



Research Administration

STATE PLANNING & RESEARCH PART II PROGRAM

FISCAL YEAR 2013

ANNUAL REPORT

OCTOBER 1, 2012 - SEPTEMBER 30, 2013



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Fiscal Year 2013 Annual Report**

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**STATE PLANNING AND RESEARCH, PART II, PROGRAM
2013 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 a 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 30, 2012. This annual report covers the MDOT SPR, Part II, Program from October 1, 2012 through September 30, 2013.

Summary

Fiscal Year 2013 research was conducted in the following focus areas, representing several modes of transportation and MDOT's diverse business functions:

Multi-Modal Transportation

- Freight Rail

Planning & Finance

- Asset Management
- Contract Administration

Program & Project Development

- Bridges & Structures
- Environment & Water Sources
- Transportation Safety
- Rest Areas, Utilities, & Landscaping
- Work Force Development

Delivery & Operations

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

The Fiscal Year 2013 SPR, Part II, Program consisted of 85 projects. 56 were 80% federally funded and 29 were 100% federally funded, for total expenditures of \$5,943,728.35. Expenditures remained within the approved budget as follows:

<u>Expenditures</u>	<u>Budget</u>
\$5,943,728.35	\$11,441,186.00

Tables 1 & 2 summarize 80% federally funded projects that were funded in Fiscal Year 2013. Table 1 includes every project in the FHWA-approved Fiscal Year 2013 program. Projects in Table 1 are listed in ascending order by job number. In addition to the project data provided in this table, the page number of each detailed project report is included. These detailed reports found on pages 12 through 97 provide information on the scope of the project and project progress. Table 2 provides a summary of 80% federally funded projects completed in Fiscal Year 2013. Information is presented by focus area.

Table 3 summarizes 100% federally funded projects. The information is listed in ascending order by job number. Table 3 indexes the 100% federally funded projects' reports by page numbers 100 through 157. 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 2013:

- Completed 12 80% federally funded projects with current and previous year expenditures of about \$2.1 million, as summarized in Table 2.
- Initiated 19 new 80% federally funded projects in Fiscal Year 2013, with total budgets equaling about \$3.7 million. Project managers led research advisory panels and held meetings to guide and manage the principle Investigator's research.
- Published issues of the *Research Update*, Research Administration's newsletter, with a focus on research outcomes. Feature articles highlight research projects, while a portion of the newsletter focuses on the research program.
- Published several *Research Spotlights*, highlighting the value of individual research projects.
- MDOT's research project, *Impact of Non-Freeway Rumble Strips – Phase 1*, was selected as one of the top 16 projects in the nation by the research advisory committee of AASHTO. The standing committee on research went on to identify this project as one of the top five research projects in the nation.
- MDOT, in cooperation with FHWA, improved the research management process by developing an eligibility document outlining appropriate uses of SPR, Part II, funding. MDOT began using SPR Part II funds for technology transfer sessions including a workshop on innovative nondestructive bridge evaluation methods.
- In July of 2013 the new Research and Implementation Manual was published. The Research and Implementation Manual describes the administrative processes used by Research Administration to develop and implement the MDOT research program. Contents of this manual include a discussion of program development, project administration, implementation, and federal funding requirements.
- In July and August of 2013 the Research Executive Committee (REC), began early discussions to identify the strategic priorities for Fiscal Years 2015-2017.
- Research Administration received FHWA approval of the proposed Fiscal Year 2014 SPR, Part II, Program on August 26, 2013.
- In September of 2013 Research Administration published an *Innovations Report* presenting project details and implementation status updates for many of MDOT's innovation activities in four key areas:
 - Research Administration research program results
 - National and international research results from the Transportation Research Board annual meeting
 - Best practices identified from state, national or international sources
 - MDOT pavement demonstration projects

TABLE 1 80% FEDERALLY FUNDED PROJECTS

Job No.	FY 2013 Expenditures	Expenditures to Date	Project Total Budget	Project Manager	Agency	Principal Investigator	Title	Start Date	End Date	Pg No
114076	\$155,770.69	\$298,434.19	\$400,000.00	Eacker, Michael	MSU	Buch	Preparation of Implementation of the Mechanistic-Empirical Pavement Design Guide in Michigan	10/1/2011	9/30/2014	12
114077	\$4,871.51	\$171,882.44	\$172,901.00	Firman, Jason	WSU	Gates	Transportation Reliability and Trip Satisfaction	10/1/2011	12/31/2012	15
114108	\$80,865.74	\$140,605.82	\$223,895.17	Torres, Carlos	WSU	Savolainen	Study of High Tension Cable Barrier on Michigan Roadways	10/1/2011	12/31/2014	17
114119	\$116,651.84	\$194,123.80	\$297,774.10	Kulkarni, Sudhakar	WSU	Eamon	Evaluation of Prestressed Concrete Beams in Shear	10/1/2011	9/30/2014	19
114128	\$95,197.75	\$194,965.14	\$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	20
114147	\$11,123.37	\$227,897.93	\$227,897.93	Lariviere, Kim	U of M	Eby	Transportation Patterns of Older Driver in Rural Michigan	10/1/2011	12/31/2012	21
114155	\$0.00	\$171,149.96	\$185,254.98	Kremer, Angie	Cambridge Systematics	Krechmer	Implementation of Quick Clearance in Michigan	10/1/2011	9/30/2012	22
114378	\$0.00	\$175,603.31	\$178,082.00	Kremer, Angie	Kimley Horn	Dunzo	Best Practices for Emergency Rerouting	10/4/2011	9/30/2012	23
114487	\$43,472.22	\$234,696.57	\$299,747.00	Jansson, Pete	MSU	Burgueno	Development and Validation of Models for Concrete Bridge Decks	10/20/2009	12/31/2012	24
114488	\$0.00	\$169,968.00	\$169,968.00	Burns, Eric	MSU	Burgueno	Identification of Causes & Solution Strategies for Deck Cracking in Jointless Bridges	10/20/2009	5/31/2012	26
114494	\$81,630.20	\$207,668.03	\$209,405.64	Wagner, Brad	Michael Baker Jr. Inc	Spangler	Review and Revision of Overload Permit Classification	10/1/2010	2/28/2013	28
114495	\$0.00	\$96,159.91	\$99,819.00	Larkins, Christal	MSU	Korkmaz	Implementation of Sustainable and Green Design and Construction Practices for Bridges	10/1/2010	12/31/2012	30
114496	\$87,750.44	\$340,571.43	\$400,672.27	Juntunen, Dave	WMU	Aktan	Improving Bridges with Prefabricated Precast Concrete Systems	10/1/2010	12/31/2013	32
114502	\$10,152.57	\$506,832.60	\$550,905.00	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	12/20/2013	35
114504	\$0.00	\$145,803.83	\$149,576.66	Kanitz, Dean	Opus International	Bagdade	Evaluating the Performance and Effectiveness of Roundabouts	10/1/2010	12/31/2011	36
114524	\$0.00	\$156,127.31	\$159,887.20	Kanitz, Dean	Opus International	Bagdade	Evaluating Performance and Making Best Use of Passing Relief Lanes	10/1/2010	12/31/2011	38
114525	\$0.00	\$188,704.36	\$199,751.95	Thompson, Deirdre	TY Lin	LaPlante	Sharing the Road - Optimizing Pedestrian and Bicycle Safety and Vehicle Mobility	10/1/2010	4/30/2012	40
114527	\$44,801.30	\$199,605.38	\$199,998.86	Thompson, Deirdre	WMU	VanHouten	Evaluating Pedestrian Safety Improvements	10/1/2010	12/31/2012	41
114528	\$15,564.52	\$299,960.16	\$299,960.16	Maack, Nathan	MTU	You	Alternative Materials for Sustainable Transportation	11/13/2009	12/31/2012	42
114529	\$0.00	\$324,368.92	\$333,956.31	Krom, Ben	U of M	Hansen	Improved Performance of JPCP Overlays	10/20/2009	5/15/2012	43
114532	\$27,437.74	\$179,988.00	\$179,988.00	Chelotti, Erin	APT	Peshkin	Cost Effectiveness of the MDOT Preventive Maintenance Program	10/1/2010	3/31/2013	45
114533	\$954,244.79	\$1,605,720.44	\$3,689,576.45	Castle, Collin	Mixon Hill	Mixon	Advanced Applications of IntelliDrive Data Use Analysis and Processing 2 (DUAP2)	8/9/2011	6/30/2014	46
114907	\$0.00	\$242,836.00	\$250,000.00	Cook, Steve	U of M	Robinson	Slippery Road Detection and Evaluation	10/20/2009	6/1/2012	49
114908	\$18,849.37	\$89,458.27	\$89,758.00	Foondle, Kris	WSU	Datta	Timing Issues for Traffic Signals Interconnected with Highway-Railroad Grade Crossings	8/1/2011	3/1/2013	52
114911	\$27,200.00	\$40,800.00	\$68,000.00	Annelin, Niles	FTCH	Buckler	Greenhouse Gas Inventory for the Michigan Department of Transportation	9/16/2011	12/31/2013	54
114912	\$0.00	\$86,168.94	\$215,422.36	Cook, Steve	Alfred Benesch	Darwish	Infrastructure Monitoring Data Management	9/30/2009	4/1/2015	55

TABLE 1 80% FEDERALLY FUNDED PROJECTS

Job No.	FY 2013 Expenditures	Expenditures to Date	Project Total Budget	Project Manager	Agency	Principal Investigator	Title	Start Date	End Date	Pg No
114937	\$21,880.31	\$51,980.10	\$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	56
115041	\$12,162.11	\$167,448.96	\$193,065.02	Collins, Pat	U of M	Davis	Examining the Disadvantaged Business Enterprise (DBE) Program	10/1/2010	11/30/2012	57
115196	\$7,565.74	\$214,975.71	\$214,975.71	Jansson, Pete	WSU	Fu	Skewed Bridges	7/12/2007	9/30/2010	59
115235	\$0.00	\$3,499,999.63	\$3,500,000.00	Cook, Steve	Mixon/Hill	Mixon	Usage & Impact of the Michigan Vehicle Infrastructure (VII) Integration Program	2/15/2007	8/31/2011	60
115238	\$0.00	\$129,707.10	\$129,707.10	Endres, Dick	U of M	Hryciw	Feasibility of Digital Imaging to Characterize Earth Materials	10/1/2010	12/31/2011	63
115241	\$0.00	\$138,002.39	\$149,281.00	Leix, Tracie	MSU	Lyles	Safety Analysis of 4-Lane to 3-Lane Conversions (Road Diets) in Michigan	10/1/2010	12/31/2011	64
115243	\$373,525.00	\$406,262.00	\$489,997.00	Croze, Tim	Dye Management	Zilay	Monitoring Highway Assets with Remote Technology	7/31/2012	1/31/2014	66
115244	\$178,426.35	\$188,198.38	\$190,000.00	Lynwood, Lynn	WSU	Gates	Roadside Corridor Planning	6/30/2012	8/30/2013	67
116238	\$99,792.04	\$99,792.04	\$249,999.97	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	9/30/2014	69
116248	\$169,598.47	\$169,598.47	\$201,851.00	Thompson, Deirdre	WMU	Oh	Development of Performance Measures for Non-Motorized Dynamics	10/1/2012	12/31/2013	70
116251	\$74,638.22	\$74,638.22	\$102,239.41	Yalda, Dan	WSU	Eamon	Side-by-Side Probability for Bridge Design and Analysis	10/1/2012	4/15/2014	72
116558	\$34,885.83	\$34,885.83	\$99,453.00	Endres, Dick	MSU	Khire	Predictive Modeling of Freezing and Thawing of Frost-Susceptible Soils	10/1/2012	9/30/2014	73
116559	\$45,276.10	\$45,276.10	\$163,854.14	Kahl, Steve	WSU	Eamon	Design and Construction Guidelines for Strengthening Bridges using Fiber Reinforced Polymers (FRP)	10/1/2012	9/30/2014	74
117426	\$52,092.74	\$52,092.74	\$311,125.21	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	75
117428	\$73,130.19	\$73,130.19	\$286,529.00	Kahl, Steve	WMU	Attanayake	Remote Monitoring of Fatigue Sensitive Details on Bridges	10/1/2012	9/30/2014	77
117429	\$102,800.70	\$102,800.70	\$243,251.57	Burns, Eric	MTU	Ahlborn	Evaluation of Bridge Decks using Non-Destructive Evaluation (NDE) at Near Highway Speeds for Effective Asset Management	11/1/2012	10/31/2014	79
117432	\$54,608.59	\$54,608.59	\$249,999.90	Morena, Jill	WSU	Datta	Evaluation of Non-Freeway Rumble Strips - Phase II	2/8/2013	9/30/2014	81
117433	\$11,730.66	\$11,730.66	\$250,000.00	Owen, Hilary	WSU	Savolainen	Balancing the Costs of Mobility Investments in Work Zones	6/19/2013	5/15/2015	83
117434	\$17,751.05	\$17,751.05	\$268,560.45	Firman, Jason	WMU	Kwigizile	Evaluating Michigan Commercial Vehicle Enforcement Strategies and Facilities	5/7/2013	3/30/2015	84
117436	\$10,415.15	\$10,415.15	\$233,394.69	Castle, Collin	WMU	Oh	Cost and Benefits of MDOT Intelligent Transportation System Deployments	6/3/2013	4/30/2015	86
117437	\$17,845.03	\$17,845.03	\$186,661.15	Croze, Tim	LTU	Bandara	Evaluating the use of Tow Plows	3/30/2013	3/30/2015	87
117439	\$101,178.11	\$171,892.96	\$239,863.00	Polsdofer, Mark	CTC	Casey	Research Administration Section Planning and Communications	1/31/2012	9/30/2014	89
118058	\$26,225.03	\$26,225.03	\$175,060.61	Firman, Jason	WSU	Savolainen	Evaluating Differential and Non-Differential Freeway Truck and Bus Speed Limits	2/26/2013	5/1/2014	90
118059	\$43,473.44	\$43,473.44	\$240,898.91	Cook, Steve	MTU	Brooks	Evaluating the use of Unmanned Aerial Vehicle (UAVs) for Transportation Purposes	5/22/2013	11/30/2014	91

TABLE 1 80% FEDERALLY FUNDED PROJECTS

Job No.	FY 2013 Expenditures	Expenditures to Date	Project Total Budget	Project Manager	Agency	Principal Investigator	Title	Start Date	End Date	Pg No		
118297	\$0.00	\$0.00	\$250,100.20	Kanitz, Dean	WSU	Savolainen	Michigan Urban Trunkline Intersections Safety Performance Function (SPFs) Development and Support	9/1/2013	5/31/2015	92		
118298	\$24,908.27	\$24,908.27	\$24,999.52	Kahl, Steve	WMU	Aktan	Non-Destructive Evaluation Seminar	1/1/2013	9/30/2013	93		
119806	\$6,212.27	\$6,212.27	\$161,657.01	Tansil, William	U of M	Belzowski	Evaluating Roadway Surface Rating Technologies	8/20/2013	7/8/2014	94		
120457	\$0.00	\$0.00	\$551,176.40	Guerrazzi, Sam	MTU	Colling	Bridge Design System Analysis and Modernization	11/1/2013	11/30/2015	95		
120669	\$0.00	\$0.00	\$36,541.61	Chynoweth, Matt	WMU	Aktan	Accelerated Bridge Construction and Structural move WorkShop	8/31/2013	6/30/2014	96		
120981	\$0.00	\$0.00	\$300,000.00	Chynoweth, Matt	TBD	TBD	Statewide Overall Carbon Fiber Composite Cable Bridge Monitoring	FY 2014	9/30/2019	97		
	\$3,335,705.45	\$12,523,951.75	\$18,942,568.25	TOTAL 80% FEDERALLY FUNDED PROJECTS								

TABLE 2 RESEARCH PROGRAM HIGHLIGHTS – 12 COMPLETED 80% FEDERALLY FUNDED PROJECTS

	PROJECT AREA	NUMBER OF PROJECTS	TOTAL EXPENDITURES	TOTAL EXPENDITURES IN PERCENT
Program & Project Development	Bridges and Structures	4	\$563,432.78	27%
	Environment & Water Sources	0	\$0.00	0%
	Innovative Contracting	0	\$0.00	0%
	Real Estate & Permits	0	\$0.00	0%
	Transportation Safety	2	\$427,503.31	21%
	Rest Areas, Utilities, & Landscaping	1	\$188,198.38	9%
	Surveys & Automated Design	0	\$0.00	0%
	Work Force Development	1	\$167,448.96	8%
	Subtotal	8	\$1,346,583.43	65%
Delivery & Operations	Construction	0	\$0.00	0%
	Geotechnical & Foundation Design	0	\$0.00	0%
	Intelligent Transportation Systems	0	\$0.00	0%
	Fleet/Facility Management & Operations	0	\$0.00	0%
	Maintenance	0	\$0.00	0%
	Mobility, Systems, & Signal Operations	1	\$171,882.44	8%
	Pavements & Materials	2	\$479,948.16	23%
	Worker/Facility Safety & Security Emergency Management	0	\$0.00	0%
	Subtotal	3	\$651,830.60	31%
Multi-Modal Transportation	Aviation	0	\$0.00	0%
	Freight & Logistics	0	\$0.00	0%
	Freight Rail	1	\$89,458.27	4%
	Intercity Bus	0	\$0.00	0%
	Local Transit	0	\$0.00	0%
	Maritime	0	\$0.00	0%
	Passenger Rail	0	\$0.00	0%
	Private/For Hire Passenger Carriers	0	\$0.00	0%
	Subtotal	1	\$89,458.27	4%
Planning & Finance	Asset Management	0	\$0.00	0%
	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	0	\$0.00	0%
	TOTAL	12	\$2,087,872.30	100%

TABLE 3 100% FEDERALLY FUNDED PROJECTS

Project No.	FY 2013 Expenditures	Expenditures to Date	Project Total Budget	Agency	Project Manager	Title	Start Date	End Date	End Date(rev)	Pg No.
TPF-5(054)	\$85,000.00	\$110,000.00	\$110,000.00	SD DOT	Cook	Development of Maintenance Decision Support System	6/01/2012	9/30/2013		100
TPF-5(159)	\$10,000.00	\$45,000.00	\$59,000.00	IA DOT	Staton	Technology Transfer Concrete Consortium (TTCC)	10/01/2008	09/30/2015		102
TPF-5(174)	\$10,000.00	\$70,000.00	\$70,000.00	KS DOT	Stallard	Construction of Crack-Free Bridge Decks, Phase II	10/01/2008	09/30/2013		104
TPF-5(183)	\$35,000.00	\$175,000.00	\$175,000.00	IA DOT	Grazioli	Improving the Foundation Layers for Concrete Pavements	10/01/2008	09/30/2013		106
TPF-5(206)	\$50,000.00	\$50,000.00	\$100,000.00	VA DOT	Smith	Research Program to Support the Research, Development, and Deployment of System Operations Applications of Vehicle Infrastructure Integration (VII)	10/01/2012	9/30/2014		108
TPF-5(209)	\$20,000.00	\$80,000.00	\$100,000.00	FHWA	Chaput	Support of the Transportation Curriculum Coordination Council (TCCC)	10/01/2009	09/30/2014		110
TPF-5(215)	\$7,000.00	\$23,500.00	\$30,500.00	MN DOT	Clover	Transportation Engineering and Road Research Alliance (TERRA)	10/01/2009	09/30/2014		112
TPF-5(218)	\$25,000.00	\$100,000.00	\$100,000.00	MN DOT	Croze	Clear Roads Winter Highway Operations Pooled Fund (continued from TPF-5(092))	10/01/2009	09/30/2011	09/30/2013	115
TPF-5(224)	\$15,000.00	\$60,000.00	\$60,000.00	IA DOT	Staton	Investigation of Jointed Plain Concrete Pavement Deterioration at Joints and the Potential Contribution of Deicing Chemicals	10/01/2009	09/30/2013		117
TPF-5(225)	\$50,000.00	\$100,000.00	\$100,000.00	VA DOT	Bennett	Validation and Implementation of Hot-Poured Crack Sealant	10/01/2009	09/30/2013		120
TPF-5(231)	\$70,000.00	\$140,000.00	\$175,000.00	MDOT	Nederveld	ITS Pooled Fund Program (ENTERPRISE)	10/01/2009	09/30/2014		124
TPF-5(237)	\$5,000.00	\$20,000.00	\$25,000.00	MO DOT	Briseno	Transportation Library Connectivity and Development	05/01/2011	9/30/2013	9/30/2014	128
TPF-5(242)	\$25,000.00	\$50,000.00	\$50,000.00	LA DOT	Eacker	Traffic and Data Preparation for AASHTO MEPDG Analysis and Design	06/1/2012	9/30/2013	8/31/2014	131
TPF-5(247)	\$60,000.00	\$60,000.00	\$60,000.00	MO DOT	Kathrens	Field Testing Hand-Held Thermographic Inspection Technologies Phase II	11/10/2011	9/30/2013		133
TPF-5(254)	\$0.00	\$120,439.75	\$146,000.00	MDOT	Juntunen	Evaluation and Analysis of Decked Bulb T Beam Bridge	09/19/2011	09/30/2014		136
TPF-5(269)	\$40,000.00	\$40,000.00	\$60,000.00	MN DOT	Krom	Development of an Improved Design Procedure for Unbonded Concrete Overlays	4/13/2012	9/30/2014		138
TPF-5(271)	\$10,000.00	\$10,000.00	\$30,000.00	KS DOT	Chynoweth	Reorganization of Section 5, Concrete Structures, of the AASHTO LRFD Bridge Design Specifications	10/01/2012	9/30/2015		140
TPF-5(277)	\$181,766.00	\$181,766.00	\$206,710.00	FHWA	Clover	Core Program Services for a Highway RD&T Program - FFY 2013 (TRB FY 2014)	10/01/2012	9/30/2013		142
TPF-5(285)	\$0.00	\$0.00	\$50,000.00	MD DOT	Endres	Standardizing Lightweight Deflectometer Measurements for QA and Modulus Determination in Unbound Bases and Subgrades	10/01/2013	9/30/2014		143

TABLE 3 100% FEDERALLY FUNDED PROJECTS

Project No.	FY 2013 Expenditures	Expenditures to Date	Project Total Budget	Agency	Project Manager	Title	Start Date	End Date	End Date(rev)	Pg No.	
TPF-5(286)	\$0.00	\$0.00	\$75,000.00	IA DOT	Staton	Next Generation Concrete Pavement Map	10/01/2012	9/30/2017		144	
TPF-5(413)	\$1,053,818.46	\$1,053,818.46	\$1,150,000.00	FHWA	Clover	NCHRP for FY 2013	10/01/2012	9/30/2013		145	
SHR-2(013)	\$398,387.00	\$398,387.00	\$399,960.00	FHWA	Clover	SHRP 2 Implementation	10/01/2012	9/30/2013		147	
SPR-2(207)	\$50,000.00	\$50,000.00	\$100,000.00	FHWA	Peplinski	Transportation Management Center (TMC) Pooled Fund Study	10/01/2013	9/30/2015		148	
115024	\$8,000.00	\$8,000.00	\$24,000.00	AASHTO	Barondess	AASHTO's Environmental Technical Assistance Program (ETAP)	10/01/2012	9/30/2013	9/30/2015	150	
115193	\$85,000.00	\$85,000.00	\$85,000.00	AASHTO	Clover	AASHTO Technical Service Program (TIG SICOP TSP2 NTPEP EMTSP APEL SAFETY DAMS LRFDSM)	10/01/2012	9/30/2013		151	
116226	\$79,572.82	\$83,044.82	\$100,000.00	UDM	Edgar	University Transportation Center: A Study of Factors that Inhibit and Enable Effective Development of Sustainable Regional Transit Systems in Southeastern Michigan	7/01/2012	12/31/2013		153	
116233	\$42,500.04	\$42,500.04	\$50,000.05	GVSU	Fandialan	University Transportation Center: A Study on the Remanufacturing, Repurposing, and Recycling of Lithium-Ion Batteries in Public Transit Vehicles	9/19/2012	9/30/2013	12/31/2013	154	
116234	\$66,978.58	\$66,978.58	\$99,470.00	MTU	D'Lamater	University Transportation Center: National University Rail Center for Research, Education and Technology Transfer (NURails)	10/08/2012	1/31/2014		155	
121242	\$125,000.00	\$125,000.00	\$250,000.00	AASHTO	Curtis	AASHTOWare Bridge Management Software- PONTIS 5.2	10/01/2012	9/30/2014		157	
	\$2,608,022.90	\$3,348,434.65	\$4,040,640.05	TOTAL 100% FEDERALLY FUNDED PROJECTS							

80% FEDERALLY FUNDED PROJECTS

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	114076	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-022	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Neeraj Buch		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$162,080.00	Total Vendor Budget	\$400,000.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$155,770.69	Total Budget	\$400,000.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$298,434.19
		Total Contract Amount Available	\$101,565.81

PURPOSE AND SCOPE

Part 1: HMA Mixture Characterization

- 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.
- 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.
- Provide recommendations on the appropriate values and input levels for HMA mixtures for use in the M-E PDG pavement designs.
- 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.
- Recommend what types of changes in the HMA should trigger new characterization testing.

Part 2: Evaluation of Rehabilitation Fixes

- 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.
- 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.
- Perform comparisons between the M-EPDG predicted pavement performance and the observed performance of selected pavement sections.
- 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.
- Provide recommendations on the appropriate values and input levels for all critical/sensitive parameters for use in M-E PDG pavement rehabilitation designs.
- 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 PROPOSED ACTIVITIES

The project record search for new and reconstruct projects will continue until completed. MDOT expects to deliver the transverse laser profiles. Once all project records have been searched, MDOT and MSU will agree on the appropriate inputs for all of the projects that will be used in the calibration process. MSU will create the designs in ME and compare the predictions with actual distresses as recorded in MDOT's Pavement Management System. The calibration coefficients will then be adjusted so that the measured and predicted are matching as closely as possible. A smaller set of projects will then be used to validate these new coefficients.

The final report will be delivered by Michigan State University and reviewed for acceptance by MDOT. The completion date for the project is September 30, 2014. It is expected that a one day technology transfer class (part of the deliverables of this project) will occur shortly thereafter (in fiscal year 2015).

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

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.

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

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Transportation Reliability and Trip Satisfaction

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

PROJECT MANAGER: Jason Firman

CONTRACT/AUTHORIZATION NO.	2010-0298 Z4	PROJECT START DATE	10/1/2011
PROJECT NO.	114077	COMPLETION DATE (Original)	9/30/2012
OR NO.	OR10-028	COMPLETION DATE (Revised)	12/31/2012
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$107,976.00	Total Vendor Budget	\$172,901.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$4,871.51	Total Budget	\$172,901.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$171,882.44
		Total Contract Amount Available	\$1,018.56

PURPOSE AND SCOPE

1. Identify problems travelers encounter on the state's transportation system that could adversely impact travel time reliability. Provide insight and recommendations as to how best to minimize and/or eliminate them.
2. Determine the best practices to measure reliability.
3. Determine those reliability measures most important to travelers.
4. Determine those reliability measures most important to the freight industry.
5. Determine what factors are considered by motorists when choosing a particular mode of travel.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Literature Review and State-of-the Practice Survey: All relevant literature documents have been acquired and summarized in the final report. State practices for communication traffic related information to travelers were also included and summarized.

A stakeholder focus group was formed that included representatives from the following agencies: MDOT, Michigan State Police, freight shippers, receivers, logistics specialists, transit agencies, local government officials and others. The focus group was useful in assisting the research team to identify issues, needs and desires of users of the Michigan transportation network as they relate to transportation reliability.

Two traveler surveys were completed. The first version was a face-to-face interview questionnaire form distributed to travelers and commercial vehicle drivers at MDOT rest areas and welcome centers. The second survey was similar to the general traveler survey form, but included more detailed questions related to commuter travel and was broadly distributed to various employers throughout Michigan for distribution to their employees. The results were utilized towards development of recommendations, which are discussed in the final report.

A freight industry survey was administered to two different groups utilizing different procedures: 1) Commercial vehicle drivers traveling en route and 2) Managers/shippers/logistics specialists via telephone survey. The surveys were analyzed and utilized toward development of recommendations, which are included in the final report.

A final report was prepared and included conclusions and recommended strategies for appropriate communication techniques for distribution of travel reliability and traffic related information to the public based on the needs of users.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Incorporated PM and RAP member comments into the final Report.

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

PM and RAP members needed more time to review the final report.

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

The recommended changes to MiDrive should be phased beginning with a pilot project either within a particular region, such as the Metro Region, or along a particular route, such as I-94. The pilot implementation project would include the addition of travel reliability data (buffer time index, planning time index) to the MiDrive interactive map along with the additional recommended modification to the user interface. It is recommended a survey or focus group of travelers and freight industry personnel to obtain feedback

pertaining to the changes to MiDrive. Statewide implementation may occur thereafter. MiDrive continues to have a relatively low level of familiarity and use among travelers. MDOT should continue to advertise MiDrive and try to distinguish MiDrive from the variety of other available real-time traffic information websites.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	114108	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$188,683.00	Total Vendor Budget	\$223,895.17
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$80,865.74	Total Budget	\$223,895.17
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$140,605.82
		Total Contract Amount Available	\$83,289.35

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 begin 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 PROPOSED ACTIVITIES

1. Complete crash data collection, review, and analysis.
2. Complete collection of maintenance and repair cost data.
3. Analyze all data collected and complete the objectives of the research study.
4. 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.
5. Prepare a draft report for this research study and submit to MDOT (RAP members) for review and approval.
6. Submit a final report for this research study addressing all of the objectives of the study.
7. Complete the project deliverables by September 30, 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 2013**

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.	114119	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$260,142.00	Total Vendor Budget	\$277,774.10
MDOT Budget FY 2013	\$20,000.00	Total MDOT Budget	\$20,000.00
Vendor FY 2013 Expenditures	\$116,651.84	Total Budget	\$297,774.10
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$194,123.80
		Total Contract Amount Available	\$83,650.30

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 sufficient sample prestressed concrete bridges with shear crack 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) MCFT/LFD based shear design and evaluation method development continued but was not completed

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Continue work on finite element analysis, MCFT/LFD based shear design and evaluation method development, and prepare final report.

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

The extension provides time to thoroughly evaluate test results and validate FEA models after the delayed beam test occurs. 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 process.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	114128	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$172,422.00	Total Vendor Budget	\$229,370.76
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$95,197.75	Total Budget	\$229,370.76
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$194,965.14
		Total Contract Amount Available	\$34,405.62

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 PROPOSED ACTIVITES

- MDOT will review the draft final report.
- UM will revise the report and submit the final draft

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)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Transportation Patterns of Older Driver in Rural Michigan

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

PROJECT MANAGER: Kim Lariviere

CONTRACT/AUTHORIZATION NO.	2010-0296 Z8	PROJECT START DATE	10/1/2011
PROJECT NO.	114147	COMPLETION DATE (Original)	9/30/2012
OR NO.	OR10-037	COMPLETION DATE (Revised)	12/31/2012
RESEARCH AGENCY	The Regents of the University of Michigan		
PRINCIPAL INVESTIGATOR	David Eby		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$158,288.00	Total Vendor Budget	\$227,897.93
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$11,123.37	Total Budget	\$227,897.93
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$227,897.93
		Total Contract Amount Available	\$0.00

PURPOSE AND SCOPE

1. Survey older drivers, those age 65 and above, to determine their driving patterns, awareness of alternative options available, purpose of trips in the following counties: Iron, Marquette, Hillsdale, Mason, Huron, and Alpena and the regionalized services they provide.
2. Survey older adults to determine the awareness of existing services, do they use them, why or why not, both positive and negative in the counties listed in task #1.
3. Determine all available services for alternatives to driving, and all older drivers training available in the counties listed in task #1.
4. What services would adults age 65 and older use/like for alternative transportation if they were no longer able to drive?
5. Identify the cultural and psychological issues associated with older transportation user preferences regarding mass transit systems.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Literature review and the survey of older drivers in six counties have been completed. Research into the services available in these six counties was completed. Transportation service surveys with 3 Tribal governments completed.

FISCAL YEAR 2013 ACCOMPLISHMENTS

The final report and implementation recommendations are complete. Within the final report is also the cultural and psychological issues that were found during the interviewing process.

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

Time extension was already granted; no further extension is being requested.

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

There are 16 implementation recommendations in this report. MDOT will prioritize the implementation recommendations and proceed with disseminating the information through the appropriate MDOT divisions, and also the Senior Mobility Work Group when they are not within MDOT's control. A few of the recommendations are already being implemented by MDOT or one of our partner agencies in the Senior Mobility Work Group.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Implementation of Quick Clearance in Michigan

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

PROJECT MANAGER: Angie Kremer

CONTRACT/AUTHORIZATION NO.	2011-0477 Z1	PROJECT START DATE	10/01/2011
PROJECT NO.	114155	COMPLETION DATE (Original)	09/30/2012
OR NO.	OR10-027	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Cambridge Systematics of Michigan, Inc.		
PRINCIPAL INVESTIGATOR	Daniel Krechmer		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$96,255.00	Total Vendor Budget	\$185,254.98
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$185,254.98
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$171,149.96
		Total Contract Amount Available	\$14,105.02

PURPOSE AND SCOPE

The study will help MDOT reduce congestion, improve safety, increase travel time reliability, reduce pollution and reduce user costs. During delays motorists are faced with unexpected queues in traffic which result in many secondary crashes. Incident cost to society is \$7,000 for every minute a roadway is partially or totally closed. MDOT will improve Michigan's economy by implementing quick clearance strategies to provide the highest quality transportation for improved economic benefit and quality of life. New legislation in Michigan allows MDOT to modify its incident management practices to optimize the quick clearance of vehicle obstructions on the roadway that slows traffic and lead to crashes. In order to improve its incident management practices to meet the demands of quick clearance, MDOT needs to understand the challenges and information gaps faced by those in the field. Researchers will survey the public to see what quick clearance information is already known. Researchers will review MDOT's infrastructure (such as ability to handle bump-outs); contracts/relationships with towing companies, law enforcement, and others involved in clearance outside of MDOT. The project would enhance a current database that stores incident clearance.

FISCAL YEAR 2012 ACCOMPLISHMENTS

1. Review literature listed in the literature search along with any other studies that may be published. Survey other states' emergency routing practices.
2. Survey the public about existing knowledge of quick clearance and Traffic Incident Management (TIM) initiatives.
3. Meet with stakeholders and obtain support for quick clearance outside of MDOT.
4. Develop a list of projects that will enable quick clearance (SteerIt, Clear It) Campaign.
5. Recommendation for future data collection program and enhance the current MicroSoft Access Database for Traffic Incidents.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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 objective of this research was to determine what actions can be taken to improve understanding of the quick clearance law, and compliance with it, in order to attain the full mobility and safety benefits of the law. The research involved a literature search, a survey of 800 Michigan commuters and a workshop and outreach program to first responder stakeholders. Research established that most drivers comply with the law but are not aware that it is a requirement. Demographic groups less aware of the law and less likely to comply include older drivers, those with lower education levels and residents of rural regions. Based on the research a variety of low-cost marketing and outreach strategies are detailed in the report, all featuring a common, recognizable graphic theme, a superhero character Captain ClearIt. Based on funding available these marketing strategies will be implemented. MDOT will also work with MSP, Michigan Chief of Police, Michigan Sheriff Association and other first responders and partners to get the message to the public. Strategies for using both traditional media and social media are proposed. The report also includes an analysis of the statewide incident management database and recommended modifications.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Best Practices for Emergency Rerouting

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

PROJECT MANAGER: Angela Kremer

CONTRACT/AUTHORIZATION NO.	2011-0497	PROJECT START DATE	10/4/2011
PROJECT NO.	114378	COMPLETION DATE (Original)	9/30/2012
OR NO.	OR10-026	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Kimley Horn		
PRINCIPAL INVESTIGATOR	Mark Dunzo		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$ 144,583.00	Total Vendor Budget	\$178,082.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$178,082.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$175,603.31
		Total Contract Amount Available	\$2,478.69

PURPOSE AND SCOPE

Many emergencies/incidents require closing lanes or roadways or rerouting traffic. This creates numerous challenges for maintaining mobility and safety. Researchers will identify best practices in other states for efficiently and effectively shutting down or rerouting traffic and alerting motorists to the changing situation. MDOT will use the results to improve rerouting by giving the motorist clear and concise directions. This will increase mobility and safety during emergency situations.

FISCAL YEAR 2012 ACCOMPLISHMENTS

1. Review literature listed in the literature search along with any other studies that may be published. Focus should include current best practices in other states with success implementing emergency rerouting schemes for congestion mitigation.
2. Survey other states' emergency routing practices.
3. Develop strategies to mitigate the impacts of a traffic incident to traffic flow.
4. Develop a best practice manual for emergency routing.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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)

MDOT has identified the need for a single statewide approach to documentation for emergency rerouting practices. This research effort documents some of the best practices in incident management and emergency rerouting that have been implemented across the country. The research documents components of programs that are applicable and can easily be adopted by the State of Michigan to increase safety and mobility. This guidance includes recommendations for establishing and maintaining effective inter-agency relationships that foster resource sharing and improved traffic management strategies. It also provides recommendations for permanent signing of emergency reroutes that will be used in future emergency rerouting plans.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Development and Validation of Models for Concrete Bridge Decks

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

PROJECT MANAGER: Peter Jansson

CONTRACT/AUTHORIZATION NO.	2009-0746 / Z2	PROJECT START DATE	10/20/2009
PROJECT NO.	114487	COMPLETION DATE (Original)	09/30/2012
OR NO.	OR09-156	COMPLETION DATE (Revised)	12/31/2012
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Dr. Rigoberto Burgueño		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$158,035.00	Total Vendor Budget	\$299,747.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$43,472.22	Total Budget	\$299,747.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$234,696.57
		Total Contract Amount Available	\$65,050.43

PURPOSE AND SCOPE

Assess the deterioration mechanisms in concrete decks, develop mechanistic and history based degradation models for concrete decks, develop computer software that integrates the developed degradation models and provide a bridge specific preservation strategy within regions and for design.

FISCAL YEAR 2010 ACCOMPLISHMENTS

Task 1: Assessment of the deterioration mechanisms in reinforced concrete (RC) bridge decks through literature review and evaluation of MDOT inspection and maintenance databases. Task 1 is estimated to be 50% complete.

Task 2: Identification of computational, mechanistic, and phenomenological degradation models. Progress in this task as a whole is in the order of 10%.

Task 3: The NBI database was further refined to reduce bad (i.e., erroneous or meaningless) data that would disturb the training of the artificial intelligence models. Identification of parameters that influence the deterioration of the bridge decks was completed through statistical analyses. These parameters were used to develop and train a multi-layer-perceptron (MLP) artificial neural network (ANN). Degradation curves, which graphically represent the predicted deterioration of a bridge deck, were developed using the best performing MLP model. Degradation models using ensembles of neural networks have been preliminarily developed. As expected, these models are performing better than the single MLP models. Progress in this task as a whole is in the order of 50%.

The PI has dedicated his time in guiding and supervising the graduate students in the above mentioned tasks. The graduate students have been performing assigned tasks and summarizing findings in weekly reports. These reports will become part of the final report for the project.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Task 1: Assessment of the deterioration mechanisms in reinforced concrete (RC) bridge decks through literature review and evaluation of MDOT inspection and maintenance databases. Continued literature review was conducted to support the different project tasks. Recently a significant effort was placed on literature concerning: (i) degradation of reinforced concrete elements with epoxy-coated reinforcement, (ii) computational methods for the simulation of degradation in reinforced concrete elements, (iii) statistical and probabilistic approaches for the development of degradation models, and (iv) approaches for sensitivity analyses on artificial intelligence models. Task 1 is almost complete

Task 2: Work continued on the integration of mechanistic models for corrosion, carbonation and freeze-thaw effects for developing degradation models. The framework is being developed and programmed using the mathematical software Matlab. A key element in the approach is the generalization of individual prediction models by means of Monte Carlo simulations. Progress in this task as a whole is in the order of 35%.

Task 3: Development of degradation models based on ensembles of neural networks. Most recent work was focused on the development of project (i.e., bridge specific) and network degradation models based on MLP and ensembles of neural networks models. The project and network level models have been used to evaluate the effect of design parameters such as skew angle and reinforcement protection (i.e., epoxy coating) on deck degradation. The developed models show improvements with respect to traditional methods using Markov chains. Progress in this task as a whole is 95%.

Task 4: The degradation models developed in Task 3 were generalized into simplified models using logistic fit functions at the project level. The effect of deck repairs on the actual reported (rating) improvement of bridge decks was assessed. Based on this evaluation, post-repair improvement and longevity models were developed and codified for the creation of degradation curves with repair. Performance was compared with field data. Progress in this task as a whole is in the order of 85%.

Task 5: A framework for the development of a Bridge Management System was developed. Life-cycle cost considerations were implemented by means of a repair matrix that considers improvement and longevity as well as cost. The BMS system was developed as an optimization problem using genetic algorithms with the objective of determining optimum repair intervention strategies based on cost, budget and operational constraints. The system has been preliminarily implemented for a representative

bridge system network of 30 bridges. Task progress in the order of 70%.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Task 2: Implementation of a framework for the development of structural degradation of RC elements using mechanistic degradation models. The framework is to include local effects using experimentally calibrated mechanistic models from the literature and develop a new framework for expanding the local models to bridge decks through probabilistic methods. Finalize modeling and document outcomes.

Task 3: Finalize the documentation and evaluation of the artificial intelligence models.

Task 4: Finalize the documentation and evaluation of the simplified degradation models.

Task 5: Improve the definition of constraints in the optimization problem for the Bridge Management System and finalize its documentation and evaluation.

Task 6: Produce a the final report to this project. Document methods of each task and the conclusions. Report on the developed artificial intelligence degradation models, mechanistic degradation models, maintenance and intervention models, and develop a systems-level approach for the management of maintenance interventions on bridge decks. develop computer software that integrates the developed degradation models and provide a bridge specific preservation strategy within regions and for design.

FISCAL YEAR 2013 ACCOMPLISHMENTS

The second half of the final report was completed and accepted for publishing by MDOT, as was the revised version of the first half of the final report. Software development was completed and provided to the research advisory panel (RAP) for evaluation. The RAP provided several comments and revisions were incorporated into the software to provide more informational content and increase the user-friendliness of the graphical interface. A training session was conducted with the RAP and region bridge engineers. A users guide was also provided for the two software programs.

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)

MDOT Region Bridge Engineers and designers to use the software programs as a tool in determining the most efficient bridge deck repair method or replacement. MDOT to consider development of a system wide approach to the preservation of concrete bridge decks by using calibrated degradation models based on durability mechanics, history dependent models and life-cycle cost considerations.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Identification of Causes and Solution Strategies for Deck Cracking in Jointless Bridges

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

PROJECT MANAGER: Eric Burns

CONTRACT/AUTHORIZATION NO.	2009-0746 / Z1	PROJECT START DATE	10/20/2009
PROJECT NO.	114488	COMPLETION DATE (Original)	08/15/2011
OR NO.	OR09-150	COMPLETION DATE (Revised)	05/31/2012
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Dr. Rigoberto Burgueño		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$22,000.00	Total Vendor Budget	\$169,968.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$169,968.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$169,968.00
		Total Contract Amount Available	\$0.00

PURPOSE AND SCOPE

MDOT has experienced cracking of bridge decks designed and constructed continuous for live load and without expansion joints on the bridges but located on the bridge approaches. The causes of these cracks are not clearly known. The expansion joints allow for the thermal expansion and contraction based on temperatures. Moving the expansion joints to the approaches reduces future maintenance costs for expansion joint replacement and beam end repair. This project will review how the jointless bridge decks are designed and seek to identify causes of the bridge deck cracking without expansion joints on the bridges but located on the bridge approaches.

FISCAL YEAR 2010 ACCOMPLISHMENTS

Task 1: The findings of the literature review indicated key parameters controlling the behavior of jointless bridges, along with the sources that contribute to deck cracking. The most dominant source appears to be restrained concrete shrinkage, which has become the focus of this research. Task 1 is estimated to be 95% complete.

Task 2: Additionally, MDOT has provided information on prototype jointless bridge systems that are candidates to be studied for the field investigation. The information has been studied and a prototype continuous steel bridge has been selected for the computer modeling and first test experimental test unit. Task 2 is estimated to be 70% complete.

Task 3: Extensive work has been completed on the computer modeling task. The finite-element program ABAQUS has been used to model shrinkage. Verification models have been created to compare with results from the literature. A full bridge system has been created based on a prototype bridge. Further work has been completed on the global bridge model to accurately simulate soil-structure interaction and temperature has been induced to simulate concrete shrinkage. Task 3 is estimated to be 35% complete.

Task 4: The initial design for the experimental studies on a continuous steel bridge system has been completed. The test unit is a 1/3 scale model of a local bridge identified with the assistance of MDOT. Task 4 is estimated to be 10% complete.

The PI has dedicated his time in guiding and supervising the graduate student in the above mentioned tasks. The graduate student has been performing assigned tasks and summarizing findings in weekly reports. These reports will become part of the final report for the project.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Task 2: Conduct field inspections of candidate bridges for detailed study and summarize the information provided by MDOT into a matrix of deck cracking cases. Task 2 is estimated to be 90% complete

Task 3: Improve the computational simulation of shrinkage effects by introducing material nonlinearity. In addition, the simulation will focus on the simulation of the prototype bridge and support analyses for the design of the experimental investigation. Task 3 is estimated to be 70% complete.

Task 4: Designs for four test assemblies with different design features that will allow the evaluation of restrained concrete shrinkage effects were completed. Materials were procured and steel framework has been assembled. Instrumentation plans were developed. Finalize the design of the first test unit and initiate construction. Task 4 is estimated to be 60% complete.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Task 2: Finalize matrix of deck pattern distress. Task 2 was completed 100%

Task 3: Study and evaluate jointless bridge behavior based on experiment results. Task 3 was completed 100%

Task 4: Conduct experimental studies on small-scale assemblies. A portion of a full scale bridge deck model was built. Task 4 was completed 100%

Task 5: Summarize findings and draft recommendations. Relevant experimental and simulation results were summarized. Task 5

was been completed 100%.

Task 6. A prepare final report. A draft final report was prepared and provided to the Project Manager for review. A final report was submitted. Task 6 has been completed 100%.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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)

Recommend to publish the research report. Concrete mixtures optimized for low shrinkage used for bridge decks are currently being researched by MDOT's Materials Section. Other recommendations for improving design characteristics such as density of shear connectors will be reviewed as well.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Review and Revision of Overload Permit Classification

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

PROJECT MANAGER: Brad Wagner

CONTRACT/AUTHORIZATION NO.	2010-0317 / Z1	PROJECT START DATE	10/01/2010
PROJECT NO.	114494	COMPLETION DATE (Original)	09/30/2011
OR NO.	OR10-010	COMPLETION DATE (Revised)	2/28/2013
RESEARCH AGENCY	Michael Baker Jr., Inc.		
PRINCIPAL INVESTIGATOR	Bryan J. Spangler		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$110,305.00	Total Vendor Budget	\$209,405.64
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$81,630.20	Total Budget	\$209,405.64
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$207,668.03
		Total Contract Amount Available	\$1,737.61

PURPOSE AND SCOPE

The objectives of this project include the following:

- 1) Review current Overload Permitting procedure from the structure and vehicle perspective. Compare this procedure to current National Best Practices, MDOT and local agency business needs, and reliability of the system.
- 2) Create an interim report summarizing the current method identifying deficiencies of the current procedure and proposing a method to be approved by MDOT.
- 3) Create a software program to replace the current BridgeOv program that addresses all vehicle and structural variables outlined in the problem statement.
- 4) Educate MDOT staff and local agency bridge owners.

The scope of work includes the following tasks:

- 1a).Review current Overload Permitting procedure from the structure and vehicle perspective. Interview key MDOT staff.
- 1b).Verify the deficiencies noted by in Task 1a and the impact of the deficiencies by comparing the current process to a sample of the MDOT bridge inventory taking into account factors including but not limited to: year of construction, functional classification, material type and design loading. A research database with standard MDOT structures is available for use with the AASHTOWare Virtis program.
- 2). Submit draft interim report identifying areas of current process that require improvement. As part of this report, develop an action plan to create a proposed process for MDOT Overload Permitting. The action plan should outline how the proposed process will impact current practice and the implementation of the proposed process.
- 3a).Incorporate MDOT comments from the above Task 2. Develop the software tool for implementation of the proposed process.
- 3b).Test and verify the software.
- 3c).Verify the proposed process against the review performed in above Task 2.
- 3d).Provide software documentation of coding for possible future edits and third party developers.
- 4). Prepare material and give a minimum of two training sessions for MDOT staff and local agencies bridge owners on use of the software tool and the proposed process.
- 5). Prepare final report including proposed revisions to the BAG for the process as modified in Task 3a.

FISCAL YEAR 2011 ACCOMPLISHMENTS

During FY 2011, several accomplishments were made. The research agency began an in-depth evaluation of our load rating and permitting process. Tasks completed include: interviews of MDOT Load rating and permit unit staff, evaluation of a subset of bridge models, submittal of an outline for the draft interim report to be completed in December 2011

FISCAL YEAR 2012 ACCOMPLISHMENTS

During FY 2012, the interim report was completed, additional investigation into the overload permit process was conducted and a software tool was substantially developed. The project was extended to February 2013 to allow proper time for completion of software development and implementation.

FISCAL YEAR 2013 ACCOMPLISHMENTS

During FY 2013, the project was completed. A draft of the final report was submitted in October, and a demonstration of the software was completed on October 31, 2012. The final report and software deliverables were accepted on February 28, 2013. Implementation of the results is on hold pending coordination with the transport permits unit and availability to schedule training.

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

Time extension from 9-30-11 to 3-31-12 due to project manager leaving MDOT and delay in hiring a replacement.
 Time extension from 3-31-12 to 10-31-12 to allow additional time for analysis. In addition, timeframe allows for software to be developed under other funds by a third party. Third party software will be adapted for MDOT use upon completion.
 Time extension from 10-31-12 to 2-28-13 to allow MDOT additional time for software implementation.

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

Implementation of this project involves 2 parts. The first part is to implement the software API into the MiTrip software for use by the transport permits unit. This involves coordination with the MiTrip software developer and will need to get into their workplan. The second part includes deployment of the stand-alone software to MDOT Local Agencies. Implementation will include training and support for the software.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Implementation of Sustainable and Green Design and Construction Practices for Bridges

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

PROJECT MANAGER: Christal Larkins

CONTRACT/AUTHORIZATION NO.	2010-0294 / Z1	PROJECT START DATE	10/01/2010
PROJECT NO.	114495	COMPLETION DATE (Original)	12/31/2012
OR NO.	OR09-157	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Dr. Kasim Armagan Korkmaz		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$35,696.00	Total Vendor Budget	\$99,819.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$99,819.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$96,159.91
		Total Contract Amount Available	\$3,659.09

PURPOSE AND SCOPE

The objectives of this project include the following:

- 1) Understand the key factors that define and measure sustainability.
- 2) Determine how existing sustainability methodologies can be adapted and incorporated into bridge design and construction.
- 3) Incorporate sustainability into bridge design and construction practices at MDOT.

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

- 1) Understanding current practices – The PI will gain an understanding of MDOT's current bridge design, construction and maintenance processes.
- 2) Framework development -- Develop a framework to define and measure sustainability. Review literature and best practices to determine the most important and sensitive factors.
- 3) Sustainability Rating System – The framework will be used to develop a rating system for bridges, similar to LEED's (Leadership in Energy and Environmental Design) ratings system for buildings, that will be used to determine how sustainable the bridge is.
- 4) Assessment of current practice -- Based on the rating system developed above, assess the sustainability of current MDOT bridge design procedures.
- 5) Recommendations -- Recommend modifications to MDOT's bridge design and construction procedures to improve sustainability.
- 6) Education -- Develop and deliver appropriate tools to educate MDOT engineers about sustainability practices.

FISCAL YEAR 2011 ACCOMPLISHMENTS

The principal investigator did extensive research on MDOT's current practices in the design, construction, and maintenance of state bridges. He took the sustainable principles that we currently follow and the sustainable approaches used in other states to create the framework for a rating system to be used for bridges. The framework addresses multiple issues in each of the three areas. Some areas include:

- Design
 - Brownfield redevelopment – rehabilitate damaged sites to reduce pressure on undeveloped lands
 - High-Occupancy-Vehicle/Bike/Pedestrian Lanes – to promote the use of alternate transportation
- Construction
 - Accelerated Bridge Construction Techniques – to reduce construction times and minimize traffic disruptions
- Maintenance
 - Bridge Painting/Coating/Sealing – to prevent bridge components from deteriorating due to corrosion
 - Bridge Deck Drainage – maintaining proper drainage will reduce damage to the deck and reinforcing bars

FISCAL YEAR 2012 ACCOMPLISHMENTS

The final three tasks for this research project were addressed:

Task 3: Framework for Assessing Sustainability in Bridge Design, Construction, and Maintenance

- The framework was finalized after being reviewed by MDOT professionals in the design, construction, and maintenance divisions.

Task 4: Sustainability Rating System and Guidelines for MDOT

- A rating system and guidelines were developed to apply specifically to bridges in MDOT's jurisdiction. The scoring for each criterion noted in the framework was determined by performing a survey of project managers.
- The guidelines include steps for Life Cycle Assessment to determine the carbon footprint of different bridge elements as well as Life Cycle Cost Analysis to compare material alternatives and determine which would increase the service life of the bridge with reasonable cost.
- The Principal Investigator created examples on how the rating system will be applied to new and existing bridges.

-
- The final report with the framework, rating system, and guidelines have not yet been delivered.

Task 5: Training Materials

- The final step in this research project will be for MSU to recommend changes to our current practices and develop a recorded power point presentation of the final deliverable with audio to be used to train MDOT professional in the new sustainable bridge rating system at a later date.
- The training materials have not yet been delivered.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received

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)

If the sustainability measures outlined in this report become a priority for MDOT, the power point presentation with audio will be used to train MDOT professionals statewide.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	114496	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$250,468.00	Total Vendor Budget	\$400,672.27
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$87,750.44	Total Budget	\$400,672.27
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$340,571.43
		Total Contract Amount Available	\$60,100.84

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 PROPOSED ACTIVITIES

- Complete the Michigan specific ABC decision-making framework and deliver a final Excel spreadsheet; MiABCD with user's instructions
- Provide final report for ABC precast pier caps
- Provide final examples and details for bulb-T beams, decked prestressed box beams, and full depth deck panels, and provided recommendations in final report.
- Provide standardized design details for longitudinal connections between decked box and bulb T beams
- Provide final report on comprehensive list of PBES, connection details suitable for Michigan exposure, constructability checklist for PBES and further research needs.

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)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT – FISCAL YEAR 2013**

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.	114502	COMPLETION DATE (Original)	05/24/2011
OR NO.	OR10-048	COMPLETION DATE (Revised)	12/20/2013
RESEARCH AGENCY	URS Corporation Great Lakes		
PRINCIPAL INVESTIGATOR	Mike Guter		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$181,530.00	Total Vendor Budget	\$550,905.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$10,152.57	Total Budget	\$550,905.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$506,832.60
		Total Contract Amount Available	\$44,072.40

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 PROPOSED ACTIVITIES

Research will be extended to review recently discovered video from the original 1994 study. URS is to have final draft report to MDOT in the winter of 2014, allowing time for presentation to the EOC a second time. The report will be published and public comments responded to by URS through the contract end date.

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. In 2014 an anticipated Amendment 4 should allow time for 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 will be reviewed and implemented if found advisable to do so. Proposed research will be reviewed for viability. Use of the pipe laser profiler equipment on projects has commenced.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Evaluating the Performance and Effectiveness of Roundabouts

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

PROJECT MANAGER: Dean Kanitz

CONTRACT/AUTHORIZATION NO.	2010-0278 / Z2	PROJECT START DATE	10/01/2010
PROJECT NO.	114504	COMPLETION DATE (Original)	09/30/2011
OR NO.	OR09-083	COMPLETION DATE (Revised)	12/31/2011
RESEARCH AGENCY	Opus International Consultants, Inc.		
PRINCIPAL INVESTIGATOR	Jeffrey Bagdade		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$3,773.00	Total Vendor Budget	\$149,576.66
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$149,576.66
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$145,803.83
		Total Contract Amount Available	\$3,772.83

PURPOSE AND SCOPE

The objectives of this project include the following:

- 1) Determine the impact on crash severity at locations where roundabouts have been installed.
- 2) Observe roundabout operations including truck maneuvers.
- 3) Identify the key geometric configurations and site characteristics that influence safety, performance and return on investment.

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

- 1) Literature Review -- Conduct a review of national and international research on the cost, effectiveness and performance of roundabouts, identifying effective research approaches that could potentially apply to this study.
- 2) Field Data Collection -- Document driver maneuvers in roundabouts, including trucks, as well as design features and variations.
- 3) Data Collection -- Compile three years of before and after traffic and crash data on the roundabouts installed on Michigan state trunklines. In addition, compile data on roundabout construction costs, including time to return traffic to the roadway.
- 4) Final Analysis -- Analyze the costs, geometric configurations and characteristics of roundabouts as they influence safety, operations and performance.
- 5) Final Report -- Synthesize the results of above tasks (literature review, field data collection, data collection, and final analysis) and provide guidance on site and design characteristics that most influence safety and performance in Michigan roundabouts.
- 6) Presentation -- Develop a PowerPoint presentation of the research approach and findings to support dissemination of findings within MDOT.

FISCAL YEAR 2011 ACCOMPLISHMENTS

- Observations at all defined locations
- Draft literature review and best practices
- Completed data collection
- Draft final analysis
- A rough draft report was completed and submitted for initial review.
- Literature review and survey for best practices review are nearly complete.
- Persaud & Lyon completed an initial crash analysis.
- Continued to progress on the operational impacts of roundabout site.

FISCAL YEAR 2012 ACCOMPLISHMENTS

- Complete the literature review and best practices review incorporating any comments received during the review process.
- Persaud & Lyon to complete analyzing crash data and develop safety performance functions and crash reduction factors based on an empirical Bayes analysis.
- Complete the operational impacts of roundabout sites.
- Complete draft report writing addressing comments that may be given during the review process.
- Complete Final Report
- Complete Presentation Materials

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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

- Target start date was intended to be October 1st, 2010, however the contract was not started until the beginning of November.
- During the data collection process, there was a MDOT computer failure which caused a delay in retrieving data for analysis
- The initial start delay compressed the time available for data collection

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

-
- Presentation to upper management
 - Research spot light
 - Implementation into Michigan Roundabout design guide – *Currently Developing*
 - *Short article for the Monday Memo – Currently Developing*
-

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Evaluating the Performance and Making Best Use of Passing Relief Lanes

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

PROJECT MANAGER: Dean Kanitz

CONTRACT/AUTHORIZATION NO.	2010-0278 / Z1	PROJECT START DATE	10/01/2010
PROJECT NO.	114524	COMPLETION DATE (Original)	09/30/2011
OR NO.	OR09-117	COMPLETION DATE (Revised)	12/31/2011
RESEARCH AGENCY	Opus International Consultants, Inc.		
PRINCIPAL INVESTIGATOR	Jeffrey Bagdade		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$3,760.00	Total Vendor Budget	\$159,887.20
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$159,887.20
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$156,127.31
		Total Contract Amount Available	\$3,759.89

PURPOSE AND SCOPE

The objectives of this project include the following:

- 1) Evaluate the safety performance of design and operations of passing relief lanes in Michigan.
- 2) Assess the effectiveness of current designs to reduce delay.
- 3) Use modeling to determine before-and-after impacts of passing relief lanes on traffic characteristics.

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

- 1) Literature review -- Review literature on passing relief lane best practices (design, deployment, modeling and analysis) nationwide. Summarize current practices in Michigan, including both practices required by specification and common practices not included in specifications.
- 2) Field test design and site selection -- Design the field analysis based on existing and available data sets and data that can be collected. Consider and select appropriate field sites, which may include collecting data on highway sections that already have passing relief lanes (for before-and-after analysis) as well as those that may benefit from them.
- 3) Testing -- Conduct testing and collect data according to the test design, modifying as necessary.
- 4) Analysis and recommendations -- Analyze the data for conclusive impacts — actual or modeled — of passing relief lanes on safety, capacity, cost, and other performance factors. Recommend candidate sites for future deployments and possible design modifications as appropriate based on the data.
- 5) Deliverables -- Prepare the final deliverables. These will include a final report, a technical presentation, and materials suitable for executive decision-making at MDOT.

FISCAL YEAR 2011 ACCOMPLISHMENTS

- Observations at all defined locations
- Completed data collection
- A rough draft report was completed and submitted for initial review.
- Literature review and survey for best practices review are nearly complete.
- Persaud & Lyon completed an initial crash analysis.

FISCAL YEAR 2012 ACCOMPLISHMENTS

- Complete the literature review and best practices review incorporating any comments received during the review process.
- Persaud & Lyon to complete analyzing crash data and develop safety performance functions and crash reduction factors based on an empirical bayes analysis.
- Complete the study of safety performance of design and operations of passing lane sites.
- Complete draft report writing addressing comments that may be given during the review process.
- Complete Final Report
- Complete Presentation Materials

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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

- Target start date was intended to be October 1st, 2010, however the contract was not started until the beginning of November.
- During the data collection process, there was a MDOT computer failure which caused a delay in retrieving data for analysis
- The initial start delay compressed the time available for data collection

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

- Presentation to upper management
- Research spot light
- Provide the research as needed for future inquiry on passing lane safety and performance

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Sharing the Road: Optimizing Pedestrian and Bicycle Safety and Vehicle Mobility

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

PROJECT MANAGER: Deirdre Thompson

CONTRACT/AUTHORIZATION NO.	2010-0352 / Z1	PROJECT START DATE	10/01/2010
PROJECT NO.	114525	COMPLETION DATE (Original)	03/31/2012
OR NO.	OR09-101	COMPLETION DATE (Revised)	4/30/2012
RESEARCH AGENCY	T.Y. Lin International Great Lakes, Inc.		
PRINCIPAL INVESTIGATOR	John LaPlante		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$11,047.00	Total Vendor Budget	\$199,751.95
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$199,751.95
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$188,704.36
		Total Contract Amount Available	\$11,047.59

PURPOSE AND SCOPE

The objectives of this project include the following:

- 1) Document reasoning for pedestrian safety improvements.
- 2) Investigate pedestrian and bicycle safety countermeasures and effects on vehicle mobility.
- 3) Investigate best practices for pedestrian and bicycle safety.
- 4) Investigate effects of vehicle safety and pedestrian safety improvements.

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

- 1) Literature review -- Conduct a review of pedestrian and bicycle research related to signalization and rights of way for roadways that have volumes of both pedestrians and vehicles. Identify innovative pedestrian and bicycle safety countermeasures that may be applicable in Michigan.
- 2) Data collection -- Identify challenging roadways in Michigan with high volumes of pedestrian and vehicle traffic. For those roadways, gather crash history; vehicle, pedestrian and bicycle mobility data; and roadway design information. Analysis of innovative pedestrian and bicycle safety countermeasures.
- 3) Data analysis -- Analyze the data collected to identify opportunities for improving pedestrian and bicycle safety and when pedestrian and bicycle safety should take priority over vehicle mobility. Make recommendations for applying the innovative treatments identified based on the outcomes of the analysis.
- 4) Final report -- Produce a final report of the study format and findings as well as recommendations for implementing the results.

FISCAL YEAR 2011 ACCOMPLISHMENTS

The five case study sites were selected. Field visits were conducted at each of the five sites and data was collected both during those site visits and through MDOT for analysis. A crash analysis has been initiated at each site.

The national summary of crashes was completed and the results of the Michigan crash summary have been added to the national statistics and compared. The draft crash summary report has been completed and reviewed and commented on by MDOT staff.

A draft of the review of crash countermeasures has submitted and reviewed and commented on by MDOT staff.

Two project meetings were held

FISCAL YEAR 2012 ACCOMPLISHMENTS

Completed crash summary, case study, countermeasures and mobility effects, best practices guide, NACTO summary, final report and mobility matrix.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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

Time extension was requested due to work being added to the scope of the project to review the NACTO Bicycle Guide.

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

Implementation includes educating MDOT staff, local agencies and the consultant community about the Best Practices Guide and the Mobility Matrix. Best practices and Mobility Matrix guide has been introduced to Region and TSC staff for their use. It will also be discussed at the upcoming MITECH conference in November which will include MDOT staff and representatives of the consultant community.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Evaluating Pedestrian Safety Improvements

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

PROJECT MANAGER: Deirdre Thompson

CONTRACT/AUTHORIZATION NO.	2010-0297 / Z1	PROJECT START DATE	10/01/2010
PROJECT NO.	114527	COMPLETION DATE (Original)	09/30/2012
OR NO.	OR09-096	COMPLETION DATE (Revised)	12/31/2012
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Ron VanHouten		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$93,536.00	Total Vendor Budget	\$199,998.86
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$44,801.30	Total Budget	\$199,998.86
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$199,605.38
		Total Contract Amount Available	\$393.62

PURPOSE AND SCOPE

The objectives of this project include the following:

- 1) Identify national practices with regard to pedestrian safety countermeasures that can influence practices in Michigan.
- 2) Understand the effectiveness of current Michigan countermeasures at reducing pedestrian crashes.
- 3) Gauge public response to the pedestrian safety improvements.
- 4) Develop recommendations for application of future pedestrian safety improvements in Michigan.

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

- 1) Literature review -- Scan and evaluate national guidance, research findings and state-of-the-practice related to pedestrian safety improvements similar to the signage and traffic control countermeasures used in the recent Detroit installations.
- 2) Data collection and analysis -- Conduct before-and-after studies of pedestrian crashes at Detroit installation sites to determine the effects of the countermeasures on pedestrian safety. Identify the location characteristics relevant to any safety gains made.
- 3) Driver survey -- Conduct a survey of drivers and pedestrians using selected installation sites to determine public perception of the pedestrian safety improvements.
- 4) Final report -- Submit a final report that synthesizes the results of the literature review, driver survey and before-and-after studies. Include recommendations for implementing the countermeasures in similar locations statewide.
- 5) Best practices guide -- Produce a guide for implementing safety countermeasures in Michigan that outlines effective available measures, provides guidance on the location characteristics desirable for installation, and discusses how and why the countermeasures are effective at reducing pedestrian crashes.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Almost all data has been collected at surrogate sites. Crash analysis sites have been identified and analysis has begun. Significant work has gone into identifying sites and obtaining data for those sites. The literature review has been completed, reviewed and commented on by MDOT staff. Literature review is being finalized. Data collection continues as weather allows. Two project meetings were held as well as numerous phone conferences.

FISCAL YEAR 2012 ACCOMPLISHMENTS

A Draft Final Report and executive summary have been submitted that includes surrogate data, statistical analysis and survey data. New data have been completed at surrogate sites which increased the amount of work to be done. Surveys have been completed on the comprehension of In Street Signs, PHBs, and RRFBs. Dr. Van Houten wrote the draft final report, TYLIN edited the reports before submission. The Research Assistant, Hana Manal, supervised the collection of survey data and organized spreadsheets for the statistical analysis. Dr. Van Houten supervised all data collection and analysis; Brad Huitema performed the statistical analysis of the crash data and prepared the section of the report on the crash data.

FISCAL YEAR 2013 ACCOMPLISHMENTS

The final report and best practices report were reviewed and finalized. Project was completed in 2013.

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

Data collection activities were completed prior to literature review. This was done because data collection is sensitive to weather conditions.

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

A best practice report is part of the final deliverables. This best practice report will be shared internally with MDOT staff. It will provide guidance on how to best implement innovative pedestrian safety device in Michigan.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Alternative Materials for Sustainable Transportation

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

PROJECT MANAGER: Nathan Maack

CONTRACT/AUTHORIZATION NO.	2009-0750 / Z1	PROJECT START DATE	11/13/2009
PROJECT NO.	114528	COMPLETION DATE (Original)	09/30/2011
OR NO.	OR09-152	COMPLETION DATE (Revised)	12/31/2012
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Dr. Zhangping You		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$81,488.00	Total Vendor Budget	\$299,960.16
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$15,564.52	Total Budget	\$299,960.16
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$299,960.16
		Total Contract Amount Available	\$0.00

PURPOSE AND SCOPE

Across the country planners, policy makers and engineers are increasingly considering the use of alternative materials to promote sustainable development. With the increase of crude oil prices asphalt producers have shifted production of asphalt to other oil products, creating a shortage of asphalt. This shortage of asphalt, along with a shortage of polymers, motivates engineers to utilize alternative pavement materials.

Bio oil produced from biomass waste from the forest products industry and waste tires are two sustainable alternatives. Bio oil can be used as an asphalt binder that replaces asphalt binder made from crude oil. Bio oil is a sustainable and renewable resource and reduces the use of finite petroleum resources. Bio oil can also be used as a polymer added to the asphalt binder. The use of bio oil as a polymer has shown to retard the aging of asphalt pavements which prolongs the life of the pavement.

This research will provide the MDOT with short-term and long-term solutions for alternative materials, a technical report, related technical publications, educational materials on the alternative materials and samples of the alternative materials.

FISCAL YEAR 2010 ACCOMPLISHMENTS

Completed the literature review. Based on the literature review an experimental plan was developed. The research team collected woodchips for bio oil production and shipped the samples to Iowa State University (ISU) for processing into bio oil. The research team prepared control asphalt binder to mimic the properties found in typical MDOT Hot Mix Asphalt (HMA) mixes. The team started testing the asphalt binder that will be blended with bio oil to get the starting binder properties.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Signed the Iowa State University subcontract. Prepared the bio oil and tire oil samples. Test the bio oil and three bio oil-asphalt binder blends for six common binder properties. Mix up various Hot Mix Asphalt mixtures and test for dynamic modulus, rutting using the APA machine, IDT Tensile Strength Ratio and Flow number. Determined the carbon footprint for the production of bio oil.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Finished lab testing of the binder properties and Hot Mix Asphalt mixtures. Produced and submitted a draft final report to MDOT for review.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Finished the final report and submit it to MDOT.

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

10/3/2011-approved no cost time extension due to the delay in signing of the Iowa State University subcontract

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

Use of bio oil is not recommended at this time. HMA Operations will continue to monitor the research and use of bio oil.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Improved Performance of JPCP Overlays

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

PROJECT MANAGER: Ben Krom

CONTRACT/AUTHORIZATION NO.	2009-0747 / Z4	PROJECT START DATE	10/20/2009
PROJECT NO.	114529	COMPLETION DATE (Original)	05/15/2012
OR NO.	OR09-141	COMPLETION DATE (Revised)	
RESEARCH AGENCY	The Regents of the University of Michigan		
PRINCIPAL INVESTIGATOR	Dr. Will Hansen		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$45,525.00	Total Vendor Budget	\$333,956.31
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$333,956.31
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$324,368.92
		Total Contract Amount Available	\$9,587.39

PURPOSE AND SCOPE

Conduct a comprehensive performance evaluation of concrete overlays used as a major rehabilitation treatment for severely distressed concrete and flexible pavements. The primary study objectives are: (1) Conduct a comprehensive field investigation of representative overlay projects, including a five-year review of the overlay demonstration project on I-75, near West Branch, which has unique design features, to find relationships of their design features and a tendency for early cracking. (2) From modeling and data analysis of field results, develop new or modified overlay designs and their related construction practices that can prevent the formation of premature distress cost-effectively. (3) Estimate the respective life/cycle costs and any likely time savings in construction for these modifications.

FISCAL YEAR 2010 ACCOMPLISHMENTS

A field investigation of six in-service overlays has been completed. Lab testing (air void analysis, etc.) of field collected concrete cores has been completed for several locations. Major findings from the field testing were presented to the Research Advisory Panel (RAP) for the I-75 West Branch demonstration project. A SurPRO 2000 rolling surface profiler was purchased to measure the change in slab surface elevations for pavements that were field tested. Wireless temperature sensors were installed in two concrete overlays that were constructed this season (US-10 EB in Midland, and M-1/Woodward Ave in Detroit). A workshop with the principle investigator and the RAP for the use of the Multi-Layer System (MLS) software for overlay analysis was held in March with Dr. Schlangen. Some initial analysis and models of unbonded concrete overlay systems has been conducted using the MLS software.

FISCAL YEAR 2011 ACCOMPLISHMENTS

The field investigation of three in-service overlays was completed, which concludes the field testing for this project. Data from temperature sensors placed in FY 2010 concrete overlays were downloaded. Temperature sensors were installed in one FY 2011 overlay (Little Mack Avenue in St. Clair Shores) in order to obtain data for early-age overlay stress analysis during hot weather paving. The lab testing of field collected concrete cores is nearly complete. Laboratory concrete mixes have been produced using different slag cement contents, in order to develop a material database of low cement content concretes for future concrete overlays. After continued use of the Multi-Layer System (MLS) software, the principle investigator (PI) doesn't believe that it is adequately designed to model concrete overlay pavements, even though it was advertised to do so. PI proposed to use HIPERPAV (High PERFORMANCE Concrete PAVing) software to analyze early-age cracking, and EverFE to evaluate the loss of joint support, dowel bar features and axle loading on slab stresses, as it relates to cracking potential. Project Manager and several Research Advisory Panel (RAP) members agreed, and have given approval for PI to move forward with analysis using these two software packages, in place of MLS.

FISCAL YEAR 2012 ACCOMPLISHMENTS

A RAP meeting was held on November 14, 2011, where the PI presented the major findings to the panel. Lab testing of field collected cores was completed; the data was summarized and sent to the RAP in draft form. The analysis of early age cracking in unbonded concrete overlays using the HIPERPAV and EverFE software was completed, with input from RAP members. A draft report was submitted regarding the I-75 Demo Project in West Branch, and comments were sent back to the PI to make revisions. PI and RAP also discussed possible new overlay design features & construction practices to address problems encountered in existing concrete overlays. Life-Cycle Cost Analysis for new/improved overlays was accomplished jointly with PI and RAP based on the major findings from this study. Several field testing sites were revisited and visually inspected to clarify & validate previously collected data. The PI has submitted, and the RAP has reviewed & commented on all draft chapters of the final report, including several appendices. RAP is awaiting submittal of the final report, with appendices, along with the implementation plan.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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 results include an implementation plan for MDOT as suggested next steps:

- Education and communication internal/external to MDOT about improvements to drainage systems installation practices.
- Improve QC measures and ID new QC/QA procedures that may be needed; cleaning drainage outlets.
- Prepare and develop revised drainage system designs to reduce the chance of pumping erosion activities.
- Monitor IRI as a pre-cursor to determining the need for CPM.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Cost Effectiveness of MDOT Preventive Maintenance Program

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

PROJECT MANAGER: Erin Chelotti

CONTRACT/AUTHORIZATION NO.	2009-0663 / Z3	PROJECT START DATE	10/01/2010
PROJECT NO.	114532	COMPLETION DATE (Original)	09/30/2012
OR NO.	OR09-160	COMPLETION DATE (Revised)	3/31/2013
RESEARCH AGENCY	Applied Pavement Technology		
PRINCIPAL INVESTIGATOR	David Peshkin		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$75,640.00	Total Vendor Budget	\$179,988.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$27,437.74	Total Budget	\$179,988.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$179,988.00
		Total Contract Amount Available	\$0.00

PURPOSE AND SCOPE

The objectives of the project include the following:

- 1) Determine the costs and benefits (in terms of pavement life extension) of each pavement preventive preservation option used by MDOT.
- 2) Document the cost and benefits of the MDOT pavement preservation program.
- 3) Determine the variability in the costs and benefits of each pavement preservation option relative to the types of pavement distress and the timing of the treatment application.
- 4) Establish a relational matrix for the selection of time, location, and pavement preservation option for given pavement project and pavement surface distresses.

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

- 1). Data collection -- Obtain from MDOT and Asset Council (PASER) a list of pavement projects where pavement preservation actions were taken, the cost of the action, and the historical pavement distress before and after preservation.
- 2) For each project, determine the benefits (pavement life extension) that are directly related to the undertaken pavement preservation action.
- 3) Prioritize the pavement preservation actions relative to their cost and benefits.
- 4) Produce final report containing all the data, recommendations, and conclusions

FISCAL YEAR 2011 ACCOMPLISHMENTS

The major task worked on in the past year has been data collection. The effort has been extensive and is near completion.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Complete data collection and perform data analysis. Develop cost/benefit results of the Capital Preventative Maintenance Program and deliver preliminary research results to the Project Manager and Research Advisory Panel for review/comments. Activities include determining the benefits (pavement life extension) that are directly related to the undertaken pavement preservation action, prioritizing the pavement preservation actions relative to their cost and benefits, and producing the final report containing all the data, recommendations, and conclusions.

FISCAL YEAR 2013 ACCOMPLISHMENTS

This year the report was finalized.

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

Additional time required to complete the draft and final version of all the project deliverables.

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

This research project supports the contention that maintaining existing good roads in good condition using the CPM program is a cost-effective strategy for MDOT. However, care should be taken to select appropriate candidates for preservation in conjunction with the appropriate treatments to ensure maximum benefit and performance. The results of this study should help to improve the guidance offered in MDOT's CPM manual on preventive maintenance treatment performance and use.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	114533	COMPLETION DATE (Original)	06/30/2014
OR NO.	OR10-044	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Mixon Hill of Michigan, Inc.		
PRINCIPAL INVESTIGATOR	Lee Mixon		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$1,691,840.00	Total Vendor Budget	\$3,689,576.45
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$954,244.79	Total Budget	\$3,689,576.45
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$1,605,720.44
		Total Contract Amount Available	\$2,083,856.01

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 13 Expenditures	Total Expenditures	Total Budget
SPR II - JN 114533	\$954,244.79	\$1,605,720.44	\$3,689,576.45
ITS - JN 111941	\$26,335.92	\$44,198.09	\$195,162.55

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
- Concept of Operations

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 PROPOSED ACTIVITIES

- 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)

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- 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

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 2013**

PROJECT TITLE: Slippery Road Detection and Evaluation

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

PROJECT MANAGER: Steve Cook

CONTRACT/AUTHORIZATION NO.	2009-0747 / Z1	PROJECT START DATE	10/20/2009
PROJECT NO.	114907	COMPLETION DATE (Original)	06/01/2012
OR NO.	OR09-119	COMPLETION DATE (Revised)	
RESEARCH AGENCY	The Regents of the University of Michigan		
PRINCIPAL INVESTIGATOR	Ralph Robinson		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$12,142.00	Total Vendor Budget	\$250,000.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$250,000.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$242,836.00
		Total Contract Amount Available	\$7,164.00

PURPOSE AND SCOPE

The purpose of this project is to evaluate the ability to detect slippery road conditions using a data collection and evaluation application on vehicles equipped with wireless on-board telemetry systems.

This project seeks more specifically to:

- Demonstrate that the above scenario is practical using real test vehicles
- Demonstrate that slippery conditions can be reliably detected using probe data and
- Assess the potential cost-benefit of a full deployment

The project will equip two vehicles with telemetry equipment to monitor driving conditions while operating on winter roads and other potentially slippery situations. Evaluations will be conducted over two full winter driving seasons. Additional equipment for more vehicles will be made available for purchase as needed. While the focus is on slippery road detection, the system will be configured to provide segment by segment travel time data in real time to monitor the impacts of weather conditions on normal roadway trip times.

FISCAL YEAR 2010 ACCOMPLISHMENTS

Quarter 1: Work was temporarily suspended during the quarter. The initial project schedule was based on an expected approval to start work in July 2009, at which time equipment would have been purchased and modified for the 2009/2010 winter season. Unfortunately, the start of work authorization only came in September 2009. This left insufficient time for vehicle instrumentation design and build before the 2009/2010 winter season. UMTRI discussed this issue with MDOT's Project Manager and a mutual agreement was reached to extend the program (at no cost) one year to accomplish the intended two winter year drive cycles.

Quarter 2: Work began on system design, architecture and vehicle configuration assumptions. A draft version of the slippery road system Requirements document was completed, along with a draft Statement of Work to solicit a software developer. Both of these documents were sent to and discussed with MDOT's project manager (PM). An investigation into available CAN interfaces was also initiated with the intent to find vehicles with ABS status messages.

Quarter 3: The Droid Data Collection Description and Requirements document was completed and refined to accommodate the Motorola Droid Smartphone and sensor interfaces needed. A n RFQ was distributed to multiple software contractors with the requirements document. A survey of outside vendors found four suppliers, from which Intersog was chosen as the most capable, with the best resources. A sample software algorithm was generated to validate the accelerometer functionality. Vehicle data was collected showing the three axis accelerometer working as expected. Investigation into available CAN interfaces continued, still with the intent to find vehicles with ABS status messages that could be used as test vehicles. This investigation led UMTRI to contact Ford Motor Company with a request to provide CAN data, which required the signing of a Non-Disclosure Agreement (NDA).

Quarter 4: A NDA with Ford was approved August 3. A 2010 Fusion data set was then obtained and filtered for the CAN messages needed. The format and constructs were extracted and sent to the contracted software developer for integration into the CAN OBDKey interface. Surface temperature sensor and interface module were received July 26, 2010, from the supplier, three months after the order was placed. The unit is now in a bench setup for testing and software development, as it requires a conversion from a standard serial output to a USB interface to allow communication with the Droid Smartphone. Framework of the software application has also been delivered and tested in several phases over the quarter.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Quarter 1: The DataProbe software application being developed is functionally completed, however, an in-stability observed has prevented extended vehicle testing. The current software version successfully implements four types of data: internal GPS/time/date, CAN data (Ford Fusion configuration), external surface temperature (Surface Patrol system), and the internal 3-axis accelerometer. Data files are formed and transferred to the Microsoft SQL server at UMTRI. The instability occurs in the

scheduling routines initiated by the power on/off cycles. The developer is currently working to resolve these issues with the instability. A separate issue involves the CAN message set provided by Ford. Two CANID messages identified do not work as specified in the documentation. These two messages include 4 signals: Air Temp, Barometer, Coolant Temp, and Odometer. UMTRI is working with Ford to find a solution. Fourteen CAN signals are being received and captured successfully. A Microsoft SQL server has been implemented at UMTRI to develop and test the system functionality, monitor data acquisition and post analyze data received. Once a data stream has been established with the launch of two vehicles, data will be transferred to the DUAP server at Mixon/Hill on a daily basis.

Quarter 2: The DataProbe software application being developed is functionally completed. The software instability identified last quarter has been resolved and all elements of the software are now functional. Detailed operational testing is being completed now to confirm full operational performance prior to release. Collected data files are being uploaded to an SQL server at UMTRI. The csv file format was finalized and is consistent with the Matlab visualization and analysis tools developed for this purpose. Refinements to the visualization tools will proceed as new needs arise. The current DataProbe application runs on a Droid with OBDKey Bluetooth connection to the CAN network of a 2010 Ford Fusion. A summary overview of initial test results and observations to date:

- Droid internal accelerometer is sensitive enough to monitor road roughness, sense potholes and observe vehicle dynamics and turning movements and a vehicles acceleration or braking.
- A rich data set for vehicle dynamics can be obtained from the Droid device without requiring CAN. The combination of GPS receiver providing lat/long, altitude, speed, direction, distance, and time along with the 3-axis accelerometer sensing of vehicle turning movements, vehicle acceleration and braking can provide critical traffic movement, congestion, incident sensing and so forth. This capability significantly enhances the systems value over sensing road roughness alone.
- Slippery Road detection is significantly improved when CAN messages are available for ABS lock-up, and Traction Control activation.

Since the software development is late being completed, the opportunity to obtain large volumes of winter driving data has passed. However, during development, some data was collected during winter weather when roads were snow covered or icy. The vehicle was tested under harsh driving conditions and the brakes and traction control subsystems were locked up intentionally. This will provide a source of data to evaluate and develop both visualization routines as well as automatic sensing algorithms for deployment with the upcoming winter cycle. Since the software development is contracted with the supplier under a fixed price agreement, no cost impact to the program has occurred.

Quarter 3: The DataProbe application developed for this project has been refined in several ways. The data output format has been adjusted; 1) Heading data source changed from the internal Droid magnetometer to a calculated value from GPS coordinates, 2) Headlight status (ON/OFF) added to the CAN data set which includes ABS, Traction control, throttle, brakes, RPM, etc., and 3) labels and format of data set re-arranged to provide easier readability. Matlab script files were created to analyze and summarize the "csv" data files collected from the DataProbe output. The first scans and maintains a summary list of the over 1200 data files contained in the database (so far). As files come in daily they are added to the list. The list contains file information such as: size, where the file data was collected, time/date collected, number of errors found (if any), min and max speeds, total distance covered, average 3-axis accelerometer values, mounting condition, CAN present, events found, and ambient temp.

Another Matlab script file was developed to evaluate and plot data from individual csv files. The script reads and extracts the raw data from the csv in a form that can be cross-plotted with other data. Since each csv file contains 300 data samples (5 minutes), the plots are also 5 minute samples. Three types of data are available for plotting: 1) location (coordinates, altitude, heading); 2) vehicle dynamics (speed, steering wheel angle, brake, throttle, pitch and roll angles); 3) road roughness (vertical forces, lateral and longitudinal forces). Using these facilities, for example, plotted data can easily identify rough spots in pavement surfaces which can be monitored over time, viewed on Google Earth, or physically examined by inspection. Due to the variations on vehicle characteristics (suspension, weight, size, tire pressure and body "tightness") and Droid mounting variations (rigidity, orientation, and resonance), the amplitude of road surface irregularities cannot be accurately measured with this system. However, considerable value can be obtained from comparative analysis. There is considerable value in having large amounts of data repetitively over the same road over long periods can be used to monitor current conditions, watch changes to the conditions over time, and identify specific faults that are comparatively worse than surrounding conditions.

Quarter 4: The DataProbe application continues to collect data files in UMTRI's SQL server database. Currently the database contains 6,400 files totaling 5.9 GB of data. While UMTRI is continuing to collect data on its vehicle, MDOT has deployed DataProbe on 10 of their internal fleet vehicles. A summary file is updated regularly to monitor progress and identify anomalies that may occur. A script file to automatically report out and summarize data volumes via e-mail to the project team is being completed. It will be activated in a week or so after final debug. A number of new Matlab programs have been generated to analyze the data collected. To assist in assessing road roughness data, two types of software programs have been developed. One type examines the accelerometer data in a file for levels, corrects for orientation errors, separates lateral and longitudinal vehicle dynamics from vertical acceleration data and computes normal distribution variance values for specific road segments. These computed variance values will be correlated to the PASER ratings used by MDOT to rate road roughness. The plotting programs have been updated to visualize this data for specific files of interest. The second type of software tools developed automatically scan the database to find specific files containing specific road segments. The user inputs two sets of coordinates that define the end points of a segment. The software searches the database looking for files containing these coordinates. The variance value of each segment found is calculated and reported. Another program searches the database finding all segments in each file, calculates the variance and reports out the results. This output containing this information can be examined to find segments with the worst case roughness, average values of segments given many vehicle passes made, changes in roughness values over time, and so forth.

A test route was defined and the route was traversed with three vehicles seven times. One vehicle was a truck equipped with profilometer instrument, one vehicle was equipped with the COGO Droid system and the third was a vehicle equipped with the DataProbe system. Each segment in the route was then rated by a skilled technician using PASER methodology. The outputs are being compared to find a correlation between the instrumented results and the manually generated PASER values. Initial results are promising. The results of this work will be provided in a report in the next quarter.

FISCAL YEAR 2012 ACCOMPLISHMENTS

PASER correlation with DataProbe measuring methodology was completed. Also, the PASER measuring algorithms was incorporated into the DataProbe application display so that drivers can read real time PASER values directly. This PASER tool and methodology was transferred to the MDOT Asset Management Division for in-use evaluation.

An evaluation was done to determine whether the PASER tools can be used to detect snowfall. It appears that the damping effects of fresh snow on the road surface can be detected with near-real time PASER measurements. This possibility has considerable potential to assist MDOT and other road commissions to deploy snow removal assets more efficiently. This approach does not require CAN data for its functioning. A method was investigated that automatically compares recent road roughness data with current roughness to detect a sudden change in roughness levels that might be caused by a snowfall.

Another approach to be investigated is monitoring the actual vehicle speed using GPS versus the wheel speed as determined by CAN data. A significant difference on a cold day can indicate slippery conditions. Likewise, comparing vehicle de-acceleration measured with GPS to vehicle speed measured by CAN may indicate wheel lockup as a result of slippery conditions. Of course, directly detecting Traction Control activation and ABS lockup via CAN messages are also preferred but not available on all vehicles.

While this work proceeds, data will continue to be collected and monitored from the MDOT vehicles equipped with DataProbe. Temperature sensing equipment will be deployed on an UMTRI employee owned Ford vehicle and an MDOT owned Ford vehicle for the winter season.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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)

Smartphone technologies have proven applications that can add-value to a DOT's operations, maintenance and asset management programs. The software used for this project, "DataProbe", has the ability to coalesce data from other sensing devices on a vehicle into a smart phone and deliver the data from those sensors to a server for analysis and use. DataProbe has proven successful in this pilot program but a number of additional functions and services are needed to make it fully scalable. These additions would include:

- DataProbe software needs funding to provide continuous technical support for updates and troubleshooting issues.

- More fleet vehicles are needed so that a comprehensive comparison of data can be documented and consistencies in data sets between various collection platform types or similar vehicles can be made.

- More CAN bus and Surface Patrol devices are needed to link to the smart phone

- Expand vehicle fleet data collection.

DataProbe and the smart phone technology in vehicles could be used to enhance a decision support system for winter maintenance operations as well. With enough penetration of fleet vehicles, this method of data collection could be used to collect atmospheric information between stationary Environmental Sensor Stations (ESS) or Roadway Weather Information Stations (RWIS). With information like this, economies of scale could be achieved for winter maintenance operations. Further, improvements toward defining initiatives like level of performance, regain time and winter severity index would likely be achieved as well.

As a result of this research project and pilot development, smart phone technology and DataProbe will be used on a Federal Highway Administration/MDOT project call Integrated Mobility Observations (IMO) 2.0. This project will start in January with data collection from 60 MDOT fleet vehicles that travel along the I-94 corridor. Data from these vehicles will be received for about 15 months from the smart phone in the vehicle, vehicle CAN bus, and a roadway surface sensing device. Data from these vehicles will be sent to DUAP2, RITIS, Navteq, NCAR, Clarus, USDOT/UMTRI Safety Pilot Model Deployment, and MDSS pilot project in the Southwest Region.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT – FISCAL YEAR 2013**

PROJECT TITLE: Timing Issues for Traffic Signals Interconnected with Highway-Railroad Grade Crossings

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

PROJECT MANAGER: Kris Foondle

CONTRACT/AUTHORIZATION NO.	2010-0298 Z2	PROJECT START DATE	8/1/2011
PROJECT NO.	114908	COMPLETION DATE (Original)	7/30/2012
OR NO.	OR10-031	COMPLETION DATE (Revised)	3/1/2013
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Dr. Tapan Datta		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$42,188.00	Total Vendor Budget	\$89,758.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$18,849.37	Total Budget	\$89,758.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$89,458.27
		Total Contract Amount Available	\$299.73

PURPOSE AND SCOPE

The state of Michigan has approximately 200 public highway-railroad grade crossings with active warning devices (railroad crossing flashers and/or gates) that are interconnected with adjacent highway traffic signal systems. The purpose of an interconnection is to allow the railroad warning device system to preempt the normal operation of the traffic signal, allowing a special traffic signal programming sequence to coordinate traffic flow through the street intersection and safely clear the highway-railroad grade crossing environment. Ideally, the design and implementation of an interconnection provides sufficient time to resolve vehicle storage, queuing and clearance issues at the railroad tracks when a train approaches the crossing.

It has come to MDOT's attention that many of these interconnection systems may not be functioning efficiently and that preemption timing adjustments may be necessary. While there have been no documented cases of vehicle-train crashes caused by less-than-optimal timing of interconnects in Michigan, field reports indicate close calls. With several interconnected traffic signals and railroad warning devices located on high-speed rail routes and heavily-traveled roadways, less-than-optimal timing for interconnected warning systems could result in preventable crashes and dire consequences. As all public crossings are within MDOT's regulatory jurisdiction and many interconnected crossings are on MDOT trunklines, this is an important issue for MDOT safety professionals in both railroad safety and highway disciplines.

However, due to the complicated track circuitry and variable train speeds involved with train prediction, many traffic engineers are simply not familiar with procedures used to develop timing for effective operation of highway-railroad warning device systems. Conversely, many railroad signal engineers are equally unfamiliar with traffic signal timing. Consequently, this creates special challenges when highway and railroad staff attempt to translate and coordinate railroad warning time with intersection warning time. A review of national research on the topic has revealed a variety of studies and templates that address certain types of interconnected systems, but there remains a significant lack of consolidated knowledge on the topic.

As our roads become more congested and as more people turn to alternative transportation options such as commuter rail or high-speed rail, the need for effective and efficient coordination of railroad and roadway traffic becomes critically important. This is especially true on high volume roads that intersect with high-speed passenger and commuter rail services, as motorists and increasing numbers of rail users alike would benefit from enhanced highway safety systems. The purpose of this research is to compile and review existing interconnection data and, if possible, to develop a uniform template that can be applied to any highway-railroad intersection configuration.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Contract was awarded and kick-off meeting was conducted in August 2011. MDOT staff finalized and transmitted database of research locations to the research team in late September 2011. The research team started its review and analysis. At close of FY 2011, this project was basically very near its inception.

FISCAL YEAR 2012 ACCOMPLISHMENTS

During FY 2012, WSU successfully conducted research efforts and held quarterly meetings to discuss objectives and the progress of the research toward those objectives. Major activities included study of interconnected highway-railroad grade crossings, review of timing operations to help establish existing unmet needs, lab work to simulate highway-railroad grade crossing configurations, computer-aided modeling for grade crossing/intersection timing, and collaboration between the research team and MDOT staff. WSU completed its draft report on time and as scheduled, submitting said document to MDOT in late FY2012. MDOT staff turnover, changes to the RAP team, and alternative staff assignments have delayed the MDOT review of the draft final report. Pending the MDOT RAP response on the draft report, the project is now expected to be completed in early FY 2013, at which time results will be available for review and implementation, as applicable.

FISCAL YEAR 2013 ACCOMPLISHMENTS

During FY 2013, WSU responded to MDOT comments on the draft final report and incorporated revisions per MDOT requests. Upon validation of changes, WSU staff then completed its work and submitted its final report to MDOT, including all required copies and related materials. MDOT staff convened an implementation strategy session and discussed ways in which the results of the study could be incorporated into future work operations.

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

Initial revision was due to turnover in RAP staff and internal MDOT delays in reviewing draft final report. (approval date) No further revisions.

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

Implementation recommendation is for MDOT staff to use report results and software tool internally during project development and on-site inspections. Recommendation also incorporates continued contact with WSU to solicit their voluntary participation in reviewing interconnected locations in SE Michigan when projects may impact traffic signals. Upon field validation of results and effectiveness of software tool, MDOT staff will reconvene to further discuss strategy for sharing externally. Follow-up will be provided to all parties involved with the research project.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	114911	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$68,000.00	Total Vendor Budget	\$68,000.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$27,200.00	Total Budget	\$68,000.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$40,800.00
		Total Contract Amount Available	\$27,200.00

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 PROPOSED ACTIVITIES

Review final draft and communicate the results of the study to the department. The final deliverables for this project will be completed in FY14. MDOT will determine the best course of action for implementation.

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 2013**

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.	114912	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$0.00	Total Vendor Budget	\$215,422.36
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$215,422.36
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$86,168.94
		Total Contract Amount Available	\$129,253.42

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

Complete Milestones 3, 4, 5, 6, and 2014 - ITS World Congress demonstration

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Complete project tasks 3-6.

- 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 final project report.

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 2014 we anticipate the next milestone will be completed.

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

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	114937	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$55,967.00	Total Vendor Budget	\$66,756.87
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$21,880.31	Total Budget	\$66,756.87
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$51,980.10
		Total Contract Amount Available	\$14,776.77

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 PROPOSED ACTIVITIES

Final completion of the report and the findings will be presented and accepted by MDOT early in FY 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 to add value to the final product.

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

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Examining the Disadvantaged Business Enterprise (DBE) Program

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

PROJECT MANAGER: Pat Collins

CONTRACT/AUTHORIZATION NO.	2010-0296 Z9	PROJECT START DATE	10/01/2010
PROJECT NO.	115041	COMPLETION DATE (Original)	09/30/2012
OR NO.	OR10-049	COMPLETION DATE (Revised)	11/30/2012
RESEARCH AGENCY	The Regents of the University of Michigan		
PRINCIPAL INVESTIGATOR	Timothy Davis		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$12,162.11	Total Vendor Budget	\$193,065.02
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$12,162.11	Total Budget	\$193,065.02
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$167,448.96
		Total Contract Amount Available	\$25,616.06

PURPOSE AND SCOPE

Key stakeholders need a better understanding of the role, legal responsibilities and accomplishments of the Michigan Department of Transportation (MDOT) Office of Business Development (OBD) and the Disadvantaged Business Enterprise (DBE) Program. The DBE Program recruits and certifies DBE firms, implements an On-the-job Training Program, conducts contractor and DBE monitoring, and conducts external equal opportunity compliance monitoring. Misconceptions about the overall program's mission, role and responsibilities can lead to various questions about the program and the continuous education of stakeholders.

FISCAL YEAR 2012 ACCOMPLISHMENTS

1. Identify best practices and methods for communicating program role, mission, and responsibilities to key stakeholders. The researchers successfully completed this task by talking to DBE Program managers from around the country, looking at various websites and researching best practices of private firms. The researchers also attended the 2012 AASHTO Civil Rights Subcommittee Conference and interviewed several practitioners. This task was successfully accomplished.
2. Identify and survey stakeholders to determine levels of knowledge about this program and their ideas about the program's role and responsibilities.

The researchers surveyed several MDOT staff, DBE firms and prime contractors. As a result of these surveys the researchers were able to determine the level of knowledge and program understanding of individuals in these three groups.
3. Develop a report that summarizes findings, assist with the education/re-education of stakeholders and incorporate national best practices.
A report was prepared that provides action steps for educating/re-educating stakeholders. This report also summarized the findings of the researchers and best practices. Suggestions for educating/re-educating stakeholders was also included.
4. Develop an action plan to be used to communicate the role, responsibilities, and mission of this program.
This task was satisfactorily completed and well outlined in the final report.
5. Create effective communication tools (video/ PowerPoint presentation, etc.) to be used to educate stakeholders, gain support, and assist with the education/re-education of stakeholders.

This task was removed from the project per the request of Federal Highway Administration Officials.

FISCAL YEAR 2013 ACCOMPLISHMENTS

- 1) Final report quality review and completion
- 2) Project was closed out

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

The extension provided time to prepare a formal presentation about the findings and make a few minor edits to the report.

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

The implementation recommendations were outlined in the report in both a written format and a work plan. These tasks are to develop a work plan for gaining executive management approval of the suggested implementation steps; Assess the level of executive leadership support and determine how deficits can be eliminated; clarify how the DBE Program is viewed by stakeholders within the Michigan Department of Transportation about the program; improve communications to stakeholders by sharing our goals and having more

internal communications; Do more to recognize successful DBE firms and make improvements to the DBE Program website. Andre Clover was a great help to the research team and ensured we received a high quality report.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Skewed Bridges

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

PROJECT MANAGER: Peter Jansson

CONTRACT/AUTHORIZATION NO.	2006-0413 / Z4	PROJECT START DATE	07/12/2007
PROJECT NO.	115196	COMPLETION DATE (Original)	10/12/2009
OR NO.	OR08-016	COMPLETION DATE (Revised)	09/30/2010
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Dr. Gongkang Fu		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$12,162.11	Total Vendor Budget	\$214,975.71
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$7,565.74	Total Budget	\$214,975.71
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$214,975.71
		Total Contract Amount Available	\$0.00

PURPOSE AND SCOPE

The objective of this research project is to simplify the design for skewed bridges that are commonly used in Michigan, by developing design tools. The simplified design methods should maximize the durability of skewed bridges in Michigan. The scope includes literature review, finite element modeling, field testing, calibration of models, and design recommendations.

FISCAL YEAR 2008 ACCOMPLISHMENTS

Literature review was completed. Two bridges were selected for field testing, one with concrete beams and one with steel beams. Instrumentation for the two bridges was preliminarily planned. Initial finite element modeling performed.

FISCAL YEAR 2009 ACCOMPLISHMENTS

Calibration for sensors used in bridge instrumentation was completed. Refinement of the test bridge models was completed. The Woodruff Road bridge (steel beams) was instrumented during the concrete bridge deck pour and load tested with truck live load after the bridge deck concrete cured. Calibration of the finite element model using the test data was performed. Development of additional finite models for steel beam bridges with varying skews, span lengths, and beam spacings was begun.

FISCAL YEAR 2010 ACCOMPLISHMENTS

Concluded development and refinement of finite element models for typical MDOT concrete I-beam and steel beam bridges. Developed design recommendations and tools for designers. Submitted and revised draft final report, currently awaiting approval of final report.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Review of draft final report and finite element models.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Review of draft final report and finite element models.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Review of the final draft was completed and the final report was revised and submitted

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

Due to delays in the letting of the second bridge selected for instrumentation and load testing, a no-cost time extension was submitted and approved on 9/24/2009. The revised completion date was 9/30/2010. The project report review was delayed several years.

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

Findings will be presented to the MDOT bridge committee for discussion and department wide implementation.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Usage & Impact of the Michigan Vehicle Infrastructure (VII) Integration Program

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

PROJECT MANAGER: Steve Cook

CONTRACT/AUTHORIZATION NO.	2007-0371	PROJECT START DATE	02/15/2007
PROJECT NO.	115235	COMPLETION DATE (Original)	12/31/2008
OR NO.	OR07-002	COMPLETION DATE (Revised)	08/31/2011
RESEARCH AGENCY	Mixon-Hill		
PRINCIPAL INVESTIGATOR	Lee Mixon		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$1,989.00	Total Vendor Budget	\$3,500,000.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$3,500,000.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$3,499,999.63
		Total Contract Amount Available	\$0.37

PURPOSE AND SCOPE

To support MDOT and its partners in the evaluation of the uses and benefits of Vehicle Infrastructure Integration (VII)-related data. Evaluate and determine how the VII program will impact how state and local departments of transportation do business as a result of the significant quantity of additional data collected on all major (and eventually minor) roads.

FISCAL YEAR 2008 ACCOMPLISHMENTS

- Procured, configured, and installed the computing hardware and software for Data Use Analysis Processing (DUAP) project development and deployment.
- Completed, reviewed, and issued the Systems Architecture Description (frame work of hardware to software). The document has been posted to the MDOT VII Web site for stakeholders' general use.
- Completed, reviewed, and issued the System Requirements Specification, building on the needs expressed in the Concept of Operations and the framework described in the System Architecture Description. The document has been posted to the MDOT VII Web site for stakeholders' general use.
- Completed development to gather data from the Chrysler FastFeedback vehicle fleet and the Michigan ITS Center freeway vehicle detectors.
- Completed development of Prototype 1 of the DUAP Web site (<http://duap.mixonhill.com>), which allows users to select particular Chrysler vehicle fleet probe data and MITS Center traffic data from the DUAP archives to be displayed on maps.
- Pursued fleet probe data hardware, software, and services to supplement existing data sources.

FISCAL YEAR 2009 ACCOMPLISHMENTS

- Completed connection to and import of archived vehicle probe data from the USDOT VII Proof-of-Concept demonstration on the Michigan VII testbed. Updated Prototype 1 of the DUAP Web site to accommodate display of the additional data.
- Completed the draft System Design Description based on the System Requirements Specification.
- Started drafts of System Test Scripts based on the System Requirements Specification and System Design Description.
- Completed development of enhancements (Prototype 2) for the DUAP Web site (<http://duap.mixonhill.com>) to increase system performance, create a more efficient user interface, and display average speed along road segments.
- Implemented tabular data output feature for Prototype 2 of DUAP.
- Pursued fleet probe data hardware, software, and services to supplement existing data sources. Evaluated potential providers of on-board data acquisition devices.
- Provided support for DUAP-related presentations at ITS World Congress.
- Provided DUAP data to the USDOT/FHWA VII Road Weather Management Program for assessing the use of vehicle probe data in weather applications.
- Reviewed the draft System Design Description.
- Evaluated and implemented a DUAP connection to the Teletrac XML gateway to collect data from 20 MDOT vehicles previously instrumented by Teletrac.
- Supported MDOT DUAP presentations at ITS Michigan 2009.
- Worked for MDOT with Motorola and its team of subcontractors (IOSiX, TeleRad) to identify and implement the means of equipping 70 MDOT vehicles with vehicle telematics equipment for IntelliDrive probe data collection.

-Met with MDOT and Michigan International Speedway (MIS) to assess use of MIS facilities as an IntelliDrive test bed.

FISCAL YEAR 2010 ACCOMPLISHMENTS

- Continued to collect data from multiple sources into DUAP data repository.
- Worked with MDOT in deploying data collection from 70 MDOT vehicles.
- Developed methodology for analyzing new data, including accelerometry, from MDOT fleet.
- Standardized processing and presentation of fleet probe data in DUAP user interface.
- Performed initial structured testing of pavement data acquisition and analysis from MDOT vehicles.
- Supported MDOT DUAP presentations at ITS Michigan 2010, with potential data partners and with other agencies.
- Developed and demonstrated methods of determining potential pothole locations and relative pavement condition measures from probe vehicle accelerometry.
- Developed and demonstrated data acquisition from third-party Android phone application.
- Started development of collector for demonstration of OnStar probe data collection.

FISCAL YEAR 2011 ACCOMPLISHMENTS

- Continued collection of Chrysler fleet, MITS center, and Teletrac data
- Continued work with MDOT to generate and collect data from MDOT fleet
- Developed and demonstrated method of determining potential pothole locations from probe vehicle accelerometry
- Completed development of collector for demonstration of OnStar probe data collection
- Supported MDOT preparations for presentation at ITS World Congress in October 2010
- Supported MDOT in preparing for discussions with USDOT on DUAP
- Continued monitoring for and collection of vehicle probe data from the IOSiX devices in MDOT vehicles
- Developed consolidated reports of incoming IOSiX probe data files
- Continued monitoring for and collection of vehicle probe data from the COGO Android applications/devices
- Developed means of correlating and concurrently displaying acceleration and pothole data from multiple sources
- Performed comparative structured testing of pavement condition data from IOSiX, COGO Android, and profilometry van on May 4-5
- Analyzed pavement condition test data
- Prepared pavement condition data presentation for demonstration at ITS Michigan on June 1

FISCAL YEAR 2012 ACCOMPLISHMENTS

The Final DUAP Project Summary Report was submitted March 2012. The report includes project summary and overview, description of work and deliverables completed conclusions and recommendations for further research.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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

3/18/2011 – The project was granted a time extension amendment to provide sufficient time to perform services.

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

DUAP's purpose, simply stated, was to assess the use of data from connected vehicles (originally, vehicle-infrastructure integration) to improve transportation agency operations. DUAP research was therefore based and developed on a presumption of data being available from other connected vehicle projects. Activities undertaken as part of DUAP were directed at applications of that data within MDOT and other transportation agencies.

The DUAP research was forced to take a different approach when the original connected vehicle Proof-of-Concept demonstration did not produce the intended volume and variety of connected vehicle data. Other sources of vehicle probe data outside MDOT had similar issues of scale and diversity, and were additionally found to be cost-prohibitive. DUAP research therefore turned toward identifying and developing sustainable sources of data within MDOT to support transportation agency applications. Provisions were made for collecting data from MDOT's own fleet vehicles across the state. The prototype system used to collect the data has enabled the DUAP program to demonstrate the ability to collect data and provide applications specifically related to the improvement of DOT operations.

DUAP has been successful in fulfilling its original purpose—to evaluate uses and benefits of data from probe vehicles in agency management and operations. The program demonstrated, for example:

- Acquisition of data from multiple probe data sources;
 - Deployment of aftermarket on-board sensors and data acquisition units for measurements of specific operational interest to DOTs (in this case, accelerometers);
 - Sorting and aggregation of multiple data types from each of the sources;
 - Synthesis of performance measures for specific DOT applications (for example, segment average speeds, or relative pavement conditions) from the probe data; and
 - Presentation of raw probe and processed data in consistent, flexible map-based operator interfaces.
-

DUAP experience with data collection has demonstrated its ability to get and aggregate data from multiple sources and formats into an integrated repository. The system philosophy and architecture of isolating the data collecting components from the data repository enables the system to add new collectors as needed to accommodate interfaces with varying data specifications, timing, and network protocols. If a data source already provides an interface, a new collector component for DUAP will be the most effective means of getting the data from that particular source.

Based on this experience, it is recommended that further research using the prototype system demonstrated in DUAP be developed in the DUAP-2 program. DUAP-2 will identify, develop solutions for, and fulfill the data needs of MDOT as they contribute to improving the cost efficiency and enhancing the effectiveness of its operations, with the emphasis on integrating mobile data gathered as part of MDOT's ongoing operations with other data sources from across the agency.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Feasibility of Digital Imaging to Characterize Earth Materials

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

PROJECT MANAGER: Richard Endres

CONTRACT/AUTHORIZATION NO.	2010-0296 / Z2	PROJECT START DATE	10/01/2010
PROJECT NO.	115238	COMPLETION DATE (Original)	12/31/2011
OR NO.	OR09-158	COMPLETION DATE (Revised)	
RESEARCH AGENCY	University of Michigan		
PRINCIPAL INVESTIGATOR	Dr. Roman Hryciw		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$5,781.00	Total Vendor Budget	\$129,707.10
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$129,707.10
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$129,707.10
		Total Contract Amount Available	\$0.00

PURPOSE AND SCOPE

The objectives of this project include the following:

- 1) Identify or develop innovative methods for soil characterization.
- 2) Test and evaluate the new method for potential application in Michigan.
- 3) Investigate implementation opportunities or challenges for the new method.

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

- 1) Perform a literature search on developed alternatives and approaches for image-based soil grain size assessment.
- 2) Develop an optimal method based on the available alternatives.
- 3) Perform testing to validate this method, including a range of soil types to fill gaps in previous research.
- 4) Refine the procedure and produce instructional materials to make the new method readily usable by technicians.

FISCAL YEAR 2011 ACCOMPLISHMENTS

- 1) A literature review of methods for aggregate size distribution assessment was completed. A comprehensive report on the literature review titled "A Review of Commercial Systems for Determination of Soil Particle Size Distributions" by Nicholas J. Brant, Hyon-Sohk Ohm, Yong Sub Jung and Roman D. Hryciw was submitted in January, 2011.
- 2) Construction of the prototype sedimaging system was completed for characterizing the size of aggregate particles less than 2mm in diameter. It was determined that about 10 minutes were required to perform a test.
- 3) Sedimaging tests were performed on a limited number of soils indicating similar graphical results to sieving, though they are not exactly the same. The tests are not similar enough to replicate each other.
- 4) A method was developed for determining the percentage of fines, the equivalent to "loss by wash over a #200 sieve"
- 5) For particles larger than 2 mm, a "Translucent Segregation Table (TST)" test was designed and constructed. Tests were performed showing agreement with sieving results.
- 6) Camera systems and software for image based characterization of soils were refined.
- 7) Demonstrations of the Sedimaging and TST tests were held at the University of Michigan (UM) for MDOT personnel and representatives from the largest quarries in SE Michigan including E. C. Levy Co., Great Lakes Aggregates and Stoneco.
- 8) A Sedimaging system was installed in the METRO region soils laboratory and MDOT personnel were trained in its use.
- 9) Michigan Test Methods (MTM) for Sedimaging and the Translucent Segregation Table (TST) tests were developed.
- 10) A "blind" test study for statistical comparison to sieving tests was initiated from samples prepared by MDOT.

FISCAL YEAR 2012 ACCOMPLISHMENTS

- 1) Completion of statistical analysis of specimens tested in "blind study" (MDOT activity).
- 2) Incorporation of "blind study" data into final report.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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

No formal revisions have been requested.

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

MDOT will support further research at the national level for image based characterization of aggregates. MDOT will not be implementing this test for quality assurance testing because it does not exactly replicate the sieve test results.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

PROJECT TITLE: Safety Analysis of 4-Lane to 3-Lane Conversions (Road Diets) in Michigan

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

PROJECT MANAGER: Tracie Leix

CONTRACT/AUTHORIZATION NO.	2010-0294 / Z2	PROJECT START DATE	10/01/2010
PROJECT NO.	115241	COMPLETION DATE (Original)	12/31/2011
OR NO.	OR09-118	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Dr. Richard Lyles		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$11,279.00	Total Vendor Budget	\$149,281.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$149,281.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$138,002.39
		Total Contract Amount Available	\$11,278.61

PURPOSE AND SCOPE

The objectives of this project include the following:

- 1) Determine the safety impact 4-lane to 3-lane conversions have had on the corridors in Michigan where this countermeasure has been implemented.
- 2) Determine the impact on motorist delay of those conversions.
- 3) Develop a statistically sound crash reduction factor for 4-lane to 3-lane conversions.
- 4) Provide guidance within the draft and final reports on when MDOT and/or local agencies should be considering the use of a 4-lane to 3-lane conversion for a corridor.

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

- 1) Literature Review -- Review relevant research and provide a summary to the oversight team.
- 2) Data Collection -- Collect data on the segments that have been converted, including location of installations, installation dates, crash data, volume information, photos of locations, before and after installation, etc.
- 3) Data Analysis and Crash Reduction Factor (CRF) Development -- Analyze the data collected to capture crash and traffic delay impacts of the conversions. In addition, develop a crash reduction factor(s) based on this analysis for guiding effective future application of the treatment.
- 4) Develop Preliminary Draft Report.
- 5) Develop Final Report consisting of all data collected, pictures taken, study format and findings, and recommendations.

FISCAL YEAR 2011 ACCOMPLISHMENTS

First Quarter: Literature review 50% complete. Data collection ~12% complete.

A survey was developed by the PI in order to facilitate consistent data collection across sites and jurisdictions. The survey conducted of personnel assembled by MDOT regarding site identification and data collection.

Second Quarter: Literature review 80% complete, data collection 60% complete, data analysis and CRF or Crash Modification Factor [CMF] development 15% complete, development of preliminary draft final and other reports 10% complete.

The principal investigator (PI) conducted a follow-up survey of state and local personnel involved in "road diet" projects. These were non-respondents to the earlier survey and newly identified individuals through FHWA (FHWA personnel had a road diet project list) and through a variety of other sources (e.g., e-mails accompanying earlier survey responses and other project-related correspondence).

The PI, consultant (including quality assurance), and (lead) graduate student provided direction for developing site graphics (e.g., to determine adjacent land use and driveway density), provided direction for site data analysis, and reviewed preliminary crash data in the context of identifying site types for which accident modification factors (AMFs) can be developed. Data problems were also discussed (e.g., issues with coded site information, irregularities w/crash data). Alternative definitions of a "unit of analysis" were developed and proposed. The PI also provided day-to-day supervision and management of the project and reviewed all work products from others.

Graduate and undergraduate students coded and checked site surveys, developed site graphics for each site, developed reviews of projects in the literature, and assembled site-related data (i.e., the graphics and ADTs). The lead graduate student also provided direction and management for specific tasks done by other students.

Third Quarter: Literature review 95% complete, data collection 90% complete, data analysis and CRF [CMF] development 50% complete, development of preliminary draft final and other reports 40% complete, development of final report 30% complete.

The PI, consultant (including QA), and (lead) graduate student provided direction for final definitions for all sites, provided direction for site data analysis, and reviewed crash data in the context of developing AMFs. While alternative definitions of a “unit of analysis” were developed and proposed, they were not pursued. The PI also provided day-to-day supervision and management of the project and reviewed all work product from others.

Graduate and undergraduate students finalized site graphics, searched for PR/implementation-related material, searched for and/or downloaded average daily traffic (ADT) and crash data for each site, and developed background trends (including graphics) for ADT and crash data for each site.

Fourth/Last Quarter:

The PI, consultant (including quality assurance), and (lead) graduate student provided direction for and/or executed the final operational analysis, development of CMFs, and preparation of all final report documents. The PI also provided day-to-day supervision and management of the project and reviewed all work products from others.

Graduate and undergraduate students finalized the operational analysis and performed background analysis for CMFs.

FISCAL YEAR 2012 ACCOMPLISHMENTS

The draft final report was submitted in FY 2012 after the project deliverables due date. The draft was reviewed by MDOT staff and MSU submitted a final report with revisions.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Final report was completed, approved, and received in FY 2012.

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

N/A

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

The final report will be reviewed and recommendations considered for implementation.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	115243	COMPLETION DATE (Original)	1/31/2014
OR NO.	OR10-030	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Dye Management Group, Inc.		
PRINCIPAL INVESTIGATOR	Robert Zilay		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$319,688.00	Total Vendor Budget	\$489,997.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$373,525.00	Total Budget	\$489,997.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$406,262.00
		Total Contract Amount Available	\$83,735.00

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 PROPOSED ACTIVITIES

Develop final recommendation report and implementation strategy.

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 2013**

PROJECT TITLE: Roadside Corridor Planning

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

PROJECT MANAGER: Lynn Lynwood

CONTRACT/AUTHORIZATION NO.	2010-0298 Z8	PROJECT START DATE	6/30/2012
PROJECT NO.	115244	COMPLETION DATE (Original)	6/30/2013
OR NO.	OR12-014	COMPLETION DATE (Revised)	8/30/2013
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Timothy Gates		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$190,000.00	Total Vendor Budget	\$190,000.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$178,426.35	Total Budget	\$190,000.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$188,198.38
		Total Contract Amount Available	\$1,801.62

PURPOSE AND SCOPE

To identify a broad range of roadside functions and values to support integrated decision-making and policy level considerations for ROW use.

Perform a roadside contextual analysis:

1. Conduct a landscape level inventory and assessment using a transect approach to identify and map context zones within the corridor.
2. Using geospatial technologies, compile features and characteristics within each context zone, including environmental, cultural and socio-demographic considerations.
3. Investigate existing geo-spatial data sets for applicability and compatibility to corridor contextual analysis.
4. Identify critical data sets that are needed to complete contextual analysis for corridor management planning, and provide priority recommendations for future data collection. Demonstrate this process can be replicated across the state regional areas in the future for other corridor planning efforts.

Perform a roadsides corridor refinement:

1. Using a proposed pilot corridor on I-94 between Mile 88 and the I-69 Interchange in Kalamazoo and Calhoun counties, which spans urban, suburban, and rural contexts. Adjacent land use considerations include tribal lands, Fort Custer federal lands, the Kalamazoo River Watershed and the Battle Creek metropolitan area.
2. Undertake a planning level analysis of the pilot corridor. Look at environmental data (land cover type, flora and fauna, watersheds, soils, air quality); existing and proposed land use (zoning, jurisdictional boundaries, real estate, infrastructure, and safety considerations). The analysis will consider socio-demographic information in support of future stakeholder engagement.
3. Identify affected stakeholders, resource/regulatory agency, local planning interests and community partners within the pilot area.
4. Identify interrelated conditions to prioritize opportunities and constraints for use of the roadside environment using the best available geo-spatial data sets.
5. Identify safety considerations associated with non-transportation use of the ROW.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Project kick-off meeting with the PI, PM, RAP, and RM was held on July 24, 2012. Corridor stakeholder groups were identified. A focus group meeting with agency stakeholders for the I-94 pilot corridor was held on Thursday, September 13, 2012. Literature review is in progress.

FISCAL YEAR 2013 ACCOMPLISHMENTS

1. Completed literature review
2. Completed state of the practice survey
3. Completed survey of MDOT regional and local practices
4. Compiled and sorted relevant GIS datasets for I-94 corridor pilot;
5. Developed framework and analysis tool for performing contextual analysis
6. Completed contextual analysis for pilot corridor
7. Final Report submitted
8. Conducted training session to demonstrate analysis tool

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

The extension provided sufficient time for WSU to deliverable satisfactory draft final deliverables 90 days in advance of the project end date, for the PM and RAP to complete a thorough review, and for WSU to make subsequent necessary revisions to all deliverables prior to final submission.

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

This study was intended to identify and investigate the availability of relevant geospatial datasets needed to inform right of way use decisions as a first step to understanding the efficacy of a GIS analysis approach. Important gaps in GIS right of way boundary data and utility accommodation data were identified and efforts have been launched with Real Estate and Utilities/Permits to close these gaps. This research developed an analysis process that allows MDOT to upload datasets from a variety of entities to create a layered map to screen for possible impacts and to understand competing priorities associated with various actions on the subject corridor.

MDOT will use this methodology to assemble, reconcile and integrate existing geo-referenced shape files in order to share data, increase collaboration, and improve the quality and speed of transportation decision-making – for both projects and right of way use permits.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	116238	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-038	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Lawrence Technological University		
PRINCIPAL INVESTIGATOR	Elin Jensen		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$137,825.00	Total Vendor Budget	\$249,999.97
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$99,792.04	Total Budget	\$249,999.97
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$99,792.04
		Total Contract Amount Available	\$150,207.93

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, profometer and hammer
- Preparation of specimen II

FISCAL YEAR 2014 PROPOSED ACTIVITES

Complete testing on group II and III.
Perform field evaluation in spring of 2014.
Prepare 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 2013**

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.	116248	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$201,851.00	Total Vendor Budget	\$201,851.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$169,598.47	Total Budget	\$201,851.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$169,598.47
		Total Contract Amount Available	\$32,252.53

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 PROPOSED ACTIVITIES

Task 6. Develop Guidance

- Complete guidance for analysis process
- Develop an implementation plan

Task 7. Prepare final report

- Complete the 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 2013**

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.	116251	COMPLETION DATE (Original)	12/15/2013
OR NO.	OR10-042	COMPLETION DATE (Revised)	4/15/2014
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Chris Eamon		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$80,000.00	Total Vendor Budget	\$102,239.41
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$74,638.22	Total Budget	\$102,239.41
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$74,638.22
		Total Contract Amount Available	\$27,601.19

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 PROPOSED ACTIVITES

- Complete remaining tasks.
- Task 4. Compare WIM Data to MDOT Vehicles
- Task 5. Compare Load Effects to Design and Rating Load Effects
- Task 6. Develop Recommendations.
- Publish final report

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 will allow enough time to carefully complete the data analysis required in the remaining tasks and thoroughly develop well-constructed design and rating recommendations. Approved 10/8/2013.

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

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	116558	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-047	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan State University		
PRINCIPAL INVESTIGATOR	Milind Khire		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$99,453.00	Total Vendor Budget	\$99,453.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$34,885.83	Total Budget	\$99,453.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$34,885.83
		Total Contract Amount Available	\$64,567.17

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. Underprediction 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 underclearance 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 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, dataloggers, hydraulic sensors, etc.).
- May 3, 2013 presented draft results from heat flow simulation model.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

- 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
- Final Report; including an executive summary with 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 2013**

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.	116559	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$100,000.00	Total Vendor Budget	\$163,854.14
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$45,276.10	Total Budget	\$163,854.14
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$45,276.10
		Total Contract Amount Available	\$118,578.04

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 PROPOSED ACTIVITIES

Continue with Tasks 2, 3, and 4.

Begin the following Tasks

Task 5: Development of use construction inspection, and maintenance guidelines

Task 6: Field Implementation and Testing for Validation

Task 7: Prepare and submit final deliverables

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 2013**

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.	117426	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$200,000.00	Total Vendor Budget	\$311,125.21
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$52,092.74	Total Budget	\$311,125.21
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$52,092.74
		Total Contract Amount Available	\$259,032.47

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 PROPOSED ACTIVITIES

Task 4 – Simulation Studies of np-UHPC Components: UofM will prepare finite element models of the bridge deck application specified in Task 1 using the material properties identified for the 3 mixes of np-UHPC developed in Task 3. The models, which will account for elastic material response, will be exercised to investigate their behavior under common highway loading conditions. The calculated response will be contrasted to the computed response of equivalent components made from conventional materials.

Task 5 – Field and Structural Testing: Working with MDOT engineers, UofM will conduct field and structural testing to demonstrate proof-of-concept and provide confidence for MDOT to consider implementation and widespread use of the new np-UHPC.

Task 6 – Synthesis: Using the information gleaned from Tasks 1 through 5 and additional information obtained from the literature, UofM will develop design, operational, and maintenance guidance for the chosen np-UHPC applications. The guidance will pertain to methods of design, recommendations for development length of steel reinforcement, and wet concrete properties.

Task 7 – Cost Benefit Guidance: The data from Tasks 3 and 4 will provide an opportunity of identify the cost/benefit characteristics of the developed np-UHPC for the two applications studied in Task 4. UofM will state assumptions for this exercise so that MDOT engineers can understand the limitations when applying it to future situations. Based on the proposals outlined in Task 3, UofM will also refine the means for classifying the new np-UHPC.

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 2013**

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.	117428	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR10-041	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Upul Attanayake		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$151,291.24	Total Vendor Budget	\$249,997.83
MDOT Budget FY 2013	\$36,531.17	Total MDOT Budget	\$36,531.17
Vendor FY 2013 Expenditures	\$67,469.62	Total Budget	\$286,529.00
MDOT FY 2013 Expenditures	\$5,660.57	Total Expenditures	\$73,130.19
		Total Contract Amount Available	\$213,398.81

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 PROPOSED ACTIVITIES

Task 1: State-of-the-Art Literature Review
Continue with literature review.

Task 2: Bridge Structural Analysis
Conduct load testing.
Update and calibrate model using load test data.

Task 4: SHM System Installation, Calibration, and Data Analysis
Data collection and analysis will be continued.

Task5: Technology Integration and Training:
SHM system capabilities will be demonstrated.
MDOT staff will be trained on the use of equipment.

Task 6: Reporting
Final report.

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

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

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

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	117429	COMPLETION DATE (Original)	10/31/2014
OR NO.	OR10-043	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Theresa Ahlborn		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$190,000.00	Total Vendor Budget	\$243,251.57
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$102,800.70	Total Budget	\$243,251.57
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$102,800.70
		Total Contract Amount Available	\$140,450.87

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. Begin analyzing field data.

FISCAL YEAR 2014 PROPOSED ACTIVITES

Spring field reviews of bridges. Review and analyze field data. Summarize findings and prepare the final report.

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

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

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

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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

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

PROJECT MANAGER: Jill Morena

CONTRACT/AUTHORIZATION NO.	2013-0070 Z1	PROJECT START DATE	2/8/2013
PROJECT NO.	117432	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR13-007	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Tapan Datta		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$200,000.00	Total Vendor Budget	\$249,999.90
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$54,608.59	Total Budget	\$249,999.90
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$54,608.59
		Total Contract Amount Available	\$195,391.31

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 PROPOSED ACTIVITES

The following tasks are proposed:

1. Continuation of “after” period crash review
2. Review of new and forthcoming literature relevant to centerline rumble strips
3. Completion of survey and beginning analysis.
4. Capture and analyze traffic volume data from the MDOT Traffic Monitoring Information System Database
5. Conduct focus group meeting.
6. Prepare ‘How-to’ guidelines.
7. Prepare 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 2013**

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.	117433	COMPLETION DATE (Original)	5/15/2015
OR NO.	OR13-004	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Peter Savolainen		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$120,000.00	Total Vendor Budget	\$250,000.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$11,730.66	Total Budget	\$250,000.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$11,730.66
		Total Contract Amount Available	\$238,269.34

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 PROPOSED ACTIVITES

- 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
 Task 7: Begin field testing of strategies
 Task 8: Begin developing decision support tool, if Part 2 is authorized

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 2013**

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.	117434	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$160,000.00	Total Vendor Budget	\$268,560.45
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$17,751.05	Total Budget	\$268,560.45
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$17,751.05
		Total Contract Amount Available	\$250,809.40

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 PROPOSED ACTIVITES

Task 2: Surveying other states and Canada:

- Complete the survey of other states and Canada

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

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

- Examine usability of WIM data for identifying locations with higher overweight problems
- Acquire Michigan Truck Flow Model from 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 2013**

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.	117436	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$100,000.00	Total Vendor Budget	\$233,394.69
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$10,415.15	Total Budget	\$233,394.69
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$10,415.15
		Total Contract Amount Available	\$222,979.54

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 PROPOSED ACTIVITES

- Task 3 - User perception survey
- Task 4 - Collecting performance data
- Task 5 - Selection of analysis tool and modeling ITS corridor
- Task 6 - Costs and benefits of ITS system

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 2013**

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.	117437	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$25,000.00	Total Vendor Budget	\$186,661.15
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$17,845.03	Total Budget	\$186,661.15
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$17,845.03
		Total Contract Amount Available	\$168,816.12

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 PROPOSED ACTIVITIES

During the Fiscal Year 2014, the following tasks will be completed:

1. Task 1: Conduct a comprehensive Literature Review
This task will continue throughout this research project.
2. Task 2: Perform a Survey of Winter Weather States
 - a. The survey responses will be analyzed during the next quarter.
 - b. Follow-up contacts will be made with selected respondents to collect more information.
3. Task 3: Compare the Effectiveness of Tow Plow to Traditional Plow
 - a. Comparison sites will be finalized and test sections will be established during the next quarter.
 - b. Dynatest "Survey" program will be configured to measure the pavement condition behind the Tow Plow/traditional snow plow.
 - c. Comparison measurements will be performed if winter weather storms occur during the next quarter.
4. Task 4: Perform Benefit-Cost Analysis for Tow Plow to Truck/Wing Plow setup
 - a. Benefit-cost analysis method will be finalized.
 - b. Assigning winter weather accidents to each snow route in Livingston County will be completed during next quarter.
 - c. Winter storm database for Livingston County will be finalized during the next quarter.
 - d. Winter maintenance data will be recorded if winter weather storms occur during the next quarter.

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 2013**

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.	117439	COMPLETION DATE (Original)	9/30/2014
OR NO.	OR12-021	COMPLETION DATE (Revised)	
RESEARCH AGENCY	CTC & Associates, LLC		
PRINCIPAL INVESTIGATOR	Patrick Casey		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$100,000.00	Total Vendor Budget	\$239,863.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$101,178.11	Total Budget	\$239,863.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$171,892.96
		Total Contract Amount Available	\$67,970.04

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 PROPOSED ACTIVITES

1. Annual Report.
2. Update Innovations Report.
3. Develop Communications of documents such as At-A-Glance, Research Spotlights and other newsletters as directed by Research Administration.
4. Assist with May 2014 Research Summit.

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 2013**

PROJECT TITLE: Evaluating Differential and Non-Differential Freeway Truck and Bus Speed Limits

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

PROJECT MANAGER: Jason Firman

CONTRACT/AUTHORIZATION NO.	2013-0070 Z2	PROJECT START DATE	2/26/2013
PROJECT NO.	118058	COMPLETION DATE (Original)	5/1/2014
OR NO.	OR13-009	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Peter Savolainen		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$175,000.00	Total Vendor Budget	\$175,060.61
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$26,225.03	Total Budget	\$175,060.61
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$26,225.03
		Total Contract Amount Available	\$148,835.58

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.

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 PROPOSED ACTIVITIES

The following activities are proposed for fiscal year 2014:

- Complete surveys of state agencies and trucking industry.
- Continue collection of historical data.
- Finish field speed data collection.
- Begin analysis of speed and crash data.
- Conduct Economic Analysis of Policy Alternatives.
- Document findings in the research report.
- Present Findings to Leadership.

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 2013**

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.	118059	COMPLETION DATE (Original)	11/30/2014
OR NO.	OR13-008	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Colin Brooks		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$150,000.00	Total Vendor Budget	\$240,898.91
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$43,473.44	Total Budget	\$240,898.91
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$43,473.44
		Total Contract Amount Available	\$197,425.47

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 PROPOSED ACTIVITES

- 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.

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 2013**

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.	118297	COMPLETION DATE (Original)	5/31/2015
OR NO.	OR14-015	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Wayne State University		
PRINCIPAL INVESTIGATOR	Peter Savolainen		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$20,000.00	Total Vendor Budget	\$250,100.20
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$250,100.20
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$0.00
		Total Contract Amount Available	\$250,100.20

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

FISCAL YEAR 2013 ACCOMPLISHMENTS

Literature review and identification of sites are currently underway.

FISCAL YEAR 2014 PROPOSED ACTIVITES

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

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 2013**

PROJECT TITLE: Non-Destructive Evaluation Seminar

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

PROJECT MANAGER: Steve Kahl

CONTRACT/AUTHORIZATION NO.	2010-0297 Z8	PROJECT START DATE	1/1/2013
PROJECT NO.	118298	COMPLETION DATE (Original)	9/30/2013
OR NO.	OR13-010	COMPLETION DATE (Revised)	
RESEARCH AGENCY	Western Michigan University		
PRINCIPAL INVESTIGATOR	Haluk Aktan		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$25,000.00	Total Vendor Budget	\$24,999.52
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$24,908.27	Total Budget	\$24,999.52
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$24,908.27
		Total Contract Amount Available	\$91.25

PURPOSE AND SCOPE

The workshop held on March 28 at the MDOT Aeronautics Auditorium in Lansing, Michigan, was organized with the goal of providing an overview of readily available and proven NDE technologies and the process of integrating these technologies into the bridge management program. The presentations focused on the NDE technologies that have been successfully evaluated under laboratory and field conditions. Further, the capabilities and limitations of each technology were discussed with respect to the intended applications. Based on the information received during the workshop and the expertise of the authors, a two-tier inspection process and a NDE implementation program is described.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Workshop held, final report 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)

Ground penetrating radar (GPR) is recommended to evaluate deteriorated concrete (decks, beams, and soffits) for delamination due to corrosion of embedded steel, and to map concrete delamination exposed by the presence of a moisture layer. This GPR data will be useful for developing deck deterioration models.

For verifying the GPR results. Infrared thermography imaging (IR) can be a supplemental technology to GPR as it heavily depends on environmental and radiant exposure conditions. GPR combined with IR and laser based imaging systems is recommended for acquiring deck and beam condition data for program development and project selection during the statewide scoping process.

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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.	119806	COMPLETION DATE (Original)	7/8/2014
OR NO.	OR14-030	COMPLETION DATE (Revised)	
RESEARCH AGENCY	University of Michigan		
PRINCIPAL INVESTIGATOR	Bruce Belzowski		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$100,000.00	Total Vendor Budget	\$161,657.01
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$6,212.27	Total Budget	\$161,657.01
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$6,212.27
		Total Contract Amount Available	\$155,444.74

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 Division of Planning). 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 PROPOSED ACTIVITES

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.

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 2013**

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.	120457	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$110,000.00	Total Vendor Budget	\$551,176.40
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$551,176.40
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$0.00
		Total Contract Amount Available	\$551,176.40

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 2013 ACCOMPLISHMENTS

Project is expected to start in Fiscal Year 2014.

FISCAL YEAR 2014 PROPOSED ACTIVITES

The first year's proposed activities include reviewing and documenting the bridge design calculations, procedures, and methodology contained in the MDOT Bridge Design System.

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 2013**

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.	120669	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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$15,000.00	Total Vendor Budget	\$36,541.61
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$36,541.61
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$0.00
		Total Contract Amount Available	\$36,541.61

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.

FISCAL YEAR 2014 PROPOSED ACTIVITES

WMU will execute the workshop and develop post workshop report and a summary of workshop highlights.

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 2013**

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.	TBD	PROJECT START DATE	FY 2014
PROJECT NO.	120981	COMPLETION DATE (Original)	9/30/2019
OR NO.	OR14-039	COMPLETION DATE (Revised)	
RESEARCH AGENCY	TBD		
PRINCIPAL INVESTIGATOR	TBD		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$50,000.00	Total Vendor Budget	\$300,000.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$0.00	Total Budget	\$300,000.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$0.00
		Total Contract Amount Available	\$300,000.00

PURPOSE AND SCOPE

MDOT has used CFCC in four bridge projects, which represent a valuable source of information to evaluate the long-term behavior of CFCC strands. The bridges are instrumented and need to be monitored to evaluate their performance. Data collected from this investigation will help MDOT understand the performance of CFCC/CFRP materials and build more efficient bridges.

Two major tasks are required through this research project. The first task is bridge monitoring and data collection until 2020, while the second task is data analysis and design recommendation. Once the data is collected and the monitoring reports become available, the research team will perform the data analysis to evaluate the readings from different sensors and establish the long-term behavior of the CFRP reinforcement. The research team will arrange the findings and the observations in a separate report to be attached to the monitoring report and submitted to MDOT for review.

Monitoring is proposed for the following structures until the year 2020:

Bridge Street Bridge over the Rouge River, Southfield, MI:

This bridge is a prestressed double-T beam structure, containing CFCC longitudinal prestressing, transverse and longitudinal post-tensioning, beam mild reinforcement, and deck and barrier reinforcement. This structure was constructed in 1999 and included gages (strain gages on CFCC strands, load cells for post tensioning strands, and deflection gages on select beams) and data collection equipment that was transmitting data until 2010.

Pembroke Avenue over M-39, Detroit, MI

This bridge is a prestressed side-by-side box beam structure, containing CFCC transverse post tensioning and deck reinforcement. This structure was constructed in 2011 and included gages (strain gages on the deck reinforcement, load cells for the post tensioning strands, and deflection gages on select beams) and data collection equipment that has been transmitting data since 2011. The construction contract included a 5-year monitoring period, which will expire in 2015, upon which time this project will resume the data collection.

M-50 over NSRR, Jackson, MI

This bridge is a prestressed side-by-side box beam structure, containing CFCC transverse post tensioning. The structure was constructed in 2012, and included load cells on the transverse post tensioning strands, and the data is manually downloaded by MDOT staff on a regular basis.

M-102 over Plum Creek, Detroit, MI

This bridge is a prestressed spread box beam structure, containing CFCC prestressing strands, beam mild reinforcement, and deck reinforcement. The structure is currently under construction, with an anticipated completion date of December 2013. Strain gages will be installed on select prestressing strands and deck reinforcement bars, along with deflection gages on select beams. Upon completion of the bridge, data collection will begin.

FISCAL YEAR 2013 ACCOMPLISHMENTS

Project is expected to start in Fiscal Year 2014.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

Proposed activities include many data collection system setup tasks at each of the sites for this long term monitoring project. Once

the data logging systems are in place data collection and storage will begin and progress through the fiscal year. Additionally, maintenance of the monitoring and data collection systems will be conducted.

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)

100% FEDERALLY FUNDED PROJECTS

**RESEARCH ADMINISTRATION
TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

STUDY TITLE: Development of Maintenance Decision Support System

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(054)	MDOT START DATE	06/01/2012
OR NO.	OR14-034	MDOT COMPLETION DATE (Original)	9/30/2013
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	David Huft 605-773-3358		
LEAD AGENCY	South Dakota Department of Transportation		
PROJECT MANAGER	Steve Cook		
CONTRACTOR	Meridian Environmental Technology, Inc.		

BUDGET STATUS

*FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$25,000.00	TOTAL COST	(Original)	\$50,000.00
	(Revised)			(Revised)	\$110,000.00
TOTAL FY 2013 EXPENDITURES		\$85,000.00	Total Committed Funds Available		\$.00

PARTICIPATING STATES

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

CA, CO, FHWA, IA, ID, IN, KS, KY, MD, MI, MN, ND, NE, NH, NY, PA, SD, VA, WisDOT, WY

PURPOSE AND SCOPE

Develop a Maintenance Decision Support System (MDSS) winter maintenance operations forecasting tool (computer web-based) that helps reduce winter maintenance costs, increases level of service based on recommendations, and helps provide a reduction in damage to infrastructure and the environment. Also, pilot the MDSS winter maintenance forecasting tool in the Southwest Region during the 2012 & 2013 winter seasons.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Meridian provided training in-person, via email, and over teleconference. The MDSS Graphical User Interface (GUI) manual was updated to reflect the new features that had been developed before the 2012 winter season. The development of a reference guide was also developed and distributed.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

- Meridian (the MDSS vendor) will continue to provide training to any agency requesting training via in-person, teleconferences, or webinars. Meridian will also provide impromptu training sessions with those individuals that need additional information during the operational season.
- Develop a post recommendation survey compiled by the operator (did MDSS recommendations match actual conditions?).
- Develop a mobile (smartphone) MDSS application. Additional, training materials will be created to assist with the release of the mobile application.
- Develop a Mobility Index Factor to give users an indication of level of service achieved using MDSS treatment recommendation.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

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

- Refinement of GUI for quality forecasts
- Refined interface/screen displays
- Continued support for training in MDOT maintenance garages
- MDSS smart phone app for Android platform (working on iPhone app)
Ingest of mobile data

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

- Refined forecast and treatment recommendation
- Better system functionality of the GUI
- More efficient use of MDSS program by staff as a result of training.
- Forecast and treatment recommendations providing anticipated savings on materials used
- Collaboration with other states on better use of program and changes needed

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

*The revised completion date is necessary to provide additional time to accomplish all tasks required under the revised \$60,000 budget increase, included in amendment 6 of FY2012.

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.).

MDSS is used in four MDOT maintenance garages along the I-94 corridor in the SW Region. MDOT will continue participation in the pooled fund study through September 30, 2015 and will expend the remaining fund balance using the MDSS program.

Due to the success of the implementation in the SW region the department has expanded its use of MDSS to include all garages statewide. MDOT has recently selected a vendor to provide AVL/GPS as well as a fully functional MDSS for all maintenance garages. The MDSS will include snow route specific treatment recommendations as well as a detailed garage specific weather forecast.

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 2013**

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 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$7,000.00	TOTAL COST	(Original)	\$38,000.00
	(Revised)			(Revised)	\$59,000.00
TOTAL FY 2013 EXPENDITURES		\$10,000.00	Total Committed Funds Available		\$14,000.00

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 Minneapolis, MN. The theme for this meeting is yet to be determined.

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

The FHWA acknowledges that the NCC is a continuing forum for technical engagement of the state DOT's. With this recognized level of continuity, this project was recently designated by the FHWA as a continuing pooled fund project.

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.).

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.

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.

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 2013**

STUDY TITLE: Construction of Crack-Free Bridge Decks, Phase II

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(174)	MDOT START DATE	10/01/2008
OR NO.	OR09-142	MDOT COMPLETION DATE (Original)	09/30/2013
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Rodney Montney, rodney@ksdot.org, 785-291-3844		
LEAD AGENCY	Kansas Department of Transportation		
PROJECT MANAGER	Tim Stallard		
CONTRACTOR	University of Kansas		

BUDGET STATUS

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$10,000.00	TOTAL COST	(Original)	\$70,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$10,000.00	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.

CO, ID, IN, KS, MI, MN, MS, ND, NH, NY, OH, OK, TX, WI

PURPOSE AND SCOPE

The purpose of this project is to study the causes of, and possible solutions for, cracking in bridge decks. An important component of the project is to assist with implementation of the findings into the ongoing design and construction of bridge decks.

FISCAL YEAR 2009 ACCOMPLISHMENTS

The TPF-5(174) Web page quarterly report for 9-30-2009 notes the project work completed is approximately 25% and that the project is on schedule.

The project is continuing with knowledge/technology transfer and looking for additional methods to reduce early age cracking. Additional bridges are being built by state DOT's involved with the project. The latest attempts to reduce early age cracking include extending the wet cure duration, "light" use of shrinkage reducing admixtures, supplemental cementitious materials, and lightweight aggregate for internal curing.

FISCAL YEAR 2010 ACCOMPLISHMENTS

Knowledge/technology transfer continues. The constructions of two new LC-HPC bridge decks were completed in October and November 2010, using the latest recommendations. Evaluation of shrinkage reducing admixtures continues and evaluation of their impact on long term durability has begun. Base parameters have been measured, and the use of cementitious replacements is now being explored. The annual deck crack surveys were completed.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Long term durability tests continued with shrinkage reducing admixtures, cementitious replacements, and lightweight aggregates. The effects of viscosity modifying admixtures were evaluated. Field support and construction of further bridges continue. Evaluation of Tough Air admixture began.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Several mix designs (containing lightweight aggregate, silica fume, and/or slag cement) were evaluated for shrinkage, scaling, and freeze-thaw durability performance. The combinations were successful in meeting scaling and freeze-thaw requirements, but decreased scaling performance. Durability tests were performed on mixes containing shrinkage reducing admixtures, and the scaling and freeze-thaw performance were decreased. Annual crack surveys for Kansas LC-HPC decks were completed, showing an increase in cracking compared to the previous year. Control decks showed greater crack densities than the LC-HPC decks.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

Additional shrinkage reducing admixtures will be evaluated. Additional combinations of materials tested in 2012 will be tested in 2013, including combinations with the new shrinkage reducing admixtures and fly ash. Mixes with lightweight aggregate will be produced with moisture contents that better reflect anticipated field conditions. Control and test deck crack surveys will be performed in Minnesota.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013?
 - Test results from laboratory work were shared.
 - Task 7- Document the results of the study accomplished approximately 64% during fiscal year 2013.

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

The documentation delivered to MDOT will provide guidance on those strategies; if implemented, may result in reduced cracking. Also, guidance as to which material selections amongst the recommended strategies that may be the most effective.

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.).

Answer:

- A. Reducing total cementitious content- MDOT has adopted this policy for some projects and had successful implementation.
 - B. Require use of supplemental cementitious material. MDOT has also adopted this policy for some project and had successful implementation.
 - C. Require optimized aggregate gradation. This policy/practice has also been adopted by MDOT for some project and had successful implementation.
 - D. Require shrinkage reducing admixture. Adopted on one project and had very unsuccessful implementation.
 - E. Require extended curing period. MDOT has adopted this policy for one project that has not yet been constructed.
 - F. Require lightweight aggregate to provide "internal curing". MDOT has not yet specified this practice.
 - G. Require rheology modifying admixtures. MDOT has not yet specified this.
 - H. Require full size trial placement. MDOT has not yet specified this.
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.

See E-H above.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

STUDY TITLE: Improving the Foundation Layers for Concrete Pavements

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(183)	MDOT START DATE	10/01/2008
OR NO.	OR09-143	MDOT COMPLETION DATE (Original)	09/30/2013
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Linda Narigon Linda.Narigon@dot.iowa.gov Phone: 515-239-1471		
LEAD AGENCY	Iowa Department of Transportation		
PROJECT MANAGER	Mark Grazioli		
CONTRACTOR			

BUDGET STATUS

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$35,000.00	TOTAL COST	(Original)	\$175,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$35,000.00	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.

CA , CO , FHWA , IA , MI , PA , WisDOT

PURPOSE AND SCOPE

To improve the foundation layers and construction practices and verification for base support of Portland Cement Concrete pavements. This work will also be applicable for foundation layers for Hot Mix Asphalt pavements.

FISCAL YEAR 2009 ACCOMPLISHMENTS

The project began. The research team surveyed each state regarding specifications, construction testing and practices, past relative state DOT research projects and material source information. Two Technical Advisory Group conference call meetings were held. In May 2009 the research team mobilized and spent one week testing, sampling and assessing materials and practices on MDOT's I-94 pavement reconstruction project in St. Clair County. They arranged and performed unique to Michigan testing including Intelligent compaction equipment, Light Weight Deflectometer stiffness and in place field permeability using a gas permeameter. They also visited projects in Iowa and Pennsylvania later in the summer. In October, Dr. White from Iowa State University presented initial results from the I-94 testing at the National Concrete Consortium Fall Technology Transfer Conference.

FISCAL YEAR 2010 ACCOMPLISHMENTS

In May 2010, the research team visited a second MDOT project, the I-96 reconstruction work west of Lansing in Delta Township. They performed many of the same testing as the previous year on I-94 in St. Clair County. Of interest, on I-96, was the constructed base was bound cement treated crushed concrete. Comparison with the unbound aggregate base on I-94 will help MDOT assess base selection in the future. No project report has been produced to date.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Following will be the main emphasis for 2011:

- Complete data analysis for the field projects and develop project reports for TAC review and comments.
- Finish a report summarizing M-EPDG sensitivity analysis results.
- Finish phase I report.
- Conduct periodic performance monitoring testing in Iowa.
- Finish fabrication of the large scale permeameter and the frost-heave susceptibility test equipment.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Completed material laboratory characterization testing on 10 different material types collected throughout the study.

Completed draft research project reports for I-94 and I-96 in Michigan and US-10 in Wisconsin.

Completed draft research reports for non-uniform support finite element analysis ISLAB 2000.

Tests were selected to characterize stiffness, permeability, freeze thaw durability and strength.

Began characterization of material types for Mechanistic- Empirical pavement analysis/design inputs.

Field instrumented US Highway 30 in Iowa.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

Continue frost-heave and thaw-weakening testing (emphasis on stabilized materials), and aggregate degradation tests, and finish analysis of laboratory test results.

Continue frost-heave (with emphasis on stabilized materials), CBR, cyclic triaxial, and aggregate degradation testing on samples collected from all field project sites.

Complete data analysis for the field projects and develop project reports.

Develop recommendations for Mechanistic Empirical entries for base support layers.

Calibrate Mechanistic Empirical models using base support layer inputs.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

Accomplished frost-heave and tri-axial laboratory testing.

Collected in-situ data on instrumented pavement test section in Iowa.

Update past project reports to include new methods for evaluating pavement support layers that were developed through this project.

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

The current end date listed by the PI is 3/15/2014. In the last quarterly report he lists the final report and "field manual" being 50% complete even though the project is listed at 90% complete. It is anticipated no extra costs will be incurred, by last accounting only 60% of the total project funding had been invoiced and subsequently paid.

SUMMARY OF THE IMPLEMENTATION RECOMMENDATION

Implementation recommendations will need to be reported on when the final report is delivered in 2014.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

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)	
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 2013 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$50,000.00	TOTAL BUDGET	(Original)	\$100,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$50,000.00	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.

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.

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.).

The Footprint Analysis will be used directly for the planning and programming of money to support Connected Vehicle Deployment. This deliverable will be 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 will be 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 2013**

STUDY TITLE: Support of the Transportation Curriculum Coordination Council (TCCC)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(209)	MDOT START DATE	10/1/2009
OR NO.	OR10-019	MDOT COMPLETION DATE (Original)	9/30/2014
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Jason Harrington jason.harrington@dot.gov Phone: 202-366-1576		
LEAD AGENCY	Federal Highway Administration		
PROJECT MANAGER	Mark Chaput		
CONTRACTOR			

BUDGET STATUS

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$20,000.00	TOTAL COST	(Original)	\$100,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$20,000.00	Total Committed Funds Available		\$20,000.00

PARTICIPATING STATES

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

CA , FL , GA , IA , ID , KS , MD , MI , MN , MO , ND , NE , OH , OK , OR , SC , TX , WA

PURPOSE AND SCOPE

Rebuilding and maintaining the nation's highways requires agencies and industry to have a trained and qualified workforce from agencies and industry. With the loss of experience in the workforce, training is an industry priority. Agencies and the highway industry across the country face this serious shortage of trained and experienced personnel because of attrition and an aging workforce. We must meet the challenge to preserve the system investments and carry out capital improvements for future growth.

Since 2000, the TCCC, a partnership between the FHWA, State and local DOTs, and private industry, has diligently worked to support the training of transportation industry's technical personnel. The TCCC's mission is to:

- Provide leadership at the national level.
- Develop and maintain national curricula for the various transportation disciplines.
- Identify training and certification requirements.
- Coordinate/facilitate training efforts.

To achieve its mission, the TCCC embraces the following objectives:

- Optimize resources through concentrated efforts in the development of core training and qualification mediums.
- Improve the skills and abilities of the transportation technical personnel.
- Promote the sharing of technical training resources among government and private transportation industry organizations.
- Promote uniformity in training content and qualification requirements to facilitate reciprocity between States, local organizations, and regions.
- Optimize the usage of AASHTO standards in training development.

This project will be for the creation of a new pooled fund with similar goals to support the TCCC. It will be used for the further development of core curriculum, development of training materials, and tools for sharing training materials.

FISCAL YEAR 2010 ACCOMPLISHMENTS

The TCCC has released a series of free online training sessions related to concrete materials and construction, made possible through pooled funds participation. We expect widespread department and contractor participation in the training modules, as a part of the Department/Industry Construction Quality Partnership initiative. Participation in these training modules is expected to improve quality through a shared knowledge.

FISCAL YEAR 2011 ACCOMPLISHMENTS

We anticipate the continued development and release of more online training modules related to transportation construction materials, inspection, and administration, all free to those who chose to take the training. By continued support of the TCCC Pooled Funds Study, we will continue to have a voice for the subject matter identified for development into formal curriculum.

FISCAL YEAR 2012 ACCOMPLISHMENTS

The TCCC has several new training courses under development or recently completed for use by State and local agencies:

- Managing Construction Workmanship (134055), designed for construction inspectors and resident engineers, provides information on roles and responsibilities, acceptance of work, and construction quality.
- The Bridge Construction Inspection (130088) course has been completed and is designed to give basic knowledge of bridge construction procedures to construction inspectors.
- Quality Assurance Technologies training developed as a joint effort between FHWA and the NETTCP

- The Pavement Preservation Online Guide and Training (131110) is now available for delivery and is intended to provide participants with an introduction to the Pavement Preservation Online Guide (PPOG) created by Caltrans and the National Center for Pavement Preservation. This course is primarily target at individuals unfamiliar with pavement preservation policy and technical information.
- The Ethics Awareness for the Transportation Industry course has been developed for online training and is designed to provide employees with the ethical expectations within their respective DOT. It may be modified to any States' codes.
- The Geotechnical steering committee has developed two new training courses: Mechanically Stabilized Earth Walls/ Reinforced Soil Slopes, and Subsurface Investigation Qualification Course.
- Courses under development include Inspection of Bridge Rehabilitation, Maintenance Leadership Academy, Use of GIS in Construction, and Environmental Factors in Highway Construction. Other recently-identified training needs include Embankment Inspection, Basic Earthwork for Inspectors, Placement and Testing of Self-Consolidating Concrete, and Inspection of Pipe Installation.
- The TCCC is partnering with contractor associations in the pavement preservation industry to expand the Maintenance Core Curriculum to provide greater detail on training and qualification contractor personnel and inspectors involved in the placement of pavement preservation treatments.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

The focus continues to be on the development of web based training.

The TCCC Executive Board and FHWA sent out request for proposal to contract services to develop 20 hours of training courses. Board reviewed proposals and recently selected a contractor to do the work - PTG International was awarded the contract. Contract was for \$195,747. TCCC is working with NHI on a MOA in support of the hosting of the WBT courses.

TCCC leadership has re-visited their goals and objectives in light of request by FHWA to work towards being financially supported by those who need the training. Discussions with AASHTO about having an AASHTO-TCCC center have been underway. FHWA's role was recently decreased due to change in organization priorities and that has increased the role of the TCCC leadership team and the State DOT members. Conference calls and exchanged of information between the TCCC leadership team with FHWA has been on going in order to conducted the review of the business plan of the TCCC.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

1. What products or services were delivered from study activities performed in 2013? The TC3 has developed and rolled out over 20 hours of new Web Based Training courses. The TC3 also was successful in moving their organization under the AASHTO umbrella. At the AAHSTO spring meeting, the AASHTO Executive Board approved the establishment of the TC3 as a new AASHTO Technical Service Program. This will provide a stronger link to the States for the TC3 and move away from some of the more challenging Federal regulations and restrictions.
2. Please list those deliverables that will benefit MDOT if implemented.

MDOT will continue to review the entire TC3 curriculum, include the newly released courses for consideration to add into our Michigan CQP training program.

FISCAL YEAR 2014 PROPOSED ACTIVITIES

MDOT should withdraw their commitment to this Federal Pooled fund for FY 2014. The TC3 has been established as a new AASHTO Technical Service Program and MDOT has already committed FY 2014 SPR2 dollars to support that program.

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 staff as members of the Michigan CQP Steering Committee will take the lead to review the full TC3 curriculum to determine which courses may be beneficial to add to our CQP training program. MDOT maintenance staff is also reviewing TC3 courses for consideration to incorporate into the Maintenance Peer Academy currently under development.

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.

MDOT has already incorporated a number of TC3 developed courses into our technical training program in the areas of maintenance, materials and construction. We will continue to review the curriculum and look to utilize additional TC3 courses that are determined to be beneficial for our staff.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

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

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(215)	MDOT START DATE	10/01/2009
OR NO.	OR10-012	MDOT COMPLETION DATE (Original)	09/30/2014
		COMPLETION DATE (Revised)	
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 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$7,000.00	TOTAL COST	(Original)	\$25,000.00
	(Revised)			(Revised)**	\$30,500.00
TOTAL FY 2013 EXPENDITURES		\$7,000.00	Total Committed Funds Available		\$7,000.00

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.

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.

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.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

STUDY TITLE: Clear Roads Winter Highway Operations Pooled Fund

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(218)	MDOT START DATE	10/1/2009
OR NO.	OR13-015	MDOT COMPLETION DATE (Original)	9/30/2011
		COMPLETION DATE (Revised)	9/30/2013
TECHNICAL CONTACT	Debra Fick deb.fick@dot.state.mn.us Phone: 651-366-3759		
LEAD AGENCY	Minnesota Department of Transportation		
PROJECT MANAGER	Tim Croze		
CONTRACTOR			

BUDGET STATUS

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$25,000.00	TOTAL COST	(Original)	\$50,000.00
	(Revised)			(Revised)**	\$100,000.00
TOTAL FY 2013 EXPENDITURES		\$25,000.00	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.

CA , CO , IA , ID , IL , KS , MA , ME , MI , MN , MO , MT , ND , NE , NH , NY , OH , OR , PA , UT , VA , VT , WA , WisDOT , WV , WY

PURPOSE AND SCOPE

This pooled fund project will maintain its focus on advancing winter highway operations nationally but will include a more pronounced emphasis on state agency needs, technology transfer and implementation. State departments of transportation are aggressively pursuing new technologies, practices, tools and programs to improve winter highway operations and safety while maintaining fiscal responsibility. This pooled fund is needed to evaluate these new tools and practices in both lab and field settings, to develop industry standards and performance measures, to provide technology transfer and cost benefit analysis and to support winter highway safety. This project responds to research and technology transfer needs not currently met by other pooled fund projects. Existing partners make every effort to coordinate with other agencies to avoid duplication of efforts and to encourage implementation of results.

Objectives of this ongoing pooled fund project will include:

- Conduct structured field testing and evaluation across a range of winter conditions and different highway maintenance organizational structures to assess the practical effectiveness, ease of use, optimum application rates, and barriers to use, durability, safety, environmental impact and cost-effectiveness of innovative materials, equipment and methods for improved winter highway maintenance.
- Establish industry standards and develop performance measures for evaluating and utilizing new materials and technologies.
- Support technology transfer by developing practical field guides and training curriculum to promote the results of research projects.
- Conduct cost-benefit analysis to ensure that new technologies, materials or methods contribute to operational efficiency.
- Support the exchange of information and ideas via peer exchanges and collaborative research efforts that provide opportunities for winter maintenance specialists to share experiences related to winter maintenance.
- Promote public education and outreach related to winter maintenance and winter driving safety.
- Conduct state of the practice surveys to share best practices on current operational issues (for example salt shortages, level of service requirements or other hot button issues).

Scope of work - Research reports, technical briefs, synthesis reports, field guides, specifications, PowerPoint presentations, video documentation, training materials, public safety messages and software programs.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Clear Roads closed out the following projects in FY2012:

- Mapping Weather Severity Zones
- Snow Removal At Extreme Temperatures
- Developing a Training Video for Field Testing of Deicing Materials

The following research projects either began or remained in progress during FY 2012:

- Environmental Factors Causing Fatigue in Snowplow Operators
- Cost-Benefit Analysis Toolkit Phase II
- Determining the Toxicity of Deicing Materials
- Development of a Totally Automated Spreading System
- Understanding the True Costs of Snow and Ice Control Operations

MDOT staff will be incorporating results from some of these research projects into presentations given to our maintenance personnel at the TSC's and contract agencies during the Winter Operations Workshops this fall

FISCAL YEAR 2013 PROPOSED ACTIVITIES

Research activities shall continue and/or be completed for the above projects that either began or were in progress in 2012.

The following projects will commence in FY 2013:

- Comparison of Material Distribution Systems – Phase I
- Understanding the Chemical and Mechanical Performance of Snow and Ice Control Agents on Porous/Permeable Pavements
- Establishing Effective Anti-icing and Deicing Application Rates
- Snowplow Operator and Supervisor Training

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

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

The Clear Roads pooled fund study completed two research projects and several other projects commenced during the 2013 fiscal year. The two completed projects and their respective deliverables are described below:

Cost-Benefit Analysis Toolkit: Phase II

An updated version of the cost-benefit analysis toolkit with enhanced features and expanded functionality to include additional materials, equipment and methods was developed.

Snow Removal at Extreme Temperatures

The final report compiled strategies for winter maintenance during extreme cold events where salt is not an effective deicer. The strategies outlined in the report are currently used in other states and countries for maintaining an acceptable level of service during cold weather.

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

Cost-Benefit Analysis Toolkit: Phase II

MDOT has already used the toolkit to help justify instrumenting our winter maintenance truck fleet with AVL/GPS devices for monitoring the activities of our fleet and reporting the hours and miles driven; as well as operational data, such as amount of deicing material used, amount of hours the plow blade was down, etc. By inputting MDOT specific cost data into the cost-benefit toolkit we were able to generate a cost-benefit (C/B) that is specific to MDOT. This C/B information was provided to management.

Snow Removal at Extreme Temperatures

Some of the strategies as outlined in the final report were incorporated into our winter maintenance training program for use by our direct-force garages and contract agencies.

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

Effective April 13, 2012 FHWA- Michigan Division approved MDOT's request to continue support through fiscal year 2013. Minnesota DOT is the new lead agency.

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.).

Expand the use of the Cost-Benefit toolkit to justify implementation of other best practices and technologies.

- 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.

Recommendation to RAC to use the toolkit for other practices and/or technology deployments.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

STUDY TITLE: Investigation of Jointed Plain Concrete Pavement Deterioration at Joints and the Potential Contribution of Deicing Chemicals

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(224)	MDOT START DATE	10/01/2009
OR NO.	OR10-017	MDOT COMPLETION DATE (Original)	09/30/2013
		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	Quality Saw & Seal, PCA		

BUDGET STATUS

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$15,000.00	TOTAL COST	(Original)	\$60,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$15,000.00	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.

CO , FHWA , IA , IN , MI , MN , NY , SD , Wisconsin DOT

PURPOSE AND SCOPE

Research Tasks:

1. Perform a literature search on the incidence of PCC joint deterioration nationwide and any proximate causes.
2. Conduct a survey of states and Canadian provinces to determine the incidence of joint deterioration, collect available information on possible causes, including construction practices, maintenance and repair activities, current deicing/anti-icing practices and other concrete performance issues. Distribute the survey, after a panel review of the draft, to obtain suitable information for use in conducting the research.
3. Select appropriate locations for coring and extensive concrete analysis based on survey results and panel input. Each participating state will provide a list of at least two potential sites, including a control, for consideration at the meeting outlined in Task 4. Documentation provided for each site will include age and service history, concrete mix design, aggregate characterization (coarse and fine), method of curing, deicer types and application history, sealant, climatic conditions and the presence and type of any concrete surface treatments.
4. Meet with the technical panel four months after initiation of the project to discuss the project scope and finalize the list of coring locations and develop a sampling plan for each.
5. Examine concrete field samples that will be obtained by the state DOT's, with the cooperation of the researchers, using appropriate test methods to determine concrete quality, hardened air content, permeability, possible mechanisms of deterioration and any effects due to various deicers including a chemical analyses of the cement paste for chloride, sodium and magnesium ions in the top and bottom portion of each specimen (estimated xx cores).
6. Develop a laboratory testing plan, based on any evidence obtained from field cores, designed to duplicate, in an accelerated fashion, the joint deterioration process, or processes, emphasizing any chemical or mechanical agencies which may be involved. Provide an interim report summarizing the results obtained from completing the above tasks and outlining necessary further laboratory testing of both field and laboratory specimens, both to demonstrate any mechanisms thought to cause joint deterioration and to validate proposed methods to repair damage in existing concrete and mitigate any future damage in new concrete.
8. Meet with the technical panel at the researcher's facility to review the interim report and scope of work prior to approval for further testing.
9. Conduct the second phase of laboratory testing to demonstrate joint deterioration by under controlled conditions.
10. Develop joint repair guidelines based on the field and laboratory results and any input from state DOT's as to successful repair strategies.
11. Develop general guidelines for current practices, which will insure minimal damage to concrete pavements and structures while allowing the ongoing application of appropriate liquid deicers if they are implicated in the deterioration.
12. Estimate effects on concrete life and performance characteristics based on the utilization of different deicers and proposed mechanisms of deterioration with various concrete types using available deicer application strategies and develop life cycle cost analyses derived from the research results.
13. Prepare a final report and executive summary of the literature review, research methodology, findings, conclusions, guidelines and recommendations.

14. Make an executive presentation to the research panel and provide each panel member with an MS PowerPoint version of the presentation after submission of the final report.

FISCAL YEAR 2010 ACCOMPLISHMENTS

- A face to face TAC / technical expert meeting was held in June to develop a future work plan.
 - Initial laboratory tests were completed and data are being analyzed.
 - Work has been started in investigating effects of salts on freeze thaw cycle frequency and intensity based on weather data and heat of solution calculations.
 - Questions for the surveys have been reviewed.
 - Work is being done on the third T2 document.
 - Perform literature search as described in Task 1. Research panel plans to discuss research results next fiscal year.
-

FISCAL YEAR 2011 ACCOMPLISHMENTS

- Continue collection of field samples.
 - Continue laboratory evaluation of field samples.
 - Continue evaluation of survey responses.
 - Develop plan for further activities based on field, laboratory, and survey findings.
 - Prepare technical briefs, as necessary.
 - Results from the literature review will be discussed.
-

FISCAL YEAR 2012 ACCOMPLISHMENTS

A survey was developed that sought information from regions reporting the distress. Information was collected from 19 states and has been compiled in a spreadsheet. The data were analyzed to seek for commonalities and trends, but the information received was incomplete and not particularly useful.

As a supplement to this activity, tours were conducted in IA, IN, WI, MI and WI to inspect, photograph, and gather information for use in selecting potential coring locations. These tours were conducted by team members from ISU and MTU. Other tours are being planned in KS and PA. Based on the tours, core samples have been collected from WI, MN, IN and IA and submitted for petrographic analysis. It is planned to collect more samples from MI when the weather permits.

Petrographic reports have been published.

Work at ISU has shown that the risk of distress is dependent on w/cm, air content and curing. Analysis has shown that distress is unlikely to be related to early traffic loading.

Work at ISU to study the early damage caused by sawing is complete. Some limited damage was incurred under aggressive sawing.

A field permeameter has been built to measure permeability of the base and has been tested in one location. More trips are being planned.

MIP has been conducted on lab samples to assess whether w/cm affects the risk of water being trapped in the pore system in the same way as D-cracking aggregates.

Previous work at Purdue examined microstructural and chemical changes in concretes from numerous field locations (both damaged and non-damaged). The results of these tests confirmed that many of the microstructural changes observed in the field concretes have been to great extent duplicated in the laboratory.

Prior work at Purdue examined stresses development and cracking at saw cut locations. The work identified that damage can develop at the base of the saw cuts in an 'upside down' heart shaped lobe and this microcracking may accelerate water ingress.

Work at Purdue has demonstrated the effects of saturation on increasing the risk of freeze thaw damage regardless of the air content of the system. Work has shown that salts exhibit different wetting and drying processes than water due to alterations in the viscosity, surface tension and equilibrium relative humidity. This work has highlighted issues with sample conditioning for ASTM C-1585 as well as testing field samples.

Work at Purdue has developed a testing protocol (under a part of TP(5)-179) that uses electrical resistance to provide an indication of the concretes resistance to chloride ingress.

Work at Purdue has demonstrated benefits of penetrating sealers on slowing the rate of saturation and reducing the potential for damage. Numerical models have also been developed to quantify the ingress of fluids. Additional testing is currently underway to obtain remaining data for use in these models.

Work at Purdue has recently extended the use of sealants to three field sites. One site, US 231, evaluates the use of SME-PS as a repair technology for a pavement showing early distress. The second and third sites (town of Fishers) evaluate the use of SME-PS on new pavement joints. A fourth site is under discussion as a test site in Michigan while a fifth site is being evaluated in Indiana for materials with a known low entrained air content.

Other tasks complementary to this work are being conducted at ISU, MTU, Purdue and UMKC from funding sources. The findings are being pooled to develop a comprehensive understanding of the multiple mechanisms that are involved in this distress.

Presentations have been made in 9 states discussing the current understanding developed from the research and making recommendations. A presentation is planned at a national conference in California for spring 2012.

A revised 30 page publication was published (using other funds) to provide interim guidance on what the mechanisms are and how to reduce the risk of distress.

A number of papers have been submitted to journals and conferences. These are listed in section 5.

A report summarizing the work to date has been published.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

Iowa State University continues to assess the effects of the inter-facial zone on a form of damage observed in the field. Samples have been submitted for mercury intrusion porosimetry.

Michigan Technological University continues to assess the mechanisms behind and effects of ettringite formation in air voids

Purdue University has recently extended the use of sealants to various field sites.

Site No. 1: US 231- Evaluate the use of SME-PS as a repair technology for a pavement showing early distress.

Sites No. 2 &3: The second and third sites (town of Fishers) will evaluate the use of SME-PS on new pavement joints.

Site No. 4: A fourth site is under discussion as a test site in Michigan and a fifth site is being evaluated in Indiana for materials with known low entrained air contents.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

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

- Training workshops that discussed the findings of the work were conducted in 7 states (IA, IN, MI, WI, MN, SD, NY).
- Planning two more workshops this winter; one in CO and another in NE.
- Continue performing research work investigating the benefits of topical sealants
- Continue field testing in IN and MN with a variety of products and application rates.
- Continue working on a draft final report.
- Start tests to evaluate the benefits of sealants in the field at MNRoads in the state of Minnesota. Joints in 3 cells have been treated with 4 products. Cores have been extracted for base line evaluation.

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

- One of the workshops was conducted in Michigan.
- A booklet providing guidance has been published.
- Findings from the sealants work are intended to provide a means of addressing existing pavements.

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.).

- It is believed that implementation of the guidance booklet recommendations will significantly reduce the risk of joint deterioration in new pavements.
 - A synopsis of training session held in Michigan in 2013.
-

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

STUDY TITLE: Validation and Implementation of Hot-Poured Crack Sealant

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(225)	MDOT START DATE	10/01/2009
OR NO.	OR10-018	MDOT COMPLETION DATE (Original)	09/30/2013
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Kevin McGhee Kevin.McGhee@VirginiaDOT.org Phone: 434-293-1956		
LEAD AGENCY	Virginia Department of Transportation		
PROJECT MANAGER	Andy Bennett		
CONTRACTOR			

BUDGET STATUS

*FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$25,000.00	TOTAL COST	(Original)	\$100,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 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.

CO , MI , MN , NH , NY , Ontario MOT , RI , VA , WisDOT

PURPOSE AND SCOPE

Round robin tests at five to seven various laboratories will be conducted. As an outcome of the TPF-5(045) study preliminary threshold(s) for each test were established based on extensive laboratory testing and limited field data. Therefore, a comprehensive field study is urgently needed to validate and to fine-tune the threshold values. Eight test sections in various climatic regions (dry-freeze, dry-non-freeze, wet-freeze and wet-non-freeze) will be included in the study. Representative crack sealants will be installed in these field sections and monitored for three years. At least five field surveys will be conducted. The field surveys will include sealant inspection and data and sample collection. Collected samples will be used to validate the laboratory tests and the proposed parameter threshold values. The following tasks are proposed in this study:

Task I : Laboratory Validation

Conduct round robin testing to establish test precision and bias for the recently developed six tests.

Develop training program that includes detailed testing procedures.

Task II: Field Validation

Construct eight test sections in the four environmental regions (Wet-Freeze, Wet-Non-freeze, Dry-Freeze, Dry-Non-freeze). Install two sealant types at each test section.

Task III: Monitoring Test Section for Four Years

Conduct field inspection of crack sealant five times during the project duration. Collect sealant samples annually from the test sections to measure their rheological properties and identify any changes. Monitor crack movement and temperature variation to provide insight into the selection of the current temperature shift used in the proposed guidelines.

Task IV: Threshold Value Fine-Tuning

Use field performance to fine-tune the testing parameter thresholds in the proposed guidelines.

Task V: Quantify the Cost Effectiveness of Utilizing Crack Sealants

Measure pavement condition annually, in accordance with SHRP Distress Manual, to examine the cost effectiveness of crack sealant.

FISCAL YEAR 2010 ACCOMPLISHMENTS

No work on Phase II done prior to 10/01/2010. Kickoff meeting scheduled for 11/09/2010 in Urbana Illinois.

FISCAL YEAR 2011 ACCOMPLISHMENTS

Task-I: Laboratory Validation (20% completed):

A small size kettle was rented from Sherwin Industries (a distributor of Crafcro products in Illinois) to perform a laboratory sealant aging study. The kettle was kept in the laboratory for four weeks to conduct the needed experiments. Ten of the sealant products, proposed in this study, were melted in the kettle for a certain period of time in order to collect samples from the kettle. The samples were collected at 2, 3, 4, and 5th hours of heating.

Mechanical and rheological characterization of these samples is currently underway to evaluate the effects kettle-aging of sealants during construction. Bending beam rheometer (BBR), rotational viscometer (RV), direct tension dynamic shear rheometry, and adhesion tests are planned for testing the collected sealant the samples. BBR and RV tests are being conducted.

In addition, eight of the products melted in the kettle were used to seal routed cracks in a test section at ATREL facility of the University of Illinois. These sealants will be sampled every six months for mechanical and rheological characterization to evaluate field aging.

Task-II: Field Testing and Installation (40% completed):

Test site installations in two states and a Canadian province were completed during this quarter. These states are Wisconsin, Minnesota, and Ontario, Canada. Some of installation details and information on test sites follows:

- 1- Hwy 92, Brooklyn, Wisconsin - July 18-20: Five sealant materials were installed down on the test site. These products are Crafcro 244, Crafcro 522, McAsphalt 3060LM, Right Pointe 3405 and Right Pointe 3405M. All cracks are routed and sealed with overband.
- 2- I-90, St. Charles, Minnesota - September 12-14: Seven crack sealant products were installed on the test site. These products are Crafcro 231, Crafcro 244, Crafcro 241, Right Pointe 3405, Right Pointe 3405M, Maxwell Nuvo 3405, and Maxwell Nuvo 6690. In addition to standard installation method proposed in the project, different rout geometries and crack filling (without routing) were also exercised in this site. The length of the test section is 1.7 miles and total number of cracks treated is 280.
- 3- HWY 35 Ontario, Canada - September 19-22: Six sealants were installed on the test site. The products are McAsphaltBeram 195, Crafcro 231, Right Pointe 3405, Maxwell Nuvo 3405, Ultraseal, and Crafcro 515. Similar to Minnesota test site, cracks were treated using various additional techniques including different rout sizes and crack filling without routing. Total length of the section is 5.5 miles and total number of cracks treated is 276.

Candidate test sites for the filed installation at the state of New York were visited. The research team was accompanied by Josh Rowinski from NYDOT. None of these sites were found suitable for the study.

Task-III: Test section monitoring (0% completed).

Task-IV: Threshold value fine tuning(0% completed).

Task-V: Cost effectiveness quantification (0% completed).

Task-VI: Development of crack sealant selection procedures and installation guidelines (0% completed).

Work to be done in the last quarter of 2011:

1. Preparation of field installation for other test sites is underway. New Hampshire installation will take place on the week of October 3rd. The sealant products (five products were proposed for this site) and survey tools were already sent to the test site (Task-II).
2. Laboratory tests on the samples collected during installation of test sites and laboratory kettle study in addition to original samples will be continued. In addition to BBR and RV tests, which is already underway, dynamic shear rheometer (DSR), direction tension test (DTT), and adhesion tests will also be conducted on these samples (Task-I).
3. Scheduling for winter evaluation of the installed test sites is in progress (Task-III).
4. Search is in progress for candidate test sites for three states whose installations were postponed to 2012. These states are New York, Michigan, and Rhode Island (Task-II).
5. A face-to-face meeting will be scheduled to discuss and review the progress in the project within the first completed year after TRB annual meetings.

FISCAL YEAR 2012 ACCOMPLISHMENTS

Task-I: Laboratory Validation (40% completed):

Lab aging study has been conducted on the materials Ad, Bb, Ca, Da, Ed, Fb, Jd, Mb, and Ob products using a test protocol involving BBR, RV, and adhesion tests. The main objective of this task is to verify and fine-tune aging procedure developed in the first phase. The stages considered are laboratory short-term and long-term aging using a lab melter, kettle aging, and field aged. The results have been compared to accelerated laboratory vacuum oven aging procedure. Samples were collected from ATREL test section for characterization. The same protocol of aging testing was applied to these samples. The samples were sliced into two fractions "bottom" and "crust" as suggested in the panel meeting in February 2012 to monitor the extent of weathering effects on the surface of sealants. This study was conducted on eight of the sealants installed in the test section.

A sealant tracking resistance test is being investigated. Two different test methods have been evaluated. These are multiple stress creep and recovery (MSCR) and yield test. The MSCR test was proposed in the first phase to determine high temperature grading of sealants considering tracking resistance. An alternative test to MSCR has been studied to simulate tracking resistance. The yield test has been conducted on five of the materials along with the MSCR test.

Task-II: Field Testing and Installation (45% completed):

Test site selection and installation for New York, Colorado, Virginia, Rhode Island, and San Antonio is underway.

A candidate test site was determined for San Antonio and Virginia. The search continues for determining a proper test site in New York.

Additional and new sealants were requested for the next installations. Two stiff products were requested from Crafcro for San Antonio installation.

Task-III: Test section monitoring (20% completed).

First year survey data is digitized. Data interpretation has been continued.

Task-IV: Threshold value fine tuning (0% completed).

Task-V: Cost effectiveness quantification (0% completed).

Task-VI: Development of crack sealant selection procedures and installation guidelines (0% completed).

FISCAL YEAR 2013 PROPOSED ACTIVITIES

1. Field installations in New York, Virginia, San Antonio, and Colorado are planned. San Antonio test site installation can take place in the fourth quarter.
 2. Laboratory validation efforts will be continued on lab aged and field aged samples using BBR, Adhesion, and RV test. Complex modulus using DSR will be added to the protocol to investigate intermediate temperatures.
 3. Preparation for inter laboratory testing will be initialized. Materials to be included in this study will be finalized.
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4. First year survey data will be analyzed. A field installation and evaluation report will be prepared.
 5. Test sites for Colorado, New York and Rhode Island will be finalized. A test matrix (with the sealant products) for each site will be prepared.
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FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

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

Task-I: Laboratory Validation (70% completed):

- Lab aging investigation was completed on the materials Ad, Bb, Ca, Da, Ed, Fb, Jd, Mb, Ob, and Kc using the test protocols of CSBBR, CSRV, adhesion, and CSDSR. Short-term and long-term aging were considered using a lab melter, kettle aging, and field aged. The results have been compared to the accelerated laboratory vacuum oven aging procedure developed in phase 1. A progress report summarizing the aging study will be made available in the next quarter report.
- Low temperature characterization of 18-month field-aged samples has been completed. Intermediate temperature testing Using DSR is in progress.
- The initial test results from the inter-laboratory testing program have been received. New samples were prepared for some of the labs; due to inconsistency of the results.
- The research team will use an accelerated test section at ATREL for tracking test validation. Two sections were routed and cleaned during the previous quarter. Loading will be applied after installation to simulate tracking failure of sealants. Six sealants were considered. Accelerated testing is expected this summer.
- Data analysis of the samples collected from Michigan test sections was completed.

The correlation between laboratory and field survey results (cohesion failure) was very good (agreement between lab and field for 5 out of 6 products).

Task-II: Field Testing and Installation (100% completed):

This task was completed.

Task-III: Test section monitoring (60% completed).

No progress in this task this quarter.

Task-IV: Threshold value fine-tuning (30% completed).

The survey results obtained from different test sections were analyzed. A summary of analysis results were provided as an attachment to this document. A performance index considering full depth and partial depth failures were introduced. Some of the sealants used in these sections were selected for laboratory performance testing. A correlation between field and laboratory results was sought. This is the preliminary stages of threshold validation and fine-tuning. The laboratory experimental matrix will be expanded to the other materials installed in the test sections in order to complete this task.

Task-V: Cost effectiveness quantification (0% completed).

Task-VI: Development of crack sealant selection procedures and installation guidelines (5% completed).

The work on field installation guidelines was launched last month. An outline for the document was prepared.

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

Tasks I – VI are being done to develop tests procedures that are a better indicator of actual sealant field performance. MDOT's involvement in this study through laboratory round robin testing will prepare us for adopted test procedures.

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

*FY2012 and FY2013 payments were made in FY2013

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.).

Based on the field validation study at various test sites, performance thresholds for use in the Sealant Grade System will be updated. These thresholds were initially determined based on limited field data. When finalized, the grade system can be used by States and other agencies for selecting sealants based on climatic region. Sealant field installation guidelines will also be available at the end of this project.

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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.

The research project will continue until September of 2015. It is too early in research to determine how MDOT will incorporate the research into an implementation action plan. Approximately 65% of the work is completed and 23% of the project time remains.

MDOT federal fund commitment has been fulfilled.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

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)	
TECHNICAL CONTACT	Lee Nederveld, nederveldl@michigan.gov, 517-335-5317		
LEAD AGENCY	Michigan Department of Transportation		
PROJECT MANAGER	Lee Nederveld		
CONTRACTOR	Athey Creek Consultants		

BUDGET STATUS

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$70,000.00	TOTAL COST	(Original)	\$175,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES**		\$70,000.00	Total Committed Funds Available		\$35,000.00

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.

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

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 ENTERPRPRISE on May 13, 2011. FHWA agreed to provide further funding in late May to support non-ENTERPRPRISE 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:

- Project 1: 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 ATSSA 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://www.enterprise.prog.org/Projects/2010_Present/developingconsistency.html
 - Project 2: 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://www.enterprise.prog.org/Projects/2010_Present/travelinfoimpacts.html
 - Project 3: 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
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- o the 3rd party data as part of this project. The Data Collection Plan was distributed on 1/23/12.
 - o Each ENTERPRISE state with 3rd Party Data experience shared information at the March 28 and 29, 2012 ENTERPRISE in person meeting.
 - o 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.
 - o Project completed. The final report is available at: http://www.enterprise.prog.org/Projects/2010_Present/utilizationtraveldata.html
- Project 4: 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.
 - o Project was authorized by ENTERPRISE on March 2, 2012.
 - o 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.
 - o Highlights of the survey and an overview of the project was presented during the ITS Heartland conference on March 27, 2012
 - o 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.
 - o 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.
 - o 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.
 - Project 5: 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.
 - o 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.
 - o 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.
 - o 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.
 - o 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 pproved work plans will be posted on t he ENTERPRISE website at: <http://enterprise.prog.org>

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

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.
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**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

STUDY TITLE: Transportation Library Connectivity and Development

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(237)	MDOT START DATE	05/01/2011
OR NO.	OR13-017	MDOT COMPLETION DATE (Original)	09/30/2013
		COMPLETION DATE (Revised)	9/30/2014
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 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$5,000.00	TOTAL COST	(Original)	\$10,000.00
	(Revised)			(Revised)	\$25,000.00
TOTAL FY 2013 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

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.).
 - 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 2013**

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 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$25,000.00	TOTAL COST	(Original)	\$50,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$25,000.00	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.

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.

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.

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.).

No immediate 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.

This was not the last year of participation.

**RESEARCH ADMINISTRATION
TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

STUDY TITLE: Field Testing Hand-Held Thermography Inspection Technologies Phase II

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(247)	MDOT START DATE	11/10/2011
OR NO.	OR13-016	MDOT COMPLETION DATE (Original)	09/30/2013
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Jennifer Harper Jennifer.Harper@modot.mo.gov Phone: 573-526-3636		
LEAD AGENCY	Missouri Department of Transportation		
PROJECT MANAGER	Rich Kathrens		
CONTRACTOR	University of Missouri - Columbia		

BUDGET STATUS

*FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$30,000.00	TOTAL COST	(Original)	\$60,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$60,000.00	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 , KY , MI , MN , MO , NY , OH , OR , PA , TX , WisDOT

PURPOSE AND SCOPE

The goal of this research is to further develop this technology and guidelines for the condition assessment of concrete to help ensure bridge safety and improve the effectiveness of maintenance and repair. The objectives of the research are to:

- Quantify the capability and reliability of thermal imaging technology in the field
- Put the technology in the field with typical maintenance and inspection personnel to identify and overcome implementation barriers
- Field test and validate inspection guidelines for the application of thermal imaging for bridge inspection.

To address the research needs, a program of research is proposed with the objectives of validation of the inspection guidelines, validating the capability and reliability of the technology, and identifying implementation barriers. To meet these objectives, the proposed program is focused on field validation of the technology intended to develop a better understanding of the limits of the technology and evaluate its ability to effectively detect damage in concrete bridges.

- Provide thermal cameras and training to participating states for conducting field testing of the technology (for states that were not part of the phase I Pooled Fund project)
- Study the implementation challenges faced for integrating thermal cameras within traditional paradigms for bridge inspection and maintenance
- Validate the effectiveness and reliability of the technology under real condition in the field
- Develop methodologies and tools to support implementation in the field, including tools for determining the effectiveness of the technology for on-site environmental conditions.

FISCAL YEAR 2012 COMPLETED ACTIVITIES

A pre-training survey was conducted in January 2012 with 9 states participating. From the results, the research team determined that most states anticipate improving bridge inspection accuracy by using thermography and that the greatest implementation challenges for this technology would be limited staff time and the complexity of using the cameras and interpreting the images.

A pre-training teleconference was held March 22, 2012 with 7 states participating. The research team leader discussed the project scope of work, progress to date, the training plan, and the preliminary training schedule.

Training trips were made to Pennsylvania, New York, Michigan, and Georgia which brings the total number of state DOT personnel trained in infrared imaging to 73. One FliR T620 camera was transferred to MDOT in August 2012.

FISCAL YEAR 2013 PROPOSED ACTIVITIES

Verification will continue as bridges become available for destructive evaluation. The shared data site will be populated with infrared images of bridge delaminations from all participating states. Data analysis will begin as verifications are completed. A first revision of the 2009 'guidelines for use of infrared imaging' developed in phase 1 of this project will be drafted.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

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

Last lead agency reported quarter through September 30, 2013:

Progress during this quarter included conducting infrared camera training in Lexington, Kentucky July 31- August 1, 2013, and a webinar to update the participating state transportation departments on the project's progress, executed on August 13, 2013.

Another verification trip was made to Oregon in August, 2013. Equipment was also procured to assist with the verification stage of the project; including an impact-echo device for the verification phase of the project. Also included this reporting period was the redesign of the project's weather website, which is now functioning much more effectively. Revisions to the guidelines to provide additional data on wind speeds and guidance on lens usage were implemented this quarter. The changes are currently being finalized.

Interim reports are being developed on the progress made during the verification stage of the project and laboratory/modeling efforts. Surveys of participants regarding implementation challenges were also developed this quarter.

- Product: Develop a computer application for hand-held devices to assist camera-users in determining acceptable weather conditions for infrared imaging. This application provides an instant recommendation regarding if the weather is suitable for testing.
- Services: Verification testing (coring to confirm the presence of delaminations) was conducted in Pennsylvania, Wisconsin, Texas, and Oregon with findings that substantiate the conclusions reached from last quarter's verification testing. This testing confirms that state DOT personnel using hand-held infrared cameras in accordance with the training provided as part of this project are able to find concrete delaminations under the prescribed weather conditions. Additional verification trips to Georgia were unsuccessful due to poor weather conditions.
- Completed was the modeling of thermal response for practical challenges such as water-filled or epoxy-filled delaminations. The response(s) and are being incorporated into updates to the guidelines. Revise wind speed recommendations were also developed based on a statistical analysis of National Weather Service data. Revisions to the guidelines are ongoing.

Researchers are also pursuing two different imaging options that utilize and supplement the research results. This includes a method of mounting a camera on a common maintenance vehicle to rapidly collect deck data with stationing for more rapid assessments, and a pole-mounted camera that can be left in-place over a period of days to mitigate the effects of poor weather during a particular bridge visit.

Next reporting period:

Verification trips are planned to Ohio, New York, Iowa and Texas

The Implementation Challenges phase of the project will begin utilizing an on-line survey of all the participating states followed by phone interviews of selected states.

Delivery of a thermal camera that can be mounted on a vehicle using a typical trailer hitch is anticipated in the coming quarter.

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

- FLIR T620 Infrared Camera and Camera Guide
- Guidelines for Thermographic Inspection of Concrete Bridges
- Infrared of Concrete, Training Modules

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

*FY2012 and FY2013 payments were made in FY2013

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 has already placed this technology in the hands of our Region Bridge Engineers to be used during their inspection and scoping process. Statewide Maintenance has bought an additional camera to be used during their process of repairing concrete elements. CFS – Concrete Section has used the camera for field verification construction techniques for both Carbon Fiber Arch bridges.

 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.
-

MDOT continues to implement and research the use of Infrared technologies for determining the condition of the concrete elements on our structures. MDOT should create a state specific guideline for the use of Infrared Technology which would include the use of this technology and how the data should be collected. This infrared data should be incorporated into MDOT's bridge database so Bridge Managers, Bridge Inspectors, and Bridge Designers have access to information through MDOT's MiBRIDGE application so these areas can make better decisions in regards to the bridge safety and condition basements.

MDOT Design should review specification for using carbon fiber wraps on bridge beams and columns to incorporated the acceptance of this work by checking the boding of the wrap using infrared cameras. MDOT Bridge Field services has inspected a few locations where the carbon fiber wrap has not fully bonded with the concrete as specified in the construction process.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

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
		COMPLETION DATE (Revised)	
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 2013 BUDGET	(Original)	\$27,000.00	TOTAL COST	(Original)	\$349,000.00
	(Revised)	\$0.00		(Revised)	\$367,200.00**
TOTAL FY 2013 EXPENDITURES		\$0.00***	Project Total Committed Funds Available		\$106,241.00

Year	MDOT Total Expenditures	Project Total Expenditures
2011	\$1,041.75	\$1,041.75
2012	\$119,398.00	\$131,454.19
2013	\$0.00 ***	\$128,462.96

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 soffits 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

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- Perform ultimate load test on the ½ scale Bulb-T Bridge Model with CFRP materials.
 - RAP meeting in the spring of 2014.
 - Final Report

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

*As lead agency; MDOT obligated Michigan's SPR-II research funds to cover the initial cost of the research until partner states were in a position to transfer their respective funds. As other partner states transferred funds to Michigan, MDOT subsequently decreased its obligation to \$146,000.

** During fiscal year 2013, the total project budget was increased by \$18,200 for out-of-state travel. The revised out-of-state travel budget should cover the anticipated cost reimbursements to TAC members for travel expenses in FY's 2013 & 2014. As of September 30, 2013, the balance of funds for research and travel is \$92,366 and \$13,875, respectively.

***Travel expenses for Michigan TAC member(s) to travel to Iowa DOT were incurred in late September 2013; as such, these expenses will be invoiced in fiscal year 2014 and will be included in the 2014 posted expenditures.

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.
-

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

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	4/13/2012
OR NO.	OR14-036	MDOT COMPLETION DATE (Original)	9/30/2014
		COMPLETION DATE (Revised)	
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

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$40,000.00	TOTAL COST	(Original)	\$60,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$40,000.00	Total Committed Funds Available		\$20,000.00

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

Since the project started later in the year than expected, FY 2013 proposed activities will carry over into FY 2014.

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.).
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 2013**

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 2013 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$10,000.00	TOTAL BUDGET	(Original)	\$30,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$10,000.00	Total Committed Funds Available		\$20,000.00

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.

-
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.

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 2013**

STUDY TITLE: Core Program Services for a Highway RD&T Program - FFY 2013 (TRB FY 2014)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5 (277)	MDOT START DATE	10/01/2012
PROJECT NO.	n/a	MDOT COMPLETION DATE (Original)	09/30/2013
		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 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$206,710.00	TOTAL COST	(Original)	\$206,710.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$181,766.00	Total Committed Funds Available		\$24,944.00

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.

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

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.). NA
- 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

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

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 2013 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$50,000.00	TOTAL BUDGET	(Original)	\$50,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$0.00	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.

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 2013 PROPOSED ACTIVITIES

Funding requested and approved in FY2013, however project will not begin until FY2014.

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

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 2013 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$0.00	TOTAL BUDGET	(Original)	\$75,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$0.00	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.

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 fund 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.

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

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.).

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 2013**

STUDY TITLE: National Cooperative Highway Research Program (NCHRP) for FY 2013

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	TPF-5(413)	MDOT START DATE	10/01/2012
PROJECT NO.		MDOT COMPLETION DATE (Original)	09/30/2013
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT			
LEAD AGENCY	Federal Highway Administration		
PROJECT MANAGER	Andre Clover		
CONTRACTOR			

BUDGET STATUS

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$1,150,000.00	TOTAL COST	(Original)	\$1,150,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$1,053,818.46	Total Committed Funds Available		\$96,181.54

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.

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.

- 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
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

STUDY TITLE: SHRP 2 Implementation

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	SHR-2(013)	MDOT START DATE	10/1/2012
PROJECT NO.		MDOT COMPLETION DATE (Original)	9/30/2013
		COMPLETION DATE (Revised)	
TECHNICAL CONTACT	Steve Bower		
LEAD AGENCY	FHWA		
PROJECT MANAGER	Andre Clover		
CONTRACTOR			

BUDGET STATUS

SPR- II Portion of FY 2013 MDOT Budget			FY 2013 MDOT Total Budget		
FY FUNDS	(Original)	\$398,387.00	TOTAL BUDGET	(Original)	\$399,960.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$398,387.00	Total Committed Funds Available		\$1,573.00

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.

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)

**RESEARCH ADMINISTRATION
MDOT TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

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

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	SPR-2(207)	MDOT START DATE	10/1/2013
OR NO.	OR14-040	MDOT COMPLETION DATE (Original)	9/30/2015
		COMPLETION DATE (Revised)	
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 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$50,000.00	TOTAL COST	(Original)	\$100,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$50,000.00	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.

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 2013 ACCOMPLISHMENTS

- Final reports for the Travel Time on Arterials/Rural Roadways – State-of-the-Practice Synthesis on Technology Project were published on the FHWA web site.
- The Effectiveness of Safety and Public Service Messages on DMS project was on schedule. Surveys were conducted in Houston in September 2013. Surveys for three other metropolitan areas are planned to be conducted in October 2013.
- The kickoff meeting for the Best Practice for Road Condition Reporting Systems project was held on July 31, 2013. The project was on schedule.
- The Roles of TMCs in Incident Management on Managed Lanes project was kicked off on July 15, 2013. A webinar for early results and progress discussion is scheduled to be held in November.
- The kickoff meeting for the Guidebook for Development Virtual TMCs project was held in August 2013. This would be a 12-month effort with a final guidebook expected in August 2014.

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.

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.).
 - ***Use of the final reports for Travel Time on Arterials/Rural Roadways: State of the Practice Synthesis on Technology.***
 - ***MDOT should plan for staff to register for the webinar for early results and progress discussion that is scheduled to be held in November 2013.***

 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 2013**

STUDY TITLE: Environmental Technical Assistance Program (ETAP)

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

OR NO.	OR11-009	MDOT START DATE	10/1/2012
PROJECT NO.	115024	MDOT COMPLETION DATE (Original)	9/30/2013
		COMPLETION DATE (Revised)	9/30/2015
TECHNICAL CONTACT			
LEAD AGENCY	FHWA/ AASHTO		
PROJECT MANAGER	Margaret Barondess		
CONTRACTOR			

BUDGET STATUS

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$8,000.00	TOTAL COST	(Original)	\$24,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$8,000.00	Total Committed Funds Available		\$16,000.00

PARTICIPATING STATES

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

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. FY2013 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 54 people, mostly MDOT employees. The newsletters provide current information on environmental research, policy and procedure, which was especially important this year with Congressional approval of MAP-21, new federal re-authorization that includes numerous environmental provisions.

FISCAL YEAR 2013 ACCOMPLISHMENTS

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

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 PROPOSED ACTIVITIES

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.).

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 2013**

STUDY TITLE: AASHTO Engineering Technical Service Programs

FUNDING SOURCE: FHWA OTHER (PLEASE EXPLAIN)

TPF NO.	Not applicable	MDOT START DATE	10/1/2012
PROJECT NO.	115193	MDOT COMPLETION DATE (Original)	9/30/2013
OR NO.	OR12-016	COMPLETION DATE (Revised)	
TECHNICAL CONTACT			
LEAD AGENCY	AASHTO		
PROJECT MANAGER	Andre Clover		
CONTRACTOR			

BUDGET STATUS

FY 2013 Budget			Total Budget		
FY FUNDS	(Original)	\$90,000.00	TOTAL COST	(Original)	\$90,000.00
	(Revised)	\$85,000.00		(Revised)	\$85,000.00
TOTAL FY 2013 EXPENDITURES		\$85,000.00	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:

- Technology Implementation Group (TIG): \$6,000.00
- Transportation Curriculum Coordination Council (TC3): \$20,000.00
- Snow and Ice Cooperative Program (SICOP): \$4,000.00
- Transportation System Preservation Program (TSP2): \$20,000.00
- AASHTO Equipment Management Technical Services Program (EMTSP) : \$3,000.00
- National Transportation Product Evaluation Program (NTPEP): \$12,000.00
- AASHTO Product Evaluation Listing (APEL)- **Withholding Support in 2013**
- Safe, Reliable, and Secure Transportation Operations (SAFETY): \$10,000.00
- Technical Service Program to Develop AASHTO Materials Standards (DAMS)- **Withholding Support in 2013**
- Load and Resistance Factor Design (LRFDM) Bridges and Structures Specification Maintenance (LRFDSM): \$10,000.00

FISCAL YEAR 2013 ACCOMPLISHMENTS

MDOT's financial support of the Technical Service Programs.

FISCAL YEAR 2013 ACCOMPLISHMENTS (Benefits to MDOT)

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- An 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.

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

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.
-

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$100,000.00	Total Vendor Budget	\$100,000.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$79,572.82	Total Budget	\$100,000.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$83,044.82
		Total Contract Amount Available	\$16,955.18

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

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 2013**

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 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$50,000.00	Total Vendor Budget	\$50,000.05
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$42,500.04	Total Budget	\$50,000.05
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$42,500.04
		Total Contract Amount Available	\$1,582.82

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 PROPOSED ACTIVITIES

Hold review sessions. Submit 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)

**RESEARCH ADMINISTRATION
MDOT RESEARCH PROJECT
ANNUAL REPORT - FISCAL YEAR 2013**

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)	
RESEARCH AGENCY	Michigan Technological University		
PRINCIPAL INVESTIGATOR	Pasi Lautala		

BUDGET STATUS

FY 2013 Budget		Total Budget	
Vendor Budget FY 2013	\$100,000.00	Total Vendor Budget	\$99,470.00
MDOT Budget FY 2013	\$0.00	Total MDOT Budget	\$0.00
Vendor FY 2013 Expenditures	\$66,978.58	Total Budget	\$99,470.00
MDOT FY 2013 Expenditures	\$0.00	Total Expenditures	\$66,978.58
		Total Contract Amount Available	\$32,491.42

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 PROPOSED ACTIVITIES

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.
2. MTU will be completing its final recommendations and report on this item.
3. MTU will be finalizing dynamic testing of aggregate samples and preparing its final recommendations and report to MDOT on this item.
4. MTU will begin discussions with MDOT regarding the planning of the 2014 Michigan Rail conference.

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 TRANSPORTATION POOLED FUND STUDY
ANNUAL REPORT - FISCAL YEAR 2013**

STUDY TITLE: AASHTOWare Bridge Management Software- PONTIS 5.2

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 2013 MDOT Budget			MDOT Total Budget		
FY FUNDS	(Original)	\$125,000.00	TOTAL BUDGET	(Original)	\$250,000.00
	(Revised)			(Revised)	
TOTAL FY 2013 EXPENDITURES		\$125,000.00	Total Committed Funds Available		\$125,000.00

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.

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- 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.

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.
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