

Transportation Asset Management Pooled Fund Research Program 2002- 2011

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16. Abstract This report details the overall management and related activities of the Transportation Asset Management Pooled Fund Research Program. The TAM Pooled Fund Research Program was established in 2002 as a partnership between the states of Michigan and Wisconsin. Administered by the University of Wisconsin's Midwest Regional University Transportation Center, the Pooled Fund conducted several research projects. Among the featured projects supported by the pooled fund were the Maintenance Quality Assurance Peer Exchanges, the National Transportation Asset Management Conferences and Workshops, and an assessment of capital preventive maintenance in the states of the upper Midwest region. This report summarizes the operation of the Pooled Fund and traces its history and contributing partners. For more information on the Transportation Asset Management Pooled Fund Research Program, please refer to http://www.wistrans.org/mrutc/research/asset-management-pooled-fund/ .			
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Acknowledgments

Technical Advisory Committee

The Transportation Asset Management Pooled Fund has had 22 state sponsoring organizations through the years. Each state appointed an individual to serve as the representative for that state in the project selection process. The following members served:

- Arizona DOT: Lonnie Hendrix
- California DOT: Al Wilson, Steve Takigawa
- Georgia DOT: Frank Danchetz
- Illinois DOT: Dick Smith
- Maryland DOT: Peter Stephanos
- Michigan DOT: Lou Lambert, Rick Lilly, Ron Vibbert
- Minnesota DOT: Steve Lund, Marthand Nookala
- Missouri DOT: Kyle R Kittrell
- Montana DOT: Sandra Straehl
- Nebraska DOT: John Craig
- New York State DOT: Tim Gilchrist, Steve Wilcox, Brad Allen
- Ohio DOT: Leonard Evans
- Tennessee DOT: Michael Shinn
- Washington DOT: Gretchen White
- Wisconsin DOT: Scott Bush, David Vieth
- Wyoming DOT: Tim McDowell, Kevin Hibbard

Several other states participated exclusively in the Maintenance Quality Assurance Peer Exchanges.

Research Managers and Others

The authors also wish to acknowledge the corresponding Research Administrators in the states that participated in the pooled fund, including Ernie Perry of the Missouri DOT.

Introduction

Modeled after the Nebraska Crash Test Project Pooled Fund, the Transportation Asset Management Pooled Fund Research Program was a coordinated and comprehensive approach to recognizing and addressing needs in the area of transportation asset management. It was an on-going, collaborative effort among states to identify, prioritize, and pursue a coordinated program of synthesis, research, and evaluation to guide implementation of asset management.

Asset Management

As a business process and decision-making framework, asset management provides a means to demonstrate the sound investment decisions that are demanded of transportation agencies. Since every state possesses transportation assets and each state must be accountable to taxpayers who are demanding returns on transportation investments, it is imperative that states develop tools, processes, and understanding to help improve the decisions and management process used by transportation agencies. Defining common management strategies, systems and tools will require research, training, and technology transfer. More than 50 state or district DOTs, 600 transit agencies and nearly 400 metropolitan planning organizations generate a staggering amount of valuable research, yet the transportation sector lacks a systematic approach to effectively manage this information.

Transportation Asset Management is a systematic process of maintaining, upgrading, and operating multi-modal transportation assets in order to maximize the social benefits these assets provide. It combines engineering principles with sound business practices and economic analysis allowing for tradeoffs. It provides tools to facilitate an organized, logical approach to decision-making and facilitates decision-making based on principles drawn from engineering, economics, accounting, public policy, risk management, and customer service, ensuring efficient resource allocation. Comprehensive transportation asset management covers multiple disciplines to solve the transportation problems of the twenty-first century.

Currently, most state transportation agencies have methods in place to manage individual assets but few are taking more comprehensive approaches to include life-cycle costs, user impacts, safety concerns, or secondary impacts in the allocation of limited resources. Transportation asset management and optimization allows for a better understanding and analysis of the broad array of tradeoffs made in any public transportation investment decisions.

Optimizing these transportation investments represents a dramatic shift in the historical paradigm of monitoring conditions and then planning projects to address the “worst first”. Asset Management seeks to *maximize* the greatest public good from infrastructure investments rather than *minimize* the investment required to reach a given performance level. It also requires new skill sets for transportation professionals. In the 1950-60s, new construction dominated the landscape and highway agencies sought out engineering specialists. Yesterday’s highway agencies are today’s multi-modal Departments of Transportation with far broader challenges that require managers to obtain additional expertise in economics, sociology, environmental and land use policy as well as conflict resolution.

Asset management carries rising importance because of changes in the transportation environment including changes in public expectations and extraordinary advances in technology. Transportation budgets are strained by rapidly increasing demand for transportation services, state DOTs face a deteriorating infrastructure, and users demand transportation systems that are environmentally sensitive while maintaining engineering credibility and financial feasibility.

To better educate transportation practitioners and advance the practice of asset management, the Midwest Regional University Transportation Center, the states of Wisconsin and Michigan, and the FHWA began a dialogue in 2001 to set up a pooled fund study for asset management.

The initial projects proposed by the Michigan DOT addressed the issue of capital preventive maintenance. A broad-based call for research was also issued in the Fall of 2001.

The Wisconsin DOT executed an interagency agreement with the University of Wisconsin-Madison (WisDOT 0092-02-18) to manage the activities of the pooled fund and participate in National Conferences and other asset management activities.

This project summary report is arranged by year of operation. When possible, the author has also included information on what individual states participated in the projects.

Chronology

2002

The Transportation Asset Management Pooled Fund Research Program held its initial project selection meeting in cooperation with the Midwest Regional University Transportation Center's Research Advisory Committee meeting in Chicago Illinois in April 2002.

Prior to this selection process, the participants in the Pooled fund had released an RFP for projects related to Transportation Asset Management. A specific request was made for projects that developed a business case that defines the institutional, managerial, analytic, and educational methods and processes to ensure that routinely performed capital preventive maintenance activities extending the life of a transportation facility are performed in a timely manner, consistent with short and long term asset management strategies.

The first project of the Transportation Asset Management Pooled Fund Research Program in 2002 was entitled Capital Preventive Maintenance (WisDOT 0092-02-20). The project documented budgeting and programming processes and strategies, contractual processes and relationships with the private sector, use and structure of life cycle analysis, relevant outreach and educational activities as they impact capital preventative maintenance. It was completed by Dr. Robert Eger of the University of Wisconsin-Milwaukee.

The project built upon on the work of the SHRP task force on Transportation Asset Management (which in turn led to a TRB Task Force and a TRB Committee) and created a clear definition and discussion of the continuum between capital, preventative, and routine maintenance. The researchers specified what types of activities are included within capital preventative maintenance portion.

The project also included a brief review of the potential benefits of private sector contractual relationships in this arena and a review of capital budgeting strategies that better support capital maintenance practices.

Complete information on the final project report is available at:
<http://www.wistrans.org/mrutc/research/completed-research/03-01/>.

Dr. Teresa Adams was awarded partial funding through the Pooled Fund for project MRUTC 03-02: Synthesis of Best Practices for Data Integration (WisDOT 0092-02-21). This project addressed how state transportation agencies deal with numerous technical and organizational challenges in building integrated data and information systems to provide high-quality information for supporting analysis, control, and decision making in asset management. The researchers identified a need to select approaches that work and to develop guidelines for

agencies working to achieve data integration. This project identified relevant metrics for performance measurement and the underlying factors and best practices that contribute to successful approaches.

The research was comprised of six tasks: literature review; design of data collection instruments; pilot testing of data collection instruments; collection of data – interviews; identification and analysis of key success factors, best practices, and performance measures; and preparation of the guidelines document. Comprehensive case studies on data integration issues and best practices regarding asset management and information systems development were conducted on the Wisconsin, Michigan and Ohio Departments of Transportation.

All data integration efforts must be business driven. Without a business imperative for investing in systems development, there is no incentive for people to learn or implement the new system. Successful development of asset management systems require constant involvement of both business and technology people and a great deal of communication with both end users and users of the business systems being integrated.

Complete information on the project is available at:

<http://www.wistrans.org/mrutc/research/completed-research/03-02/>.

2003

The year 2003 brought new direction to the pooled fund process as several additional states were added and new partners expressed interest in a host of new activities.

The first project funded in 2003 was the Development of a Short Course on Maintainability (WisDOT 0092-03-18). This project was completed and test piloted in September of 2003. A formal offering was presented in 2004 with the final report prepared in Spring 2005.

The short course was designed to answer the following questions: How can the life of a pavement be extended? How often does a bridge require painting? Are drainage structures operating as designed? Are the structural members of a bridge in good repair? How can traffic be managed on a facility during maintenance or construction operations?

This short course provided the participants with tools and methods that can be employed to incorporate these issues into the design and construction phases of a project. The course was offered in cooperation with the University of Wisconsin's Engineering Professional Development program.

2003 also saw the initiation of a project that funded a portion of the MRUTC Project 04-04: Incorporating Road Safety into Pavement Management: Maximizing Surface Friction for Road Safety Improvements. This project was led by Dr. David Noyce of the University of Wisconsin. WisDOT funded a portion of the project under 0092-03-20.

This research explored the relationship between asphalt mix design, skid friction, and roadway safety. Initial tasks attempted to find a relationship between pavement skid resistance (friction) and crash frequency, particularly wet weather crashes.

Friction and crash data collected over 10 years at six study sites in Wisconsin were analyzed. The results of the analysis did not indicate a relationship between crash frequency and pavement skid friction. Although some evidence suggests that the number of wet pavement crashes increased as the pavement life increased (and skid friction values decreased), the frequency of crashes was not sufficient to statistically support. Nevertheless, the fact that the relationship seems to behave inversely proportional, that is to say more crashes occurred at low friction numbers (FNs), is an important indication that skid resistance may indeed be a factor affecting wet weather crashes. It was not possible to determine a skid friction threshold value

that indicates the critical point where pavement maintenance would be needed. Although the data obtained in the research could not support a specific value, it is clear that friction values less than 35 are problematic from a safety standpoint. A possible indicator of friction on high-speed roadways is macrotexture. Therefore, macrotexture (measured as MTD) combined with friction data was of great interest in this research. Plots of MTD and FN values did not show a clear relationship between the two values, although it was evident that the larger FNs were concentrated in low MTD values. Skid resistance is an important feature which should be considered while evaluating roadway safety. An effective asphalt pavement asset management approach will include an annual testing program to monitor skid friction values. The researchers held that FN values less than 35 should trigger a safety monitoring program and those pavements scheduled for future rehabilitation or reconstruction.

More information on this project is available at:

<http://www.wistrans.org/mrutc/research/completed-research/04-04/>.

The pooled fund also selected a third project in 2003. MRUTC 04-02: System Management and Monitoring-Providing a Continuous, Real-Time Evaluation of the Columbus Metropolitan Freeway Management System was partially supported by Asset Management Pooled Funds. WisDOT Project Number 0092-03-21 was assigned to this project effort.

This project examined the value of information collected over time from a conventional traffic system deployed for real time control. Several metrics were generated and those data were used to illustrate different means of presentation, such as statistical measures throughout the “typical day” and curves of equi-travel time. From the travel time, it was simple to measure and quantify delay. VMT, ADT, hours, and delay were examined on each link. Most of these results were expressed in a daily measure per station, temporal measure across all stations, or a daily measure across many stations. Due to results varying from day to day, a weekly-median filter was used to show evolving conditions over many years. Finally, a prototype was deployed in real time.

The project used the Columbus, Ohio area as a test case. More information on the project can be found at: <http://www.wistrans.org/mrutc/research/completed-research/04-02/>.

The Pooled Fund also supported the 2003 National Transportation Asset Management Conferences. To accommodate both east and west coast participation, the event was held in Seattle, Washington and repeated in Atlanta, Georgia. The Pooled Fund supported participation of several presenters and state DOT professionals.

2004

2004 marked somewhat of a departure for the typical pooled fund research selection process as the development of the Maintenance Quality Assurance peer exchange was undertaken in cooperation with the AASHTO Subcommittee on Maintenance. The MQA peer exchange attracted over 20 state participants. The event, held in Madison in the fall of 2004 attracted over 70 participants and included a highly successful showcase of maintenance training materials and literature.

The pooled fund also selected two additional projects in 2004. The first was MRUTC 05-01: Transportation Asset Management Threshold Levels (WisDOT 0092-04-21). This project was completed by the Northwestern University research team of Dr. Pablo Durango Cohen and Ed Czepiel. The project report represents an important reference and resource for local government agencies and functions as a synthesis by (1) reviewing and re-presenting the concepts, strategies and tools of asset management, (2) identifying other important transportation asset management references and resources for local agencies, and (3)

documenting the successful implementation of asset management techniques by local governments. The report makes important new contributions to the field by (4) identifying strategies, such as coordinated maintenance and group purchasing, particularly important for asset management at the local level, (5) reviewing commercially available software tools, (6) recommending standards of practice for agencies of various sizes, and (7) identifying future work important to advancing the state of the practice of asset management at the local government level. The report was based upon an extensive review of both the academic and professional literature, including online/web resources; a review and metaanalysis of surveys of local agencies on the topic of transportation asset management supplemented by a new, limited survey; a survey of software vendors providing asset management software to county and municipal governments; and the input of practitioners and experts in the field.

The final project report is posted at: <http://www.wistrans.org/mrutc/research/completed-research/05-01/>.

The other 2004 project activity was 04-01: A GIS Tool to Measure Performance of Winter Highway Operations (WisDOT 0092-05-22). This project involved the extension of previous work. A five-year research effort (fifth-year funding through the Asset Management Pooled Fund) culminated in development, implementation, and installation of a GIS application for assessing performance of winter highway applications. The software accepts data recorded on board winter maintenance vehicles during operations and combines it with spatial data representing roadways and vehicle patrol sections. Analysts can then select among a number of performance measures and decision management tools for outputs from the system. Outputs are categorized according to labor, equipment, materials, and map displays that indicate vehicle routes and data collected along the way. The software, full user documentation, and necessary spatial databases were installed in two Wisconsin county highway department offices and at Wisconsin DOT headquarters. Training was provided to staff.

The spatial databases were developed, and scrutinized for quality, by the research team from data provided by the counties. FGDC-standard metadata were included with the spatial databases. Documentation of the full system included internal and external technical documentation for the software.

Final development of the application required refinement of performance measures, decision management tools, and the user interface. A number of previously unsolved technical problems also needed to be addressed. These included the “map-matching” problem in which moving vehicles must be tracked by roadway and patrol section by registering strings of two-dimensional vehicle coordinates to digital maps (spatial databases). The problem is exacerbated by errors in the coordinates and in the maps. A decision-rule algorithm was developed and tested against a number of available data sets. The algorithm resolves nearly all ambiguities encountered in the data. This algorithm is embedded in the installed version of the software. Testing revealed the limit (1:24,000) on source-scale of the spatial databases, needed to support the application.

Future maintenance of both the software and the data raise technical and institutional issues that were identified and described by the research team. Recommendations concerning these issues are included in the final sections of this report.

Full information is available at: <http://www.wistrans.org/mrutc/research/completed-research/04-01/>.

The pooled fund made an award to the Iowa State University to complete MRUTC Project 05-05: Use of Functional Silos to Optimize Agency Decision-Making (WisDOT 0092-05-21). The purpose of the project was to document how agencies make positive use of functional silos and

then efficiently allocate resources across them. Functional silos are considered to be any group of expertise within a transportation organization that focuses on one area of expertise. Often, different functional silos compete for agency resources.

Functional silos impact their agency positively by allowing members to accumulate expertise in the area of the silo. On the other hand, silos can have a negative impact on resource allocation. The solution to efficient resource allocation is bridging the silos and making overall decisions that offer the most satisfactory solutions globally. The project was completed in 2008.

2005

In 2005, the Midwest Regional University Transportation Center Advisory Committee combined its research selection meeting with the Transportation Asset Management Pooled Fund.

FHWA requested that the Pooled Fund undertake a project Documenting Training Opportunities Related to Transportation Asset Management. The project (MRUTC 06:02 Documenting Training Opportunities Related to Transportation Asset Management) was conducted by research staff at the University of Wisconsin. The project stemmed from a lack of coordination between groups providing training courses that led to a lack of accessibility. Before this project, no comprehensive inventory had been done of available training. This study represents the first attempt at such an inventory.

Since no registry of Asset Management training existed, the project relied heavily on an advisory group of transportation professionals who are close to Asset Management activities. The group made valuable suggestions on agencies, institutions, and vendors to include in the survey, and often provided information on courses not available on the internet. The project is divided into two primary parts; Asset Management courses available to practitioners of transportation for professional development and for-credit course offerings available at universities. For the purposes of this study professional development courses were defined broadly, and include the traditional half-day, single-day, and multi-day seminars as well as web-based seminars, on-line courses, and teleconference-based classes. The second part of this study involved identifying Asset Management courses available for credit through universities. These courses are also documented in this report. Ultimately, an online database was created.

The database is still available at: <http://www.wistrans.org/mrutc/training-libraries/tam-training/>.

The pooled fund also provided funding to two projects completed in the state of Ohio. MRUTC 05-02: Vehicle Classification from Single Loop Detectors utilized the advances in velocity and length estimation from single loop detectors to develop a vehicle classification methodology. It also worked to improve length-based classification at dual loop detectors. The research extended vehicle classification to existing stations using only single loop detectors and offers viable options in the event that one of the loops in a dual loop detector fails. It expanded some of the 04-02 project activities.

MRUTC 05-04 : Accelerated Construction Decision-Making Process for Bridges (WisDOT 0092-05-28) used an Analytical Hierarchy Process to apply to bridge maintenance activities. The decision making process for selecting appropriate construction plan for rehabilitation / reconstruction of bridges involves evaluating plans for their performance on qualitative and quantitative metrics. The decision maker has to decide the relative importance of various criteria in the decision making process. The qualitative nature of some of the criteria such as mitigation of impact on communities, businesses, environment, ensuring safety of stakeholders makes it difficult to establish a transparent decision making process. It is sometimes difficult for the decision-maker to justify extra expenditure for accelerating construction to achieve these non-quantifiable objectives.

The decision making process developed in this research study provides the decision maker with a tool to transparently extract quantitative weights which reflect the relative importance of both qualitative and quantitative criteria in the decision making process. It also enables the decision maker to evaluate various alternative construction strategies for their performance in meeting these qualitative and quantitative criteria.

The project used several locations in Ohio area as a test case. More information on the project can be found at: <http://www.wistrans.org/mrutc/05-04/>.

In 2005, the Pooled Fund also supported participation in the National Transportation Asset Management Conference. The 2005 conference was held in New Orleans, Louisiana. The primary author served as program chair for this event. The Pooled Fund supported conference participation by the primary research team.

2006

Project activities continued in 2006 with new project awarded to the University of Wisconsin, including MRUTC 07-12: Estimating Cost Per Mile for Routine Highway Operations and Maintenance (WisDOT 0092-06-12). The primary result of this research is a set of probabilistic distribution functions for annual maintenance costs for a wide range of maintenance activities. Confidence intervals can be constructed around the average using the chosen level of confidence (i.e., 95%). The functions are useful for sensitivity and simulation analyses. The researchers hypothesized that data would reveal relationships between cost and condition. A regression tree analysis approach was used to search for relevant model equations. However, the statistical analysis of the data revealed weak evidence of these relationships. This finding is common for all three of the states that were investigated. There are at least two clear limitations of the data. First, to see trends overtime, three years of data may not be enough. Furthermore, even with budget cuts, noticeable deterioration in condition, deficiencies, or maintenance backlog may take longer than three years. Second, the available cost and condition data are aggregated over many highway miles. Maintenance management and cost records generally do not include precise highway locations where maintenance was performed, the specific activities that were performed, nor the precise cost and timing of those activities. Consequently the trends and relationships between cost and condition are “washed out” by the lack of precision.

Complete information is posted at: <http://www.wistrans.org/mrutc/research/completed-research/07-12/>.

Another 2006 Pooled Fund Supported effort was MRUTC 0704: Frozen Road Operations (WisDOT 0092-06-11). WisDOT’s Bureau of Highway Operations, (BOH) used software, known as UWFROST, during the '98-'99 and '99-'00 winter seasons and found the software’s fall freezing and spring thawing projections to be quite accurate for normal winters.

Since this study was conducted, additional data has been collected using frost tubes to declare the roads frozen and then unfrozen. Changes in Wisconsin climate have also been noted which will affect the model. More data has been collected at the national level, which relates pavement material moduli to temperature.

2006 also saw the initiation of projects completed in cooperation with the Wisconsin Highway Research Program. WisDOT project 0092-06-13 “Regional Pavement Performance Database for Validation and Local Calibration of the Predication Models was completed by Drs. Hussain Bahia and Teresa Adams of the University of Wisconsin. This project created a database for use in calibrating the factors, which are used to predict pavement performance, in the M-E design guide. Data was collected from multiple states including Illinois, Indiana, Iowa, Michigan,

Minnesota, Ohio, and Wisconsin. This study also expanded the number of pavement sections in the Midwest region that were completely analyzed. It is expected that the extended database could result in a more precise calibration factors for the implementation of the design guide in the Midwest region. The project final report is available at: <http://www.wistrans.org/mrutc/research/completed-research/07-01/>.

2007

In 2007, the pooled fund funded seven projects, including a peer exchange on Traffic Operations Asset Management that was led by Jason Bittner. MRUTC 07-0x (WisDOT 0092-08-35) culminated in a peer exchange at the WisDOT Statewide Traffic Operations Center in 2008 in Milwaukee. The scope of the project included an assessment of current asset management systems for operations infrastructure including ITS, traffic signalization, and associated network and information architecture. The research effort brings together transportation professionals to discuss and advance the state of the practice for traffic operations asset management. The project also led to a recommendation of concepts leading to development of a next generation Traffic Operations Asset Management System (TOAMS). The information was used to formulate a phase 2 proposal to create and administer a multi-state pooled-fund pilot of next generation TOAMS. The second phase of the project was not selected. More information on this effort is available at: <http://www.wistrans.org/mrutc/research/completed-research/08-14/>.

WisDOT 0092-07-19 “An Asset Management Approach to Drainage Infrastructure and Culverts” applied TAM principles in the stormwater management realm. The project was completed by a research team at the University of Cincinnati. The project included a follow-up project “Use of Trenchless Technologies for Comprehensive Asset Management of Culverts and Drainage Structures.” This project provided a comprehensive study and decision making procedures for the selection of appropriate trenchless technology methods for construction, renewal, renovation, and maintenance of culverts and drainage infrastructures. Details are available at: <http://www.wistrans.org/mrutc/research/completed-research/07-15/>.

Planning began for the Maintenance Quality Assurance Peer Exchange 2 in 2007 (WisDOT 0092-08-34). The 2008 event served as a followup to the highly successful 2004 peer exchange. More details are provided in the 2008 section.

MRUTC researchers also initiated project looking at Guidelines for the Implementation of the Bridge Health Index (WisDOT 0092-07-14). This study focused on understanding the sensitivity of the BHI to small and large changes in the element failure costs and the element condition, the two input data sets for computing the BHI. For these sensitivity analyses, 221 bridges were selected from Wisconsin’s inventory. The study looked at bridges with simple and continuous span prestressed concrete girders. The findings can guide state agencies and practitioners with a sense of how BHI responds to changing bridge condition as well as element failure costs.

The element failure costs were acquired from a previous study by a consultant to the FHWA and the element level inspection data were from the Wisconsin Department of Transportation (WisDOT). The analysis considered the impact of Smart Flags used to identify local problems that are not reflected in the element condition states. Because they may indicate critical defects in the bridges, they should be reflected for BHI. To investigate the impact of Smart Flags, computation rules suggested by the Kansas DOT were applied to the selected bridges in Wisconsin.

More information on the project is available at: <http://www.wistrans.org/mrutc/research/completed-research/08-07/>.

A research team lead by partners at the University of Illinois-Chicago were awarded a project entitled "Scoping Data Access and Integration Needs to Facilitate Better Management of Research Innovation." This project (WisDOT 0092-07-16) provided input on scoping data access and integration for Wisconsin Department of Transportation. The research team scanned the published literature on data integration to understand the progress made and the challenges faced in integrating data, completed a needs analysis of stakeholders to get a listing of databases, the various queries/uses of databases, gaps in knowledge about existing data, all with an eye toward integrating the available data, and also involved a survey to capture the different perspectives offered by the different stakeholders – staff, investigators/researchers, and contractors. More information on the project is available at: <http://www.wistrans.org/mrutc/research/completed-research/08-10/>.

Guidelines for the Preventive Maintenance of Bridges (MRUTC 07-14 , WisDOT 0092-07-20) was also awarded in 2007. This report discusses concepts and essential characteristics of a systematic process for bridge preventive maintenance with examples. The information presented herein was prepared based upon conversations with the FHWA Offices of Asset Management and Bridge Technology and by review of documents describing the successfully approved bridge PM programs of eight State transportation agencies.

To assist WisDOT and other State agencies, examples from several States are organized into a template for preparing a bridge PM plan that includes the essential features of a systematic process. The results are expected to help State agencies understand and apply the concepts when establishing bridge PM programs and prepare proposals to obtain approval to use HBP funds for bridge preventive maintenance projects.

For more information, visit: <http://www.wistrans.org/mrutc/research/completed-research/07-14/>.

The Pooled Fund also supported MRUTC 08-08: Materials Characterization and Analysis of the Marquette Interchange HMA Perpetual Pavement. This project was contracted initially in the Fall of 2007. The project (WisDOT 0092-07-13) was a partnership between UW-Milwaukee, Marquette University, and Iowa State University.

This project focused on the characterization of materials used to construct the Hot Mix Asphalt (HMA) perpetual pavement within the Marquette Interchange and on the analysis of collected pavement response data to investigate the interactions between materials, environment, and traffic loadings. While these pavements are designed for a service life in excess of 50 years, to date there is insufficient field data to confirm this performance expectation. To help bridge this knowledge gap, this study included a mechanistic-empirical appraisal of the HMA perpetual pavement to provide predictions of key performance indicators over a fifty year service period. Laboratory testing was conducted following appropriate AASHTO testing protocols to provide valuable data to characterize the HMA, unbound aggregate and unbound soil pavement layers. This data was used to develop Level 1 HMA inputs to the current version 1.003 of the Mechanistic-Empirical Pavement Design Guide (MEPDG) and to better characterize the unbound aggregates and soils during Level 3 analysis. Weigh-In-Motion (WIM) data obtained as part of WHRP Project 0092-06-01 was analyzed to develop site-specific inputs characterizing the heavy axle loading spectra using this pavement facility.

Pavement performance predictions were developed using the MEPDG v1.003 and stand-alone KENPAVE software. Consideration was given to both free flow (55 mph) and congested (15 mph) traffic conditions. Using a combined traffic approach, pavement distress at the 90% reliability level were projected to 50 years of trafficking. Only top-down fatigue cracking, which should be confined within the uppermost 0.5 inches of the pavement surface, is projected to exceed typical design limits. This projected distress will easily be corrected using the standard practice of mill and relay.

Furthermore, after 50 years of service the 90% reliability level for bottom-up fatigue damage is expected over 15% of the total lane area, or 30% of the loaded wheel paths, which is well below typical design limits of 25% and 50%, respectively. All analysis results indicate the constructed HMA perpetual pavement should meet or exceed performance expectations.

For more information visit, <http://www.wistrans.org/mrutc/research/completed-research/08-08/>.

In 2007, the National Transportation Asset Management Conference was held in Kansas City, Missouri.

2008

In 2008, the Federal Highway Administration proposed a TAM Pooled Fund Project that assessed the benefits of using asset management Systems. MRUTC 06-06 (WisDOT 0092-07-24) was finally ready for contracting following some delays in the spring of 2008. The project used FHWA's HERS-ST, a free software that delivers several asset management functions, to document benefits. This report uses a generic methodology to document a strategy to assess the benefits to be gained using tools such as HERS-ST. The impact of decisions made using HERS-ST (referred to as "with HERS-ST") are compared with decisions made using a naïve worst first strategy (referred to as "without HERS-ST") using common performance measures, net present value and benefit cost ratios. The methodology is applied to three different data sets. The data from New Mexico are used to explore strategies for communicating the results using charts, graphs and tables. Data from Kentucky and Delaware are used to develop more in-depth case studies. All three data sets demonstrate that significant benefits can be realized using HERS-ST. A Step-by-Step Guide for implementing the methodology and a training module are also developed.

More information can be found in the final report at:
http://www.wistrans.org/mrutc/files/AM_BENEFITS_110623.pdf.

The 2008 National Maintenance Quality Assurance Peer Exchange was held in Raleigh, North Carolina. The peer exchange attracted over 70 participants from 37 states and provinces. It preceded a workshop on data acquisition technologies. More details on the MQA peer exchange are posted at MRUTC.org.

This MQA peer exchange project further defined the essential terms necessary to discuss the concepts of highway maintenance quality assurance and presented an updated synthesis of the measures for maintenance quality assurance used by state transportation agencies. The peer exchange was very successful for connecting maintenance managers with their cohorts from other states. The agenda and other information is available at www.mrutc.org.

The Pooled Fund also acquired data for research in 2008. This data purchase was made by the Wisconsin DOT and included international freight data sets and other usage calculations.

2008 also marked the final year of the Midwest Regional University Transportation Center program. The Center was not selected as part of a re-competition by the USDOT. The UW-Madison was selected as a national University Transportation Center and named the National Center for Freight and Infrastructure Research and Education (CFIRE) under the program in 2005.

2009

In 2009, the final projects of the Pooled Fund program were selected. The final four efforts included projects that assisted the development of the National Center's program efforts.

WisDOT project 0092-09-11 “Performance Measures for the Long Range Plan” and 0092-10-14 Development of Additional Freight Modeling Systems for the East Central Wisconsin Regional Planning Commission” identified current topics for the state. These projects were completed by researchers elsewhere.

WisDOT project 0092-09-32 “Local Roads Compendium” developed an online users community targeting information concerning local roads officials. The project was completed in cooperation with the Local Roads and Streets Council. CFIRE 03-07 created the compendium. It serves as an internet clearinghouse for selected local road issues important to local transportation stakeholders. The compendium allows local officials to quickly access existing manuals, reports, ordinances, policies, articles, best practices, and projects pertaining to local roadway issues. Having full access to local roads related resources is particularly important. Currently, valuable local roads information is scattered around the Internet accessible from a variety of locations and search engines, some more visible than others. This compendium consolidates available information and efficiently maintains it. It provides current and applicable content for a variety of transportation officials’ needs in a user-friendly format.

In the long run, the compendium strives to encourage an online community of local roads professionals to be actively involved generating and maintaining the content that comprises it. For the purpose of protecting the quality of the website, the levels of participation are informed by membership levels tied to specified permission levels.

WisDOT 0092-09-12 Best Practices Guidance for Workforce Transition and Succession Planning (CFIRE 04-03) deals with strategies for transition planning—in particular, strategies for transition planning in a specialist organization such as the Wisconsin Department of Transportation’s Rail and Harbor Section. The project also helped develop follow-up that led to the National Workforce Summit being organized by the Council of University Transportation Centers and the USDOT. More information on the project effort is available at: <http://www.wistrans.org/cfire/research/projects/04-03/>.

In 2009 the National Conference on Transportation Asset Management was held in Portland, Oregon.

2010

No new projects were awarded in 2010 – the research team focused on monitoring and completion of existing project efforts. A new pooled fund effort was initiated to help develop Transportation Asset Management conferences. This pooled fund is lead by the Federal Highway Administration.

2011

The year 2011 was the final closeout of the Transportation Asset Management Pooled Fund. By the end of 2011, all projects were completed and final reports submitted. The pooled fund was officially closed at the end of 2011. No new project awards were made in 2011.

Appendix 1: Memorandum of Understanding

**NATIONAL POOLED FUND
TRANSPORTATION ASSET MANAGEMENT
RESEARCH PROGRAM**

Memorandum of Understanding

**Federal Highway Administration
Midwest Regional University Transportation Center
Midwest Transportation Consortium
Participating State Agencies**

Memorandum of Understanding

➤ Introduction/Background

Asset management is a concept with rising importance in state DOT environments, especially related to changes in public expectations and extraordinary advances in technology. Transportation budgets are strained by growing demand for transportation services, state DOT's face challenges in addressing system preservation, and users demand transportation systems that are environmentally sensitive yet maintain engineering credibility and financial feasibility.

As a business process and decision-making framework, asset management promises states new tools to demonstrate the sound investment decisions that have been increasingly demanded of transportation agencies. Since every state possesses these assets and each state must be accountable to taxpayers who are demanding returns on transportation investments, it is imperative that we develop tools, processes, and understanding to ease the transition for transportation professionals. Defining common management strategies regardless of states' diverse transportation needs will require research, training, and technology transfer.

Fulfilling these requirements within each state is financially stressful and time consuming. In response to these concerns, the National Pooled Fund for Transportation Asset Management Research has been established through the Wisconsin Department of Transportation, and administered by the Midwest Regional University Transportation Center in the Department of Civil and Environmental Engineering at the University of Wisconsin-Madison. The intent of the pooled fund program is to supplement the national asset management research efforts, prevent duplicity of coexisting efforts, and provide a means for regional state DOT's to share resources, technology, and ideas in a coordinated environment.

➤ Name and Purpose of the Program

This program shall be known as the "National Pooled Fund for Transportation Asset Management Research." Hereinafter referred to as the "program."

➤ Purpose of the Memorandum of Understanding (MOU)

The MOU formally describes administrative, financial and organizational procedures to implement the program and establishes roles and responsibilities for the contracting parties in carrying out the contract requirements.

➤ Lead Agency

The Wisconsin Department of Transportation shall be the lead agency. Responsibilities of the lead agency shall include:

1. Administration of an agreement with the Midwest Regional University Transportation Center and Midwest Transportation Consortium.
2. Initiate the overall contracts and scopes of services with the University of Wisconsin-Madison Office of Research and Sponsored Programs and Iowa State University.
3. Review and submit quarterly vouchers through the FHWA Wisconsin Division Office to the FHWA Washington Office for payment and transmit a copy to the Technical Committee member from each participating state.
4. Solicitation of program proposals from participating states, the Midwest Transportation Consortium, and the Midwest Regional University Transportation Center at the University of Wisconsin-Madison.
5. Obtain Financial Commitment forms from each individual state for each specific fiscal year's program of project (see attached form).

➤ **Participating States**

Participating states must sign this Memorandum of Understanding. Other states may request to join the pooled fund program by contacting the Steering Committee or Midwest Regional University Transportation Center. With concurrence of the Steering Committee, state(s) will become member(s) upon signing this Memorandum of Understanding.

➤ **Steering Committee**

A Steering Committee will be established with the following membership:

1. At least one person from each participating state who is knowledgeable in the funding process and in Transportation Asset Management terminology. One of the members will be elected to serve as Chairperson for a period of one year. Each state will have one vote.
2. A representative from the FHWA Office of Asset Management, Ex-Officio member.
3. A representative from the FHWA Division Offices of participating states, Ex-Officio member.
4. A representative from the Midwest Regional University Transportation Center, Ex-Officio member.
5. A representative from the Midwest Transportation Consortium, Ex-Officio member.

The Chairperson shall be the state representative who will deal with FHWA and will establish needed meetings of the participating states and the FHWA. The Chairperson will work with the Midwest Regional University Transportation Center through the Wisconsin Department of Transportation and the FHWA Wisconsin Division and Washington Offices to coordinate reviews of the following:

1. Overall program contract and the annual budget for the program.
2. Contract administration charges.
3. Coordinate review of individual studies and check for possible duplication of other Transportation Asset Management research.

The Steering Committee duties shall be as follows:

At the beginning of the program:

1. Develop research topic selection priority criteria.
2. Prioritize the research projects.
3. Determine the overall pooled fund program budget and the contribution per state.

Annually, prior to the beginning of the program year (July 1-June 30):

1. Develop and approve the annual priority list of Transportation Asset Management topics to be researched.
2. Determine funding source and contribution per state.
3. Authorize the Midwest Regional University Transportation Center and Midwest Transportation Consortium to put forth a general call for proposals related to Transportation Asset Management research.

For each research project (through Wisconsin DOT contract with MRUTC):

1. Prepare and post Requests for Proposals (RFP's) for each research topic.
2. Determine participating states, review proposals, and select a research team.
3. Review project status reports.
4. Review and recommend for FHWA approval final reports for nationwide distribution and implementation.

➤ **Project Managers**

The MRUTC or MTC Directors will serve as the project managers. The project managers will be the first line of contact for technical issues related to a particular research project. The project managers will coordinate decision

making with the technical advisory committee members from participating states and will lead the information exchange on each particular project.

➤ **Funding of Pooled Fund Study**

The Steering Committee will establish an overall program of projects. An annual budget shall be prepared and each participating state will sign a Financial Commitment Form.

Sources of funds may include FHWA Office of Asset Management, State Planning & Research allocations, state matching funds, and other sources that may be made available. As agreed, costs for each year's program will be shared among all participating states.

States can use 100% State Planning and Research (SPR) funds for this program. FHWA has established project _____ for this program.

➤ **The Flow of Funds**

The flow of funds will take place as follows:

1. When Federal-aid SPR funds are used and states wish to pool their annual funds in FHWA Washington Headquarters, states will provide FHWA the state matching funds for their share of the costs, at the beginning of the year. One hundred percent (100%) federal or state funds may also be pooled in this manner for draw-down. Each state must develop the necessary documentation (e.g. PR-2A) and approvals for their SPR Part II Work Program.
2. When other fund sources are used, the program should be referenced in the SPR Part II Work Program.
3. On a quarterly basis, the lead agency will directly bill the FHWA. FHWA Washington Headquarters will draw-down from each participating state's account.
4. Contracts will be executed between the lead agency and the Midwest Regional University Transportation Center for documentation and accounting of financial activities under this Memorandum of Understanding. Each State understands that funds will be used as the non-federal matching funds under the USDOT University Transportation Center Program.
5. Financial Commitment Forms will be signed by each participating state for each specific fiscal year's program of projects on a federal fiscal year basis.

➤ **Procedures to Withdraw from the Study**

If a signatory to this Memorandum of Understanding desires to terminate participation in the program, the appropriate official should notify the chairperson at least thirty days in advance. Signatory(s) requesting termination will retain responsibility for all existing commitments.

➤ **Audits**

The Midwest Regional University Transportation Center, Midwest Transportation Consortium, and Wisconsin Department of Transportation will comply with Federal audit requirements and their records will be available for review by the participating states and FHWA. All records relating to the performance of any work accomplished under this program shall be retained for a period of three years after the final payment.

Execution of Memorandum of Understanding

The _____ and the Federal Highway

(State Department of Transportation)

Administration agree to this Memorandum of Understanding and authorize their officers to sign it.

State Highway Agency

Federal Highway Administration

(Agency Name)

(Division Office)

(Signature)

(Signature)

Name: _____

Name: _____

Title: _____

Title: _____

Date: _____

Date: _____

