MEANINGFUL USE OF COLLECTED LOCAL ROADS DATA AND INFORMATION

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Meaningful Use of Collected Local Roads Data and Information
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| 16. Abstract | There are more than 39,000 local agencies managing 2,000,000 miles of roads throughout the United States. The responsibility for such an immense infrastructure network in a time of limited resources demands the application of contemporary pavement management principles. Yet, the vast majority of these agencies could be classified as small or rural, and implementation of management systems and practices is a significant challenge. The study analyzed responses of an extensive survey completed by over 400 local agencies throughout the upper Midwest. The report identifies current pavement management practices, factors that promote management system implementation, and the challenges (organizational, cultural and technical) that impede implementation. Pavement management systems used throughout the U.S. were cataloged along with capabilities and system specifics. Training available in the survey states was identified and cataloged, and training objectives were applied against a Body of Knowledge Framework. Researchers also conducted in-depth review of the models that had been adopted for use in the RoadSoft® GIS Pavement Strategy module. This review reconsidered the original assumptions of the models, made adjustments to conform to those assumptions, and used actual condition data (three counties, 1733 data points) to compare the output of the new models. The findings are of value to FHWA, state DOTs, local agencies, universities and technology transfer centers in their efforts to expand pavement management system implementation within cities, counties, towns, and villages. |
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Executive Summary

Project Summary

This project centered on gathering the following information:

- Pavement management systems used by local agencies throughout the U.S.
- How the management system data is being used by agencies in the states of Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin.
- Identifying training available throughout that region.
- The validation of the pavement deterioration curve models used in RoadSoft® GIS using actual local agency pavement condition data.

Background

There are more than 39,000 local agencies managing road networks throughout the United States. Of those, the vast majority could be classified as small or rural. Implementation of management systems and practices among these types of agencies is a significant challenge.

When the Intermodal Surface Transportation Equity Act (ISTEA) was authorized in 1995, the use of management systems was required as a condition of federal funding at both the state and local level. Although the ISTEA mandate was eventually rescinded, a number of states and local agencies believed that the use of management systems was the future of infrastructure management. Those agencies continued to move forward, essentially breaking trail, to what is now considered Transportation Asset Management.

Process

Task 1—State-of-the-Practice Summary involved Internet searches and review of publications for leads to information on management systems being used by local agencies throughout the U.S. Systems ranged from those used widely in statewide initiatives to those used only by a few local agencies. Features and functionality was documented for all the systems. Coordinated approaches being used throughout the U.S. by multiple local agencies were also identified.

Data for Task 2—Survey of Data Collected and Systems Analysis Used by Local Agencies In the Region, Task 3—Suggestions for Use of Local Road Condition Data in Wisconsin and Michigan for Statewide and Region-wide System Analysis and Issues Related to Such Use and Task 4—Data Gaps that Hamper Needed Analysis and System Implementation was collected through the use of an extensive survey that was distributed to 1973 agencies throughout the region during June/July 2006. Of the agencies contacted, 429 (22%) responded. The survey data was analyzed in numerous ways in an attempt to identify substantive relationships.

Task 5—Summary of Existing Training Materials for Local Road System Management and Recommendations for Enhancing Those Materials involved Internet searches and telephone interviews to gather background information on all
the road management training being offered throughout the region. A Body of Knowledge Framework was developed against which the training available in each state was assessed.

Task 6—Validation of RoadSoft®-GIS Deterioration and Strategy Evaluation Models involved an in-depth review of the models that had been adopted for use in the RoadSoft® GIS Pavement Strategy module. This review reconsidered the original assumptions of the models, made adjustments to conform to those assumptions, and used actual condition data (three counties, 1733 data points) to compare the output of the new models.

Findings
Researchers were encouraged by the 22% response rate to the agency survey. This rate is especially impressive considering that the responses from Minnesota and Indiana were so light. Of particular note is the participation from Villages, Towns/Townships and Rural Counties. These agencies accounted for 61% of the total respondents and demonstrate that PMS implementation is no longer only the realm of cities and urban counties. Increased adoption of PMS over the past 5 years (53% of agencies with PMS) indicates that agencies are becoming more knowledgeable about the benefits of PMS.

It Takes an Initiative—Broad Implementation
Statewide initiatives appear to have a positive impact on PMS implementation. In Michigan and Wisconsin, both with statewide initiatives, 81% of the respondents indicated PMS use compared to 31% of the respondents in the Other States grouped together. Survey data also shows that training attendance was higher in Michigan and Wisconsin than in the Other States. 86% of Michigan respondents and 88% of Wisconsin respondents participated in training, but only 40% of respondents in the Other States participated. Ohio has begun a statewide initiative and their experience over the next few years could further support this claim. PMS champions at the state and federal levels need to use their influence to encourage statewide PMS initiatives for local agencies.

Adoption—Those Who Understand the PMS Concept
The survey data and comments indicate that agencies are beginning to understand the PMS concept and the benefits a system can provide. Comments like “A PMS is essential for getting funding, planning maintenance and monitoring progress or forecasting the future of the highway system condition” and “We follow a six-step planning process in the development of our annual budget for Road Maintenance & Construction. Pavement Management is a core component of this process…” demonstrate that agencies are getting a payoff from system use and investment. There was even indication that agencies without a PMS system were able to apply the principles of pavement management as indicated by this comment, “Our basic system is to seal the pavement to keep the water out, crack fill within 3 years of resurfacing, and sealcoat at about 8-10 years and each 5 years thereafter. Resurfacing occurs on a 20-25 year cycle. By staying with this regimen, we have very little if any pavement deterioration problems. We are building more new lanes every year.”
Failure to Adopt—Those Who Do Not Understand the PMS Concept

A common bias in surveys is negative written comments—more people complain than give praise. That was true with this survey, where comments indicating failure to adopt were plentiful. The comments usually indicated that agencies have never really been able to get a system up and running or where agencies did try, output is ignored by decision makers. Comments ranged from, “For a small county system, pavement management systems are more trouble than they are worth” and “We really don’t need the extra work of maintaining management systems for the sake of reporting to federal or state officials” to “Our budgets have been frozen year after year and all the charts and graphs in the world won’t change that.” These comments confirm that too many agencies still don’t understand the PMS concept in its totality and adopting PMS for the wrong reasons doesn’t lead to a successful implementation.

Different Audiences—Different Training

The lack of training importance indicated by Policy Makers and Upper Management and Maintenance Crews demonstrates that training tailored to these particular groups is needed. Most training programs focus on the needs of the technical staff and the specifics of running a PMS. These other audiences normally don’t see PMS as a topic they should take interest in. Special effort needs to be made, even personal contact, to coax these audiences to attend. For example, in 2007 the Michigan LTAP, in conjunction with the Michigan Transportation Asset Management Council, began conducting half-day sessions titled Introduction to Asset Management: A workshop for elected officials. The sessions, held morning, afternoon, or evening, are organized by the county engineer at the host county. Through direct contact with township board members and city/village council members, the engineer is able to fill the room with participants crucial to moving his/her transportation plan forward. LTAP has structured the material so it is understandable by this audience. These trainings have proved to be very successful.

Use of Advanced Features Leads to More Positive Experiences

Of the agencies that indicated Excellent and Very Good PMS experiences, on average 61% used advanced features in their PMS system. Yet of those agencies that indicated a Negative PMS Experience, only 14% used advanced features in their PMS system. It seems clear that an understanding of the advanced features in an agency’s PMS and taking advantage of those features has an influence on the agency’s PMS experience. Training and experience sharing could have an impact on expanding agencies’ understanding of advanced PMS capabilities.

PMS Output as a Communication Device

The relationship between engineers/technicians and elected officials, and in turn the general public is often a classic case of miscommunication. Too often, engineers/technicians get wrapped up in the technical aspects of pavement and the PMS. To the point where they forget that the end result is for decision making and that their audience doesn’t understand pavement like they do. The survey data shows that PMS output is being used by the Policy Makers and Upper Management for Annual Budget Requirements and Capital Improvement Plans. Written
comments, however, indicate that at many agencies PMS output is ignored. Researchers suggest that this rejection is caused by poor communication on the part of engineers and lack of general understanding on the part of elected officials (and the public). The researchers’ own experience as trainers includes decision-maker participants commenting at the end of a training that “no one ever explained [pavement management] like this before.” Once decision makers understand PMS concepts and the benefits they can use to their advantage, their attitudes will change. Engineers/technicians have the responsibility to communicate with their non-technical constituents. Presented in the appropriate way, PMS output can be a very powerful justification in the decision making process.
Introduction

There are more than 39,000 local agencies managing road networks throughout the United States. Of those, the vast majority could be classified as small or rural. Implementation of management systems and practices among these types of agencies is a significant challenge.

When the Intermodal Surface Transportation Equity Act (ISTEA) was authorized in 1995, the use of management systems was required as a condition of federal funding at both the state and local level. Although the ISTEA mandate was eventually rescinded, a number of states and local agencies believed that the use of management systems was the future of infrastructure management. Those agencies continued to move forward, essentially breaking trail to what is now considered Transportation Asset Management.

Local agency adoption of management systems has progressed, but clearly not to the level of state departments of transportation. This limited progress is due to the lack of agency coordination, lack of system software and training, lack of decision making tools, and lack of funding that can make implementation a reality.

Some local agencies have overcome these hurdles through statewide initiatives that create systems which can be used by all of a particular state’s counties, cities, villages and towns. In Wisconsin, PASERWARE and WISLR are available to local agencies and in Michigan, RoadSoft® GIS is available. Use of these systems is provided at no direct cost to local agencies. Training in both states is provided in cooperation with the Local Technical Assistance Program (LTAP) (also known as the Transportation Information Center in Wisconsin).

In the past few years, revenue constraints have raised constituent demands for accountability of public spending and forced road agency managers to look for ways to document the engineering decision-making process. Management systems serve well in that purpose, but the power of management systems is not simply as a documentation tool. Its true power is as an analysis tool that allows agencies to: model road surface deterioration; build complex repair strategies (mix-of-fixes); predict future performance; optimize between needs, expectations and revenues; and produce output that enable engineers and elected officials to communicate transportation needs effectively.

While the above accomplishments are significant in that they overcame existing hurdles, much remains to be known in how data analysis is being done, the validity of the analysis models, and how the analysis is being used or not used in the decision making process.

Now that a considerable amount of local road condition data is being collected, the question arises, “How can it best be used?” The answer is based in both engineering and politics. On the engineering side, the data can be used to conduct system prediction and develop sophisticated management plans. In the political arena, data analysis can eliminate some of the politics that negatively influence the transportation decision making process. The success of pavement management system implementation at the local level depends on the agencies’ ability to use the data in a positive way, be it at the jurisdictional, regional or statewide level.
Research Objective

The objective of this research is to gain a better understanding of the current use of pavement management data and systems by local road agencies and how these could be better exploited to local agency advantage through the use of jurisdictional, regional and statewide analysis. This includes validating the deterioration and strategy evaluation models used in RoadSoft® GIS. Each task was performed independently, but when and where appropriate the gathered information was integrated into other tasks.

The Research Plan is broken down into the following functional tasks:

Task 2. Survey of Data Collected and Systems Analysis Used by Local Agencies In the Region.
Task 5. Summary of Existing Training Materials for Local Road System Management and Recommendations for Enhancing Those Materials.
Task 7. Investigating the Use of PASERWARE and WISLR by Local Agencies.
   (Issued under separate MRUTC contract and not included in this report.)

Application of Findings

Most of the data used in this study came from a survey distributed to local agencies throughout the states in the upper Midwest. The number of responding agencies (429) are considerable when compared to the total agencies notified (1,973). Factors such as the statewide pavement management initiatives in Michigan and Wisconsin may have enhanced the response rate, while the inherent bias of a volunteer survey directly influenced the data, thereby making some conclusions specific to the region, rather than representative of local agencies nationwide. Those region specific conclusions can provide insight for other areas of the country in understanding how agency implementation proceeds. Other conclusions, such as those related to training needs, conceptual understanding, data gaps, etc., are not affected by these regional influences and hence, could be applied to local agencies nationwide.

With the exception of Task 1, which covers systems used by local agencies throughout the U.S., the geographic focus of this project is the states of Wisconsin, Michigan, Indiana, Minnesota, Illinois, Ohio and Iowa and throughout the report is referred to as the “Region.” In some analysis, Indiana, Minnesota, Illinois, Ohio and Iowa are grouped together as “Other States” for comparison against Wisconsin and Michigan.
1. Task 1 State-of-the-Practice Summary

1.1. Task Description
The researchers will prepare a summary of system management practices currently used by local road agencies throughout the Region as well as coordinated approaches being used by local agencies elsewhere in the United States. The Local Technical Assistance Program Centers (LTAP) nationwide will be used as a resource for identifying these initiatives.

1.2. Method Used
Although pavement management systems have been documented in the past, such as the survey done by Bernardin (2006 pp.39-62) this study attempted to identify all systems being used by local agencies nationwide as well as coordinated approaches that were being used on a statewide or regional level. The researchers took advantage of the fact that there is an LTAP Center in every state throughout the United States working directly with local road agencies. A request for information on current management systems being used by local road agencies was sent via e-mail to all these centers. Searches were conducted on the Internet and through existing publications for management systems that could be used by local road agencies. In an effort to confirm the accuracy of the technical information gathered, a standard form was created and each prepared summary was sent to its respective vendor/developer for technical confirmation. Some of the vendors/developers did not respond to requests for additional technical information about their system. Missing information was marked as “Not Provided” in the summary for each system.

1.3. Results
There are 29 different Pavement Management Systems (PMS) currently being used by local road agencies throughout the United States. See Table 1.1.

Of the systems available for local road agencies nationwide, 13 are in the Public Domain, and 16 are in the Private Domain. Comparison analyses of the system’s use within the Region are included in the Task 2 Results. Two Public Domain systems are no longer supported by their developers. PASERWARE, still in use by some agencies in Wisconsin, is being replaced by WISLR (Wisconsin Information System for Local Roads). RSMS (Road Surface Management System), used primarily by local road agencies in the north-eastern states, is no longer supported by the New Hampshire LTAP Center.

The capabilities of the identified systems range from satisfying the basic needs of a PMS to sophisticated analysis and data integration. Most all of the systems currently in use are more than just documentation tools, they are analysis tools that allow agencies to model road surface deterioration, build complex repair strategies (mix-of-fixes), predict future performance, and optimize between needs, expectations and revenues. All but four of the systems, regardless of domain, are structured as part of a Geographic Information System (GIS) and all but one have some type of Maintenance & Rehabilitation Strategy tool.
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<td></td>
</tr>
<tr>
<td>PMS Pro</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RoadManager 2000® TM</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RoadSoft®</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>RSMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Stantec PMS</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>StreetSaver™</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>StreetWise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>TAMS</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>WISLR</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>WY LTAP AMS</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Table 1.1 along with Appendix A provides a general comparison between the systems. Additionally, the FHWA Pavement Management Catalog (Pavement Management Software/Data Collection Equipment) is currently being revised and updated under contract with Soils and Materials Engineering, Inc. The publication is expected sometime in 2008. The catalog should provide more in-depth information on most, if not all, of the systems listed.

### 1.3.1. Coordinated Approaches

Some of the above systems are being used in coordinated approaches at the jurisdictional, regional and statewide level.

**Iowa—Iowa Pavement Management Program (IPMP)**

This program was originally initiated in response to the management system mandate within the ISTEA transportation legislation, and continued on after the mandate was lifted. IPMP is managed by the Center for Transportation Research and Education at Iowa State University. IPMP has adopted Deighton Total Infrastructure Management System (dTIMS\textsuperscript{TM} CT) with GIS capability. The system is used by approximately 20 local agencies, using the Road Condition Index (RCI) as a road rating system.

**North Carolina—Infrastructure Management System (IM)**

The Institute for Transportation Research and Education (ITRE) at North Carolina State University modified a system used by NCDOT to accommodate the pavement management needs of counties and municipalities in North Carolina and South Carolina. It is used by approximately 100 local agencies. It is GIS-based and includes various other management modules. It uses the Pavement Condition Rating (PCR) as a road rating system. Training is provided by ITRE staff.

**Washington—Mobility (Road Inventory and Management System)**

The State of Washington County Road Administration Board (CRAB) developed this system. It is used by approximately 35 local agencies. Mobility is a non-GIS system; it provides several other management modules. It uses the Pavement Structural Condition (PSC) as a road rating system. Training is provided by CRAB staff.

**Wisconsin—Wisconsin Information System for Local Roads (WISLR)**

The Wisconsin Department of Transportation, with the assistance of the University of Wisconsin Transportation Center (WI LTAP), developed a pavement management tool that is offered through the Wisconsin Information System for Local Roads (WISLR) database. WISLR is a shared state and local resource that provides local governments and the DOT convenient access to data that help to enhance local transportation and related planning decision-making.

The system has an Internet-accessible GIS platform and uses PASER (Pavement Surface Evaluation and Rating) as a road rating system. The system is provided at no cost to local agencies. Over 950 local agencies have submitted pavement condition data via WISLR. WISLR and PASER training is conducted jointly by WisDOT and the Transportation Information Center.
Michigan—RoadSoft® Integrated Roadway Management System

The Michigan Department of Transportation (MDOT), the County Road Association of Michigan (CRAM) and the Michigan LTAP at Michigan Technological University (MTU) initiated this system in response to the management system mandate within the ISTEA transportation legislation and continued on after the mandate was lifted. It is a user-driven, GIS-based roadway management system with various management modules integrated throughout the system. The system was designed by local agencies to specifically fill the needs of counties, cities and villages. It is used by over 240 local agencies throughout the State. RoadSoft® and its Laptop Data Collector have been adopted by the Michigan Transportation Asset Management Council (Asset Management Council, 2008) to collect surface and inventory data on 47,000 miles of federal-aid roads; 2007 will be the fifth year of data collection. The Council has also adopted the RoadSoft® Asset Management Module (Strategy Analysis and Optimization) for statewide analysis of the federal-aid network. The system uses the PASER road rating system and is developed and supported by the Technology Development Group at MTU through funding from MDOT. Training is provided by the Michigan LTAP.

California—StreetSaver™

The Metropolitan Transportation Commission (MTC) in the San Francisco Bay area initiated this effort in 1982 in response to local road maintenance and revenue shortfalls. System simplicity was an emphasis during system development. The system is used by over 290 local agencies. Software upgrades, database storage and backup, and regular maintenance is handled by the MTC. The system supports GIS linkage and uses the Pavement Condition Index (PCI) as a road rating system. Training is provided by MTC staff.

Washington—StreetWise

The Washington State Department of Transportation developed this simplified manual system to assist smaller cities (population of less than 22,000). It is based on the concepts used by computerized systems. The system is used by approximately 30-35 local agencies. It uses five distresses to rate asphalt pavements as a road rating system in Washington. It does not have a GIS Platform.

Wyoming—Wyoming LTAP Asset Management System (WY LTAP AMS)

The Wyoming LTAP Center developed this system in cooperation with three counties. The system is based on one used by the Wyoming Department of Transportation for asphalt and concrete roads. The system is used by the three original local agencies. It is GIS based and includes additional management modules. The system uses the PASER road rating system. Training is provided by the WY LTAP.
2. Task 2 PMS Survey for Local Road Agencies

2.1. Task Description

Teleconference meetings were held during April 2006 with LTAP Staff and one identified local agency representative from each state in the Region. This meeting served to organize support for the research project and provide a snapshot of what types of data collection and analysis were being done in the Region. The outcome of the meetings was used as the basis for the survey.

The LTAP Centers in the Region and the local agency representatives identified local agency practitioners and built a database of contact information. Using the input from the meetings above and the researchers’ general knowledge of local agency road network management, a draft survey was created and submitted to the project advisory committee in May 2006 for comments. Upon receipt of comments, a web survey was created (see Appendix B) in compliance with US Section 508 Guidelines.

Each LTAP Center contacted their respective local road agencies through their current database of contacts by U.S. mail, fax and/or e-mail with a request to complete the survey. Each notice enclosed a hard copy of the survey and the link to the online web survey.

The LTAP Centers notified 1,973 local road agencies in the Region. Of the agencies notified, 429 agencies (22%) responded to the survey. The web survey was available on-line for a period of 29 days during June/July 2006. There was no cut off date for the acceptance of hard copy surveys, but none arrived after 60 days.

2.2. Data Summary

The survey data is summarized below following the same order as the questions were presented in the survey. Agency comments are included and have not been edited, except for grammar corrections and the omission of language that was considered inappropriate. It should be noted that the survey was distributed during the same period that Wisconsin was making its transition to the WISLR system, and during that time both in Wisconsin and Michigan outreach activities were being increased. Hence, comments may not reflect the benefit of those activities.

2.2.1. Contact Information

Agencies were asked to provide their agency contact information. This information was not intended to be used for the final report; it was collected so that agencies could be contacted later if necessary. The distribution of responding agencies by state is shown in Table 2.1.
Table 2.1 Distribution of Responding Agencies by State

<table>
<thead>
<tr>
<th>State</th>
<th>Number of Agencies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa</td>
<td>54 (13%)</td>
</tr>
<tr>
<td>Illinois</td>
<td>108 (25%)</td>
</tr>
<tr>
<td>Indiana</td>
<td>10 (2%)</td>
</tr>
<tr>
<td>Michigan</td>
<td>108 (25%)</td>
</tr>
<tr>
<td>Minnesota</td>
<td>13 (3%)</td>
</tr>
<tr>
<td>Ohio</td>
<td>33 (8%)</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>103 (24%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>429 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: This information was collected for information purposes only.

2.2.2. Local Agency Information

Agency Type

Table 2.2 shows the distribution of agency types that completed the survey. The researchers were surprised to find that 29% (112/429) of respondents were from Villages and Towns/Townships, which have small networks, very small staffs and very small budgets.

Of the Counties/County Road Commissions, 93% (151/162) identified their agency as Rural or Rural/Urban. These agencies typically have large, dispersed networks, small staffs and small budgets. The interest displayed by these types of agencies and their current implementation of PMS is encouraging and demonstrates that PMS is not just for large or urban agencies.

Table 2.2 Distribution of Agency Type

<table>
<thead>
<tr>
<th>Type of Agency</th>
<th>Number of Agencies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village</td>
<td>72 (17%)</td>
</tr>
<tr>
<td>City</td>
<td>132 (31%)</td>
</tr>
<tr>
<td>Town or Township</td>
<td>50 (12%)</td>
</tr>
<tr>
<td>County or County Road Commission</td>
<td>162 (38%)</td>
</tr>
<tr>
<td>Other</td>
<td>13 (3%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>429 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: Other is comprised of nine consultants in Illinois and Iowa, one Department of Transportation (DOT) in Illinois, one DOT in Iowa, a Metropolitan Planning Organization in Wisconsin and a non-profit in Michigan.

The Type of Agency data was queried against the following data elements, but none yielded any significant or enlightening results:

- Contact Information
  - State
- Local Agency Information
  - Population
  - County or County Road Commission
- Policy Maker (Appointed versus Elected)
- Number of certified street/road miles (paved and unpaved)
- Annual Street/Road Maintenance and Construction Budget

• Pavement Management System
  - PMS Use
  - Software (Public vs. Private Domain)
  - Implementation (Number of Years)
  - Data Collection Frequency/Process
  - Experience
  - Data Output Use (How Often/How)

• Implementing/Running a PMS
  - Challenges
  - Data gaps
  - Data sharing (comfort level/reason)

• PMS Training
  - Provider
  - Level
  - Importance

Political Structure
Respondents indicated that 79% (312/395) of the agencies had a political structure of Elected Policy Makers, as compared to 21% (83/395) of agencies with a structure of Appointed Policy Makers. Note: 8% (34/429) of the responding agencies did not answer this question.

Population
Although population provides some insight into the nature of the agencies surveyed, it should be noted that counties include cities, villages, and towns/townships in their population. In most cases though, counties are not responsible for these other agency’s road networks. Thus, population is not an accurate representation of agency responsibility.

Number of Road Miles (Paved and Unpaved)
The number of road miles in an agency’s network is a better representation of agency responsibility. This is measured as linear road miles, not lanes miles. See Figure 2.1. The distribution of agencies by total number of miles aligns with the general demographics of the agency types responding.
Figure 2.1 Number of Network Miles (Paved and Unpaved) Distribution

<table>
<thead>
<tr>
<th>Range of Miles (Paved and Unpaved)</th>
<th>Total Number of Network Miles Distribution (N = 429)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-50</td>
<td>22%</td>
</tr>
<tr>
<td>50-100</td>
<td>16%</td>
</tr>
<tr>
<td>100-150</td>
<td>19%</td>
</tr>
<tr>
<td>250-500</td>
<td>11%</td>
</tr>
<tr>
<td>500-1K</td>
<td>13%</td>
</tr>
<tr>
<td>1K-2K</td>
<td>9%</td>
</tr>
<tr>
<td>&gt;2K</td>
<td>0%</td>
</tr>
<tr>
<td>N/A</td>
<td>10%</td>
</tr>
</tbody>
</table>

Agency Budget
An agency’s budget is a good indicator of their maintenance and reconstruction capacity. See Table 2.3.

Table 2.3 Annual Street/Road Maintenance and Construction Budget Distribution

<table>
<thead>
<tr>
<th>Annual Budget</th>
<th>Number of Agencies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $100,000</td>
<td>45 (11%)</td>
</tr>
<tr>
<td>$100,000 to $500,000</td>
<td>85 (22%)</td>
</tr>
<tr>
<td>$500,000 to $1 Million</td>
<td>65 (17%)</td>
</tr>
<tr>
<td>$1 Million to $5 Million</td>
<td>126 (32%)</td>
</tr>
<tr>
<td>$5 Million to $10 Million</td>
<td>49 (12%)</td>
</tr>
<tr>
<td>$10 to $50 Million</td>
<td>20 (5%)</td>
</tr>
<tr>
<td>More than $50 Million</td>
<td>3 (1%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>393 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 8% (36/429) of the respondents did not answer this question.

2.2.3. Pavement Management Systems
This section of the survey collected information about systems and their use by local road agencies in the Region.

PMS Use by Local Agencies
Agencies were asked to indicate if they used a PMS or not. The results from this question are shown in Table 2.4.
The PMS user data for Michigan and Wisconsin was combined because both have statewide PMS initiatives. The combined data was compared to the PMS users in the Other States, which do not have statewide PMS initiatives. See Figure 2.2. The comparison is drastic and appears to demonstrate that a statewide PMS initiative has a positive impact on local agency PMS implementation.

Figure 2.2 Agency PMS Use by States with Initiative vs. No Initiative

Task 1 identified the different PMS software that was generally available and being used by local road agencies throughout the United States. This identified software was provided as a list in the survey for respondents to select from. See Table 2.5. The total number of responses exceeds the number of agencies using PMS because some responses indicated the use of two PMS software programs (mostly PASERWARE and WISLR). Of the 24 agencies that selected Other, 18 used in-
house/self created systems: one used Baxter & Woodman Inc., one used Good Point, and four used Infrastructure Management Services, LLC.

Table 2.5 Pavement Management System Software Use

<table>
<thead>
<tr>
<th>PMS Software (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>dTIMSTM™ CT</td>
<td>5 (2%)</td>
</tr>
<tr>
<td>ICON PMS</td>
<td>5 (2%)</td>
</tr>
<tr>
<td>MicroPAVER</td>
<td>26 (11%)</td>
</tr>
<tr>
<td>PASERWARE</td>
<td>62 (26%)</td>
</tr>
<tr>
<td>Pave Pro Manager</td>
<td>6 (2%)</td>
</tr>
<tr>
<td>PAVEMENTview® / Plus</td>
<td>10 (4%)</td>
</tr>
<tr>
<td>PMS 4.0</td>
<td>1 (&lt;1%)</td>
</tr>
<tr>
<td>RoadSoft®</td>
<td>57 (24%)</td>
</tr>
<tr>
<td>Stantec PMS</td>
<td>3 (1%)</td>
</tr>
<tr>
<td>WISLR</td>
<td>43 (18%)</td>
</tr>
<tr>
<td>Other</td>
<td>24 (10%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>243 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 1% (2/216) of the responding agencies did not answer this question.

System Implementation and Data Collection

The ISTEA mandate that required the use of PMS as a condition for federal funding at the state and local level was rescinded more than ten years ago (1995). The ISTEA mandate, however, did bring attention to the benefits that a PMS can provide to local road agencies and led to not only individual agency adoption but also statewide and regional coordinated approaches that support implementation. In the Region, 53% (115/216) of the local agencies implemented their PMS in the past 5 years, so clearly the trend of implementation is rising. Note: 1% (3/216) of the responding agencies did not answer this question.

The influence of organizational structure (Appointed vs. Elected Policy Makers) of an agency on the implementation of PMS was considered, but the data does not indicate any influence. See Figure 2.3.
Data Collection & Staffing

Effective PMS implementation requires good data—good in quality and good in quantity. Data collection is recommended either once per year or every two years. In the Region, 78% (157/201) of the local agencies collect data once per year or every two years. Note: 7% (15/216) of the responding agencies did not answer this question.

The majority of agencies 77% (158/204) use In-House (by Your Agency) as their method for data collection. Only 21% (43/204) of agencies use Consultants as their method for data collection. Note: 6% (12/216) of the responding agencies did not answer this question. Due to the labor intensive nature of data collection, associated cost is often a limiting factor for many agencies. Most agencies mitigate that cost burden by using in-house staff.

This data does not contradict that from an earlier study by Wittwer (2003) that reported 60% of agencies did use private firms and that just more than a quarter used in-house resources (p.7). The Wittwer study surveyed 40 larger cities, whereas only 4 of the agencies responding to this survey were larger cities of which 3 used consultants.

Software Advanced Features

Agencies were asked which advanced features of PMS software were being used. The choices were: GIS (Geographic Information System), PDC (Pavement
Deterioration Curve), RSL (Remaining Service Life), Strategy M&R (Maintenance & Rehabilitation) and Optimization M&R (Maintenance & Rehabilitation). See Figure 2.4.

Figure 2.4 PMS Software Advanced Features Use

<table>
<thead>
<tr>
<th>PMS Software Advanced Features</th>
<th>GIS (N = 199)</th>
<th>PDC (N = 197)</th>
<th>RSL (N = 198)</th>
<th>Strat. (N = 199)</th>
<th>Opt. (N = 199)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opt. (N = 199)</td>
<td>YES</td>
<td>58%</td>
<td>61%</td>
<td>63%</td>
<td>79%</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>42%</td>
<td>39%</td>
<td>37%</td>
<td>21%</td>
</tr>
</tbody>
</table>

Note: 8% (18/216) of the respondents did not answer this question.

PMS Experience

PMS software provides a wide range of functionality and interfaces that influence an agency’s experience. Agencies were asked to classify their experience. Being a voluntary survey, the respondents do not represent all agencies or a scientific sample, but it is worth noting that of the 200 agencies responding that use PMS, 80% indicated an experience as Good, Very Good or Excellent. See Table 2.6. This positive experience seems to indicate that local road agencies have embraced pavement management and that the systems are producing practical and positive results.

Table 2.6 PMS Experience

<table>
<thead>
<tr>
<th>PMS Experience</th>
<th>Number of Agencies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>19 (10%)</td>
</tr>
<tr>
<td>Very Good</td>
<td>80 (40%)</td>
</tr>
<tr>
<td>Good</td>
<td>60 (30%)</td>
</tr>
<tr>
<td>Fair</td>
<td>38 (19%)</td>
</tr>
<tr>
<td>Poor</td>
<td>3 (1%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 7% (16/216) of the respondents did not answer this question.
Further analysis revealed that the Advanced Features of PMS software (GIS, PDC, RSL, Strategy and Optimization M&R) were a factor influencing PMS experiences. Excellent and Very Good were grouped together as Positive Experience. Fair and Poor were grouped together as Negative Experience. See Figure 2.5.

The agencies with Positive Experience have, on average, a 61% use rate of the advanced features. The influence of the advanced features becomes more apparent when the PMS experiences are compared; for Good Experience the advanced features use rate lowers to an average of 26% and for Negative Experience the use rate drops again to an average of 14%. This may indicate that agencies that take advantage of advanced features gain benefits that in turn enhance their overall experience.

Figure 2.5 Software Advanced Features Influence on PMS Experience

This section of the survey included an opportunity for agencies to provide additional comments. Comments were provided by 19% (37/216) of the agencies. In order to better understand the comments, they are grouped by state and PMS experience. Due to the small number of responses from these Illinois, Indiana Ohio and Iowa the comments for these states have been grouped together. Each comment includes an indication of the PMS software and type of agency.

**Michigan PMS Experience: Excellent**

“We have the ability to guide the future enhancements of our PMS through user groups- the most valuable tool.” – RoadSoft®, County Road Commission.

**Michigan PMS Experience: Very Good**

“The software developer is always responsive to the users needs, often times taking suggestions for implementation.” – RoadSoft®, County Road Commission.
“We have the ability to evaluate and optimize, however we don't have the staff time to undertake these activities. Our Board expects construction and maintenance activities to have first priority and we run out of time before we can conduct any meaningful strategies with PMS.” – RoadSoft®, County Road Commission.

“Able to do RMS (Roadway Management System), strategies and optimize, but not comfortable enough to use these features routinely.” – RoadSoft®, County Road Commission.

“For our road commission, the Annual System Condition Benchmark is a key outcome of the condition survey and database update of completed road improvements.” – MicroPAVER & RoadSoft®, County Road Commission.

“I don't believe we can customize deterioration curves, but there are 18 different ones built into the system.” – Stantec PMS, City.

**Michigan PMS Experience: Good**

“System capability may be there, but I have not yet been able to use them.” – RoadSoft®, County Road Commission.

“We are currently trying to keep our program updated with the city's street information. The program had been neglected.” – RoadSoft®, City.

“I must go back to class on the RoadSoft® system to understand its uses. Once I accomplish that, I plan to install our information and use the software for our future construction and maintenance needs.” – RoadSoft®, Township.

**Michigan PMS Experience: Fair**

“The lack of a sufficient amount of data, staffing/time restraints, and lack of adequate computer equipment has limited the use of the data collected so far.” – RoadSoft®, County Road Commission.

“Mileage of roads is approximate. Until RoadSoft® map corresponds with certification maps, all data in the program is approximate.” – RoadSoft®, County Road Commission.

“MicroPaver is a somewhat difficult software to input data and determine management and rehab strategies, etc.” – MicroPAVER, switching to RoadSoft®, City.

“The PASER (Pavement Surface Evaluation and Rating) system needs to be more detailed and location specific. Our system also averages street conditions rather than denoting bad areas on an overall good street.” – In-House System, City.

**Michigan PMS Experience: Poor**

“We just acquired RoadSoft® and have not learned how to use it yet.” – RoadSoft®, City.

**Wisconsin PMS Experience: Very Good**
“PASERWARE was not revised as planned by the state so we are not able to do the strategies and planning with the system as before.” – PASERWARE & WISLR, Town.

**Wisconsin PMS Experience: Good**

“Even though we answered ‘no’ to the questions above that does not mean our program isn't capable to the any of those things we just haven't utilized those capabilities as of yet.” – PASERWARE, County.

“I like the PASERWARE, especially the feature that allows me to print roads in the order of our annual Road Tour via the Sort Field number. I submit WISLR because it is required, but without being able to list and print roads sections in order of our Road Tour, WISLR is useless to us.” – PASERWARE & WISLR, Town.

“Use of WISLR in the rural areas is challenging do to the limitation of dial up internet service. It is faster to generate reports with PASERWARE.” – PASERWARE & WISLR, Town.

“We continue to fine tune the system.” – MicroPAVER, City.

“We are not utilizing the system to its full potential. WISLR has updated the programs abilities.” – WISLR, Village.

**Wisconsin PMS Experience: Fair**

“WisDOT has had problems keeping the software functional and current. However it is critical to have some system in place.” – PASERWARE & WISLR, County.

“The training to use WISLR seems weak. I learned on-line how to do the basic requirements of reporting. I'm sure I don't know how to use most of the finer features, but I don't know that I need to anyway. It's kind of high tech and I'm out biking on the roads in my town every day. I know where the problems are.” – WISLR, Town.

“It has been somewhat complicated converting the old way of doing things (paper) to the PMS version. Some of the terminology used to describe roads hasn't been the easiest to learn or teach to someone not up on the terms used by the WisDOT. We are working on that though.” – PASERWARE & WISLR, Town.

“I don't work with the PASER report so I am not sure what information other than road name and surface rating one can get from it. The hard copy for the town just states the road name, rating, type, year and width.” – PASERWARE, Town.

“Everything you accomplish starts with subjective evaluation of streets in a time in which budgetary allotments are tight so like many other technology based alternatives, output is equal to or no greater than input.” – WISLR, City.
“It is difficult to find resources (staff time) to commit to PMS. Sophisticated aspects of a PMS are more applicable to a system that has not been adequately funded and/or maintained.” – MicroPAVER, City.

**Wisconsin PMS Experience: Poor**

“We have had PASERWARE system for years, but it has never worked properly therefore the town is using WISLR at this time.” – PASERWARE & WISLR, Town.

**Wisconsin PMS Experience: Not indicated**

“We use the PMS because it is required by the state; we have very unique circumstances that make it very difficult for us to follow through with a PMS, at least at this time.” – WISLR, Town.

Although the PMS experience varies from *Very Good* to *Poor*, the comments seem to carry the same connotation. At the time of this survey, the statewide PMS program in Wisconsin was going through changes. The old system (PASERWARE) was still in use by many local road agencies, but the new web-based system (WISLR) was being introduced throughout the state. Based on the comments from agencies, they were finding the transition between PASERWARE and WISLR to be challenging.

**Minnesota PMS Experience: Excellent**

“Our PMS was directly credited with a County Board Bonding of $5 Million. The county only funded roads to maintain paved surfaces. Deterioration curves along with projected remaining service life graphs and high maintenance costs educated the public to fund support increase.” – MicroPAVER, County.

**Minnesota PMS Experience: Good**

“Due to staffing shortfalls we have not yet utilized the full capabilities of our management system.” – ICON PMS, County.

**Minnesota PMS Experience: Fair**

“The software and data were not kept up to date before I came on board.” – ICON PMS, County.

**Illinois, Indiana, Ohio and Iowa PMS Experience: Good**

“We are still developing our system so it is too early to tell.” – System not Specified, County, Indiana.

“I am not sure of all the capabilities of the system.” – dTIMSTM CT, County, Iowa.

“We hope to purchase PMS software that will perform the strategies mentioned above.” – In-House System, City, Ohio.

“I have not used different types of PMS, but I have fashioned one for our agency. It calculates pavement failure (square foot %) to overall pavement square footage per section of street (block). This is then multiplied by different factors such as traffic volume, location of street and etc. The result is paving
order of priority and funding needed for desired overall pavement paving cycle.” – In-House System, Village, Illinois.

**Illinois, Indiana, Ohio and Iowa PMS Experience: Fair**

“Annual review of road conditions and trends allow us to predict maintenance cost and develop a construction program, not rocket science with this many miles.” – System not Specified, County, Iowa.

**Illinois, Indiana, Ohio and Iowa PMS Experience: Not indicated**

The City is preparing to initiate a pavement management system (MicroPAVER) in the fall of 2006. Questions regarding experience with MicroPAVER are expected. – MicroPAVER, City, Illinois.

**PMS Data Output Use**

Agencies were asked how often the PMS data output is used and the specific purpose of its use. Although agencies have different organizational structures due to their size, there is generally an *Engineering/Maintenance Unit* and a *Policy Makers and Upper Management Unit*. The two units were compared to determine how often each of used PMS data output. See Figure 2.6. The results are encouraging in that 95% of the *Engineering/Maintenance Unit* and 84% of the *Policy Makers and Upper Management Unit* use the PMS data output All the Time, Often, or Sometimes.

**Figure 2.6 PMS Data Output Use**

![Figure 2.6 PMS Data Output Use](image)

Note: 7% (16/216) and 8% (17/216), respectively, of the respondents did not answer this question.

**PMS Data Output Use by Engineering /Maintenance Unit**

Agencies were asked about their specific use of the PMS output by the *Engineering/Maintenance Unit*. Their primary uses of the data are *General*
Maintenance and Construction Plan followed closely by Capital Improvement Plan and Annual Budget Requirements. See Table 2.7.

Of the agencies indicating State Reporting Requirements, 91% (75/84) were from either Michigan or Wisconsin, states where pavement condition reporting is required. In Michigan, local agencies with streets/roads eligible for federal-aid are required to submit roadway condition data to the Transportation Asset Management Council yearly as part of the statewide asset management program. In Wisconsin, local agencies are required to submit roadway condition data to the State DOT at least once every two years as part of their statewide pavement management program.

Table 2.7 PMS Data Output Use by Engineering/Maintenance Unit

<table>
<thead>
<tr>
<th>Data Output Use—How (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Reporting Requirements</td>
<td>84 (12%)</td>
</tr>
<tr>
<td>Public Meetings</td>
<td>74 (11%)</td>
</tr>
<tr>
<td>Tax Increase Proposal</td>
<td>25 (4%)</td>
</tr>
<tr>
<td>General Maintenance and Construction Plan</td>
<td>141 (21%)</td>
</tr>
<tr>
<td>GASB 34 Compliance</td>
<td>66 (10%)</td>
</tr>
<tr>
<td>Day-to-Day Activity</td>
<td>49 (7%)</td>
</tr>
<tr>
<td>Annual Budget Requirements</td>
<td>112 (17%)</td>
</tr>
<tr>
<td>Capital Improvement Plan (CIP)</td>
<td>122 (18%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>673 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 1% (1/190) of the responding agencies did not answer this question.

This section of the survey included an opportunity for agencies to provide additional comments on PMS data output use by the Engineering/Maintenance Unit. Comments are grouped by agency response to PMS use.

**PMS Output Use: All the Time**

“PMS data provides a list of needs for Reconstruction, Preservation, and Routine Maintenance. Chipseals, resurfacing, and crack sealing candidates are selected from these lists.” – MicroPAVER & RoadSoft®, County Road Commission, Michigan.

**PMS Output Use: Often**

“Our county currently uses the RoadSoft® plan to watch our roads and their condition.” – RoadSoft®, Township, Michigan.

“The reports from a program are much more credible than anything the staff will have to say.” – PASERWARE & WISLR, County, Wisconsin.

**PMS Output Use: Sometimes**
“Many of the activities listed may be brought online, as the database of historical information is included.” – RoadSoft®, County Road Commission, Michigan.

“We consider our ratings when looking at budgeting but not to the extent that we are capable of.” – PASERWARE®, County, Wisconsin.

“We do not have an Engineering/Maintenance Unit. The information we get from WISLR is used by the Town Board in the above checked areas.” – PASERWARE & WISLR, Town, Wisconsin.

“We are a small town with part-time workers who work day by day. We do not have an Engineering Department” – PASERWARE & WISLR, Town, Wisconsin.

PMS Data Output Use by Policy Makers and Upper Management Unit

Agencies were asked about their specific use of the PMS output by the Policy Makers and Upper Management Unit. Their primary uses of the data are Annual Budget Requirements, followed closely by Capital Improvement Plan (CIP) and General Maintenance and Construction Plan. See Table 2.8. Of the agencies indicating State Reporting Requirements, 90% (51/57) were from either Michigan or Wisconsin, for the same reasons as stated above.

The priorities selected by the Policy Makers and Upper Management Unit are the same three as selected by the Engineering/Maintenance Unit. The ranked order is different, with General Maintenance and Construction Plan and Annual Budget Requirements swapped between the first and third position.

Table 2.8 Data Output Use by Policy Makers and Upper Management Unit

<table>
<thead>
<tr>
<th>Data Output Use—How (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Reporting Requirements</td>
<td>58 (11%)</td>
</tr>
<tr>
<td>Public Meetings</td>
<td>69 (13%)</td>
</tr>
<tr>
<td>Tax Increase Proposal</td>
<td>28 (5%)</td>
</tr>
<tr>
<td>General Maintenance and Construction Plan</td>
<td>83 (16%)</td>
</tr>
<tr>
<td>GASB 34 Compliance</td>
<td>44 (8%)</td>
</tr>
<tr>
<td>Day-to-Day Activity</td>
<td>25 (5%)</td>
</tr>
<tr>
<td>Annual Budget Requirements</td>
<td>116 (22%)</td>
</tr>
<tr>
<td>Capital Improvement Plan (CIP)</td>
<td>102 (19%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>525 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 1% (2/169) of the responding agencies did not answer this question.

This section of the survey included an opportunity for agencies to provide additional comments on PMS data output use by the Policy Makers and Upper Management Unit. Comments are grouped by agency response to PMS use.

PMS Output Use: Often

“The 5 Year Primary Improvement Program (capital improvement program) drives the annual budgeting process and PMS output determines the level of
investments in Preservation and Construction.” – MicroPAVER & RoadSoft®, County Road Commission, Michigan.

“Engineering & Upper Management = County Engineer; we do it all.” – MicroPAVER, County, Minnesota.

“Our department head uses data to develop a five year improvement plan and budget prioritization. It is also used as a tool to preach system degradation and need for more improvement funds to policy makers/politicians. Unfortunately, this group rarely has highways as their top priority.” – PASERWARE & WISLR, County, Wisconsin.

“Director looks at each street and evaluates each year with engineer support.” – In-House System, Village, Illinois.

**PMS Output Use: Never**

“We give memos to the city commission on the road condition. They do not request or look at our written reports.” – RoadSoft®, City, Michigan.

“We get the PASER report and it is filed. The Town Board decides road work by the spring survey of road damage over the winter.” – PASERWARE, Town, Wisconsin.

### 2.2.4. Implementing a Pavement Management System

Responses to this section of the survey had similar distribution regardless of whether agencies used a PMS or did not use a PMS; therefore the data is summarized together from all 429 agencies as a way to provide a broader picture.

**Challenges in Implementing/Running a PMS**

Agencies were asked if there were specific challenges that prevented them from implementing/running a PMS. See Table 2.9. The responses coincide with comments provided by respondents in sections above. The responses were considered by state, but Cost (Implementation & Maintenance), Proper Training and Qualified Staff were predominantly among the top three choices of all the states in the Region.

**Table 2.9 Challenges in Implementing/Running a PMS**

<table>
<thead>
<tr>
<th>Challenges (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualified Staff</td>
<td>125 (18%)</td>
</tr>
<tr>
<td>Proper Training</td>
<td>159 (23%)</td>
</tr>
<tr>
<td>Upper Management Support</td>
<td>57 (8%)</td>
</tr>
<tr>
<td>Organization Structure</td>
<td>65 (9%)</td>
</tr>
<tr>
<td>Cost (Implementation &amp; Maintenance)</td>
<td>172 (25%)</td>
</tr>
<tr>
<td>We don’t have a system</td>
<td>114 (17%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>692 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 19% (80/429) of the responding agencies did not answer this question.
PMS Data Gaps that Hamper Needed Analysis

Over 700 responses regarding data gaps were gathered from 340 agencies. See Table 2.10. Task 4 reports on data gaps in detail.

Table 2.10 Common Data Gaps that Hamper Needed Analysis

<table>
<thead>
<tr>
<th>Common Data Gaps (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Evaluation Method</td>
<td>136 (19%)</td>
</tr>
<tr>
<td>Data Collection Process</td>
<td>173 (24%)</td>
</tr>
<tr>
<td>Lack of Curb and Gutter Data</td>
<td>58 (8%)</td>
</tr>
<tr>
<td>Lack of Utilities Data Integration</td>
<td>86 (12%)</td>
</tr>
<tr>
<td>Lack of Standard Maintenance and Rehabilitation Costs</td>
<td>121 (17%)</td>
</tr>
<tr>
<td>Lack of Data on Treatment Performance</td>
<td>135 (19%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>709 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 21% (89/429) of the responding agencies did not answer this question.

Data Sharing for Jurisdictional Comparison Analysis

Although difficult to initiate, jurisdictional, regional and statewide data sharing among agencies is much needed. Responses show that while 8% (28/347) are *Uncomfortable* with this idea, 60% (208/347) are *Comfortable*, and 32% (111/347) are sitting on the fence as *Skeptical*. See Table 2.11. Task 3 reports on data sharing in detail.

Table 2.11 Comfort Level for Jurisdictional Data Sharing

<table>
<thead>
<tr>
<th>Comfort Level</th>
<th>Number of Agencies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable</td>
<td>208 (60%)</td>
</tr>
<tr>
<td>Skeptical</td>
<td>111 (32%)</td>
</tr>
<tr>
<td>Uncomfortable</td>
<td>28 (8%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>347 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 19% (82/429) of the respondents did not answer this question.

Agencies were then asked for reasoning on why they felt *Comfortable*, *Skeptical* and *Uncomfortable* about data sharing. See Table 2.12.
Table 2.12 Reason for Comfort Level

<table>
<thead>
<tr>
<th>Why (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“It would be nice to know how other local agencies are doing.”</td>
<td>247 (35%)</td>
</tr>
<tr>
<td>“It would be an eye-opener for our Policy Makers and Upper Management.”</td>
<td>106 (15%)</td>
</tr>
<tr>
<td>“It would show that we are not funded properly.”</td>
<td>165 (23%)</td>
</tr>
<tr>
<td>“It would show what a great job we are doing with the current funding.”</td>
<td>101 (14%)</td>
</tr>
<tr>
<td>“Other agencies don’t need to know what we are doing.”</td>
<td>13 (2%)</td>
</tr>
<tr>
<td>“It could cause us to lose funding.”</td>
<td>35 (5%)</td>
</tr>
<tr>
<td>“It would be used against our agency.”</td>
<td>46 (6%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>713 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 1% (2/347) of the responding agencies did not answer this question.

### 2.2.5. Pavement Management Training

Training is a key component to PMS implementation—from selection of the evaluation method and collection process to development of strategies and maintenance plans (See Task 5). Training is problematic for the following reasons: training materials and instructors are a limited resource, local agencies struggle to pull staff away from other responsibilities in order to attend training, and staff turnover makes acquired expertise a lost investment.

#### PMS Training Provider

Agencies were asked to indicate their PMS training provider. See Table 2.13. Overall, agencies identified LTAP/T2 Centers as the top provider. In Illinois, Indiana and Minnesota, Consultants are the most prevalent provider.

The number of agencies identifying LTAP/T2 Centers is influenced by the higher response rate from agencies in Michigan and Wisconsin. Of the local agencies that selected the LTAP/T2 Center as their PMS training provider, 34% (60/179) are from Michigan, which has the statewide PMS program with the training coordinated directly through the LTAP/T2 Center.

The researchers suspect some confusion over training provided in Wisconsin. The 73 Wisconsin respondents indicated either the State DOT (57/107) or the University (16/40) rather than the LTAP/T2 Center. Outreach for the WISLR PMS did not begin until 2006. WisDOT provided WISLR training, while the Transportation Information Center (WI LTAP) provided the PASER training. Additionally, because local agencies are required to submit their PASER data to the WisDOT, they may have been confused as to who the PASER training provider was.

Other was selected as provider by 49 agencies. Of those, 43% (21/49) identified Local Agencies (County/City), RPOs (Regional Planning Organizations) and Town Associations (Wisconsin) as training providers. Of the remaining, 41% (20/49) responded with no answer, no one or no training, and some agencies 16% (8/49) responded they did not know.
Table 2.13 PMS Training Provider

<table>
<thead>
<tr>
<th>Training Provider (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTAP/T2 Center</td>
<td>179 (36%)</td>
</tr>
<tr>
<td>American Public Works Association (APWA)</td>
<td>24 (5%)</td>
</tr>
<tr>
<td>Consultants</td>
<td>71 (14%)</td>
</tr>
<tr>
<td>Contractors</td>
<td>10 (2%)</td>
</tr>
<tr>
<td>Universities</td>
<td>40 (8%)</td>
</tr>
<tr>
<td>Federal Highway administration (FHWA)</td>
<td>11 (2%)</td>
</tr>
<tr>
<td>State Department of Transportation (DOT)</td>
<td>107 (22%)</td>
</tr>
<tr>
<td>Other</td>
<td>49 (11%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>491 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 25% (109/429) of the responding agencies did not answer this question.

The *Training Provider* data was queried against the following data elements, but none yielded any significant or enlightening results:

- Contact Information
  - State
- Local Agency Information
  - Population
  - County or County Road Commission
  - Policy Maker (Appointed versus Elected)
  - Number of certified street/road miles (paved and unpaved)
  - Annual Street/Road Maintenance and Construction Budget
- Pavement Management System
  - PMS Use
  - Software (Public vs. Private Domain)
  - Implementation (Number of Years)
  - Data Collection Frequency/Process
  - Experience
  - Data Output Use (How Often/How)
- Implementing/Running a PMS
  - Challenges
  - Data gaps
  - Data sharing (comfort level/reason)
- PMS Training
  - Provider
  - Level
  - Importance

**Training Attendance**

Agencies were asked to indicate the number of times their staff had attended training. See Table 2.14.

Insight gathered from the general comments at the end of this section indicates that training attendance is a significant challenge for local agencies, many of which have
very limited engineering/technical or management staff—in many cases the same person. Reasons vary from lack of funds and lack of staff, to lack of time.

Table 2.14 Training Attendance

<table>
<thead>
<tr>
<th>Training Attendance</th>
<th>Number of Agencies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>121 (36%)</td>
</tr>
<tr>
<td>1 to 2 Times</td>
<td>130 (39%)</td>
</tr>
<tr>
<td>3 to 5 Times</td>
<td>62 (19%)</td>
</tr>
<tr>
<td>6 to 10 Times</td>
<td>13 (4%)</td>
</tr>
<tr>
<td>More than 10 Times</td>
<td>8 (2%)</td>
</tr>
<tr>
<td>Total</td>
<td>334 (100%)</td>
</tr>
</tbody>
</table>

Note: 22% (95/429) of the respondents did not answer this question.

Further analysis shows that there is a distinct difference between Michigan and Wisconsin, and the Other States in training attendance. See Table 2.15.

Table 2.15 Training Attendance Comparison by State

<table>
<thead>
<tr>
<th>Training Attendance</th>
<th>MI (%)</th>
<th>WI (%)</th>
<th>Other States (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>12 (14%)</td>
<td>10 (12%)</td>
<td>99 (59%)</td>
</tr>
<tr>
<td>1 to 2 Times</td>
<td>30 (36%)</td>
<td>49 (60%)</td>
<td>51 (30%)</td>
</tr>
<tr>
<td>3 to 5 Times</td>
<td>29 (34%)</td>
<td>19 (23%)</td>
<td>14 (8%)</td>
</tr>
<tr>
<td>6 to 10 Times</td>
<td>7 (8%)</td>
<td>2 (2%)</td>
<td>4 (2%)</td>
</tr>
<tr>
<td>More than 10 Times</td>
<td>6 (7%)</td>
<td>2 (2%)</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>84 (100%)</td>
<td>82 (100%)</td>
<td>168 (100%)</td>
</tr>
</tbody>
</table>

Note: 22% (24/108), 20% (21/103) and 23% (50/218), respectively, of the respondents did not answer this question.

Of all agencies responding, agencies in Michigan and Wisconsin have attendance rates more than double that of the Other States. Conversely, agencies in the Other States have never attended training at a rate 4 to 5 times greater than agencies in Michigan and Wisconsin. This reinforces the idea that statewide PMS initiatives have a positive influence on training availability and an agency’s decision to attend training. See Table 2.16.

Table 2.16 Training Attendance by Statewide PMS Initiative

<table>
<thead>
<tr>
<th>Training</th>
<th>MI (N = 84)</th>
<th>WI (N = 83)</th>
<th>Other States (N = 164)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>14% (12/84)</td>
<td>12% (10/83)</td>
<td>60% (98/164)</td>
</tr>
<tr>
<td>Trained</td>
<td>86% (72/84)</td>
<td>88% (73/83)</td>
<td>40% (66/164)</td>
</tr>
</tbody>
</table>

Further analysis shows that among agencies with a PMS in states with a statewide PMS initiative (MI and WI), 49% (68/140) attended training 1 to 2 Times. Coincidently, among agencies with a PMS in states without a statewide PMS initiative, 49% (28/57) attended training 1 to 2 Times. This similar attendance rate suggests that a basic amount of training leads to and enables PMS implementation—it doesn’t take multiple trainings to understand PMS concepts.
Level of Training
Agencies were asked to indicate the level of training that they have attended. See Table 2.17.

Table 2.17 Level of Training Attendance

<table>
<thead>
<tr>
<th>Level of Training (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory</td>
<td>149 (43%)</td>
</tr>
<tr>
<td>Intermediate</td>
<td>140 (40%)</td>
</tr>
<tr>
<td>Advanced</td>
<td>60 (17%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>349 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 100%, all 213 agencies that attended training answered this question.

Responses on level of training by agencies using PMS were grouped by Michigan, Wisconsin and Other States. See Table 2.18. The distribution is relatively similar, possibly indicating that once implementation is attempted by local agencies, the training sought out and attended is similar regardless of whether or not they participate in a statewide PMS program like in Michigan or Wisconsin.

Table 2.18 Level of Training Attendance Comparison (Using PMS)

<table>
<thead>
<tr>
<th>Level of Training</th>
<th>MI (%)</th>
<th>WI (%)</th>
<th>Other States (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory</td>
<td>43 (40%)</td>
<td>46 (42%)</td>
<td>30 (37%)</td>
</tr>
<tr>
<td>Intermediate</td>
<td>46 (40%)</td>
<td>51 (46%)</td>
<td>28 (35%)</td>
</tr>
<tr>
<td>Advanced</td>
<td>22 (19%)</td>
<td>13 (12%)</td>
<td>23 (28%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>111 (100%)</strong></td>
<td><strong>110 (100%)</strong></td>
<td><strong>81 (100%)</strong></td>
</tr>
</tbody>
</table>

Training Importance
Agencies were asked to rate the importance of training for Policy Makers and Upper Management, Engineers & Technicians, and Maintenance Crews. See Figure 2.7. Graph lines are included to illustrate the trend by responsibility type.
The difference in responses by responsibility type indicates a trend in attitude, with Engineers & Technicians providing greater percentages (66%) in Very Important and Important, and Policy Makers and Upper Management providing greater percentages (63%) in Important and Neutral. Training has traditionally been focused on data collection, and development of maintenance and construction strategies—in effect running the system. The high Neutral response from Policy Makers and Upper Management may be due to the lack of specialized training for this audience—training that would clarify for them how to use the output in ways beneficial to their responsibilities. Considering the direct influence that Policy Makers and Upper Management have on facilitating PMS implementation in their agencies (control of the financial and staff resources), the training needs of this group should be considered a priority by providers.

The Training Attendance was queried against the following data elements, but none yielded any significant or enlightening results:

- Contact Information
  - State
- Local Agency Information
  - Population
  - County or County Road Commission
  - Policy Maker (Appointed versus Elected)
  - Number of certified street/road miles (paved and unpaved)
  - Annual Street/Road Maintenance and Construction Budget
- Pavement Management System
2.2.6. General Comments on PMS

This section of the survey provided an opportunity for agencies to provide general comments as a way to obtain the overall perception on PMS implementation. Comments were provided by 14% (62/429) of the total agencies responding to the survey. The comments have been separated by state (alphabetical order) with relevant information (county/city/village, PMS used) included.

Illinois

Of the total agencies responding to the survey, 25% (108/429) were in Illinois. Villages comprised the largest group at 42% (45/108). Of the total Illinois responding agencies, 32% (34/108) currently have a PMS, but for 41% (14/34), implementation has only occurred in the past five years.

“We do currently have a PMS application associated with our GIS system, and are in the process of implementing and gathering the data required to make the thing useful.” – In-House System, County.

“The County Highway Department is in the early stages of a preventive maintenance program. This is an important priority for the Department to coordinate our management with our Maintenance Operations.” – In-House System, County.

“The usefulness of the output of Pave Pro Manager is heavily dependent on the accuracy of the known data of the existing pavement structure, as well as the quality control of the data collection. The legitimacy/reliability of the "cost-effective strategies" quickly erodes when they are incongruent with obvious visual contradictions. When confidence in the reliability of the strategies occurs, it becomes an enormous expensive task to resolve inaccuracies and may be impossible to restore a sufficient level of confidence in the data.” – Pave Pro Manager, Village.

“Our basic system is to seal the pavement to keep the water out, crack fill within 3 years of resurfacing, and sealcoat at about 8-10 years and every 5 years thereafter. Resurfacing occurs on a 20-25 year cycle. By staying with this
regimen, we have very little if any pavement deterioration problems. We are building more new lanes every year.” – No PMS, County.

“The people that were trained are gone from my organization.” – No PMS, County.

“I am interested in establishing a pavement maintenance plan for this county. Any available data from other counties would be very useful for comparison purposes.” – No PMS, County.

“We need opportunities to allow an assigned person to be trained in pavement maintenance from assessment to implementation, oversight and documentation.” – No PMS, City.

“We tried to implement a pavement management system several years ago. We had a study done and acquired a system that would be integrated with our GIS system. The elected officials at that time were unable to commit to funding the program in order for it to be effective. Roadway reconstruction is still determined on a political basis by the City Council, despite numerous attempts to develop some quantitative criteria.” – No PMS, City.

“We have used IMS (Infrastructure Management System) pavement management before. It gave some valuable information that we used with other factors in determining street maintenance. We found the "surface condition" information the most valuable.” – No PMS, Village.

“The systems mentioned for Pavement Management are not needed for a system of 35 miles, since this amount of pavement is easily managed without a technical system. However, a system is mandatory and I am surprised no consideration was made for in-house custom made systems. I would like to see the data for those types.” – In-House System, Village.

Indiana

Although the Indiana LTAP contacted 124 local road agencies, only ten responded to the survey and only two provided comments.

“I had a consultant set my pavement inventory and needs analysis. We use a grading system, A+ to D-, for pavement, curb and gutter. We also use GIS overlay with sanitary and storm sewers, and other utility information we have. I had it broken down to the council person's districts to show how much money needs to be spent in each district. This way they can help on the need for extra money for the pavement restoration. For instance, I use preservatives, restoratives, crack filling, mill-pave, curb replacement and total reconstruction as part of my PMS. I also have estimated cost for each of the six categories for my PMS.” – In-House System, City.

“The condition of our road surfaces changes so drastically from year to year. We go out and rate roads once a year to try and establish priorities, but priorities change from year to year. Also, our elected officials may not agree on our evaluation of the priorities and roads that we deem need work may not get it.” – No PMS, County.
Iowa

Of the total agencies responding to the survey, 13% (54/429) were in Iowa. Of those 15% (8/54) have a PMS and 75% (6/8) of that number implemented the system within the past five years. Although the Iowa Pavement Management Program (IPMP) has approximately 20 participating agencies using dTIMSTM CT software, the comments below are all from agencies with in-house systems or without a PMS.

“We do in-house analysis using the data provided by our state DOT, dump the data into our GIS system and do nice maps for use in "selling" our plan to elected officials and the public. Due to the cost for software maintenance, we do not own the dTIMSTM CT software.” – In-House System, County.

“Our Pavement Management System consists of a non-computerized map based system that seems to work well. Our paved system is small enough to easily monitor.” – In-House System, County.

“Our county has had brushes with PMS. We have had data collected by the Iowa DOT and by a private firm. We have used the information for some limited review and scheduling. It did not prove to be very effective and we have resorted to PMS by field review. We schedule projects based upon field review by an engineer who has been in the Secondary Road Department for 30+ years. This process has proved to be successful.” – No PMS, County.

“For a small county system, pavement management systems are more trouble than they are worth. We don't have the staff needed to keep the data current and to learn the system well enough to be productive. I do not have the luxury of having staff members available for maintaining inventories. Our staff is busy with design and construction inspection year around. We barely have time to work with the county GIS and we rely on support from other county departments with some of our data. We really don't need the extra work of maintaining management systems for the sake of reporting to federal or state officials. If the management systems do not make the office more efficient, they are useless to us. I am frustrated that the feds and others seem to feel that management systems, whether bridge or pavement, are the answer to local officials. If I could hire one additional staff member, it would be a position that would allow our construction and maintenance program to work better, not someone to manage computerized inventories.” – No PMS, County.

“Most counties do not have the staff to monitor and run a pavement management system like the DOT does.” – No PMS, County.

“With such a small amount of paving, and an even smaller budget, I know where we need to spend the small amount of maintenance money we have. PMS is a great tool, but it's kind of like using expensive diagnostic equipment on a mule.” – No PMS, County.

“Pavement Management can be an effective tool, but poor road use funding allocation methods and rationale makes the most accurate Pavement Management System useless. Most urban county engineers just try to hold their system together and replace bridges as funding allows. The majority, 51%, of
Iowa's population lives in 12 urban counties, so we maintain the roads where the people live.” – System not Specified, County.

“Good idea but we need a team effort or finance help.” – No PMS, City.

“We are really interested in results of this survey. We currently have a pavement ranking system which was never fully purchased and has not been updated accurately. We are looking for a program which will take into account other utilities as we have put several of our highly ranked streets on the back burner as we realize other utilities work and we do not have funds to fund the complete project. (We currently use only Local Option Sales Tax revenues to fund street improvements and have to bond for water and sanitary improvements).” – No PMS, City.

**Michigan**

Of the total agencies responding, 25% (108/429) were in Michigan. Of those, 63% (68/108) have a PMS and 65% (35/54) of that number implemented the system in the past five years. 79% (54/68) of those agencies with a PMS use RoadSoft® in conjunction with the state’s coordinated asset management initiative. Training has been the key to the program, where 86% (36/42) of the agencies that attended training at least three times have an Excellent, Very Good or Good PMS experience.

Even though RoadSoft® is provided at no cost to agencies in Michigan, 41% (23/56) of the agencies using the system reported Cost (Implementation and Maintenance) as the biggest challenge for implementing/running a PMS.

“Question on how often we collect data does not address how extensive. We collect some data every year but not all.” – RoadSoft®, County Road Commission.

“The system requires a tremendous commitment of time to get all of the initial information in place. Without all the information in place the advantages of the system cannot be fully utilized.” – RoadSoft®, County Road Commission.

“We follow a six-step planning process in the development of our annual budget for Road Maintenance & Construction.

1. **Survey Conditions:** Data on pavement conditions, bridge conditions, and traffic counts is collected, and safety improvements and future traffic volume projections are identified.

2. **Document Current Needs:** A comprehensive list of primary road needs is produced annually using a variety of indicators such as PCI, existing & projected congestion, and All-Season upgrade needs.

3. **Select & Package Projects:** Staff from Planning, Engineering, and Maintenance review the needs list and cooperatively identify potential projects and target investment levels in Preservation for the upcoming five-year period.

4. **Analyze Future Conditions:** Based upon the projects selected in step 3, future conditions are forecasted by using PMS condition projections to determine if system performance objectives are being achieved.
5. Update Improvement Program: The Five-Year Improvement Program is updated as part of the process of developing the annual budget. All major Expansion/Construction projects are identified as well as levels of investment in Surface Treatments and Overlays. Safety and Intersection projects are also identified.

6. Monitor Performance: A key component of our PMS is tracking and reporting the deterioration of past road projects by improvement type and correlating with the initial surface index rating. Pavement Management is a core component of this process.” – MicroPAVER & RoadSoft®, County Road Commission

“I think that the collection of road data using the PASER system is a great breakthrough in evaluating projects and maintenance. The problem has been in our agency to fund the necessary hardware to implement a PMS.” – No PMS, City.

“My biggest problem is the geographic base map used in RoadSoft®. It is generated by the state and has significant errors. The correction process is two years long.” – RoadSoft®, City.

“Staff in our agency must wear multiple hats and sometimes we don"t have the time to devote to the PMS program like we probably should.” – RoadSoft®, County Road Commission.

“The last training session, about a year ago, finally dealt with developing a pavement maintenance strategy based on several different fix treatments, the costs per unit length, available funding and estimated service life of these treatments. Really, this is the only time I have seen the entire PMS with all the pieces in place to actually attempt to analyze how to make our maintenance money work better and prolong the life of our paved roads. I"m glad I lasted this long to see an actual PMS system (since I first started with RoadSoft® about 10 years ago). It’s not pretty, needs some more tweaking, but it’s a start...Now, if we could start using it...” – RoadSoft®, County Road Commission.

“Lack of funding for streets, especially small urban centers in Michigan is the biggest challenge. The arrogance of the MDOT people in the application of all fund distribution and FHWA/MDOT policies is detrimental to our business. We can see it start to happen with pavement management systems.” – RoadSoft®, City.

“This department lost its technician that was trained on the program. The replacement hasn’t been trained yet.” – RoadSoft®, City.

“We have found that the PASER method is too over-simplified, meaning there is not enough data. The MDOT Pavement Management System is too cumbersome. So we use windshield surveys to identify distress types and by doing it annually in the spring we can get somewhat of a handle on rates of deterioration. Then we extrapolate to determine Remaining Service Life. We also do a lot of crack sealing both saw and seal and overband by contract using state specified material. We also do a lot of durapatching with our own forces. Beyond that our budget isn’t adequate to do much other preventive maintenance...
although there are needs for chipsealing, thin overlays etc.” – System not Specified, County Road Commission.

“We need more training on the RoadSoft® collection of data and how to use that data.” – RoadSoft®, City.

“I don't believe we use a Pavement Management System, we use our city engineer for all road related issues.” – No PMS, City.

“We have problems with time to do the investigation of the PMS system. If your municipality does not have an engineer on staff, who pays for the cost to evaluate the data?” – No PMS, City.

“We have no formal PMS or training. Nor do we have funds to operate it or funds to rehabilitate roads.” – No PMS, City.

**Minnesota**

Although the Minnesota LTAP contacted 201 local road agencies, only 13 responded to the survey and only three provided comments.

“We are still in the process of getting the full potential out of our PMS, as we now have our database just about up to date. Also we have kept our software up to date since 2004.” – ICON PMS, County.

“Although it wasn't an option to answer the question; the biggest obstacle to maintaining the system is having adequate time to fully utilize the system given competing priorities.” – MicroPAVER, County.

“It is a very important tool.” – System not Specified, County.

**Ohio**

Of the total agencies responding to the survey, 8% (33/429) were from Ohio. Of those, 24% (8/33) have a PMS and 38% (3/8) of that number implemented the system within the past five years. The Ohio LTAP and DOT are in the initial stages of developing a PMS statewide program for local road agencies.

“This is an area that we are looking to get involved and improve on. We did not see any need for it prior to 1997 since all are roads were chip and sealed surface. Since 1997, we have implemented a Road Reconstruction Program and in turn now we have [less than 75] miles of roads that are 22 feet uniform width and are asphalt concrete surface. Due to this improvement we feel we need to get a better handle of our pavement condition to protect our new investment.” – No PMS, County.

“PMS is just another way to get in the pocket of the local agencies. With only [less than 400] miles of road to maintain it is not cost effective for us to have this system. We continue to try to make the simple complex by introducing new programs that only benefit those that invent and market them. I have failed to see any advantage over our tried and true method which is working quite well.” – No PMS, County.

“While we have MicroPAVER and use it some, we haven't used it to its potential.” – MicroPAVER, County.
“Over the past 4 years, our director has eliminated all educational funding. If we are fortunate enough to find educational opportunities for our staff, we have taken advantage of those opportunities. Most of the classes we have been able to take are offered at no charge through consultants, ODOT and LTAP.” – No PMS, City.

Wisconsin

Of the total agencies responding to the survey, 24% (103/429) were in Wisconsin. Of those, 82% (85/103) have a PMS and 49% (42/85) of that number implemented the system within the past five years. At the time of the survey the statewide PMS program was shifting from PASERWARE to the new system WISLR so the comments were grouped accordingly by use.

Even though both systems are provided at no cost to local road agencies, 39% (33/85) of the agencies reported Cost (Implementation and Maintenance) as the biggest challenge for implementing/running a PMS. Among the agencies that have attended training at least three times, 86% (18/21) have had Very Good to Good PMS experience.

“We hope to get PMS more involved with our budgeting after staff is properly trained.” – PASERWARE, County.

“We are not using the data to the fullest extent possible - our ability to analyze data is weak.” – PASERWARE, County.

“Our town does a good job of maintaining its roads. We have many/most roads blacktopped in Town. We also maintain good gravel roads. We have 95 miles of town road.” – PASERWARE, Town.

“I do think that practical application of the PMS for the maintenance crews and then advanced training for the engineers to use the data for analysis and development of deterioration rates and maintenance schedules is needed and would be very beneficial. New video of this information would be the best way to get it to the maintenance crews.” – PASERWARE, City.

“Our budgets have been frozen year after year and all the charts and graphs in the world won't change that. There appears to be an acceptance of the fact that secondary roads simply won't be maintained at a high level.” – PASERWARE, City.

“PAREWARE does not reflect the type of base beneath the street surface, only relates to the surface.” – PASERWARE, City.

“A PMS is essential for getting funding, planning maintenance and monitoring progress or forecasting the future of the highway system condition. I wish ours was more reliable but it is better than nothing.” – PASERWARE & WISLR, County.

“Our PMS has been helpful for our Town in determining the best way to maintain our roads with meager funding.” – PASERWARE & WISLR, Town.
“The WISLR Program in Wisconsin is a good tool for having accurate information on local roads and for the rating the roads.” – PASERWARE & WISLR, Town.

“We do not have an engineer on staff and the maintenance staff does not pave roads so only management is impacted by the value of PMS.” – PASERWARE & WISLR, Town.

“Last year was the first attempt at using the WISLR program. It took a great deal of time and I was unable to print out the information put in. Without the printout for verification we sent in a generic spreadsheet (the method the chairman prefers to use).” – PASERWARE & WISLR, Town.

“The PMS (PASERWARE) system that we use is good. It is simple to use and provides the broad view of our system for budgeting purposes. We don't need a lot of detail for this purpose. As we develop a five year plan, we start with the data from the PMS, and then factor in other things such as planned bicycle improvements, project proximity each year, possible federal or state aid projects, and needed drainage improvements. The problem with PASERWARE is that I don't think it is going to continue to be supported by the University. I think the switch is going to be to WISLR, and I don't know how cumbersome that program will be. Also PASERWARE does not factor in inflation for the 5 year project simulation.” – PASERWARE & WISLR, City.

“Good tool to use to assist with street maintenance/reconstruction.” – PASERWARE & WISLR, City.

“These ratings are as good as the people doing them. I feel that the management is doing as well as they are capable. It is hard to teach older people the significance of doing this job well and the impact it has 10 years from now. It is not the fault of the programs, rather the fault of unqualified management.” – WISLR, Town.

“We do not have a maintenance crew. We use the county plan.” – WISLR, City.

“I see money and time spent on a pavement management tool that in some cases has hampered our municipality roadways.” – WISLR, City.

“City staff never attended any training sessions. We received the manuals for rating pavements and performed in-house training to the data gatherers.” – WISLR, City.

“Make the training available in local communities for a low cost and provide frequent program updates along with specific rehabilitation strategies and current costs for improvements.” – WISLR, Village.

“Staffing has been the largest setback in training and implementing an organized and productive program.” – WISLR, Village.

“The PMS we have is used as a planning and budget tool. We also use it to select potential projects when we view the city streets annually. It has the capability to integrate GIS if needed to be.” – Stantec, City.
2.3. Conclusion

The overall 22% response rate to the survey was very encouraging. This rate is especially impressive considering that the responses from Minnesota and Indiana were so light. Of particular note is the participation from Villages, Towns/Townships and Rural Counties. These agencies accounted for 61% of the total respondents and demonstrate that PMS implementation is no longer only the realm of cities and urban counties. Increased adoption of PMS over the past 5 years (53% of agencies with PMS) indicates that agencies are becoming more knowledgeable about the benefits of PMS.

2.3.1. It Takes an Initiative—Broad Implementation

Statewide initiatives appear to have a positive impact on PMS implementation. In Michigan and Wisconsin, both states with statewide initiatives, 81% of the respondents indicated PMS use compared to 31% of the respondents in the Other States grouped together. Survey data also shows that training attendance was higher in Michigan and Wisconsin than in the Other States. 86% of Michigan respondents and 88% of Wisconsin respondents participated in training, but only 40% of respondents in the Other States participated. Additionally, 60% of agencies in the Other States never attended training compared with 14% in Michigan and 12% in Wisconsin. Ohio has begun a statewide initiative and their experience over the next few years could further support this claim. PMS champions at the state and federal levels need to use their influence to encourage statewide PMS initiatives for local agencies.

2.3.2. Challenges Faced by Agencies

The predominant challenges identified by agencies to implementing a PMS were Cost (Implementation & Maintenance), Proper Training and Qualified Staff. Cost must be addressed through the appropriate selection of a PMS system, pavement evaluation method and data collection process—a selection that fits the needs of the agency. At the same time, agencies must make productive use of their PMS output so as to make the system a cost effective investment. Data collection for the sake of having a pavement inventory or solely for reporting to other state or federal agencies is poor use of a valuable resource. The value for resources spent occurs when agencies use PMS output to make their road program more efficient or as justification for additional resources. Training and qualified staff are closely related. Adequate training, across the full range of agency responsibilities, must be made available if broad reaching PMS implementation is ever expected to occur. That effort will require support and coordination from LTAP/T2 Centers, state DOTs, FHWA, consultants and agency associations.

2.3.3. Adoption—Those Who Understand the PMS Concept

A common bias in voluntary surveys is negative written comments—more people complain than give praise. Regardless, a substantial number of comments indicate that agencies adopting PMS possess a firm understanding of the PMS concept and the benefits a system can provide. Comments like “A PMS is essential for getting
funding, planning maintenance and monitoring progress or forecasting the future of the highway system condition” and “We follow a six-step planning process in the development of our annual budget for Road Maintenance & Construction. Pavement Management is a core component of this process…” demonstrate that agencies are getting a payoff from system use and investment. There was even indication that agencies without a PMS system were able to apply the principles of pavement management as indicated by this comment, “Our basic system is to seal the pavement to keep the water out, crack fill within 3 years of resurfacing, and sealcoat at about 8-10 years and each 5 years thereafter. Resurfacing occurs on a 20-25 year cycle. By staying with this regimen, we have very little if any pavement deterioration problems. We are building more new lanes every year.”

2.3.4. Failure to Adopt—Those Who Do Not Understand the PMS Concept

Written comments indicating failure to adopt were plentiful. Most of these comments indicated that agencies have never really been able to get a system up and running or where agencies did try, output is being ignored by decision makers. Comments ranged from, “For a small county system, pavement management systems are more trouble than they are worth” and “We really don’t need the extra work of maintaining management systems for the sake of reporting to federal or state officials” to “Our budgets have been frozen year after year and all the charts and graphs in the world won’t change that.” These comments confirm that too many agencies don’t understand the PMS concept in its totality and adopting PMS for the wrong reasons doesn’t lead to a successful implementation. Training and experience sharing by agencies that have successfully adopted PMS may be the only strategy that can change the current situation at these agencies.

2.3.5. Influence of Training on Implementation

Not surprisingly the survey data shows that agencies which have attended more training have a higher level of implementation. This can be simply explained by noting that training exposes agencies to new ideas and alternatives, and allows them to see and discuss what their peers are doing. Agencies that do not take advantage of training (for whatever reason—lack of time, not interested, etc.) continue to operate as they have in the past.

2.3.6. Different Audience—Different Training

The lack of training importance indicated for Policy Makers and Upper Management and Maintenance Crews demonstrates that training tailored to these particular groups is needed. Unfortunately, most training programs focus on the needs of the technical staff and the specifics of running a PMS. Training that suits the needs of these other groups needs to be developed and supported. These audiences normally don’t see PMS as a topic in which they should take interest. Promotional flyers alone cannot bring them in to the training they need. Special effort needs to be made, even personal contact, to coax these audiences to attend. For example, in 2007 the Michigan LTAP, in conjunction with the Michigan Transportation Asset
Management Council, began conducting half-day sessions titled *Introduction to Asset Management for Local Elected Officials*. The sessions, held morning, afternoon, or evening, are organized by the county engineer at the host county. Through direct contact with township board members and village council members, the engineer is able to fill the room with participants crucial to moving the road commission’s transportation plan forward. LTAP has structured the material so it is suitable for this non-technical audience. These trainings have proved to be very successful—some resulting in passage of local millage proposals.

### 2.3.7. Use of Advanced Features Leads to More Positive Experiences

Of the agencies that indicated *Excellent* and *Very Good* PMS experiences, 61% used advanced features in their PMS system. Yet of those agencies that indicated a *Negative* PMS experience, only 14% used advanced features in their PMS system. It seems clear that an understanding of the advanced features in an agency’s PMS and taking advantage of those features has an impact on the agency’s PMS experience. Here again, training and experience sharing could have an impact on expanding agencies’ understanding of advanced PMS capabilities.

### 2.3.8. PMS Output as a Communication Device

The relationship between engineers/technicians and elected officials, and in turn the general public is often a classic case of miscommunication. Engineers/technicians get wrapped up in the technical aspects of pavement and the PMS, often to the point where they forget that the end result is for decision making and that their audience doesn’t understand the technical concepts like they do. The survey data shows that PMS output is being used by the *Policy Makers and Upper Management* for *Annual Budget Requirements* and *Capital Improvement Plans*. Written comments, however, indicate that at many agencies PMS output is ignored. This rejection is most likely caused by poor communication on the part of engineers and lack of general understanding on the part of elected officials (and the public). The researchers’ own experience as trainers includes decision-maker participants commenting at the end of a training that “no one ever explained [pavement management] like this before.” Once decision makers understand PMS concepts and the benefits they can use to their advantage, their attitudes will change. Engineers/technicians have the responsibility to communicate with their non-technical constituents. Presented in the correct way, PMS output can be a very powerful justification in the decision making process.
3. Task 3 Suggestions for the Use of Local Road Condition Data in Wisconsin and Michigan for Statewide and Region-wide System Analysis and Issues Related to Such Use

3.1. Task Description

The researchers used the collected survey results and follow-up telephone calls to practitioners to identify areas of concern and areas of benefit that are related to the use of local road condition data for statewide and region-wide analysis. Collected information will be compiled into a general summary reflecting the attitude of the Region.

Researchers developed a specific question under Section 4 (Implementing a Pavement Management System) of the survey to address data sharing. The question read: How do you feel about your pavement data being used in a jurisdictional, regional and statewide comparison analysis? Why?

The survey question focused on “data” sharing, which implies and was interpreted as condition data. However, Task 2 survey data and comments in this section as well as the general comments in Task 2 indicate that sharing of condition data may be of much less importance compared to other information that could be shared. Because survey participants from outside Michigan and Wisconsin provided extensive response in this area, the focus of this task was expanded to include those states as “Other.”

That information includes other types of data related to the technical and organizational aspects of PMS implementation. The technical aspect ranges from methods of pavement evaluation, rating systems and indexes, to data collection tools and software. The organizational aspects include size of the agency, knowledge and experience of the staff, size of the network, access to funding and revenue strategies, and understanding/support from upper management and policy makers.

3.2. Results

Responses indicate that while 8% (28/347) are Uncomfortable with this idea of data sharing, 60% (208/347) are Comfortable, with another 32% (111/347) sitting on the fence as Skeptical. See Table 3.1.
Table 3.1 Comfort Level for Jurisdictional Data Sharing

<table>
<thead>
<tr>
<th>Comfort Level</th>
<th>Number of Agencies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable</td>
<td>208 (60%)</td>
</tr>
<tr>
<td>Skeptical</td>
<td>111 (32%)</td>
</tr>
<tr>
<td>Uncomfortable</td>
<td>28 (8%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>347 (100%)</strong></td>
</tr>
</tbody>
</table>

Agencies were then asked for the reasons why they felt Comfortable, Skeptical and Uncomfortable about data sharing. See Table 3.2.

Table 3.2 Reason for Comfort Level

<table>
<thead>
<tr>
<th>Why (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>It would be nice to know how other local agencies are doing</td>
<td>247 (35%)</td>
</tr>
<tr>
<td>It would be an eye-opener for our Policy Makers and Upper Management</td>
<td>106 (15%)</td>
</tr>
<tr>
<td>It would show that we are not funded properly</td>
<td>165 (23%)</td>
</tr>
<tr>
<td>It would show what a great job we are doing with the current funding</td>
<td>101 (14%)</td>
</tr>
<tr>
<td>Other agencies don’t need to know what we are doing</td>
<td>13 (2%)</td>
</tr>
<tr>
<td>It could cause us to lose funding</td>
<td>35 (5%)</td>
</tr>
<tr>
<td>It would be used against our agency</td>
<td>46 (6%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>713 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 1% (2/347) of the responding agencies did not answer this question.

The responses from Michigan and Wisconsin (both with statewide PMS initiatives) was compared to the Other States. The overall distribution of comfort level was very similar among these three groups. See Table 3.3.

Table 3.3 Comfort Level Comparison

<table>
<thead>
<tr>
<th>Comfort Level</th>
<th>MI (%)</th>
<th>WI (%)</th>
<th>Other States (%)</th>
<th>Overall (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable</td>
<td>49 (57%)</td>
<td>52 (63%)</td>
<td>107 (60%)</td>
<td>208 (60%)</td>
</tr>
<tr>
<td>Skeptical</td>
<td>30 (35%)</td>
<td>26 (31%)</td>
<td>55 (31%)</td>
<td>111 (32%)</td>
</tr>
<tr>
<td>Uncomfortable</td>
<td>7 (8%)</td>
<td>5 (6%)</td>
<td>16 (9%)</td>
<td>28 (8%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>86 (100%)</strong></td>
<td><strong>83 (100%)</strong></td>
<td><strong>178 (100%)</strong></td>
<td><strong>347 (100%)</strong></td>
</tr>
</tbody>
</table>

The reason for comfort level among Michigan and Wisconsin was then compared to the Other States. See Table 3.4. The ranked order of the responses was identical for Michigan and Wisconsin, with the Other States differing in one instance—there by only 1%. It is important to note that the highest ranked reason for all three groups was “It would be nice to know how other local agencies are
And the second highest ranked reason for all three groups was “It would show that we are not funded properly.”

Table 3.4 Reason for Comfort Level

<table>
<thead>
<tr>
<th>Reason</th>
<th>MI (N = 86)</th>
<th>WI (N = 83)</th>
<th>Other States (N = 178)</th>
</tr>
</thead>
<tbody>
<tr>
<td>It would be nice to know how other local agencies are doing.</td>
<td>57 (29%)</td>
<td>62 (37%)</td>
<td>128 (37%)</td>
</tr>
<tr>
<td>It would be an eye-opener for our Policy Makers and Upper Management.</td>
<td>30 (15%)</td>
<td>27 (16%)</td>
<td>49 (14%)</td>
</tr>
<tr>
<td>It would show that we are not funded properly.</td>
<td>54 (27%)</td>
<td>39 (24%)</td>
<td>72 (21%)</td>
</tr>
<tr>
<td>It would show what a great job we are doing with the current funding.</td>
<td>25 (12%)</td>
<td>23 (14%)</td>
<td>53 (15%)</td>
</tr>
<tr>
<td>Other agencies don’t need to know what we are doing.</td>
<td>0 (0%)</td>
<td>4 (2%)</td>
<td>9 (3%)</td>
</tr>
<tr>
<td>It could cause us to lose funding.</td>
<td>13 (6%)</td>
<td>5 (3%)</td>
<td>17 (5%)</td>
</tr>
<tr>
<td>It would be used against our agency.</td>
<td>21 (11%)</td>
<td>6 (4%)</td>
<td>19 (5%)</td>
</tr>
<tr>
<td>Total</td>
<td>200 (100%)</td>
<td>166 (100%)</td>
<td>347 (100%)</td>
</tr>
</tbody>
</table>

It is interesting to note that the ranked list of reasons followed such a similar distribution regardless of whether states had organized PMS initiatives or not. Further analysis showed that the agencies that feel Skeptical and Uncomfortable about sharing data; 50% (69/139) still indicated “It would be nice to know how other local agencies are doing.” This surprising positive attitude among agencies should be capitalized on by encouraging opportunities for these agencies to come together and share data and experiences.

As expected, agencies selecting negative reasons “It could cause us to lose funding” and “It would be used against our agency” came primarily from agencies that indicated they were Skeptical or Uncomfortable about data sharing in the previous question. Those respondents (9/10) in Michigan, (1/1) in Wisconsin and (8/11) in the Other States clearly feel that sharing could be detrimental to their agency. Although the scope of this research did not include investigating the underlying cause for this negative attitude, comments indicate that issues related to funding distribution formulas could be involved.
Responses to *Comfort Levels* and *Reasons Why* were queried against the following data elements but none yielded any significant or enlightening results:

- Contact Information
  - State
- Local Agency Information
  - Population
  - County or County Road Commission
  - Policy Maker (Appointed versus Elected)
  - Number of certified street/road miles (paved and unpaved)
  - Annual Street/Road Maintenance and Construction Budget
- Pavement Management System
  - PMS Use
  - Software (Public vs. Private Domain)
  - Implementation (Number of Years)
  - Data Collection Frequency/Process
  - Experience
  - Data Output Use (How Often/How)
- Implementing/Running a PMS
  - Challenges
  - Data gaps
  - Data sharing (comfort level/reason)
- PMS Training
  - Provider
  - Level
  - Importance

### 3.2.1. Additional Agency Comments

This section of the survey that pertains to this Task included an opportunity for agencies to provide additional comments on statewide and regionwide analysis. Comments were provided by 10% (44/429) of the agencies. In order to better understand the comments, they are grouped by comfort level and PMS use. Each comment includes an indication of the PMS software and type of agency.

**Comfort Level: Comfortable**

**PMS: Yes**

“I would like to be able to dedicate more time to using our PMS to evaluate and use the optimization tools. With insufficient funding for the roads, we will remain understaffed.” – RoadSoft®, County Road commission, Michigan.

“In terms of ’data gaps', in the future, we anticipate plugging in other infrastructure (such as guardrail and storm sewer) into the planning process.” – MicroPAVER & RoadSoft®, County Road Commission, Michigan.
“The only problem I see is that I don't think we would want to spend a bunch of time converting data just so other jurisdictions can see our road conditions.” – In-House System, City, Michigan.

“Related to the challenges and data gap questions above, I am confident that our pavement condition ratings are sound and accurate and that our improvement prioritization process resulting from that data is acceptable. Our internal weakness is in the area of using the condition data to calculate long term budgetary numbers in a rapid manner and to look at a large number of alternatives.” – PASERWARE, County, Wisconsin.

“Data gaps. Why? It is better that the decision makers have concise and well presented information” – RoadSoft®, County Road Commission, Michigan.

“We are a very small township, so I really don't feel most of this survey applies to us.” – PASERWARE, Town, Wisconsin.

“Much of our street reconstruction program is driven by required replacement of aging sewer and water facilities.” – PASERWARE, City, Wisconsin.

“Pavement surface ratings are easy to acquire and maintain; additional data collection is very time consuming and we are lacking manpower to complete this portion.” – RoadSoft®, County Road Commission, Michigan.

“Time for data collection is a challenge.” – MicroPAVER, Village, Illinois.

“We are the only agency using our custom method for our needs, which would be considered unconventional.” – In-House System, Village, Illinois.

**Comfort Level:** *Comfortable*

**PMS:** *No*

“Ten years with only one year increase in funds. How do you continue to do your work when everything else increases in cost? You start doing less, that’s how. Guess what happens when you do less? All your roads begin to deteriorate faster than you can maintain them. This cycle has already started and I would hate to estimate the cost to catch up with what already went too far.” - County Road Commission, Michigan.

“Another challenge would be the amount of time it would take to complete a system wide analysis. In addition, this is a scientific approach to pavement conditions that may overshadow the art of an experienced [engineer] determining when a pavement is in need of rehabilitation. If we pay only attention to numbers we may incorrectly identify one highway over another as requiring improvements.” – County, Illinois.

“Due to budgetary constraints, we have not been able to fill staffing positions that would allow proper record keeping for a more efficient system.” – City, Ohio.

“We are eager to be able to collect and utilize PMS data. Current staffing and funding are not to the levels needed to fully implement this system.” – City, Michigan.
“I inherited Cartegraph's Pavement Management software, but don't have the trained staff to implement and use it. Yearly maintenance costs are high.” – County, Illinois.

“Sounds great, I have hired an engineering firm to evaluate our streets and infrastructure this summer.” – City, Iowa.

“We would be very supportive of implementing a system but it must be practical for a small municipality such as ours that does not have the staffing or the resources to keep up on the record control.” – City, Michigan.

“We do have a rational method of evaluation paving options. In a growing area such as ours, capacity problems are more of an issue than surface maintenance.” – County, Illinois.

**Comfort Level: Skeptical**

**PMS: Yes**

“An answer for us is "not enough staff", period.” – RoadSoft®, County Road Commission, Michigan.

“Dependent upon "overall" subjective rating method [PASER] and interpretation; a 5 is average while 1-4's need attention and 6-10 overall could mean that we are putting too much money into your roadway system (politically speaking).” – WISLR, City, Wisconsin.

“Deterioration rates are far different in our area than in some other parts of the state because the soils are so very different. Our area also has a history of thin pavements and poorly drained streets so that we could skew the average for reasons that have little to do with pavement performance.” – PASERWARE, City, Wisconsin.

“Don't think we are keeping the data up the way we should.” – PAVEMENTview®/Plus, County, Minnesota.

“Each community has different methods of pavement maintenance based on acceptable practices. Likewise, existing pavement condition varies from one community to the next. I'm not certain that a comparison analysis would provide usable information to individual communities.” – Pave Pro Manager, Village, Illinois.

“How would data be collected consistently?” – MicroPAVER, Village, Illinois.

“I feel that there are too many variables to make the data meaningful.” – RoadSoft®, City, Michigan.

“Inconsistent ratings resulting in skewed data.” – RoadSoft®, County Road Commission, Michigan.

“It could cause us to lose funding? It COULD be used against our agency” – In-House System, City, Michigan.
“Not sure there would be any benefit.” – PAVEMENTview®/Plus, City, Iowa.

“Our PMS has already cost us some funding! However, it is partially our own fault. We applied for TRIP (The Road Information Program) money and were refused because our pavement ratings were too high. We were comparing our roads to each other rather than the pictures and descriptions in the PASER Manual. Thus, we had no paved roads rated lower than 5. Other towns submitted roads with ratings of 3 or less. We are now working to give our roads a more realistic rating, but it's hard because the Board Members have worked very hard for many years to improve our roads but the increase in traffic really takes a toll. Oh well, Live and learn.” – PASERWARE & WISLR, Town, Wisconsin.

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“Ours is a small community and other larger jurisdictions would be apples to oranges.” – In-House System, Village, Illinois.

“Regarding use of our data for a statewide comparison analysis, we are concerned that our funding might be reduced (i.e., the distribution formula altered) based on the condition of our streets compared to every one else.” – RoadSoft® & In-House System, City, Michigan.

“The rating methods may not be consistent between communities using the same rating system.” – WISLR, Village, Wisconsin.

“Truck percentages are rarely considered - need accurate data. The heavy loads and high traffic counts cause my roads to deteriorate, not area of County and number of miles of roadway.” – System not Specified, County, Iowa.

“We have already seen "political" influences in training the data gathering that could influence or skew the rating process. Whether that is intentional or not is another question.” – RoadSoft®, County Road Commission, Michigan.

**Comfort Level: Skeptical**

**PMS: No**

“None of the selections above apply. How do we know that the information is collected and evaluated the same? One jurisdiction may do it differently or evaluate differently.” – County, Indiana.

“Not sure how effective it would be.” – City, Michigan.

“Those with money have better roads.” – County, Illinois.

**Comfort Level: Uncomfortable**

**PMS: Yes**

“In-house PMS, not necessarily equivalent to other standard PMS, could skew results.” – In-House System, City, Illinois.

“We have RoadSoft® but have not been able to go to training to use it properly!” – RoadSoft®, City, Michigan.
“Comparing our roads to others unseen could be like comparing apples to oranges.” – PASERWARE, City, Wisconsin.

“Do to the lack of upkeep on the program I feel that the information is not accurate and up to date.” – RoadSoft®, City, Michigan.

“Due to the possible variables in data entered I think some jurisdictions could manipulate the system to increase their funding.” – ICON PMS, County, Minnesota.

**Comfort Level: Uncomfortable**

**PMS: No**

“Since we don't have responsibility for streets, there is nothing to share. If we did have a plan, I'd participate.” – Township, Michigan.

“Unless everyone is using the same process/methods, comparisons would be difficult to interpret” – City, Iowa.

### 3.3. Suggestions for Use

Throughout the Region the largest percentage of local road agencies responding feel comfortable with data sharing beyond their jurisdictional boundaries. The responses show that agencies are interested in what other agencies are doing and that data exchange can be used to demonstrate that local road agencies are not funded properly. There is hesitancy by some agencies, but these numbers were relatively small. Although the survey questions focused on data sharing, which inferred condition data, the sharing of other types of information related to the technical and organizational aspects of PMS implementation may be of more importance. Opportunities should be nurtured where agencies can share and discuss such topics as pavement evaluation methods, rating systems and indexes, data collection tools and software, knowledge and experience of their staff, size of the networks, access to funding and revenue strategies, as well as the understanding and support from upper management and policy makers.

#### 3.3.1. Condition Data

Exchange of specific pavement condition data is the first thing that comes to mind when PMS data sharing is proposed. Yet comparing specific condition data (our average PASER is 5.2, yours is 6.1) doesn’t provide substantial benefit. More important is the management practice that yields conditions either better or worse than another agency. Management practice considers whether a worst first approach is being used or if the mix of fixes is being applied, or, are treatment candidates chosen by political decision or because they meet engineering criteria and truly benefit from the treatment. Champions of PMS need to educate agencies and the public to the fact that comparing specific condition data isn’t the end game, but merely the first step to opening a door to a better understanding of local agency roadway management.
3.3.2. Documentation of Coordinated Approaches

Task 1 summarized different coordinated PMS approaches throughout the United States. These coordinated approaches could be documented in greater detail as part of a separate investigation. For example, Michigan and Wisconsin use the same pavement evaluation method, PASER (Pavement Surface Evaluation and Rating), which was developed by the Wisconsin TIC. In Michigan the PASER has been adjusted to meet local agencies need with regards to sealcoat surface type. Although the evaluation method is the same, the data collection process and the PMS software are different in both states. Implementation of the resulting analysis is similar—used individually by local agencies for direct management of the network and collectively to provide overall condition from a regional and statewide perspective. Documentation could serve as a guide for other local agencies to understand the realm of possibilities, benefits and challenges related to coordination PMS implementation.

3.3.3. Pavement and Treatment Performance/Cost

Making pavement and treatment performance/cost data available on a statewide or region wide level could be very helpful to agencies that are just now beginning work away from a worst-first management approach. The unknowns associated with previously unused treatments can stifle a pavement manager’s attempt to adopt state-of-the-art management practices. This data plays a critical role in communicating with decision makers and the general public, who rarely understand the concept of the Right Fix in the Right Place at the Right Time.

3.3.4. Mutual Aid

In addition to sharing data, local agencies can share equipment and trained staff at times when it is needed most—during the Pavement Evaluation Method and Data Collection Process. Sharing trained staff (summer interns) would provide homogeneity of service throughout a region or state and eliminate the reoccurring problem of lack of time to train staff properly. Agencies could also cooperatively share laptop computers and GPS equipment. Michigan has provided laptop computers and GPS units to the regional planning organizations throughout the state. This hardware is used during the collection of condition rating on the federal aid system, but is then available for local agencies to borrow for collection on the local system.

3.3.5. Beyond Technical and Into Transportation Planning

The ultimate goal of PMS implementation is to move pavement condition and analysis beyond the engineers and technicians and into the transportation planning arena, where decision makers can use the ensuing capital improvement plans as a primary communication device with their constituents. These plans not only identify what needs to occur in the future, but also demonstrate that the agency currently manages the road network efficiently and cost effectively. A number of agencies throughout the region have taken their plans all the way to the ballot box.
for voter approval of local road revenue. Broadcasting these successes, as well as failures when agencies didn’t succeed, is critical to getting agencies to see that there is an alternative to throwing up their hands in dismay. Statewide conferences, LTAP newsletters, workshops and web-based training are excellent avenues for moving the pavement management beyond the technical and into transportation planning.

3.3.6. National, Statewide and Regional Conferences

National/international conferences such as the TRB National Conference on Transportation Asset Management, International Conference on Managing Pavements, or the TRB National Conference on Pavement Management, draw minimal local road agency participation—even when sessions have been specifically planned around the local agency experience. It appears that the most productive approach is statewide events with targeted promotion to local agencies.

All LTAP centers in the region were contacted about statewide events that would bring together agencies to discuss their PMS experiences. Michigan is the only state in the region hosting such a statewide event—The Michigan Transportation Asset Management Conference.

The Michigan conference, held in 2006 and 2007 (also scheduled for 2008) has drawn 57% of the 377 participants from local agencies. Participation involves a wide range of personnel, from elected and appointed officials and managers to planners, engineers, and finance managers. The objective is to demonstrate how Transportation Asset Management (with a heavy focus on pavements) is being implemented by agencies throughout the state and show firsthand the practical application of the asset management process. Agency case examples are presented that cover the wide variety of approaches used, treatment alternatives, options for developing strategies, techniques for communicating with the public, and lessons learned when things don’t turn out exactly as planned.

Of particular importance is that this conference is sponsored by the Michigan Asset Management Council in cooperation with the County Road Association of Michigan (county road commissions), Michigan DOT, Michigan Municipal League (cities and villages), Michigan Township Association, Michigan Association of Counties, Michigan Association of Transportation Planners, Michigan Association of Regions and the Michigan LTAP. This type of broad support is critical for a successful statewide event.
4. Task 4 Data Gaps that Hamper Needed Analysis and Implementation

4.1. Task Description

Using the collected survey results, follow up telephone calls to the practitioners and results from Tasks 2 and 3, gaps in currently collected data that prohibit necessary analysis or hamper implementation of system management were identified.

Researchers developed a specific question under Section 4 of the survey. The question read: What are common ‘Data Gaps’ that hamper needed analyses?

4.2. Results

As stated in Task 2, the common data gaps ranged from the initial steps of implementation (i.e. Pavement Evaluation Method and Data Collection Process) to data integration (i.e. Lack of Curb and Gutter Data and Lack of Utilities Data Integration), to maintaining the system (i.e. Lack of Standard Maintenance and Rehabilitation Costs and Lack of Data on Treatment Performance).

Over 700 responses regarding data gaps were gathered from 340 agencies. See Table 4.1.

Table 4.1 Common Data Gaps that Hamper Needed Analysis

<table>
<thead>
<tr>
<th>Common Data Gaps (Select all that apply)</th>
<th>Number of Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Evaluation Method</td>
<td>136 (19%)</td>
</tr>
<tr>
<td>Data Collection Process</td>
<td>173 (24%)</td>
</tr>
<tr>
<td>Lack of Curb and Gutter Data</td>
<td>58 (8%)</td>
</tr>
<tr>
<td>Lack of Utilities Data Integration</td>
<td>86 (12%)</td>
</tr>
<tr>
<td>Lack of Standard Maintenance and</td>
<td></td>
</tr>
<tr>
<td>Rehabilitation Costs</td>
<td>121 (17%)</td>
</tr>
<tr>
<td>Lack of Data on Treatment Performance</td>
<td>135 (19%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>709 (100%)</strong></td>
</tr>
</tbody>
</table>

Note: 21% (89/429) of the responding agencies did not answer this question.

4.2.1. Pavement Evaluation Method

Pavement evaluation is the first step towards building a PMS. It is the foundation upon which agencies build their pavement condition databases and what in turn supports the maintenance and rehabilitation strategies for their road network.

Pavement evaluation methods currently being used by local agencies throughout the U.S. were extracted from the PMS system summary conducted in Task 1 and detailed in Appendix A. See Table 4.2.
Table 4.2 Pavement Evaluation Methods

<table>
<thead>
<tr>
<th>Pavement Evaluation Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite Condition Index (CCI)</td>
</tr>
<tr>
<td>Distress Identification Manual for the Long-Term Pavement Performance Project – Strategic Highway Research Program (SHRP)</td>
</tr>
<tr>
<td>GaDOT Rating Methodology</td>
</tr>
<tr>
<td>Hansen’s Overall Condition Index (OCI)</td>
</tr>
<tr>
<td>International Roughness Index (IRI)</td>
</tr>
<tr>
<td>MnDOT Rating Methodology</td>
</tr>
<tr>
<td>Pavement Condition Index (PCI)</td>
</tr>
<tr>
<td>Pavement Condition Rating (PCR)</td>
</tr>
<tr>
<td>Pavement Quality Index (PQI)</td>
</tr>
<tr>
<td>Pavement Structural Condition (PSC)</td>
</tr>
<tr>
<td>Pavement Surface Evaluation and Rating (PASER)</td>
</tr>
<tr>
<td>Performance and Economic Rating System (PERS), which combines the International Roughness Index (IRI) and Dynatest’s Falling Weight Deflectometer (FWD).</td>
</tr>
<tr>
<td>Qualitative (User Defined) Condition Index (QCI)</td>
</tr>
<tr>
<td>Riding Comfort Index (RCI)</td>
</tr>
<tr>
<td>Road Condition Index (RCI)</td>
</tr>
<tr>
<td>Structural Adequacy Index (SAI)</td>
</tr>
<tr>
<td>Surface Distress Assessment (SDA)</td>
</tr>
<tr>
<td>Surface Distress Index (SDI)</td>
</tr>
<tr>
<td>TxDOT Pavement Management Information System (PMIS) Methodology.</td>
</tr>
</tbody>
</table>

Pavement evaluation hampers analysis if the adopted method doesn’t meet a local agency’s need for accuracy and precision, or exceeds the agency’s need with unnecessary data and excessive collection costs. Clarification of need goes well beyond the technical aspects of the method itself, often considering feasibility (cost/staffing) of conducting the evaluation on a continual basis, whether the data collected will support the analysis expected, and whether the data will contribute to the development of maintenance and rehabilitation strategies.

**Visual Evaluation Methods**

These non-electronic methods take into consideration the condition of the entire road segment. Visual evaluation data is generally used for network analysis because it provides an overall view of the pavement condition, but does not deal with specific and detailed distress identification. Visual evaluation is most commonly done with in-house staff.

**Statistical Methods**

These methods use statistically assigned samples of a road segment from which detailed distress data is collected. Statistical data is generally compiled into a
calculated index. Statistical evaluation is sometimes done by in-house staff, but most commonly by consultants.

**Automated Methods**

Automated methods range from taking photographic/video images of the pavement surface to laser identified rutting/distress or mechanically induced deflection. Automated data can either be used directly or to generate a condition index. Due to the high cost of the equipment/vehicles, automated evaluation is most commonly done by consultants.

How much data is enough? How much data is too much? How much will it cost? These are the questions that agencies face. Data overkill often lends short life to PMS implementation simply due to cost and lack of staff resources—implementation dies on the vine. Insufficient data can raise doubt in the output of the PMS system, thereby causing decision makers to ignore the recommendations produced. Of particular importance is the experience of local agencies that have worked through the pavement evaluation method selection process. These agencies should be encouraged to share their experiences at statewide and region wide conferences and be highlighted as case examples at PMS workshops and web training.

**4.2.2. Data Collection Process**

The Data Collection Process is directly linked and sometimes unique to the Pavement Evaluation Method. Below are the three types of processes commonly used by local road agencies: basic, intermediate and advanced. Recent advances in technology (GPS—Global Positioning System) and reduced hardware cost (laptop computer or GPS data collection units) place the intermediate process well within the reach of many individual agencies or group of agencies interested in making a cooperative investment. In Michigan for example, agencies can take a typical office laptop computer running a recent version of MS Windows, combine it with a $75 GPS receiver and collect data in the field using the RoadSoft® GIS Laptop Data Collector software.

**Basic Processes (no use of computer or automated systems)**

These processes are usually a paper form used by a data collection team driving the network and visually evaluating the pavement—often termed a “windshield survey.” Collected data is later processed by hand in tables, using computer spreadsheets or in PMS software.

**Intermediate Processes (partial use of computer or automated systems)**

Intermediate processes are usually done with a laptop computer/GPS receiver or a GPS data collection unit. The data collection team evaluates the pavement or conducts statistical sampling, then enters the data on the laptop or GPS collection device. Data from automated collection systems is reviewed manually by technicians (in effect conducting a visual evaluation). GPS technology aids the collection process in navigating the road network and insuring that condition data is attached to the proper road segment. Once data collection is complete, the data is transferred electronically to the PMS software.
Advanced Processes (full use of computer or automated systems)

An advanced process is comprised of a variety of imagery and sensing technology typically housed in cars or trucks, and guided by GPS. How the collected data is handled depends on the specific collection process. In the case of photographic/video images, it is either reviewed manually by technicians (as in the intermediate process) or run through computer algorithms that identify and categorize distress. Laser and deflection evaluation data is commonly imported directly into the PMS.

Each process has its own strengths and weaknesses depending on an agency’s needs and capabilities. Therefore it is important for agencies to fully consider the cost in time, training and personnel needed to maintain a collection process as well as understanding whether the agency has the political and administrative will necessary to continue the process into the future.

4.2.3. Lack of Curb and Gutter Data

This is an issue among villages and cities that have curbs and gutters along their streets. Due to the relatively high cost to replace curbs and gutters, their replacement often influences when a street is resurfaced, rehabilitated or reconstructed. Some agencies ignore curb and gutter condition and apply resurfacing over the gutter pan, which can lead to drainage problems. Curb and Gutter is a good example of why today’s PMS should include more information than just pavements. By integrating curb and gutter data with pavement data, agencies can synchronize the management of both these assets in one maintenance plan.

4.2.4. Lack of Utilities Data Integration

This is an issue for villages, cities and urban counties due to the amount of underground utilities in their jurisdictions. As noted by Bernardin et al. (2007), overcoming the institutional hurdles to integrating the management of utilities infrastructure with that of transportation infrastructure offers tremendous benefits and a promising source of cost savings—savings far greater than the expense to coordinate the operations (pp.4-5). Knowing what is underneath streets and roads and the maintenance/upgrade/construction plans of the utility companies is critical for network analysis and in selecting candidates for maintenance and rehabilitation projects. There is nothing worse than a utility company cutting open newly constructed pavement, simply due to lack of coordination. Coordination between road agencies and utility companies is critical if roadway funding is to be spent efficiently and effectively, and the delivered pavement is to perform as expected. This coordination occurs within some agencies as projects approach, but for long range planning purposes agencies need to begin integrating utilities data with PMS.
4.2.5. Lack of Maintenance Treatment and Rehabilitation Costs

As local road agencies develop maintenance and rehabilitation strategies for their pavement management program they will need to investigate treatments that have not previously been used by their agency. Necessary in this analysis is an understanding of the benefits gained by the treatment, when to apply the treatment (trigger values), how the treatment will perform over time (deterioration curves), and what the treatment will cost. Defining these factors for previously unused treatments presents a challenge. Contributing factors include: geographic location, material quality and availability, fluctuation in the price of petroleum and other material inputs, and contractor competition or lack thereof.

Venues are needed where agencies can exchange their experiences on available treatments and rehabilitation practices—both success and failure. Statewide and regional conferences can be primary vehicles for facilitating these exchanges. LTAP Centers, DOTs, and public agency associations should be encouraged to support and facilitate such events. LTAP Center newsletters should be exploited as a low cost, far reaching communication mechanism. Web-based technologies should be exploited as an option for mass distribution of short, case-study type training.

4.3. Data Gap Comparison by State

Due to limited responses outside Michigan and Wisconsin, the data from Illinois, Indiana, Iowa, Minnesota and Ohio was grouped together as the Other States. See Figure 4.1.

Figure 4.1 Number Key

1. Pavement Evaluation Method
2. Data Collection Process
3. Lack of Curb and Gutter
4. Lack of Utilities Data Integration
5. Lack of Standard M&R Costs
6. Lack of Data on Treatment Performance
As shown, each group has its own order of priorities for common data gaps. Michigan, with a statewide PMS initiative including data collection software, had a surprising 25% (41/164) of responses identifying Data Collection Process as a data gap. Further analysis revealed that 42% (17/41) of these agencies do not have a PMS. Their other survey responses indicate small networks (less than 50 miles), and Lack of Proper Training and Lack of Qualified Staff as challenges to implementing/running a PMS. It appears that the issue is not regarding the data collection process itself, but not having the means (staff, time and funds) to collect the data. General comments in Task 2 by agencies with PMS support this finding.

Wisconsin’s top two selections were Lack of Standard M&R Costs and Lack of Data on Treatment Performance (these were also the second and third selections in Michigan). These choices seem typical of agencies currently operating PMS.

Data gaps for the Other States focus on Pavement Evaluation Method and Data Collection Process. Neither of these states had a statewide PMS initiative at the time of the survey. Among the agencies that selected both of the above data gaps, 87% (60/69) do not have a PMS. Contrary to Michigan and Wisconsin where respondents comment about lack of resources to evaluate pavement and collect data, it appears the issue in the Other States is about not having an evaluation method and collection process.

Lack of Curb and Gutter Data and Lack of Utilities Data were predominantly selected by cities and villages 72% (31/43).
4.4. Data Gaps by Grouping

Based on these results in the previous section, the data gap information was combined into three groups. The first group, *Pavement Evaluation Method & Data Collection Process*, involves data collection. The second group, *Lack of Curb and Gutter & Lack of Utilities Data Integration*, involves data integration. The final group, *Lack of Standard M&R Costs & Lack of Data on Treatment Performance*, involves standardized data to run pavement strategies and optimization.

The analysis was continued by considering responses from PMS users in Michigan and Wisconsin and non-users from the Other States. Responses were grouped by topic and agencies needed to have selected both choices to be included in the group, 47% (161/340). See Figure 4.2.

**Figure 4.2 Number Key**

Group 1) Pavement Evaluation Method & Data Collection Process  
Group 2) Lack of Curb and Gutter & Lack of Utilities Data Integration  
Group 3) Lack of Standard M&R Costs & Lack of Data on Treatment Performance

Again, responses from PMS users in Michigan and Wisconsin focus on Group 3 (*Lack of Standard M&R Costs* and *Lack of Data on Treatment Performance*). Responses from non PMS users in the Other States focus on Group 1 (*Pavement Evaluation Method and Data Collection Process*).
4.5. Conclusion

Identified data gaps that hamper analysis are influenced by whether an agency currently uses a PMS or does not use a PMS. Agencies not using a PMS predominantly chose the Group 1 data gaps (*Pavement Evaluation Method* and *Data Collection Process*). These are both directly related to the first step in implementing a PMS. Cities and villages, typically faced with curb, gutter and utility issues as part of their decision-making process, predominantly chose the Group 2 data gaps (*Lack of Curb & Gutter* and *Lack of Utilities Data*). Agencies using PMS predominantly chose the Group 3 data gaps (*Lack of Standard M&R Costs* and *Lack of Data on Treatment Performance*), both directly related to operating and maintaining an existing PMS system.

The Group 1 & 3 data gaps can be resolved through the sharing of experiences and data by local agencies. Opportunities to share information, be it statewide conferences, workshops or web training, needs support and coordination from LTAP/T2 Centers, state DOTs, FHWA, consultants and agency associations.

The Group 2 data gaps are organizational and logistical, and will eventually be resolved as agencies see the benefit of integrating curb/gutter and utility data into their PMS. The sharing of experiences by agencies that have accomplished this integration, or those that have tried but failed, should be included in the outreach described above.
5. **Task 5 Summary of Existing Training Materials for Local Road System Management and Recommendations for Enhancing Those Materials**

5.1. **Task Description**

The researchers will summarize the training agendas and educational goals for existing training materials and those under development. If existing materials could be enhanced or improved, recommendations will be made. If a distinct gap exists in available training materials, an outline will be developed for materials that could be created at a later date.

5.2. **Body of Knowledge**

Without question, PMS implementation at the local level involves training on technical topics. But as noted by Warren (2007) implementation at the local level involves changing the culture of each and every agency. Culture change involves a broader understanding of a body of knowledge than just the technical topics. This understanding must also reach beyond the technical staff, to the elected officials/decision makers and the maintenance crews. Only when all three groups are operating from the same point of reference can an agency make progress towards managing its road network in a progressive, strategic and sustainable way.

To that end, researchers explored a variety of sources, NW T2, 1994; Broten, 1996; McNeil, 2001; AASHTO 2001; Van, 2002; Adams 2003; Attoh-Okine, 2003; MI LTAP, 2007; and developed a PMS Body of Knowledge Framework as a way to facilitate the assessment of currently offered/needed training per those three audiences. See Table 5.1.

A complete summary of the training offered in the region is provided in Appendix C.
Table 5.1 PMS Body of Knowledge Framework

<table>
<thead>
<tr>
<th>PMS Body of Knowledge Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 – The Basics of a Good Road</strong></td>
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<tr>
<td>Roadway Materials</td>
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<td>Drainage</td>
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<tr>
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<td>Surface Treatments – Flexible pavement treatments, Rigid Pavement Treatments</td>
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<tr>
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<tr>
<td>Construction Inspection</td>
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<tr>
<td>Maintenance Inspection</td>
</tr>
<tr>
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</tr>
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<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>Typical Implementation Steps</td>
</tr>
<tr>
<td>The Cost of Various PMS Options</td>
</tr>
<tr>
<td>Anticipated Benefits of Various PMS Options</td>
</tr>
<tr>
<td>The Next Step: Transportation Asset Management</td>
</tr>
<tr>
<td><strong>3 – Implementing and Maintaining a Pavement Management System (PMS)</strong></td>
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<tr>
<td>Responsibility for a PMS within an Agency</td>
</tr>
<tr>
<td>Overcoming Applications Challenges – Institutional, Technical, and Funding Challenges</td>
</tr>
<tr>
<td>Assessing Pavement Evaluation Methods</td>
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<tr>
<td>Assessing Data Collection Processes, Technologies and Costs</td>
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<td>Assessing Required Resources</td>
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<td>Assessing PMS Software and Costs</td>
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<tr>
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<tr>
<td>Understanding Staff Training Needs</td>
</tr>
<tr>
<td><strong>4 – Conducting Analysis with a Pavement Management System (PMS)</strong></td>
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<tr>
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<tr>
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<tr>
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<tr>
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</tr>
<tr>
<td>Developing a Maintenance Program and Budget</td>
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</tr>
<tr>
<td><strong>5 – Using PMS Output to Communicate Your Story</strong></td>
</tr>
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<td>Assessing Your Audience’s Information Needs</td>
</tr>
<tr>
<td>Compiling PMS Data into an Understandable Format</td>
</tr>
<tr>
<td>Developing a Long Range Transportation Plan</td>
</tr>
</tbody>
</table>
5.3. Levels of Training

The PMS Body of Knowledge Framework was further broken down with three levels of training needed (introductory, intermediate, advanced) for each of the three audiences used in the study survey—Policy Makers & Upper Management, Engineers & Technicians, and Maintenance Crews. See Table 5.2.

Table 5.2 PMS Training Levels Key:

- Level 1 – Introductory
- Level 2 – Intermediate
- Level 3 – Advanced
Table 5.2 PMS Training Levels

<table>
<thead>
<tr>
<th>PMS Training Framework</th>
<th>Policy Makers &amp; Upper Mgmt.</th>
<th>Engineers &amp; Technicians</th>
<th>Maint. Crews</th>
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5.4. **Assessment of Training Provided In the Region**

Numerous challenges impede the expansion of PMS related training. Lack of training resources such as: instructors, funding to compensate the instructors or staff to organize the training, state specific materials, etc. prevent agencies from gaining both basic and advanced understanding of the benefits of using pavement management systems. Additionally, many local agencies find themselves in the classic case of someone that needs training—they don’t know what they don’t know! Causing the situation where they need to be prompted, cajoled, or even dragged to training. Combine the above with the fact that adoption of pavement management practices involves changing the culture of how infrastructure is managed by a road agency and it becomes apparent why PMS implementation has been a slow process.

To gain a better understanding of training opportunities and gaps, the *Body of Knowledge Framework* was applied to the trainings titles offered by the LTAP centers throughout the region. This summary is current as of March 2008. As the individual state assessments show, states with coordinated PMS initiatives have made the most progress towards addressing the full range of topics within the *Body of Knowledge Framework*.

**5.4.1. Illinois – Training Offered and Training Framework**

The training currently offered by the Illinois T2 Center cover topic 1 – The Basics of a Good Road, but does not address topics 2, 3, 4 or 5.

See workshop titles below and training framework in Table 5.3.

- Highway Engineering Principles
- Pavement Construction Inspection
- Pavement Maintenance
- Rehabilitation of Streets and Highways
- Seal Coats (Oil & Chipping)
Table 5.3 Topics Addressed in PMS Training by Illinois T2 Center

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<th>Illinois T2 Center</th>
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</tbody>
</table>
5.4.2. Indiana – Training Offered and Training Framework

The training currently offered by the Indiana LTAP covers most all of the five topics, but does not address some of the advanced topics in the framework.

See workshop titles below and training framework in Table 5.4 on the next page.

- Paving Sessions
- Asset Management Series
- HMA (Hot Mix Asphalt) Sessions
- Maintenance of Roads/Streets
- Annual Paving Workshop with concurrent session titles “Construction”, “Design”, & “Maintenance” (On a 3 year-cycle between Asphalt, Portland Cement, Concrete, and Gravel Pavements
- MicroPaver Workshop
- Pavement Preservation: Optimal Timing Of Pavement Preservation Treatments (NHI Course)
- Chip Seal Workshop
- Pavement Surface Evaluation and Rating using PASER
- How a GIS system can be used for Pavement Maintenance
- The Uses and Applications of Porous/Permeable Pavement
- Road Scholar Course “Basics of a Good Road/Pavement System”
Table 5.4 Topics Addressed in PMS Training by Indiana LTAP

<table>
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<th>Indiana LTAP</th>
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</table>
5.4.3. *Iowa – Training Offered and Training Framework*

The training currently offered by the Iowa Pavement Management Program (IPMP) within the Iowa LTAP covers most of the topics in the framework.

See workshop titles below and training framework in Table 5.5 on the next page.

- Fundamentals of Pavement Management
- Iowa Streets and Roads Maintenance
- Pavement Management Software
- GIS Database
Table 5.5 Topics Addressed in PMS Training by Iowa LTAP

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<tr>
<td>Anticipated Benefits of Various PMS Options</td>
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<tr>
<td>The Next Step: Transportation Asset Management</td>
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<tr>
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<td>Responsibility for a PMS within an Agency</td>
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5.4.4. Michigan – Training Offered and Training Framework

The training currently offered by the Michigan LTAP (some sessions in cooperation with the Michigan Transportation Asset Management Council) covers most of the topics in the framework, but lacks training within topic 1 – The Basics of a Good Road.

See workshop titles below and training framework in Table 5.6 on the next page.

- Introduction to RoadSoft® — Hands-On Training for the New User
- The TMAC Data Cycle and Laptop Data Collector (LDC) Webinar
- Advanced RoadSoft® – Building a Long Range Plan
- Pavement Surface Evaluation and Rating (PASER) & Laptop Data Collector
- Seminar on the Maintenance of Asphalt Pavements
- Michigan Bridge Conference and Workshop
- Culvert Installation & Maintenance Workshop
- Introduction to Transportation Asset Management – A Workshop for Elected Officials
- Local Roads Seminar—Concrete Pavements
- Michigan Transportation Asset Management Conference
- Motor Grader Training
- Inspecting Pavement Markings
- RoadSoft® Sign Management Module Webinar
- Submitting your TAMC Pavement Condition Data Webinar
- RoadSoft® Pavement Marking Module Webinar
Table 5.6 Topics Addressed in PMS Training by Michigan LTAP

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5.4.5. **Minnesota - Training Offered and Training Framework**

The workshops currently offered by the Minnesota LTAP thoroughly cover 1 – The Basics of a Good Road, and introductory sub topics in 2 - Overview of Pavement Management, but lacks training in the remaining topics of 2, 3, 4 and 5.

See workshop titles below and training framework in Table 5.7 on the next page.

- Asphalt Pavement Maintenance (CTAP course)
- Asphalt Pavement Maintenance and Preservation
- Best Pavement Design Practices for City Streets and County Roads.
- Concrete Rehabilitation for City Streets and County Roads
- Selecting Pavement Rehabilitation Methods (under development)
Table 5.7 Topics Addressed in PMS Training by Minnesota LTAP

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5.4.6. **Ohio – Training Offered and Training Framework**

The training currently offered by the Ohio LTAP together with the Ohio DOT is the beginning of a statewide implementation program for local road agencies. The training partially covers all five topics, but lacks a variety of sub topics in the framework.

See workshop titles below and training framework in Table 5.8 on the next page.

- Asset Management for Local Agencies
- Asset Management – Inventory Collection & Evaluation
- Asphalt Pavement Inspection
- Asphalt Pavement Preservation
- Concrete Pavement Inspection
- Concrete Pavement Preservation
- Maintenance & Repair of Local Roads (Chip-Seal & Asphalt)
- Maintenance & Repair of Low Volume Local Roads (Gravel & Chip-Seal)
- Pavement Condition Rating (PCR)
- Pavement Management System (PMS)
Table 5.8 Topics Addressed in PMS Training by Ohio LTAP

<table>
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<th>PMS Training Framework</th>
<th>Ohio LTAP</th>
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5.4.7. Wisconsin - Training Offered and Training Framework

The training currently offered by the Wisconsin TIC together with WisDOT covers a variety of basic topics but does not address some of the advanced topics in the framework.

See workshop titles below and training framework in Table 5.9 on the next page.

- Road Maintenance – Gravel Roads
- Road Maintenance – Asphalt Road Maintenance and Geosynthetics
- Using PASER and WISLR to Manage Your Roads
- Using the WISLR 5-Year Budget Planning Tool
- Pavement Surface Evaluation and Rating (PASER)
- Winter Road Maintenance
Table 5.9 Topics Addressed in PMS Training by Wisconsin TIC

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5.5. Conclusion

Training is a critical aspect of pavement management system implementation. Survey data clearly shows that the agencies which are making implementation progress are also the agencies that have taken advantage of training. That relationship is particularly demonstrated by the statewide initiatives in Michigan and Wisconsin, and now Ohio. Training in those states also rely on strategic partnerships with the LTAP centers: the Michigan Transportation Asset Management Council in Michigan, the Wisconsin DOT and the Ohio DOT. Those partners bring a greater importance to the training opportunities simply through their administrative and oversight relationship with the local agencies.

Progress is also being made at the national level. According to the National LTAP/TTAP Program Assessment Report for 2006, the LTAP/TTAP centers nationwide conducted 702 infrastructure management related training events (workshops, conference sessions, webinars, etc.) with 52,250 local agency participants attending. LTAP newsletters, distributed to over 450,000 recipients, included over 400 articles on infrastructure management. The centers also distributed over 136,000 related publications, software, etc. and provided over 45,000 technical assists on the topic (FHWA 2008).

All LTAP/TTAP centers should assess their training offerings against the Body of Knowledge Framework and use the successful experiences of Michigan and Wisconsin, and the current startup experience in Ohio, as guidance to create the necessary partnerships that lead to statewide training and implementation initiatives.
6. Task 6 Validation of RoadSoft® Deterioration and Strategy Evaluation Models

6.1. Introduction

The models currently used in RoadSoft® for forecasting pavement performance are based on the Ride Quality Forecasting System (RQFS) that was designed for modeling state trunk line roads by MDOT. Because actual local data in sufficient quantity was not available at the time of implementation these models were adapted using a variety of deterioration curves based on engineering knowledge and assumptions about the local road deterioration process. Validation and calibration of these models is essential in order to improve the accuracy and reliability of the forecasts.

The RoadSoft® models were evaluated with actual local road data collected from a sample of local agencies in Michigan. The analysis provided a statistical base on which to calibrate the existing models or to generate new deterioration models that better fit local conditions. The agencies selected as the data sample represent a variety of local agency attributes—pavement types, geographic regions, maintenance practices and traffic volumes.

Michigan has 120,440 miles (193,824 km) of highways and streets throughout the state, with management responsibility distributed among 617 agencies. Agencies range in size from MDOT with 20,000 miles (32,186 km), to the Road Commission for Oakland County with 2690 miles (4329 km), to the Keweenaw County Road Commission with 175 miles (281 km). Within those 617 agencies, more than 500 cities and villages manage systems ranging from as large as a few dozen miles to as small as a couple of miles. Managing this road system effectively is a challenge for all state and local agencies regardless of their size.

In response to management system requirements in the Intermodal Surface Transportation Act (ISTEA) in 1991, county road commissions in Michigan partnered with MDOT to develop a unified roadway management system that could be used by local agencies throughout the state. That initiative led to the creation of RoadSoft®. Developed at Michigan Technological University, this integrated infrastructure management system is used by over 240 local agencies throughout the state for their transportation infrastructure management needs: pavement, culvert, sign, pavement markings, guardrail, curb and gutter, and safety. The deterioration and strategy evaluation capabilities in the RoadSoft® pavement management module allow road agencies to model road surface deterioration, build complex repair strategies (mix-of-fixes), predict future network performance, and optimize between needs, expectations and revenues.

In 2002 Michigan Public Act 499 defined asset management as “an ongoing process of maintaining, upgrading, and operating physical assets cost-effectively, based on a continuous physical inventory and condition assessment.” (State of Michigan, 2002). This act also created a Transportation Asset Management
Council (TAMC). The Council was charged with “advising the [State Transportation] commission on the statewide asset management strategy and the processes and necessary tools needed to implement such strategy beginning with the federal-aid eligible highway system, and once completed, continuing on with the county road and municipal systems, in a cost-effective, efficient manner.” (State of Michigan, 2002). This legislation laid the foundation for roadway managers to break away from the traditional “tactical” approach of concentrating on the immediate and most severe problems—fixing the worst first. Instead, asset management provides a strategic and system-wide approach focused on keeping the good roads good and applying the correct fix at the correct time in the correct place.

In 2005 the TAMC considered a variety of tools available for predicting deterioration and conducting strategy analysis on over 44,000 miles (70,809 km) of federal aid roads in Michigan. The Council then selected RoadSoft® as the tool it would use. Although RoadSoft® had produced satisfactory analysis results for counties and cities for a number of years, its deterioration models had never been validated with a significant collected data set. This study examines the validity and confidence of the two models being used. The results show that the models originally used did not completely satisfy the assumptions made during their development. Modifications to the models, however, can satisfy the original assumptions and improve results. Using the PASER road surface condition data collected over a number of years in several counties demonstrated that any resulting errors in prediction are smaller when using the modified models.

6.2. Growth Models

Growth models are well developed for examining the growth process in many fields of study including biology, zoology, and the study of mortality in human beings. If we use \( y \) to denote a population size and \( t \) to denote time, then a model using \( y \) as a function of \( t \) describes the course of the population growth, hence a growth model. Most growth processes can be well described by two basic growth models, the Gompertz growth model and the Logistic growth model. If one views pavement deterioration as a “growth” process, then the application of these models could surely apply. The advantage of using the growth models versus empirical models is that they are derived from certain assumptions, so the parameters in the models are meaningful. On the contrary, the parameters of empirical models (such as a polynomial model of some degree) are meaningless.

The application of growth models to pavement deterioration was first introduced by Wen Kuo (1995). How well these models fit the actual deterioration process of pavement directly influences the accuracy of pavement performance predictions, and therefore, the repair strategies generated. RoadSoft® provides analysis using both the Gompertz and the Logistic growth models.

6.2.1. The Gompertz Growth Model

The Gompertz growth model is based on Gompertz distribution. It was first introduced by Benjamin Gompertz in 1825 to fit human mortality tables. The
The conceptual assumption used by the Gompertz model is that the relative population growth rate is linearly related to the natural logarithm of the present population size. This can be written as the following equation where the left side of the equation is the relative growth rate and $a$ and $b$ are constants.

$$\frac{dR}{R dt} = a(\ln R + b)$$

**Equation 1**

Since it is a decreasing function, $a < 0$. Solving this differential equation yields the following equation where $c$ is a constant and $R$ is the current rating at time $t$.

$$R = e^{(ce^{at} - b)}$$

**Equation 2**

Note: many dictionaries incorrectly define the Gompertz assumption such that the relative growth rate changes at a constant rate.

### 6.2.2. Logistic Growth Model

The conceptual assumption used by the Logistic growth model is that the population growth rate is assumed to be proportional to the product of the current population size and the difference between the current population size and the limiting population size as time $t$ goes to infinity. If pavement condition can be described by a score (a rating), this score would change as the pavement deteriorates over time. This score then becomes the population size in the growth model and allows the model to be used to describe the deterioration process of pavements.

We can write the assumptions that the growth rate at time $t$ is proportional to the product of rating at time $t$ and the future amount of growth as the following differential equation.

$$\frac{dR}{dt} = -aR(R - 1)$$

**Equation 3**

Where $dR/dt$ is the growth rate at time $t$, $a$ is a constant related to the quality of the initial construction, $R$ is the current rating (population size at time $t$), $l$ is the limiting rating when $t \to \infty$, and $R - l$ is the amount of change from current rating to the limiting rating (future amount of growth). Solving this differential equation yields the following.

$$R = \frac{l}{1 - Ce^{-l(a)t}}$$

**Equation 4**
6.3. The Disadvantages of the Original Growth Models Used in the RoadSoft® Pavement Management Analysis

When the growth models were introduced by Wen Kuo, the Michigan Distress Index (DI) procedure was used to describe the pavement condition. DI ranges from 0 (the best pavement condition) to 100 (the worst pavement condition). This requires that the DI rating is 0 for newly constructed pavements, which means that $R(0) = 0$, where $R(t)$ denotes the pavement performance rating at time $t$. This is impossible in Equation 1. To resolve that problem an extra term $\alpha$ was subtracted from the solution of the differential equation (Equation 2) as follows.

$$R = e^{(ce^{at} - b)} - \alpha$$

Equation 5

When this is done, the original meaning of the relationship between pavement performance rating and the age of the pavement is lost, so the original assumption is no longer valid. This violation of the assumption is inevitable when DI is used.

However, another pavement condition rating system, PASER, gained popularity in recent years. The PASER system has been used intensively in Michigan and Wisconsin for more than 15 years and the data collected has been found satisfactory for local agency and some state applications. The procedure is greatly simplified compared with the more rigorous distress data collection methods such as the DI, pavement condition index (PCI) and others. In the PASER system, the pavement condition is assessed visually and given a rating. The PASER rating scale ranges from 1 (very poor condition) to 10 (excellent condition). Thus, given that $R$ is the pavement condition rating, $R$ is a decreasing function when PASER is used, whereas it is an increasing function when DI is used.

RoadSoft®, using PASER instead of DI, adopted the same models, and therefore it inherited the previously described disadvantages. Let $\beta$ be the PASER rating when a pavement is newly constructed. RoadSoft® directly converted the Gompertz growth model to the following model for use with PASER data:

$$R = \alpha + \beta - (\alpha + \beta) \left( \frac{\alpha}{\alpha + \beta} \right)^{\frac{\ln (CDP + \alpha)}{\ln \left( \frac{\alpha}{\alpha + \beta} \right)^{1/DSL}}}$$

Equation 6

where DSL is the design service life and CDP is the critical distress point, which is the rating at which the pavement must be rehabilitated at the end of its design life.

Now consider the Logistic growth model. As with Gompertz, when the DI rating is used $R(t) = 0$ at $t = 0$. This is impossible to achieve using the solution of the differential equation (Equation 4). So an $\alpha$ value was again subtracted from the solution of the differential equation to make $R(0) = 0$ possible. RoadSoft® directly
converted the Logistic growth model to the following model for use with PASER data:

\[
R = \beta - \alpha \left[ -1 + \frac{\alpha + \beta}{\alpha + \beta \left( \frac{\beta - CDP}{\beta (CDP + \alpha)} \right)^{t/D_L}} \right]
\]

Equation 7

6.4. New Growth Models

A growth model is called a Gompertz or a Logistic model only because it is developed from certain assumptions. These assumptions are crucial to the validity of the models. Unfortunately, as discussed previously, even through the growth models currently being used in pavement management analysis are called Gompertz and Logistic growth models they do not retain the models’ original assumptions.

Modification to the growth models was thus undertaken to satisfy the original assumptions. The idea is very simple. Since PASER ratings are used, the requirement that the pavement condition rating is 0 for new pavement no longer applies in Equations 2 and 4, so the new models can be developed directly from the solutions of differential equations that describe the Gompertz and Logistic assumptions.

6.4.1. The New Gompertz Growth Model

Under the PASER system \( R(0) = 0 \) is not required, instead \( R = \beta \) when \( t = 0 \) is true. Using this condition and Equation 2, we obtain the following:

Equation 8 \[ C = b + \ln \beta \]

Substituting \( C \) into \( R \) yields

Equation 9 \[ R = e^{-b} e^{(b + \ln \beta) e^{at}} \]

Next we need to find the constant \( b \). Since \( a < 0 \), \( e^{at} \to 0 \) as \( t \to \infty \), which implies

Equation 10 \[ e^{(b + \ln \beta) e^{at}} \to 1 \]

Since \( R \to l \) when \( t \to \infty \), we have

\[
R = l \left( e^{\ln \left( \frac{\beta}{l} \right) e^{at}} \right)
\]

Equation 11
By definition, the DSL is the amount of time required for PASER ratings to reach the CDP. It means that \( R(\text{DSL}) = \text{CDP} \). Substituting this condition into the above equation helps us to find the last remaining constant \( a \) as follows.

\[
a = \frac{1}{\text{DSL}} \ln \frac{\text{CDP}}{\ln \frac{\beta}{l}}
\]

Equation 12

Substituting \( a \) into \( R \), we obtain the new Gompertz growth model as follows.

\[
R = l \left( \frac{\beta}{l} \right)^{\ln \frac{\text{CDP}}{\ln \frac{\beta}{l}} / \text{DSL}}
\]

Equation 13

6.4.2. The New Logistic Growth Model

Using the condition \( R(0) = \beta \) and Equation 4, we have

\[
\beta = \frac{l}{1 - ce^{-at(0)}}
\]

Equation 14

which implies

\[
C = \frac{\beta - l}{\beta}
\]

Equation 15

Substitute \( C \) into \( R \) gives

\[
R = \frac{l}{1 - \frac{\beta - l}{\beta} e^{-at}}
\]

Equation 16

We also know that \( t = \text{DSL} \) when \( R = \text{CDP} \). Using this condition and the previous equation yields the following:

\[
a = -\frac{1}{l/\text{DSL}} \ln \frac{\beta(\text{CDP} - l)}{\text{CDP}(\beta - l)}
\]

Equation 17

Substituting \( a \) into \( R \), we have the following new Logistic growth model:

\[
R = \frac{l}{1 - \frac{\beta - l}{\beta} \left( \frac{\beta(\text{CDP} - l)}{\text{CDP}(\beta - l)} \right)^{t/\text{DSL}}}
\]

Equation 18
Again, since an extra $\alpha$ is not subtracted from the right side of Equation 2 in the process of developing this model (Equation 18), the model satisfies the assumptions of a Logistic growth model.

### 6.5. The Model Parameters

In the previous sections, the two growth models (Equations 6 and 7) currently being used were examined and two new growth models (Equations 13 and 18) were derived. The researchers explained earlier that the meaning of the original growth models (Equations 6 and 7) is lost during the derivation using DI. RoadSoft® uses PASER, but the models were converted directly from the DI modified models, and therefore inherited the same disadvantages. The new models were developed exactly from the solution of the differential equations, so all model assumptions are valid. This gives meaningful explanations of their parameters.

The current pavement condition rating, $R$ is the dependent variable and time, $t$, is the independent variable in all growth models. CDP is a parameter in all of the models. It is commonly believed to be lower than a PASER rating of 5, so CDP = 5 will be used for this validation process.

When applying a growth model to pavement management analysis, two scenarios are considered. One is to let the rating of a newly constructed pavement be 10. Meaning that $R(0) = 10$. This model is called the “forced through 10 model.” The model will pass through 10 when time $t$ is 0 (at new construction). The other one is called the “unforced through 10 model” in which $\beta$ is estimated using the data alone at all times including $t = 0$. Since $\beta$ denotes the pavement condition rating of newly constructed pavements, it is usually 10 in practice but can fall below 10. We will only consider the case of the “forced through 10 model” in this validation process. However, all the original and new growth models considered in this process can also consider the “unforced through 10 model” cases, in which $\beta$ is treated as a parameter and is estimated using nonlinear regression.

The other parameter, $\alpha$ in the two original models (Equations 6 and 7) is estimated by RoadSoft® using nonlinear regression. However, $\alpha$ and DSL, the two most important parameters, are highly related in the “forced through 10 model.” The correlation between the two parameters is often as high as 99 percent, indicating that they are almost perfectly related. When parameters in a model are related, multicollinearity exists. It is well known that when multicollinearity exits, the error of the estimates of the parameters is very large so the estimates are not accurate. This will be shown using real data collected on Michigan roads. See Table 6.1. Since $\alpha$ and DSL are highly related, $\alpha$ is treated as a constant and only DSL needs to be estimated.
The relationship between $\alpha$ and DSL in the original models is similar to the relationship between $l$ and DSL in the new models. The two parameters, $l$ and DSL, are also almost perfectly related when $R(0) = 10$ is used (“forced through 10 model”). So $l$ becomes a constant and only DSL needs to be estimated.

The values for the constants $\alpha$ and $l$ must thus be determined. In the next section, we use $\alpha = l = 1$. The data collected in Michigan counties suggest that $\alpha = l = 1$ (details regarding this finding are reported later in this paper). From the above discussion, we can see that in the “forced through 10 models,” DSL is the only parameter remaining in the models to be estimated. This makes DSL a very important and meaningful parameter of the models.

The two parameters, $\alpha$ and DSL are not highly related when an “unforced through 10 model” is used. Similarly, $l$ and DSL do not have a high correlation in the new “unforced through 10 models.” Therefore, both of the two parameters should be estimated using the nonlinear regression models.

### 6.6. Comparisons

Now we give a graphical comparison of the two original growth models and the corresponding new models. As discussed in the previous section, $\beta = 10$, CDP = 5 and $l = \alpha = 1$ will be used in those models for the comparison. Substituting these values into Equations 6 and 7 gives the following explicit formulas for the two original growth models:

$$ R = 11 \left[ 1 - \left( \frac{1}{11} \right)^{\frac{\ln(6/11)}{\ln(1/11)}} \right] $$

Equation 19

$$ R = 11 \left[ 1 - \frac{1}{1 + 10 \left( \frac{1}{12} \right)^{t/DSL}} \right] $$

Equation 20

<table>
<thead>
<tr>
<th>Model</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>.979</td>
</tr>
<tr>
<td>L1</td>
<td>.976</td>
</tr>
<tr>
<td>G2</td>
<td>.983</td>
</tr>
<tr>
<td>L2</td>
<td>.984</td>
</tr>
</tbody>
</table>
The green and yellow curves in Figure 6.1 represent Equations 19 and 20, respectively. The horizontal-axis is time $t$ (the age of the pavement), and the vertical-axis represents pavement condition $R$.

**Figure 6.1 Comparison of the original and the new growth models**

Similarly, we also obtain the following explicit formulas for the two new growth models (Equations 21 and 22), which are represented by lines 3 and 1 in Figure 6.1, respectively.

**Equation 21**

$$R = 10 \left( \frac{\ln 5}{\ln 10} \right)^{t/\text{DSL}}$$

**Equation 22**

$$R = \frac{1}{1 - \left( \frac{9}{10} \right) \left( \frac{8}{9} \right)^{t/\text{DSL}}}$$

Since this is a theoretical comparison, we need to use the same DSL for all the models. We choose to use DSL=10 meaning that the pavement condition rating is 5 in the 10th year. All four curves meet at the initial point and at year 10 at a
Note that during this period the curves for the new models are concave up, while the curves for the original models are concave.

6.7. Application of the New Models to Actual Data

Data collected from three Michigan counties; Alcona, Lenawee, and Washtenaw; were used to compare the models. The original data set consists of 2623 PASER ratings in total. Data assumed entered by mistake or data that do not provide information concerning the relationship between \( R \) and \( t \) were deleted. For example, a pavement with only one year’s record does not give a deterioration pattern over time and was deleted. If the time gap between two ratings of a same pavement is larger than six years it was deleted since a treatment might have been applied during these six years and the ratings do not reflect the true deterioration process of the pavement. After cleaning the data, 1733 ratings are used in the analysis.

Since \( l \) represents the worst PASER pavement condition, it should be a rating of 1 by definition. However, a pavement rating may never reach 1 before repairs are made, so the limiting rating \( l \) is not necessarily 1. Different values were tried for the limiting rating \( l \) in the new models and some are reported in Table 6.2. In Tables 6.2 and 6.3, SSE stands for the Sum of Squares of Error. Since SSE measures the error, the smaller the number, the better the model. The \( r^2 \) represents the square of correlation in the regression models. We can see from Table 6.2 that the choice of \( l \) does not have a strong effect on the estimate of DSL, the error of DSL, or the \( r^2 \). Similar results are also obtained for \( \alpha \) in the original models, but are not reported here. The above results suggests that we can use \( l=1 \) in the new models.

### Table 6.2 The Choice of \( l \)

<table>
<thead>
<tr>
<th>Model</th>
<th>( l )</th>
<th>DSL</th>
<th>SSE of DSL</th>
<th>( r^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>G2</td>
<td>1</td>
<td>10.11</td>
<td>0.15</td>
<td>.977</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10.35</td>
<td>0.16</td>
<td>.978</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>10.82</td>
<td>0.18</td>
<td>.978</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>12.01</td>
<td>0.21</td>
<td>.979</td>
</tr>
<tr>
<td>L2</td>
<td>1</td>
<td>10.76</td>
<td>0.17</td>
<td>.978</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>11.08</td>
<td>0.18</td>
<td>.979</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>11.70</td>
<td>0.20</td>
<td>.979</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>13.30</td>
<td>0.25</td>
<td>.979</td>
</tr>
</tbody>
</table>

Table 6.3 gives the estimates of DSL, the SSE and the \( r^2 \) of the models. We can see from Table 6.3 that the new models (G2 and L2) have smaller SSE values compared to the original models (G1 and L1). The \( r^2 \) is the percentage of the variation in the data that can be explained by the model. So the larger the \( r^2 \) value the better the model fits the data. Table 6.3 shows that the \( r^2 \) values of the new models are slightly larger than that of the original models. This indicates that the new models describe the deterioration process of pavements better than the
original models. Also note that the estimated DSL is larger when using the new models than when using the original models.

Table 6.3 Comparison of Errors and $r^2$ of the Models

<table>
<thead>
<tr>
<th>Model</th>
<th>DSL</th>
<th>SEE of Model</th>
<th>$r^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>5.30</td>
<td>2759.5</td>
<td>.979</td>
</tr>
<tr>
<td>L1</td>
<td>6.09</td>
<td>3103.6</td>
<td>.976</td>
</tr>
<tr>
<td>G2</td>
<td>8.26</td>
<td>2197.6</td>
<td>.983</td>
</tr>
<tr>
<td>L2</td>
<td>9.28</td>
<td>2094.6</td>
<td>.984</td>
</tr>
</tbody>
</table>

6.8. The New Models as an Improvement to RoadSoft®

RoadSoft® provides the users with a default curve for agencies to compare against their own data. The current default curve was developed using historical road data collected in Wisconsin. RoadSoft® will now use historical road data collected by Michigan agencies to develop standard models for those agencies. For agencies without enough road data to develop a model, RoadSoft® will provide a model based on similar road conditions.

Since there are random variations in pavement performance, RoadSoft® could also provide upper and lower bounds of the deterioration curve, which means the rating can go as high as the upper bound and as low as the lower bound. A fixed number was used to produce the bounds in the past. Confidence intervals are recommended for use instead of a constant. If 95% confidence intervals are used, the users will know that the chance of their rating being within the upper and lower range is 95%.

6.9. Conclusion

Growth models are widely used in many fields including pavement management analysis. This paper has shown that the original application of Gompertz and the Logistic growth models for pavement management analysis did not completely satisfy the assumptions made during their development, even though the desired results were achieved. New Gompertz and Logistic growth models were introduced, thereby restoring validity to the common assumptions and meaning to the model parameters. The new models were compared with the original models both theoretically and through the study of a real data set. It was found that the new models have a slightly larger $r^2$, meaning that the variation of the deterioration process of a pavement can be explained better when using the new models.
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Appendix A. Summary of Management Systems

Accela Pavement Management™ - Pavement Management System

Contact Information:
Accela, Inc.
4160 Dublin Blvd. Ste 128
Dublin, CA 94568
Phone: (888) 722-2352 / Fax: (925) 560-6570
Email: info@accela.com
Website: www.accela.com

Summary:
Accela Pavement Management system provides network level management of pavement-related condition and inventory data, maintenance treatments and preventative maintenance schedules.

It charts the remaining service life of the entire roadway network over several years showing when large amounts of work are needed and allows the agency to budget accordingly. It also classifies roads using seven pavement types for both low and high-volume roads.

Other Accela Pavement Management Module includes:
Asset Management

Database:
Microsoft® Access™ 2000 or SQL Server™ 2000

GIS Platform:
By ESRI® ArcGIS™ or ArcSDE™

Surface Rating System:
Various surface condition distresses based on type, extent and severity, which are then compiled to calculate a pavement condition rating.

Currently Used by Local Agencies:
Yes

Area available:
United States
AgileAssets™ Pavement Manager - Pavement Management System

Contact Information:
AgileAssets Inc.
3144 Bee Caves Road
Austin, TX 78746
Phone: (512) 327-4200 / Fax: (512) 328-7246
Email: sales@agileassets.com
Website: www.agileassets.com

Summary:
AgileAssets offers a browser-based user interface capable of storing, retrieving, and processing user-defined, pavement-related condition and inventory data. The system allows users to analyze current conditions, future performance, expected needs for a pavement network, and multiple analysis scenarios with Network Optimization and Project Life Cycle Cost Analysis.

The system contains tools for GIS mapping and GPS Area referencing. It provides an integrated review of videos, photographs, drawings, audio clips, and other MS Windows supported file formats alongside associated data and analysis results.

Database:
Oracle®

GIS Platform:
ESRI® ArcGIS™

Surface Rating System:
Configurable Pavement Distress Index (PCI). Indices ranging from 0-100 are set-up and maintained by users.

Currently Used by Local Agencies:
Yes

Area available:
United States
BlockviewGIS - Pavement Management System

Contact Information:
MHM Associates Inc.
1920 Ridgedale Road
South Bend, IN 45514
Phone: (574) 291-4793 / Fax: (574) 273-4516
Email: mhmassoc@aol.com
Websites: www.blockviewgis.com

Summary:
BlockviewGIS is a web based road pavement database system. The information can be shared simultaneously by several people or on an Internet server for the general public access.

The ARIA profiler uses LaserCom and RufScan software to collect pavement data.

BlockviewGIS also includes:
- Street Signs
- Street Lights
- Traffic Signals
- Sidewalks
- Bike Paths
- Street Trees
- Guardrails
- Pavement Markings
- Parking Meters

Database:
Microsoft® Access™ 2000 / SQL Server™ 2000 or Oracle®

GIS Platform:
AutoCAD Map® Google Map® or Microsoft® Visual Earth

Surface Rating System:
International Roughness Index (IRI) & Surface Distress Assessment

Currently Used by Local Agencies:
Yes

Area available:
United States
CenterLine PMS - Pavement Management System

Contact Information:
Measurement Research Corporation
4126 4th Street NW
Gig Harbor, WA 98335
Phone: (253) 851-3200 / Fax: (253) 851-4334
Email: Sales@mrc-corp.com
Website: www.mrc-corp.com

Summary:
Centerline includes standard PMS segment/section descriptions, condition related data and work order management information. The software is compatible with GIS systems and existing SQL related databases. Analysis allows for maintenance and reconstruction budget generation across roadway classifications. Provides Worst First or Best First project sorting, user defined sorting variables and cost-effectiveness analysis.

NOTE: CenterLine PMS was initiated by the Washington State DOT working with representatives from various local agencies. The system was later developed by Measurement Research Corporation.

Database:
Microsoft® SQL Server™ 2000

GIS Platform:
ESRI® ArcView™

Road Rating System:
The software is customized by the developer to meet the surface rating needs of the customer agency.

Currently Used by Local Agencies:
Yes

Area available:
United States
CMS - CitiTech Management Software

Contact Information:
CitiTech Systems, Inc.
P.O. Box 7626
Rapid City, SD 57709
Phone: (800)738-9892 / Fax: (605)348-6224
Email: info@cititech.com
Website: www.cititech.com

Summary:
CMS includes standard PMS segment/section descriptions, condition related data and costs. Analysis can be performed on segments or "routes" (a collection of segments). Road segments are prioritized for rehabilitation analysis. The rehabilitation cost-matrix suggests the most effective repair, prioritizes segments and provides cost estimates.

CMS accommodates Log Points for GIS/GPS applications.

Database:
Microsoft® SQL Server™ 2000

GIS Platform:
ESRI® ArcGIS™ and Oracle®

Road Rating System:
User-defined distress factors calculate Pavement Condition Index.

Currently Used by Local Agencies:
Yes

Area available:
United States
dTIMS™ CT - Deighton Total Infrastructure Management System

Contact Information:
Deighton Associates Limited
112 King Street East
Bowmanville ON. CANADA L1C 1N5
Phone: (905) 697.2644 / Fax: (905) 697.2645
Email: support@deighton.com
Website: deighton.com

Summary:
dTIMS CT provides network-level asset management. It manages both hard and soft transportation related assets: pavements, bridges, subsurface utilities, mobility and safety.

It also defines performance curves, treatments and triggers, analysis sets and budget categories through the Life Cycle Cost Analyzer. The Optimizer tool generates feasible alternative strategies for each section and predicts future condition of the elements.

dTIMS CT database is compliant with GIS application software.

Database:
Microsoft® SQL Server™ 2000

GIS Platform:
ESRI® GIS

Road Rating System:
Road Condition Index (RCI)

Currently Used by Local Agencies:
Yes

Area available:
United States and International
GeoPlan® - Roads and Pavement Management

Contact Information:
Regional Planning Technologies, Inc.
624 West 26th Street
Erie, PA 16508
Phone: (814) 455-8764
Email: rich@rpt.com
Website: www.rpt.com

Summary:
GeoPlan manages roadway infrastructure and a variety of maintenance activities. It includes standard PMS segment/section descriptions, condition related data and costs. It generates budget alternatives using surface assessment and material data from various maintenance activities. Generates an overall estimated cost for the entire program as well as contract bid packages.

GeoPlan also includes:
- Sign and Appurtenance Inventory

Database:
Not Provided.

GIS Platform:
ESRI® ArcView™ and MapObjects™

Road Rating System:
Not Provided.

Currently Used by Local Agencies:
Yes

Area available:
United States
GEOSECMA - Istreet - Technical Information System

Contact Information:
Dynatest Consulting Inc.
5950 East Executive Drive
Westland, MI 48185
Phone: (734) 729 0400 / Fax: (734) 729-0401
Website: www.dynatest.com

Summary:
GEOSECMA uses mechanistic-empirical data to determine structural capability and predict performance. Costs considered in the analysis can include hard costs of construction and maintenance as well as user and vehicle costs. The system develops a network wide maintenance plan using best repair alternatives for road segments and an optimization of strategy that minimizes the total costs under a given budget or without budget constraint.

NOTE: Dynatest PMS integrated with GEOSECMA in 2005.

Database:
Microsoft® SQL Server™ 2000

GIS Platform:
ESRI® ArcView™ and MapInfo™

Road Rating System:
Performance and Economic Rating System (PERS) - combines the International Roughness Index (IRI) and Dynatest’s Falling Weight Deflectometer (FWD)

Currently Used by Local Agencies:
Yes

Area available:
United States and International
Hansen® PMS - Pavement Management System

Contact Information:
Hansen Information Technologies, Inc.
11092 Sun Center Drive
Rancho Cordova, CA 95670
Phone: (800) 821-9316 / Fax: (916) 921-6620
Email: information@hansen.com
Website: www.hansen.com

Summary:
The pavement management module is part of a larger infrastructure management system. The system is customized by Hansen for the user agency considering inputs, deterioration curves and output calculations. Inputs from other modules can be integrated into calculations for pavement lifespan analysis. Surface condition inspection can be user-configured to match any pavement distress rating system.

Database:
Microsoft® Access™ 2000 / SQL Server™2000 and Oracle®

GIS Platform:
ESRI® GIS

Road Rating System:
Hansen’s Overall Condition Index (OCI)

Currently Used by Local Agencies:
Yes

Area available:
United States and International
ICON PMS - Asset Management Software

Contact Information:
GoodPointe Technology Inc.
287 E. 6th Street, Suite 200
St. Paul, MN 55101
Phone: (866) 341.0721
Email: info@goodpointe.com
Website: www.goodpointe.com

Summary:
ICON PMS includes standard PMS segment/section descriptions, condition related data and condition score calculations. It performs system modeling using pavement performance curves and develops budget analysis scenarios for multi-year capital improvement programs. It is integrated with Traffic (Sign, Signals, and Striping) Management, Storm/Sanitary Sewer Management, Bridge Management, Right of Way Inventory, and Work Management modules.

ICON PMS also includes:
- Curb & Gutter Inventory
- Drainage Condition
- Utility Structures
- Sidewalk/Pathway Inventory
- Intersection/Island Information
- Wheelchair Ramp/Accessibility Information
- Pavement Striping Inventory
- Parking Lots Inventory
- Lights & Signals Inventory
- Boulevard/Vegetation Information
- Property Address Information
- Traffic Count Information
- Coring and FWD Deflection Testing Information
- Ride Quality Information

Database:
Microsoft® Access™ Microsoft® SQL Server™ Oracle and other SQL-compliant systems

GIS Platform:
D2_GIS—configurable with ESRI®

Road Rating System:
Pavement Condition Index (PCI), Qualitative (User Defined) Condition Index, Composite Condition Index (CCI), MnDOT Rating methodology, GaDOT Rating Methodology, and TxDOT Pavement Management Information System (PMIS) methodology, GaDOT
It is directly integrated with GPSVision™ Digital Image Data Collection System for pavement condition and feature extraction in the right of way.

Currently Used by Local Agencies:
Yes

Area available:
United States
IM - Infrastructure Management System

Contact Information:
Institute for Transportation Research and Education - ITRE
North Carolina State University
909 Capability Drive, Suite 3600
Raleigh, NC 27606
Phone: (919) 515-8899 / Fax: (919) 515-8898
Email: katie_mcdermott@ncsu.edu
Website: www.itre.ncsu.edu

Summary:
NCDOT has made this Pavement Management System available for North Carolina municipalities and ITRE modified this system for municipal streets. Pavement sections are prioritized from worst to best based on condition ratings. Recommended treatments are given for each deficient section to bring it up to an acceptable level. Treatments are recommended as a guideline.

IM also includes:
- Sidewalk
- Signs

Database:
Not Provided.

GIS Platform:
ESRI® ArcPad™

Road Rating System:
Pavement Condition Rating (PCR) – Visual distress survey from the Pavement Surface Condition Rating Manual developed by the Northwest Pavement Management Systems Users Group and WSDOT

Currently Used by Local Agencies:
Yes

Area available:
North Carolina and South Carolina
InfraManager - Pavement Management System

Contact Information:
CHEC Management Systems, Inc.
20202 Charlanne Dr.
Redding, CA 96002
Phone: (530) 222-3116 / (800) 523-2124
Website: www.cmsicorp.com

Summary:
Part of a larger, project-level infrastructure management system. Analysis prescribes maintenance treatment for road segments based on a user defined treatments matrix. Prediction modeling is conducted for up to 30 years with input from future budgets, inflation rates and lifecycle information which can be created or modified by the user. The Network Optimization tool analyzes each project list and prioritizes it in the most cost-effective order of treatment.

InfraManager also includes other add-in modules:
- Sidewalks
- Parks & Recreation System
- Signs
- Parking Lot and Pathways
- Budget Prediction Modeling (30 year outlook)

Database:
Sybase SQL

GIS Platform:
Compatible with ESRI® ArcView™ 3.2a and ArcGIS™

Road Rating System:
Uses a visual condition rating system where a field technician assesses the severity of five defects along with the number of patches and ride quality.

Currently Used by Local Agencies:
Yes

Area available:
United States
MicroPAVER - Pavement Management System

Contact Information:
Technical Assistance Center - TAC
University of Illinois at Urbana-Champaign
302 East John Street, Suite 202
Champaign, IL 61820
Phone: (877) 455-2687
Email: techctr@uiuc.edu
Website: www.tac.uiuc.edu

Summary:
MicroPAVER includes standard PMS segment/section descriptions and condition related data. The system uses pavement condition deterioration models to determine maintenance and repair alternatives, and analyzes the consequence of different budget scenarios.

MicroPAVER also includes:
- Handheld Data Import – Windows CE Handheld Device

Database:
Microsoft® Access 2000

GIS Platform:
ESRI® ArcView™

Road Rating System:
Pavement Condition Index Surveys

Currently Used by Local Agencies:
Yes

Area available:
United States and International
Mobility - Road Inventory and Management System

Contact Information:
County Road Administration Board
2404 Chandler Ct. SW, Suite 240
Olympia, WA 98502
Phone: (360) 753-5989 / Fax: (360) 586-0386
Email: mobsupport@crab.wa.gov
Website: www.crab.wa.gov

Summary:
Mobility includes standard PMS segment/section descriptions and condition related data. It can develop a budget and create a list of rehabilitations to fit the budget. It uses the information in the projects file to determine what to do with all projects in the network given a budget and a rehabilitation strategy.

NOTE: Mobility was developed in 2004 by the County Road Administration Board (CRAB), an organization of Washington Counties. It replaces the County Roads Inventory System (CRIS), which was being used by Washington counties since the 1980s.

Mobility also includes:
- Crashes
- Culverts
- Guardrail
- Sign Post
- Storm System
- Street Lights

Database:
Microsoft® SQL Server™ 2000

GIS Platform:
N/A

Road Rating System:
Pavement Structural Condition (PSC)

 Currently Used by Local Agencies:
Yes

Area available:
Washington
PASERWARE - Pavement Surface Evaluation and Rating Software

Contact Information:
Transportation Information Center - TIC
University of Wisconsin - Madison
432 North Lake Street
Madison, WI 53706
Phone: (800) 442-4615 / Fax: (608) 263-3160
Email: tic@epd.engr.wisc.edu
Website: tic.engr.wisc.edu

Summary:
PASERWARE includes standard PMS segment/section descriptions and condition related data. It projects future surface conditions, develops treatment strategies and cost estimates, and conducts budget analysis. PASERWARE was part of the Wisconsin’s DOT local road inventory and certification program, which maintained up-to-date information on the physical and administrative characteristics of all roads and streets in all transportation districts.

PASERWARE is provided at no cost to Wisconsin’s local government agencies.

NOTE: As of January 2006, PASERWARE is no longer supported by Wisconsin’s Transportation Information Center. Local agencies currently using PASERWARE will migrate to WISLR (Wisconsin Information System for Local Roads) throughout the next couple of years.

PASERWARE also includes:
- Field Inspection and Data Input

Database:
Microsoft® Access 2000

GIS Platform:
N/A

Road Rating System:
Pavement Surface Evaluation and Rating (PASER)

Currently Used by Local Agencies:
Yes

Area available:
Wisconsin
Pave Pro Manager - Pavement Management Software

Contact Information:
Infrastructure Management Services, Inc.
1895 Rohlwing Road, Suite D
Rolling Meadows, IL 60008
Phone: (800) 467.7110 / Fax: (847) 255.2938
Email: ims@ims-rst.com
Website: www.ims-rst.com

Summary:
Pave Pro Manager includes standard PMS segment/section descriptions and condition related data. It projects future pavement performance and determines the best maintenance or rehabilitation option for each project based on life cycle economic analysis. It also develops optimal maintenance and rehabilitation programs and estimates the future program budget requirements.

Pave Pro Manager also includes

- ROWMan, a right-of-way management module

Database:
Not Provided

GIS Platform:
ESRI® GIS

Road Rating System:
Not Provided.

Currently Used by Local Agencies:
Yes

Area available:
United States
PAVEMENTview® / Plus - Asset Management

Contact Information:
CartêGraph Systems, Inc.
3600 Digital Dr.
Dubuque, IA 52003
Phone: (563) 556-8120 / Fax: (563) 556-8149
Email: info@cartegraph.com
Website: www.cartegraph.com

Summary:
PAVEMENTview includes standard PMS segment/section descriptions and condition and maintenance related data. It provides multi-year treatment plans, “what if” scenarios for capital improvement, and conducts available budget optimization.

CartêGraph also includes:
- BRIDGEview
- LIGHTview, SIGNALview and SIGNview
- MARKINGview
- STORMview
- WATERview
- SEWERview
- CALLlink
- WORKdirector
- MAPdirector
- CAMlink
- DMIlink
- XYZlink
- BARlink

Database:
Microsoft® Access 2000, Microsoft® SQL Server 7.x, 2000 and Oracle® 8.1x

GIS Platform:
ESRI® GIS

Road Rating System:
Distress Identification Manual for the Long-Term Pavement Performance Project – Strategic Highway Research Program (SHRP), National Research Council

Currently Used by Local Agencies:
Yes

Area available:
United States and International
**PMS 4.0 - Pavement Management System**

**Contact Information:**
Resource International, Inc.
6350 Presidential Gateway
Columbus, Ohio 43231
Phone: (614) 823-4949 / Fax: (614) 823-4990
Email: info@resourceinternational.com
Website: www.resourceinternational.com

**Summary:**
PMS 4.0 includes standard PMS segment/section descriptions and condition related data. The system comes with preloaded GIS information abstracted from Tiger Files. It uses a project prioritization scheme that is based on Maintenance Urgency Categories. The system recommends and prioritizes specific maintenance treatments and develops appropriate maintenance strategies.

PMS 4.0 also includes:
- Hand-held field data collector

**Database:**
Microsoft® Access 2000

**GIS Platform:**
Not Provided.

**Road Rating System:**
Pavement Condition Rating (PCR) – Visual distress survey from the Pavement Surface Condition Rating Manual developed by the Northwest Pavement Management Systems Users Group and WSDOT

**Currently Used by Local Agencies:**
Yes

**Area available:**
United States
PMS Pro - Pavement Management Program

Contact Information:
Pavement Engineers, Inc.
15226 12th Drive S. E.
Mill Creek, WA 98012-3082
Phone: (888) 446-5222 / Fax: (425) 337-6084
Email: davoss@pvmtengr.com
Website: www.pavengr.com

Summary:
PMS Pro includes standard PMS segment/section descriptions and condition related data. The system applies user defined decision trees to develop rehabilitation strategies. Prioritization is based on worst-first, worst-last or by the Bayesian Information Criterion (BIC) statistical ratio method. The budget analysis is done for a variable number of years and unspent funds can be carried forward.

Database:
Microsoft® FoxPro™

GIS Platform:
ESRI® ArcInfo™

Road Rating System:
Pavement Condition Rating (PCR) – Visual distress survey from the Pavement Surface Condition Rating Manual developed by the Northwest Pavement Management Systems Users Group and WSDOT.

Currently Used by Local Agencies:
Yes

Area available:
United States
RoadManager 2000TM - Roadway Management System

Contact Information:
Vanassen Hangen Brustlin, Inc.
101 Walnut Street / P.O. Box 9151
Watertown, MA 02471
Phone: (617) 924-1770 / Fax: (617) 924-2286
Email: info@vhb.com
Website: www.vhb.com

Summary:
RoadManager 2000 includes standard PMS segment/section descriptions and condition related data. The System prioritizes treatment alternatives, calculates multi-year budgets, and develops “what if” funding scenarios.

Database:
Microsoft® SQL Server™ 2000

GIS Platform:
ESRI® ArcView™

Road Rating System:
Pavement Condition Index Surveys

Currently Used by Local Agencies:
Yes

Area available:
United States
RoadSoft® - Integrated Roadway Management System

Contact Information:
Michigan LTAP/TDG
Michigan Tech Transportation Institute - MTTI
Michigan Technological University
309 Dillman Hall, 1400 Townsend Drive
Houghton, MI 49931
Phone: (906) 487-2102 / Fax: (906) 487-3409
Email: RoadSoft@mtu.edu
Website: www.RoadSoft.org

Summary:
RoadSoft® includes standard PMS segment/section descriptions and condition related data. It comes preloaded with each local agency’s version of the Michigan Framework GIS basemap. The system uses pavement deterioration curves and treatment costs to project future surface condition, to build and optimize treatment strategies and to create “what if” scenarios which can include program budgets.

The GPS Laptop Data Collector (LDC) is used to collect Roadway Condition, Culvert and Signs Data.

RoadSoft® also includes:
- Laptop Data Collection System
- MRGens (basemap and reference generation system—outside Michigan)
- Sign Management
- Culvert Management
- Driveway Management
- Curb and Gutter Management
- Pavement Marking Management – Linear and Point
- Guardrail Management
- Safety Management (state supplied crash data)
- Bridge Inventory (PONTIS data)

RoadSoft® is provided at no cost to Michigan’s local government agencies and is available under license outside of Michigan.

Database:
Microsoft® SQL Server™ 2000 (including MS SQL Desktop Engine 2000)

GIS Platform:
TatukGIS® with industry compatible (.shp) data exports

Road Rating System:
Pavement Surface Evaluation and Rating (PASER)

Currently Used by Local Agencies:
Yes
Area available:
United States
RSMS - Road Surface Management System

Contact Information:
New Hampshire Technology Transfer (T2) Center
University of New Hampshire
Kingsbury Hall, 33 College Road
Durham, NH 03824
Phone: (603) 862-2826 / Fax: (603) 862-2364
Email: t2.center@unh.edu
Website: www.t2.unh.edu

Summary:
RSMS includes standard PMS segment/section descriptions and condition related data. The system can generate the overall condition of the network that will serve as a baseline to determine if the overall condition is improving from one year to the next.

Local agencies can update the Maintenance Repair & Rehabilitation tables to produce more accurate and cost-effective results.

NOTE: As of January 2006, RSMS is no longer supported by the New Hampshire T2 Center.

Database:
Microsoft® Access 2000

GIS Platform:
N/A

Road Rating System:
Distress Identification Manual for the Long-Term Pavement Performance Project – Strategic Highway Research Program (SHRP), National Research Council

Currently Used by Local Agencies:
Yes

Area available:
United States
Stantec PMS - Pavement Management System

Contact Information:
Stantec Michigan, Inc.
3959 Research Park Drive
Ann Arbor, MI 48108
Phone: (734) 761-1010 / Fax: (734) 761-1200
Email: Philip.Loud@stantec.com
Website: www.stantec.com

Summary:
Stantec includes standard PMS segment/section descriptions and condition related data. The Infrastructure Management Application is a tool for the management and graphical display of asset information, structural condition and other available data for municipal utilities and right-of-way assets.

Information can be analyzed graphically, or through the use of a GIS.

Database:
Road Matrix supports Oracle 8i/9i, SQL Server 200/2005 and MSDE 2000 (Microsoft SQL Server 2000 Desktop Engine)

GIS Platform:
ESRI® ArcView™

Road Rating System:
Four pavement performance indicators are used: Surface Distress Index (SDI), Riding Comfort Index (RCI), Pavement Quality Index (PQI) and Structural Adequacy Index (SAI).

Currently Used by Local Agencies:
Yes

Area available:
United States and International
StreetSaver® - Pavement Management System

**Contact Information:**
- Pavement Management Program - PMP
- Metropolitan Transportation Commission - MTC
- 101 Eighth Street
- Oakland, CA 94607
- Phone: (510) 817-5700 / Fax: (510) 817-5848
- Email: stan@mtc.ca.gov
- Website: www.mtcpms.org

**Summary:**
StreetSaver includes standard PMS segment/section descriptions and condition related data. Using the system local agencies can predict the future condition of their pavement for different levels of funding and show the effect of under-funded road programs.

The GIS Linkage and Viewer is an optional tool that allows users to link PMS data to a GIS based map.

**Database:**
- Microsoft® SQL Server™ 2000

**GIS Platform:**
- 3rd party add-ons

**Road Rating System:**
- Pavement Condition Index (PCI) - American Society for Testing and Materials (ASTM) D6433-03 Standard Practice for Roads and Parking Lots
- Pavement Condition Index Surveys

**Currently Used by Local Agencies:**
- Yes

**Area available:**
- United States
StreetWise - Pavement Condition Rating

Contact Information:
Washington T2 Center - WST2
Highways and Local Programs - WSDOT
310 Maple Park Avenue SE / PO Box 47300
Olympia WA 98504-7300
Phone: (360) 705-7000
Email: GrayL@wsdot.wa.gov
Website: www.wsdot.wa.gov

Summary:
StreetWise is a simplified, paper-and-pencil pavement management system based on the Washington methodology for small agencies. It uses forms and four look-up tables to calculate the Pavement Condition Rating (PCR). It also provides a basic process for prioritizing projects and generating proposed budgets.

Database:
FileMaker™ Pro Runtime 5.0v4

GIS Platform:
N/A

Road Rating System:
Pavement Condition Rating (PCR)

Currently Used by Local Agencies:
Yes

Area available:
State of Washington
TAMS - Transportation Asset Management System

Contact Information:
Utah LTAP Center
Utah State University
4111 Old Main Hill
Logan, UT 84322-4111
Phone: (800) 822-8878 / Fax: (435) 797-1582
Email: utaht2@cc.usu.edu
Website: www.utaht2.usu.edu

Summary:
TAMS includes standard PMS segment/section descriptions and condition related data. The system recommends maintenance and preservation treatments. Treatment costs are used to develop budget proposals and a method to evaluate alternate funding scenarios to maximize the average remaining service life of the road network.

The system provides GPS and GIS technologies to map the centerline of each street/road and establish a base reference map.

TAMS also includes:
- Signs
- Parking Lots

Database:
Microsoft® Access 2000

GIS Platform:
ESRI® MapObjects™

Road Rating System:
Distress Identification Manual for the Long-Term Pavement Performance Project – Strategic Highway Research Program (SHRP), National Research Council

Currently Used by Local Agencies:
Yes

Area available:
United States
WISLR - Wisconsin Information System for Local Roads

Contact Information:
Wisconsin Department of Transportation
Data Management Section
WISLR Program, Rm 901
4802 Sheboygan Ave
Madison, WI 53707
Phone: (608) 266-7139 / Fax: (608) 267-1856
Email: wislrinfo@dot.state.wi.us
Website: tic.engr.wisc.edu

Summary:
WISLR is an Internet-based system for local governments and WisDOT to manage local road data, improve decision-making, and to meet the reporting requirements of State statute. This statewide data and linework system combines GIS technology with standard PMS segment/section descriptions and condition related data.

WISLR currently supports > 1,500 active non-WisDOT users. It includes a Pavement Analysis Tool designed to assist local governments with development of cost-effective pavement maintenance and improvement programs. The tool provides location specific estimates of pavement needs that are prioritized and placed within a 5-year budget plan.

The WISLR Pavement Analysis 5-Year Budget Plan tool takes a “value-based” approach to pavement management. The objective of this approach is to get more value (cost-effectiveness) from improvement expenditures by:
1) getting more pavement life at a lower cost, and
2) improving ride quality.

WISLR is provided at no cost to Wisconsin’s local government agencies.

Database:
Oracle® 9.i

GIS Platform:
ESRI®

Road Rating System:
Pavement Surface Evaluation and Rating (PASER)

Currently Used by Local Agencies:
Yes

Area available:
Wisconsin
WY LTAP AMS - Wyoming LTAP Asset Management System

Contact Information:
Wyoming T2/LTAP Center
College of Engineering
University of Wyoming
1000 E. University Avenue
Laramie, WY 82071
Phone: (307) 766-6743 / Fax: (307) 766-6784
Email: georgeh@uwyo.edu
Website: wwweng.uwyo.edu/wyt2/

Summary:
WY LTAP AMS includes standard PMS segment/section descriptions and condition related data for one mile segments. The system provides the counties with a system similar to those developed by WYDOT for asphalt and concrete roads. It also allows prediction of the overall road network condition at various funding levels.

WY LTAP AMS also includes:
- Signs
- Culverts
- Cattle Guards
- Approaches
- Bridges

Database:
N/A

GIS Platform:
ESRI® ArcGIS™

Road Rating System:
Pavement Surface Evaluation and Rating (PASER)

Currently Used by Local Agencies:
Yes

Area available:
Wyoming
Appendix B. Survey – “Meaningful Use of Local Roads Data”

Task 2 – Survey of Data Collected and System Analysis Used by Local Agencies in the Region (WI, MI, MN, IL, IN, OH and IA)

This research project has been funded by the Midwest Regional University Transportation Center (MRUTC) and Michigan Technological University (MTU).

The objective of this research project is to gain a better understanding of the current use of pavement management systems by local road agencies. More specifically; what systems is being used, how they are being used, data gaps that hamper needed analysis, proper training and local’s opinion about a jurisdictional, regional and statewide data analysis.

The final report of this research project will be available through MRUTC’s website <www.mrutc.org> after October 2006.

If you don’t have internet access, please FAX the survey to the Michigan LTAP Center at (906) 487-3409.

1) Contact Information

Your contact information will not be shared with anyone at any time.

Name: ____________________________________

Title: _____________________________________

Agency: ___________________________________

City: ______________________________________

State: _____________________________________

Zip: ______________________________________

Phone: ____________________________________

Please let us know if we can contact you with further questions?

____ Yes ____ No

2) Local Agency Information

Type of Agency:

____ Village

____ City

____ Town or Township

____ County or County Road Commission

____ Other: ________________________________
Population:
_____ Less than 5,000
_____ 5,000 to 10,000
_____ 10,000 to 15,000
_____ 15,000 to 25,000
_____ 25,000 to 50,000
_____ 50,000 to 100,000
_____ 100,000 to 500,000
_____ More than 500,000

If you are from a County or County Road Commission, please specify your agency type:
_____ Rural, _____ Urban, _____ Rural / Urban

Are the “Policy Makers” in your agency: Appointed, Elected?
_____ Appointed
_____ Elected

Number of Certified Paved Street/Road Miles Maintained by Your Agency:
________ Paved Miles

Specify surface type below. Select all that apply:
_____ Asphalt, _____ Concrete, _____ Composite (Asphalt over Concrete),
_____ Sealcoat, _____ Other: _____________________________

Number of Certified Unpaved Street/Road Miles Maintained by Your Agency:
______ Unpaved Miles

Specify surface type below. Select all that apply:
_____ Gravel, _____ Earth, _____ Unimproved Earth
_____ Other: __________________________________

Annual Street/Road Maintenance and Construction Budget:
_____ Less than $100,000
_____ $100,000 to $500,000
_____ $500,000 to $1 Million
_____ $1 to $5 Million
_____ $5 to $10 Million
_____ $10 to $50 Million
_____ More than $50 Million

3) Pavement Management Systems
Does your agency currently use a Pavement Management System (PMS)?
_____ Yes _____ No (If No, go to Section 4.)
If Yes, select a system below. Select all that apply:

- Accela Pavement Management™
- AgileAssets™ Pavement Manager
- ARIA_BlockviewGIS
- CenterLine PMS
- CitiTech Management Software
- dTIMS™ CT
- GeoPlan©
- GEOSECMA – Istreet
- Hansen® PMS
- ICON PMS
- InfraManager
- MicroPAVER
- PASERWARE
- Pave Pro Manager
- PAVEMENTview® / Plus
- PMS 4.0
- PMS Pro
- RoadManager 2000™
- RoadSoft®
- RSMS
- Stantec PMS
- StreetSaver™
- TAMS
- WISLR
- Other: ______________________

How long has your agency used a PMS?
- Less than 2 years
- 2-5 years
- 5-10 years
- 10-15 years
- More than 15 years

How often does your agency collect pavement condition data?
- Once per year
- Once every two years
- Once every three years
- Once every four years
- Other: ______________________

How is the pavement condition data collection done? Select all that apply:
- In-House (by Your Agency), Regional Effort, Statewide Program,
- Consultant
- Other: ______________________________. 

B-3
Does your PMS have a Geographic Information System (GIS) platform?
____ Yes ____ No

Are you able to create Pavement Deterioration Curves with your PMS?
____ Yes ____ No

Are you able to calculate the Remaining Service Life (RSL) with your PMS?
____ Yes ____ No

Are you able to set up Pavement Maintenance and Rehabilitation Strategies with your PMS?
____ Yes ____ No

Are you able to Optimize the Pavement Maintenance and Rehabilitation Strategies with your PMS?
____ Yes ____ No

Overall, how would you rate your experience with your PMS?
____ Excellent ____ Very Good ____ Good ____ Fair ____ Poor

Additional Comments:
__________________________________________________________________
__________________________________________________________________

Is the output from your PMS being used by the Engineering/Maintenance Unit?
____ All the Time
____ Often
____ Sometimes
____ Never

If the PMS output is being used by the Engineering/Maintenance Unit in your agency, please specify how? Select all that apply:
___ State Reporting Requirements
___ Public Meetings
___ Tax Increase Proposal
___ General Maintenance and Construction Plan
___ GASB 34 Compliance
___ Day-to-Day Activity
___ Annual Budget Requirements
___ Capital Improvement Plan (CIP)

Additional Comments:
__________________________________________________________________
__________________________________________________________________
Is the output from your PMS being used by the Policy Makers and Upper Management?

___ All the Time
___ Often
___ Sometimes
___ Never

If the PMS output is being used by the Policy Makers and Upper Management in your agency, please specify how? Select all that apply:

___ State Reporting Requirements
___ Public Meetings
___ Tax Increase Proposal
___ General Maintenance and Construction Plan
___ GASB 34 Compliance
___ Day-to-Day Activity
___ Annual Budget Requirements
___ Capital Improvement Plan (CIP)

Additional Comments:
__________________________________________________________________
__________________________________________________________________

4) Implementing a Pavement Management System

What challenges does your agency face in implementing/running a PMS? Select all that apply:

___ Qualified Staff
___ Proper Training
___ Upper Management Support
___ Organizational Structure
___ Cost (Implementation and Maintenance)
___ We don’t have a system

What are common ‘Data Gaps’ that hamper needed analyses? Select all that apply:

___ Pavement Evaluation Method
___ Data Collection Process
___ Lack of Curb and Gutter Data
___ Lack of Utilities (e.g., Water and Sewer) Data Integration
___ Lack of Standard Maintenance and Rehabilitation Costs
___ Lack of Data on Treatment Performance

How do you feel about your pavement data being used in a jurisdictional, regional and statewide comparison analysis?

___ Comfortable
___ Skeptical
___ Uncomfortable
Why? Select all that apply:

_____ “It would be nice to know how other local agencies are doing.”
_____ “It would be an eye-opener for Policy Makers and Upper Management.”
_____ “It would show that we are not funded properly.”
_____ “It would show what a great job we are doing with the current funding.”
_____ “Other agencies don’t need to know what we are doing.”
_____ “It could cause us to loose funding.”
_____ “It would be used against our agency.”

Additional Comments:
__________________________________________________________________
__________________________________________________________________

5) Pavement Management Training

Who provides PMS training for your agency? Select all that apply:

_____ LTAP/T2 Center
_____ American Public Works Association (APWA)
_____ Consultants
_____ Contractors
_____ Universities
_____ Federal Highway Administration (FHWA)
_____ State Department of Transportation (DOT)
_____ Other: ______________________________.

How many times has your staff attended PMS training, since the implementation of the PMS in your agency?

_____ Never
_____ 1 to 2 Times
_____ 3 to 5 Times
_____ 6 to 10 Times
_____ More than 10 Times

What level of PMS training has the staff your agency attended? Select all that apply:

_____ Introductory (What is Pavement Management?)
_____ Intermediate (Data Collection)
_____ Advanced (Data Analyses and Applications)

What is the importance of a training session on “Pavement Management for Policy Makers and Upper Management” for your agency?

_____ Very Important
_____ Important
_____ Neutral (Don’t know)
_____ Somewhat Important
_____ Not Important
What is the importance of a training session on “Pavement Management for Engineers and Technicians” for your agency?

___ Very Important
___ Important
___ Neutral (Don’t know)
___ Somewhat Important
___ Not Important

What is the importance of a training session on "Pavement Management for Maintenance Crews" for your agency?

___ Very Important
___ Important
___ Neutral (Don’t know)
___ Somewhat Important
___ Not Important

Is there anything else you would like to tell us?
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

A web version of this survey is also available at: www.michiganltap.org/survey/
If you don’t have internet access, please FAX the survey to the Michigan LTAP Center at (906) 487-3409.
Appendix C. Training Currently Provided by LTAP Centers in the Region

Illinois Technology Transfer Center
Illinois DOT
2300 S Dirksen Pkwy.
Springfield, IL 62764
Phone: (217) 782-7820
Email: T2LRSDOT@dot.il.gov
Website: http://www.dot.state.il.us/blr/t2center.html

Highway Engineering Principles

Agenda:
- Basic Mathematics
- Horizontal and Vertical Curves
- Slopes and Grades
- Bituminous Surface Treatment
- Traffic, Highway Organization and Funding

Goals and Objectives:
To familiarize engineering and technical employees or refresh their knowledge of highway terminology and procedures used in conjunction with engineering applications and the management of streets and roads.

Target Audience:
N/A

Level: Introductory
Type: N/A
Duration: 1 Day (Between 5-8 hours)

Pavement Construction Inspection

Agenda:
- Bases: Granular, Surface Treatment/Cold Milling/Reclaim; Preparation and Prime, Design, and Construction Control;
- Bituminous Concrete: Surfaces, Binders and Intro to Superpave;
- Portland Cement Concrete: Concrete Placement, Reinforcement, Joints, Finishing and Curing, Intersection Joint Design and Field Layout

Goals and Objectives:
To enable the student to inspect the construction of bituminous surface treatments, asphalt concrete and PCC pavements to ensure compliance with plans and specifications.

Target Audience:
N/A
Level: Intermediate  
Type: N/A  
Duration: 3 Days (More than 24 hours)

**Pavement Maintenance**

*Agenda:*
- Drainage and Subsurface Maintenance
- Patching and Resurfacing Material
- Street Patching Methods
- Portland Cement Concrete and Utility Cuts
- Sealcoats and Crack Sealing
- Developing a Systematic Approach to Pavement Maintenance

*Goals and Objectives:*
To enable students to recognize the causes of pavement failure and to make and/or recommend corrective measures including alleviating the cause, selecting the proper materials and methods, and documenting the work accomplished. This workshop will discuss various types of road surfaces with emphasis on flexible bases and developing a pavement management system.

*Target Audience:*
N/A

Level: Intermediate  
Type: N/A  
Duration: 1 Day (Between 5-8 hours)

**Rehabilitation of Streets and Highways**

*Agenda:*
- PCC and Bituminous Rehabilitation Techniques
- Sealcoats and Slurry Seals
- Rehabilitation Materials
- Maintenance Planning and Programming

*Goals and Objectives:*
To familiarize students with advantages, disadvantages, capabilities, and elements of construction for various methods of rehabilitating urban streets. This will be an information sharing/discussion session for local agencies on what is and is not working for them on their urban streets.

*Target Audience:*
N/A
Seal Coats (Oil & Chipping)

Agenda:
- Types of Bituminous Materials & Aggregates
- Proper Preparation of the Existing Surface
- Proper Construction of Sealcoats
- Typical Problems that May be Encountered

Goals and Objectives:
To enable the students to select the best type of bituminous material and aggregate for prime, seal, and cover coats for their applications. As well as, help them understand proper construction methods in preparation of the surface, placement of the bituminous materials & aggregates, and to recognize typical problems.

Target Audience:
N/A

Level: Intermediate
Type: N/A
Duration: 1/2 Day (Up to 4 hours)
Indiana LTAP
1435 Win Hentschel Drive
West Lafayette, IN 47906
Toll-Free: (800) 428-7639 (Indiana only)
Direct Line: (765) 494-0315 / Fax: (765) 496-1176
Email: lmp@purdue.edu
Web: http://www.purdue.edu/INLTAP

Paving Sessions

Agenda:
"Paver Fundamentals" (What the Paver is attempting to do?)
"Paving by the Numbers" (Habits of successful crews.)
Correcting Mat Defects
Fundamentals of Compaction

Goals and Objectives:
N/A

Target Audience:
N/A

Level: N/A
Type: N/A
Duration: 1 Day (Between 5-8 hours)

Asset Management Series

Agenda:
Why We Need AMS
SIMS/RSMS
E-Roads
Deighton
Think Map
Carte’Graph
Master Mind

Goals and Objectives:
To impress upon the participants the importance of asset management and why you should be working toward a goal of “total asset management”.

Target Audience:
N/A

Level: N/A
Type: N/A
Duration: 1 Day (Between 5-8 hours)
HMA (Hot Mix Asphalt) Sessions

*Agenda:*
  "Protecting and Preserving Assets" (Pavement Management for Locals)
  Proper Applications for Performance
  Performance Grade Binders
  Maintenance Mixtures for Local Governments
  Local Guide Specifications for Quality & Performance

*Goals and Objectives:*
  N/A

*Target Audience:*
  N/A

*Level: N/A*

*Type: N/A*

*Duration: 1 Day (Between 5-8 hours)*

Maintenance of Roads/Streets

*Agenda:*
  Potheoles (A new look at an old problem.)
  Surface Treatments- Nova Chip, Koch Pavement Solutions, Road Armor,
  Asphalt Rejuvenator, Rejuvenation Technique
  Cold Mix Asphalt
  How to make your investment last longer (Crack Seal; Slurry Seal; and Micro
  Surfacing)

*Goals and Objectives:*
  N/A

*Target Audience:*
  N/A

*Level: N/A*

*Type: N/A*

*Duration: 1 Day (Between 5-8 hours)*
**Fundamentals of Pavement Management**

*Agenda:*
- PMS Fundamentals
- Automated distress data overview
- PMS software output review
- GIS database demonstration

*Goals and Objectives:*
This workshop provides training on general pavement management.

*Target Audience:*
This workshop is intended for upper management and elected officials.

*Level: Introductory*
*Type: N/A*
*Duration: 1/2 Day (Up to 4 hours)*

**Iowa Streets and Roads Maintenance**

*Agenda:*
- Maintenance Workers Handbook
  - Interacting with the Public
  - Maintaining the Roadway
  - Shoulders and Driveways
  - Maintenance of Ditches/Drainage
  - Winter Maintenance
  - Basic Inspection of Structures
- Iowa Drainage Law Manual
  - Introduction and Background
  - Practical Examples
  - Answers to Common Problems
  - Interactive Discussion
- Use and Removal of Stop/Yield Control
  - Recent research study of very low-volume intersections

*Goals and Objectives:*
To teach what’s important and why in roadway maintenance from the centerline to the edge of the right of way (based on the new Iowa Maintenance Workers Handbook). It will cover common drainage problems and what to do about them (based on the Iowa Drainage Law Manual), as
well as when very low-volume roads need stop signs, yield signs, or no traffic control (based on recent research).

Target Audience:
The target audience includes those who are associated with the day-to-day activities of local transportation agencies and are interested in methods and resources that offer potential for improving roadway safety and reducing costs. This would include those who work in or have other related activities with a county or city, such as roadway maintenance supervisors, engineers, administrators, technicians, elected officials, & consultants.

Level: N/A
Type: N/A
Duration: 1 Day (Between 5-8 hours)

Pavement Management Software

Agenda:
- IPMP Overview
- Software Introduction
- Software Parameters
- Software Operation
- Software Customization
- Software Demonstration

Goals and Objectives:
This workshop provides technical training on pavement management software. It includes information on dTIMS™ and FNOS.

Target Audience:
The target audience would include engineering and technical staff responsible for day-to-day operation

Level: Intermediate
Type: Computer Training
Duration: 1/2 Day (Up to 4 hours)

GIS Database

Agenda:
- IPMP GIS Database Overview
- Information Delivery Options
- Data Integration (PMS Results)
- Section Tool
- Database Demonstration

Goals and Objectives:
This workshop provides technical training on the GIS database

Target Audience:
The target audience would include engineering and technical staff.

Level: Intermediate
Type: Computer Training
Duration: 1 Day (Between 5-8 hours)
Level 1 Introduction to RoadSoft® — Hands-On Training for the New User

**Agenda:**
- Introduction to RoadSoft®
- Modules: Road, Crash, Culvert, Sign, Point/Linear Pavement Marking and Guardrail.
- Generating Reports and Exporting Data
- Overview of the Laptop Data Collector (LDC)

**Goals and Objectives:**
This workshop is designed for the new user; providing an overview of RoadSoft® and basic instruction on each of the modules within the program. Participants receive hands-on experience operating RoadSoft® using their own agency data.

**Target Audience:**
The target audience would include technical staff responsible for asset management of transportation facilities including engineers, technicians, managers of local agencies, and consultants who provide service to local agencies.

**Level:** Introductory  
**Type:** Computer Training/Presentation  
**Duration:** 1 Day (Between 5-8 hours)

The TMAC Data Cycle and Laptop Data Collector (LDC) Webinar

**Agenda:**
- Data cycle for collection pavement condition data.
- How to use the LDC for GPS assisted collection in the field.

**Goals and Objectives:**
This training is designed to show users how to use RoadSoft®, s Laptop Data Collector (LDC) to collect pavement, sign, and culvert data and to discuss how to move data between the LDC and RoadSoft®.

**Target Audience:**
The target audience would include technical staff responsible for pavement condition data collection including engineers, technicians, managers of local agencies, and consultants who provide service to local agencies.

**Level:** Introductory/Intermediate  
**Type:** Computer Training/Presentation  
**Duration:** 90 minutes

**Level 3 Advanced RoadSoft® — Building a Long Range Plan**

**Agenda:**
- Assembling Pavement Modeling Data  
- Establishing a Maintenance Strategy  
- Building an Improvement Plan  
- Communicating With Stakeholders

**Goals and Objectives:**
- This workshop will guide participants through developing a long term road improvement plan using RoadSoft®. Participants will learn the basics of working with RoadSoft®’s pavement deterioration model and strategy analysis engine to determine a network wide strategy.

**Target Audience:**
- The target audience would include: county road commissioners, administrators, supervisors, city council members and engineers, technicians, consultants, and anyone else interested in learning how to use RoadSoft®.

**Level:** Intermediate/Advanced  
**Type:** Computer Training/Presentation  
**Duration:** 1 Day (Between 5-8 hours)

**Pavement Surface Evaluation and Rating (PASER) & Laptop Data Collector**

**Agenda:**
- Asphalt PASER Manual  
- Sealcoat PASER Manual  
- Concrete PASER Manual  
- Gravel PASER Manual  
- Laptop Data Collector (LDC) Demonstration

**Goals and Objectives:**
- This is an introduction to PASER rating system including Asphalt, Sealcoat, Concrete, & Gravel PASER Manual. It covers kinds of asphalt pavement distress like surface defects, surface deformation, cracking, patches and potholes. The course also provides a demonstration of Laptop Data Collector.

**Target Audience:**
The target audience includes technical staff responsible for asset management of transportation facilities including engineers, technicians, managers of local agencies, and consultants who provide service to local agencies.

Level: Introductory/Intermediate
Type: Presentation
Duration: 1 Day (Between 5-8 hours)

Seminar on the Maintenance of Asphalt Pavements

Agenda:
- Treatment selection and strategies
- Maintenance as an asset management principle
- Chip Seal / Seal Coat
- Crack Seal
- Fog Seal
- Structural Overlay
- Pothole Repair
- Spray Patching
- Slurry Seal
- Microsurfacing

Goals and Objectives:
Instruction by national experts that address the technical aspects of asphalt treatment types—what they are, why you would use them, the benefits and drawbacks of each type, when and when not to apply and how to ensure that you get what you pay for.

Target Audience:
The target audience includes technical staff responsible for asset management of transportation facilities including engineers, technicians, managers of local agencies, and consultants who provide service to local agencies.

Level: Introductory/Intermediate/Advanced
Type: Presentation
Duration: 2 Days (Between 13-16 hours)

Michigan Bridge Conference and Workshop

Agenda:
- Workshop:
  - Overview of the Load Rating Procedure
  - Calculations for Special Bridge Types
  - Hands-on Exercises
- Conference:
  - Update from the Federal Highway Administration
  - Update from Michigan DOT
- New topics each year related to bridge research, construction, repair and management

**Goals and Objectives:**
Provide information on bridge research, construction, repair and management.

**Target Audience:**
N/A

**Level:** Intermediate
**Type:** Presentation
**Duration:** 2 Days

**Culvert Installation & Maintenance Workshop**

**Agenda:**
- Permits and Policies
- Culvert Sizing
- Culvert Installation
- Culvert Maintenance
- Culvert Management

**Goals and Objectives:**
You will learn about drainage permits, culvert sizing, installation methods, erosion control, maintenance and record keeping. This course covers common proven practices and its content is not highly technical.

**Target Audience:**
City, county and township highway and street department personnel responsible for the installation and maintenance of drainage culverts will benefit from this course.

**Level:** Introductory/Intermediate
**Type:** Presentation
**Duration:** 1 Day

**Introduction to Transportation Asset Management - A Workshop for Elected Officials**

**Agenda:**
- Define Asset Management
- Pavement Condition Rating
- Pavement Management Systems - What do they do?
- Asphalt Pavement Fixes

**Goals and Objectives:**
This workshop will give participants an overview of asset management principles as they apply to transportation. Instructors will discuss the need for asset management and how it can guide decision makers down the path to a better roadway system. Instructors will also spend time explaining
preventative maintenance treatments which are commonly used on asphalt pavements.

Target Audience:
This workshop was designed specifically with city, county and township elected officials in mind. All local elected officials who have an interest in transportation projects or facilities should attend. No engineering background is required.

Level: Introductory/Intermediate
Type: Presentation
Duration: 3-4 hours

Local Roads Seminar – Concrete Pavements

Agenda:
Managing Concrete Assets with a Mix of Fixes
Concrete Maintenance and Repair Options
Concrete Overlay Option

Goals and Objectives:
Industry experts will discuss concrete roads system management and will focus on concrete repair and maintenance techniques appropriate for concrete local streets. Learn to manage your concrete assets through maintenance, repair and overlays.

Target Audience:
N/A

Level: Introductory/Intermediate
Type: Presentation
Duration: 1 Day

Michigan Transportation Asset Management Conference

Agenda:
Asset Management Council Update
National and International Perspectives
Case studies from counties, cities and MDOT

Goals and Objectives:
The objective of the conference is to bring elected and appointed public officials, managers, planners, engineers, and finance personnel together to learn how Transportation Asset Management is being implemented at agencies throughout Michigan and to see firsthand the practical application of the asset management process.

Target Audience:
N/A

Level: Introductory/Intermediate
Type: Presentation  
Duration: 1 Day  

Motor Grader Training  
Agenda:  
Safety  
Grader Types  
Grader Maintenance  
Blade Pitch  
Articulation  
Grader Speed  
Aggregate Types  
Road Profiles  
Ditching  
Drainage  
Washboarding  
Dust Control  
Wetlands Issues  

Goals and Objectives:  
The classroom session is designed to have open discussion of on-the-job experiences regarding the specific training topics. The field session is a hand-on approach of specific topics that are chosen by the operators. There is one field session at each agency that is registered.

Target Audience:  
Public agency motor grader operators of all ability levels are encouraged to attend. Supervisors are strongly advised to attend the classroom session to learn about emerging products, technologies, and techniques.

Level: Introductory/Intermediate  
Type: Field/Presentation  
Duration: 2 Days (1 day in the field and 1 day classroom)

Inspecting Pavement Markings  
Agenda:  
MDOT Specifications  
Understanding Painting and Inspection  
Understanding the Equipment  
Understanding the Paint  
Understanding the Beads  
Understanding Quantities  
Inspecting the Final Product
Goals and Objectives:
This workshop will provide a thorough understanding of the pavement marking process, including application, inspection, specifications, and contract oversight.

Target Audience:
Anyone interested in developing the skills necessary to inspect all aspects of the painting process should attend this workshop.

Level: Introductory/Intermediate
Type: Presentation
Duration: 1 Day (Between 6-8 hours)

RoadSoft® Sign Management Module Webinar
Agenda:
Why is Sign Management Needed?
How to Develop a Sign Management Plan
How to Implement a Sign Management Plan Using RoadSoft®

Goals and Objectives:
The goal of this workshop is to introduce sign inventory, sign management plans, data collection and work orders.

Target Audience:
N/A

Level: Introductory/Intermediate
Type: Computer Training/Presentation
Duration: 1-2 Hours

Submitting your TAMC Pavement Condition Data Webinar
Agenda:
Why do We Need to Submit TAMC Data?
Submitting TAMC Asset Investment Data with RoadSoft®
Using RoadSoft® to Store Project Data
Changes in Requirements for Submitting Investment Data

Goals and Objectives:
This webinar is designed to provide you with the knowledge and understanding to submit your Transportation Asset Management Council (TAMC) data using RoadSoft®.

Target Audience:
This training session is designed for users who have a basic understanding of how to use RoadSoft® and would like to learn how to submit their TAMC investment data using RoadSoft®.

Level: Introductory/Intermediate
Type: Computer Training/Presentation
Duration: 90 Minutes

RoadSoft® Pavement Marking Module Webinar

Agenda:
- Overview of RoadSoft® and the Pavement Marking Module
- Adding Linear Pavement Markings
- Adding Point Pavement Markings
- Working With and Generating Reports
- Open Discussion

Goals and Objectives:
The goal of this workshop is to introduce the marking inventories, collecting marking data and how to generate management reports.

Target Audience:
- Engineers and Technicians

Level: Intermediate
Type: Computer Training
 Duration: 90 Minutes
Asphalt Pavement Maintenance (CTAP course)

Agenda:
- Evaluating Pavement Condition
- Crack Sealing, Filling, and Repair
- Correct Methods for Pothole Patching
- Chip and Slurry Seals
- Microsurfacing
- Sealcoats
- Spray Injection Patching
- Selecting the Right Treatment for the Distress
- New Techniques and Equipment

Goals and Objectives:
Complementing the one-day Asphalt Pavement Maintenance and Preservation workshop, this CTAP workshop increases participants’ awareness of the various pavement maintenance alternatives available today. It also highlights the benefits of performing preventive maintenance on roadways to extend their service life, improve ride-ability, and reduce long-term costs. This workshop incorporates best practices from the new Minnesota Best Practices Handbook on Asphalt Pavement Maintenance and Asphalt Pavement Maintenance Field Guide.

Target Audience:
The target audience includes street or road superintendents, supervisors, and roadway maintenance workers responsible for asphalt pavement construction or maintenance.

Level: Intermediate
Type: N/A
Duration: 1/2 Day (Up to 4 hours)

Asphalt Pavement Maintenance and Preservation

Agenda:
- Techniques for asphalt pavement evaluation, including pavement condition rating and non-destructive testing
Discussion of how to select the best maintenance strategy; choose the right treatment at the right time on the right project

Overview of the various maintenance treatments and their construction practices: fog seal, chip seal, double chip seal, slurry seal, micro surfacing, Macro®–Surfacing, bonded thin overlay, thin overlay, new technology or processes

Overview of material properties—how they are produced; and proper handling and storage of aggregates, emulsions, cutbacks, and asphalts

Review of Minnesota Best Practices Handbook on Asphalt Pavement Maintenance

Goals and Objectives:
To provide an overview of the available technology and tools that make implementing a pavement preservation program feasible. Additionally, the workshop will introduce some new preventative maintenance technologies

Target Audience:
It is designed for engineers, managers, supervisors, and technicians responsible for asphalt pavement maintenance, design, and construction.

Level: Advanced
Type: N/A
Duration: 1 Day (Between 5-8 hours)

Best Pavement Design Practices for City Streets and County Roads

Agenda:
Review soil factor and R-value thickness design
Introduction to MnPAVE for thickness design (including practical exercises)
Review subgrade soil evaluation and best construction practices
Overview subgrade soil enhancement practices in Minnesota
Review pavement section materials and best construction practices

Goals and Objectives:
This workshop outlines best practices for pavement design on city and county roadways. All three accepted methods of pavement design are covered, including Soil Factor, R-value thickness, and an introduction to MnPAVE for thickness design. The reference for this course is the newly completed Best Practices for the Design and Construction of Low Volume Roads.

Target Audience:
Civil engineers and technicians responsible for pavement designs on city and county streets

Level: Advanced
Type: N/A
Duration: 1 Day (Between 5-8 hours)
Concrete Rehabilitation for City Streets and County Roads

Agenda:
- Introduction to concrete pavements and CPR plates
- Training with the standard plates
- Travel to local city street for field survey
- Field survey using standard plates
- Review of team reports of field survey
- Review of standard plates and LCC of team reports
- Field review of actual city street concrete repairs

Goals and Objectives:
The workshop will cover all aspects of concrete rehabilitation for concrete pavements, concrete curb and gutter, and median or sidewalk pavements. The workshop includes two field sessions—one will involve how to determine what to repair and the other will review actual concrete rehabilitation repairs using the new Minnesota LRRB manual on the best practices for concrete repair of local streets and county roads.

Target Audience:
County and city engineers or their technical staff responsible for maintaining concrete pavements and associated concrete structures

Level: Intermediate
Type: Field
Duration: 1 Day (Between 5-8 hours)
Asset Management for Local Agencies

**Agenda:**
- Information on Asset Management
- Asset Management Decision Making- Results with real world examples
- Asset Management in Jackson County
- Implementation Presentation & Exercises

**Goals and Objectives:**
This course presents basics of asset management, examples of how this concept is working, steps & tools to get started and the linkages to GASB 34. Upon completion, the participants will be more comfortable with the concept of how asset management principles can strengthen understanding of consequences of public works infrastructure decisions.

**Target Audience:**
The target audience would include decision-makers for all local governments including counties, townships, villages, municipalities, and other elected local officials.

**Level:** Intermediate
**Type:** Presentation
**Duration:** 1 Day (Between 5-8 hours)

Asset Management- Inventory Collection & Evaluation

**Agenda:**
- How Assets are Managed
- Roads, Streets, Bridges etc. - Inventories
- Attribute Inventory Conditions
- Performance Measurement
- Data Evaluation & Management
- Computer Software
- Smart Infrastructure Asset Management System
- Performance Modeling Demonstration

**Goals and Objectives:**
This course will primarily present best methods of developing an accurate inventory for a local agency’s roadway or street system including utilities.
Examples, a group exercise, and a detailed how-to manual will be included. The manual will have spread sheets, databases, GIS info, and roadway capacity software. Asset management software sources and examples will be presented.

Target Audience:
N/A

Level: Intermediate
Type: Computer Training/Presentation
Duration: 1 Day (Between 5-8 hours)

**Asphalt Pavement Preservation**

Agenda:
- Pavement Preservation Concepts
- Introduction to HMA Pavements
- Pavement Distress Evaluation
- Distress Identification Exercise
- Maintenance & Rehabilitation Treatments: Practical Applications and Solutions – crack sealing, surface treatments, patching, micros and fabrics.
- M & R Treatments (cont’d) – Crack Sealing, Surface Treatments, Patching, Micros and Fabrics.

Goals and Objectives:
This workshop will address: basic performance characteristics of Hot- Mix Asphalt (HMA) pavements; evaluation of common distress types and their causes; and available maintenance and rehabilitation treatments (including the procedures for applying them properly). These topics and the benefits of Preventive Maintenance activities will be discussed in relation to the Pavement Preservation concept: applying ‘the right treatment to the right pavement at the right time’, in order to maximize service life and minimize long-term costs.

Target Audience:
The target audience would include local agency crew leaders/personnel, managers, engineers and others who are responsible for maintaining and preserving asphalt pavements.

Level: Intermediate
Type: N/A
Duration: 1 Day (Between 5-8 hours)

**Concrete Pavement Preservation**

Agenda:
- Pavement Preservation Concept
- Introduction to Concrete Pavements
- Pavement Distress Evaluation
Distress Identification Exercise

Maintenance & Rehabilitation Treatments – crack sealing; joint sealing; surface patching

M & R Treatments (cont’d) – partial & full-depth replacement; slab-jacking; retrofit dowel bars; diamond grinding; alternatives & selection of the right treatment

Goals and Objectives:
This workshop will address: basic performance characteristics of Portland Cement Concrete (PCC) pavements; evaluation of common distress types and their causes; and available maintenance and rehabilitation treatments (including the procedures for applying them properly). These topics and the benefits of Preventive Maintenance activities will be discussed in relation to the Pavement Preservation concept: applying ‘the right treatment to the right pavement at the right time’, in order to maximize service life and minimize long-term costs.

Target Audience:
The target audience would include local agency crew leaders/personnel, managers, engineers and others who are responsible for maintaining and preserving concrete pavements.

Level: Intermediate
Type: N/A
Duration: 1 Day (Between 5-8 hours)

Maintenance & Repair of Local Roads (Chip-Seal & Asphalt)

Agenda:
Roadway Materials and Identification, Handling and Applications
Chip Sealing: Procedures and Equipment
Asphalt Resurfacing/Overlay Projects
Surface Preparation
Asphalt Delivery
Asphalt Lay Down and Rolling
Roadway Repair Methods

Goals and Objectives:
This workshop will focus on chip-seal and asphalt roads at the local level. The basic principles and methods for constructing, maintaining and repairing these local roads will be addressed.

Target Audience:
The target audience would include public employees and officials who are responsible for maintaining local roads, including township and county personnel

Level: Intermediate
Type: N/A
Duration: 1 Day (Between 5-8 hours)

**Maintenance & Repair of Low Volume Local Roads (Gravel & Chip-Seal)**

*Agenda:*
- Introduction & Definition of Low Volume Roads
- Unpaved (Gravel) Roads
- Soil and Gravel Properties
- Motor Grader Operation Techniques
- Principles of Roadway Drainage
- Ditching & Surface Work
- Oils Used for Dust Control
- Simply Paved (Chip-Seal) Roads
- Preparation of Old Surface
- Use of Oils/Emulsions
- Installation and Specifications
- Inspection and Troubleshooting

*Goals and Objectives:*
This workshop will address the basic principles and methods for maintaining and repairing low volume local roads. The information will be presented in a straightforward, practical manner, focusing mainly on operational considerations.

*Target Audience:*
The target audience would include public employees and officials who are responsible for maintaining unpaved (Gravel) and simply paved (Chip-Seal) roads, including Township and County personnel.

*Level: Intermediate*
*Type: N/A*
*Duration: 1 Day (Between 5-8 hours)*

**Pavement Condition Rating (PCR)**

*Agenda:*
- Introduction to Pavement Management Systems/Pavement Condition Rating
- Elements of the Pavement Condition Rating process
- Road Inventory
- Distress Identification
- Procedure for Pavement Evaluation
- How to Collect the Data
- How to Calculate the Rating Score
- How to Use the Data
Analysis
Software Use
Reporting
Field Exercise (on local roads in the area)

Goals and Objectives:
This workshop will train and inform participants from local agencies on the methods used by the Ohio Department of Transportation to collect pavement condition ratings on Local roads and streets.

Target Audience:
The target audience would include persons responsible for evaluation or management of local roads and streets

Level: Intermediate
Type: Field/Computer Training
Duration: 1 Day (Between 5-8 hours)
Road Maintenance – Gravel Roads

Agenda:
- Importance of Pavement Crown and Drainage
- Solving Shoulder Problems
- What Makes Good Gravel
- How to Work with Gravel – Estimating, Handling and Spreading
- Repair of Weak Base and Subgrade
- Reshaping Gravel Roads

Goals and Objectives:
The workshop presents maintenance, repair and reconstruction options for local roads and streets and presents best practices for maintaining and improving drainage and extending pavement life.

Target Audience:
You will benefit from this workshop if you are responsible for maintaining local streets, roads and highways. Elected officials, engineers, superintendents, foremen, equipment operators and other field personnel responsible for road maintenance should attend.

Level: Intermediate
Type: Presentation
Duration: 1 Day (Between 5-8 hours)

Road Maintenance – Asphalt Road Maintenance and Geosynthetics

Agenda:
- Asphalt Road Basics
- Best Practices for Crack Sealing and Patching
- Surface Treatments Including Chip Seals, Slurry Seals and Micro-Surfacing
- Pavement Reclaiming
- Using Geosynthetics on Local Roads

Goals and Objectives:
The workshop presents maintenance, repair and reconstruction options for local roads and streets and presents best practices for maintaining and improving drainage and extending pavement life. To learn which maintenance techniques are best for particular pavement conditions.
**Target Audience:**
Elected officials, engineers, superintendents, foremen, equipment operators and other field personnel responsible for road maintenance should attend.

**Level:** Intermediate  
**Type:** Presentation  
**Duration:** 1 Day (Between 5-8 hours)

**Using PASER and WISLR to Manage Your Roads**

**Agenda:**
- What is Pavement Management?  
- Understanding WISLR  
- Rating Your Roads Using PASER  
- Using WISLR to Help Rate Your Roads  
- Using the WISLR Pavement Analysis Tools  
- Using the WISLR 5-Year Budget Planning Tool

**Goals and Objectives:**
- Rate the condition of the roads using PASER  
- Enter PASER ratings into WISLR  
- Use WISLR to print reports and maps that show road data  
- Use the WISLR pavement analysis and budget tools

**Target Audience:**
Local officials and their consultants who want to better manage their pavements by using PASER and WISLR, including those who: inspect and rate the pavements, evaluate what roads to maintain and rebuild, decide maintenance policies and programs, explain road maintenance policies and programs, and submit pavement ratings to DOT

**Level:** Intermediate  
**Type:** Presentation  
**Duration:** 1 Day (Between 5-8 hours)

**Pavement Surface Evaluation and Rating (PASER)**

**Agenda:**
- Asphalt Pavement Evaluation Using PASER  
- Concrete Pavement Evaluation Using PASER  
- Wisconsin DOT Inventory & WISLR Section Descriptions

**Goals and Objectives:**
The workshop introduces the PASER rating system for evaluating asphalt, gravel and sealcoat over gravel roads. It describes the PASER rating system and relates it to roads using slides showing typical pavement conditions and distresses. Each agency receives a copy of the Asphalt, Gravel and Sealcoat PASER Manuals to use in implementing the PASER pavement rating system.
Target Audience:
The target audience includes: commissioners, engineers, superintendents, foreperson, or other person responsible for completing the pavement evaluation using PASER.

Level: Intermediate
Type: Presentation
Duration: 1 Day (Between 5-8 hours)

Winter Road Maintenance
Agenda:
Safe Winter Driving
Winter Road Maintenance
Winter Operations
Winter Maintenance Equipment

Goals and Objectives:
The workshop offers practical information and procedures for snow and ice control on local roads. New plows and spreaders will be available for inspection at each workshop.

Target Audience:
The target audience would include: elected officials, street and highway superintendents, public works engineers, foremen, law enforcement personnel, and others with responsibilities for snow and ice control.

Level: Introductory
Type: Presentation
Duration: 1 Day (Between 5-8 hours)
Appendix D. Survey and Data Collection Timeline

April 1, 2006 - All LTAP Centers in the Region were contacted by fax with a request to schedule a teleconference meeting to discuss their local agency's PMS concerns.

April 14, 17, 18, 20 and 21, 2006 - Teleconference meetings were held with LTAP Centers and one local agency representative from each state on the Region to discuss local agency's PMS concerns. Collected information was used to build the web survey.

May 25, 2006 – Draft web survey is sent to the project advisory committee for comment.

June 12, 2006 – Notification sent to LTAP Centers in the Region requesting distribution of the survey to local agencies in their state.

June 12 to July 10, 2006 - The web survey was available through the Internet (www.supersurvey.com) for 29 days. Faxed/mailed responses were also accepted.

June 28, 2006 - First request sent to LTAP Centers in the Region to review titles and content of their Pavement Management related training.

February 5, 2007 - First request sent to software developers to review contact information and details of their systems.

March 8, 2008 – Follow up request sent to LTAP Centers in the Region to update training offerings review the Body of Knowledge Framework for their state.