted changes to proposed RTA legislation
- Meet with governmental and business leaders from SE MI regarding regional transit issues
- Draft all reports

FISCAL YEAR 2014 ACCOMPLISHMENTS

All reports were completed, reviewed and approved by the Mineta National Transit Research Consortium (MNTRC) and MDOT for final publication as of March 2014. The MNTRC is composed of nine university transportation centers led by the Mineta Transportation Institute at San Jose State University. Member universities include Bowling Green State University, Grand Valley State University, Howard University, Penn State University, Rutgers University, San Jose State University, University of Detroit Mercy, University of Nevada Las Vegas, and University of Toledo. <http://transweb.sjsu.edu/project/1136.html>

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

The UDM team will share their results with regional leaders and stakeholders at the discretion of the team and based on the interest

of regional leaders and stakeholders in hearing from the team. MDOT has no objectives for implementation and will defer entirely to the UDM team to determine how they will make use of the research results.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: A Study on the Remanufacturing, Repurposing, and Recycling of Lithium- Ion Batteries in Public Transit Vehicles

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: Angel Fandialan

CONTRACT/AUTHORIZATION NO.	2012-0635 Z1	PROJECT START DATE	9/19/2012
PROJECT NO.	116233	COMPLETION DATE (Original)	9/30/2013
OR NO.	N/A	COMPLETION DATE (Revised)	12/31/2013
RESEARCH AGENCY	Grand Valley State University		
PRINCIPAL INVESTIGATOR	Charles Standridge		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$28,797.45	Total Vendor Budget	\$50,000.05
MDOT Budget FY 2014	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$7,500.01	Total Budget	\$50,000.05
MDOT FY 2014 Expenditures	\$0.00	Total Expenditures	\$50,000.05
		Total Contract Amount Available	\$0.00

PURPOSE AND SCOPE

Develop models for demand and supply of lithium-ion batteries in powering transit vehicles, and for repurposing, remanufacturing or recycling such batteries.

The following table shows RITA, GVSU, and MDOT funding for this project:

	Totals
RITA Sponsor	\$100,000.09
GVSU Match to RITA	\$ 96,928.08
GVSU Match to SPRII	\$ 12,500.00
MDOT Match to SPRII	\$ 50,000.05
Total:	\$ 259,428.22

FISCAL YEAR 2012 ACCOMPLISHMENTS

Reviewed literature, identified issues and initiated model development.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Continue developing models, validate with data and refine models as needed. Submit interim report.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Held review sessions. Submitted final report that is ready for publication.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

To allow time for holding review sessions on interim report and wrap up meeting.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

Options in priority order:

1. Inquire whether Mineta Center has an implementation plan and see if MDOT can provide assistance.
2. Inquire through Michigan State University and Michigan's Strategic Fund whether there is any private sector interest in commercialization of the repurposing or remanufacturing of electric or hybrid vehicle batteries.
3. Inquire through the Federal Transit Administration whether funding is available for a pilot program for repurposing or remanufacturing of electric or hybrid vehicle batteries.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2014**

PROJECT TITLE: National University Rail Center for Research, Education and Technology Transfer (NURails)

FUNDING SOURCE: SPR, Part II OTHER (PLEASE EXPLAIN)

PROJECT MANAGER: James D'Lamater

CONTRACT/AUTHORIZATION NO.	2010-0295 Z8	PROJECT START DATE	10/8/2012
PROJECT NO.	116234	COMPLETION DATE (Original)	1/31/2014
OR NO.	N/A	COMPLETION DATE (Revised)	4/30/2014
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Pasi Lautala		

BUDGET STATUS

FY 2014 Budget		Total Budget	
Vendor Budget FY 2014	\$80,778	Total Vendor Budget	\$99,470.00
MDOT Budget FY 2014	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2014 Expenditures	\$32,491.02	Total Budget	\$99,470.00
MDOT FY 2014 Expenditures	\$0.00	Total Expenditures	\$99,469.61
		Total Contract Amount Available	\$0.40

PURPOSE AND SCOPE

Michigan Tech's Rail Transportation Program (RTP), as a member of a seven university consortium, has been granted the US Department of Transportation's (USDOT) first University Transportation Center (UTC) focused entirely on rail transportation. The National University Rail Center (NURail) is led by University of Illinois, Urbana-Champaign and in addition to Michigan Tech also includes University of Illinois, Chicago, University of Kentucky, University of Tennessee, Knoxville, Rose-Hulman Institute of Technology and Massachusetts Institute of Technology. The NURail Center is a rail-focused, Tier-1 University Transportation Center (UTC) under the US Department of Transportation (DOT) Research and Innovative Technology Administration (RITA) program

The primary objective of the NURail Center is to improve and expand rail education, research, workforce development, and technology transfer in the US. Michigan Tech, in collaboration with its academic, industry and state partners, will work to identify important rail knowledge areas for inclusion in these activities. The Michigan Tech team plans to expand multidisciplinary research activities in various areas, such as rural freight rail and multimodal transportation improvements, human factors and rail safety, infrastructure evaluation and assessment, high performance materials for railroad infrastructure preservation and renewal, and improved materials for the rail industry. MTU Rail Transportation Program (RTP) director will serve as the Educational Coordinator for the consortium and educational activities are a high priority with focus on expansion of undergraduate level funded projects and internships among other activities. On technology transfer, the main objective is to work with MDOT on 1st Michigan Rail Transportation Conference.

1. Improving Rural Freight Rail in the State of Michigan: This project concentrates on identifying challenges faced by rural rail service providers and shippers along light-density lines and on developing tools and methods that facilitate the use of rail and multimodal transportation alternatives in the Upper Peninsula of Michigan.
2. Undergraduate Student Project (Grade Crossing Surfaces): Based on data and analysis students will provide recommendations on what type of crossing surface would be best for certain conditions.
3. Assessment of Aggregate Sources in Michigan for High Speed Railroad Ballast : The object of the project is to investigate aggregate sources in the state of Michigan that could be used for rail and high speed rail (110 mph) ballast.
4. Michigan Rail Transportation Conference: MTU will coordinate with the Michigan Department of Transportation (MDOT) to provide a one day Rail Transportation Conference on passenger and freight rail transportation in the Lansing, MI area.

The following table shows RITA, MTU, and MDOT funding for this project:

	Totals
RITA Sponsor	\$15,169
MTU Match to RITA	\$ 29,372
MTU Match to SPRII	\$ 24,867
MDOT Match to SPRII	\$ 99,470
Total:	\$ 168,878

FISCAL YEAR 2013 ACCOMPLISHMENTS

1. Michigan Tech University (MTU) has sent out shipper surveys along with placing phone calls to railroads, shippers, and local economic development groups to gain an understanding of the amount, type, and origin/destination of car loadings being made in the Upper Peninsula of Michigan.

MTU is also working on the creation of an interactive map of GIS rail infrastructure map of the Upper Peninsula. The infrastructure map includes details regarding station, rail siding, and mainline track info (i.e. railroad class, railroad name, FRA track classification, track weight capacity, speed limit, rail weight, and rail service frequency). MTU is also conducting an analysis of potential transload facilities in the Upper Peninsula, of which the location of rail lines, highways, shipper locations and volumes, and service frequency will be included in the evaluation. While the basis of the interactive map have been developed, to date MTU has experienced little success in getting much data feedback from shippers and the railroad, in order to make solid recommendations as to where transload facilities should be located.

2. Data collection of statewide grade crossings and field visits of site specific locations (Objectives 2&4) of Highway Grade Crossing Surfaces at Railroads were completed. Due to insufficient maintenance records and underlying highway and railroad roadbed conditions, MTU has not been able to develop deterioration estimates and conduct comparative analysis of surfaces based on highway and rail volumes due to the lack of these maintenance and underlying highway/railroad roadbed conditions. MTU has reached out to a small operating railroad and another State in the mid-west, to find out their strategies and experiences with grade crossing surfaces.
3. MTU received from the Michigan Department of Transportation (MDOT) a list of aggregate sources in the Upper Peninsula, for ballast for rail and high speed rail corridors. MTU also evaluated other aggregate producers in the Upper Peninsula and also evaluated the potential to ship ballast via water transportation. MTU also conducted dynamic strength analysis of prospective aggregate sources that meet railroad ballast specifications.
4. MTU coordinated and put on a successful 2013 Michigan Rail Conference, held in Lansing, MI on 8/27/2013. MTU has prepared a summary as to Lessons Learned from the 2013 conference, in order to make the 2014 MI Rail Conference even more successful.

FISCAL YEAR 2014 ACCOMPLISHMENTS

1. MTU will be re-contacting railroads and shippers in an attempt to get more data for additional analysis to make recommendations for potential transload facilities in the Upper Peninsula. MTU is also finalizing potential Case Studies of shippers in the Upper Peninsula. MTU made further follow-up contacts with the railroads and shippers as stated, and has identified several potential transload facility locations in the Upper Peninsula.
2. MTU will be completing its final recommendations and report on this item. Task was completed and final reports submitted to MDOT.
3. MTU will be finalizing dynamic testing of aggregate samples and preparing its final recommendations and report to MDOT on this item. Analysis was completed and recommendations were reported to MDOT.
4. MTU will begin discussions with MDOT regarding the planning of the 2014 Michigan Rail conference. MTU staff led and facilitated the hosting of the 2nd Annual Michigan Rail conference, which was held at the Macomb Community College.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION (Required the last year of the project)

From the Ballast study, it was found that approximately 70% of the carbonate quarries in the State could meet the LA Abrasion requirements set for the State owned rail properties, yet none of these quarries would be able to meet the specifications set by Amtrak. Meanwhile 100% of the igneous and metamorphic quarries located in Michigan could meet the State owned rail line specification, and approximately 25% of the of the quarries could meet the Amtrak specification. From the study recommendations, the ballast specifications for the State owned properties will be reviewed this coming winter as part of our specification review meeting. The ability to utilize any of the quarries that are able to meet the Amtrak specification for high speed rail corridors, will have to be further analyzed to determine feasibility and logistics of viable locations.

From the Grade Crossing study, it was found that there is an insufficient collection of data regarding installation, maintenance, and soil conditions, to develop a recommendation between different crossing surfaces. One common trait that was observed from field observations was that those crossings that had some sort of sub-surface preparation (i.e. asphalt underlayment), showed less distress than those crossings that did not receive such treatment. MDOT will look at what ways it can possibly improve its data collection as part of its bi-annual reviews, so a database can be started so future analysis can be conducted.

From the findings presented in the UP Freight Study, MDOT is looking at the integration of the inventory data collected and combining this with MDOT's Planning groups other freight data. With this information, MDOT anticipates being able to produce maps and work with other agencies (i.e. economic development groups) to relay this transportation infrastructure to local communities, existing and potential new customers. Another method MDOT is also looking to utilize this shipper information freshly obtained is to improve shipper/railroad communication. Findings from the shipper surveys showed that the two entities had conflicting concerns of the other party, which had no merit. MDOT is looking to facilitate discussions between the two entities to remove concerns of the other party, along with increasing shipper awareness to the availability of rail and rail facilities and of rail operations. MTU also identified several potential candidate locations for transload facilities. MDOT will analyze this data, which may lead into further research and exploration into the viability of any of the identified possible locations.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2014**

STUDY TITLE: Pontis 5.2 Development - AASHTOWare Bridge Management Software

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

OR NO.	OR14-032	MDOT START DATE	10/1/2012
PROJECT NO.	121242	MDOT COMPLETION DATE (Original)	9/30/2014
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Judy Skeen, Project Manager, AASHTO, 444 N. Capitol St. NW, Ste. 249, Washington DC 20001 jskeen@ashto.org 512-963-1465		
LEAD AGENCY	FHWA/ AASHTO		
PROJECT MANAGER	Rebecca Curtis		
CONTRACTOR			

BUDGET STATUS

FY 2014 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$125,000.00	TOTAL BUDGET	(Original)	\$250,000.00
	(Revised)			(Revised)	
TOTAL FY 2014 EXPENDITURES		\$125,000.00	Total Committed Funds Available		\$0.00

PARTICIPATING STATES

ABBREVIATE THE PARTICIPATING STATES. IF MDOT IS THE LEAD AGENCY, ALSO LIST THE CONTRIBUTION PERCENTAGE PER STATE.

Not applicable

PURPOSE AND SCOPE

The next Federal Highway bill will likely require use of a risk-based prioritization method for managing the nation's bridges and the use of the updated National Bridge Elements. AASHTO is soliciting member agencies to participate in a project to develop the next generation (Pontis 5.2) Bridge Management System (BMS). The upgraded Pontis 5.2 system will incorporate both a risk-based prioritization method and use of the updated National Bridge Elements.

Pontis 5.2 will also provide a significantly improved bridge management software tool which will:

1. Support the new AASHTO National Bridge Elements for detailed bridge management
2. Meet new and anticipated Federal bridge management and inspection requirements
3. Incorporate risk assessments, multi-object optimization, and new deterioration models for more efficient planning and resource allocation
4. Easily create and use long term project and program planning to meet agency's priorities, goals, and budgets for their structures
5. Significantly upgrade the core technology to support full 64 bit operating systems and web-based interface
6. Provide focused training and implementation assistance to state agencies.

The project scope is to develop the Pontis Bridge database software version 5.2. This updated version of the Pontis software will help agencies to meet the new federal law and requirements. As a partner in the project, MDOT will have a person on the technical review team to provide influence in the development of Pontis 5.2 to provide MDOT desired functionality like compatible type forecasting abilities.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

- Establish monthly TRT (Technical Review Team) conference calls.
- Assign technical issues to TRT to research and provide input on software design choices and alternatives.
- Plan February 2013 TRT, Subject Matter Experts and Task Force meeting to discuss ongoing TRT activities.
- Review software use cases.
- Beta test the software's Inspection Modules

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013?
 - Established monthly TRT (Technical Review Team) conference calls.
 - Several technical issues previously assigned to TRT to research and provide input on software design choices and alternatives have been completed. Ongoing TRT work on remaining issues.
 - February 2013 TRT, Subject Matter Experts and Task Force meeting to discuss ongoing TRT activities.
 - Ongoing review of software use cases.
 - Beta testing of the software's Inspection Modules has started.
2. Please list those deliverables that will benefit MDOT if implemented.

-
- MDOT is currently testing version 5.2.1 for implementation.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

- Finalize new software use cases.
- Review completed TRT activities and related TRT recommendations.
- Conduct periodic progress meetings with TRT, Bentley and ASSHTO Task Force.
- Continue software development.

FISCAL YEAR 2014 ACCOMPLISHMENTS

Bridge Management 5.2.1 (SP2)

A secondary service pack will be released to supplement the BrM product. Beta testing began in August and release will follow completion of the beta testing. This release will include three key areas:

- **Federal NBE Submission:** As the federal government is requiring NBE submissions for April 2014, to better provide agencies a venue to handle these submissions, the SP2 release will have the additional functionality, allowing agencies the ability to create a NBE submission.
- **Crystal Reports Upgrade:**
 - BrM 5.2.1 SP2 will upgrade its Crystal Reports Version to 2013.
 - Crystal Reports 2013 Designer is free for users that have Microsoft Visual Studio
 - Agencies will receive one Crystal Reports Developer license key with their BrM subscription.
 - There should be little to no impact to custom, agency developed, reports.
- **Usability enhancements:**
 - The beta TAG has put together 17 enhancements that provide a large array of benefit for usability and stability of the product. These enhancements will be deployed in various areas of the software, and will provide a better, over-all user experience.

JUSTIFICATION(S) FOR REVISION(S) (List the approval date for the revision(s))

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

1. Note implementation recommendations resulting from 2013 accomplishments that MDOT may consider for implementation immediately. Please include necessary next steps to begin development of an MDOT implementation action plan (i.e. hand-off to MDOT committee/subcommittee, FAM, RAC, etc.).
 - MDOT is still participating in the TRT as the software is still under development. The release of version 5.2.1 is being reviewed for implementation.
 2. If this is the last year of MDOT participation; please note implementation recommendations resulting from the study that MDOT plans to incorporate into an implementation action plan to improve the operations or how we do business.
-