

# MPC- 441

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**Project Title:**

Developing a Pavement Management System for Small Communities

**University:**

South Dakota State University

**Principal Investigators:**

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**Research Needs:**

Transportation infrastructure (such as road, bridges, bicycle path, and pedestrian walks) plays a big role in the city public works since it is directly related to community planning and public safety. There is an obvious need that an efficient management tool should be developed for resource allocating, decision making and long-range planning. Significant advances have been made during the last decade in developing infrastructure asset management systems. However, municipal cities have difficulties in implementing asset management systems for various reasons, including inadequate staff and limited usage of condition and inventory data, a lack of training, and others. A small city, for example, might have a limited budget for infrastructure maintenance and a shortage of manpower and technical resources. Therefore, research is needed to review the current practice on transportation asset management at county and municipal levels and provide useful recommendations to local government agencies.

Pavement management is a concept that involves the coordination, scheduling, and accomplishment of all activities performed by a highway agency in the process of providing adequate pavements for the public. The system approach to pavement management is a rational, highly structured process that attempts to achieve the best value possible for the public funds expended to provide pavements. Of course, management decisions are made each day in the course of normal operations of highway agencies. The purpose of a pavement management system (PMS) is to improve the efficiency of this decision-making process, expand its scope, provide feedback regarding the consequences of decisions and the results of activities, and ensure the consistency of decisions made at different levels within the same organization.

A major objective of a pavement management system (PMS) is to assist highway engineers in making consistent and cost-effective decisions related to maintenance and rehabilitation of pavement. The effective pavement management system comprises four distinct but interrelated

components: database, pavement rating system, prediction model, and ranking method for selection of annual maintenance and rehabilitation (M&R) program

### **Research Objectives:**

The goal of this project is to provide the City of Madison with a Pavement Management System that is capable to carry the following specific objectives:

- Build a city-wide PMS database from historic data and field survey
- Identify feasible pavement rehabilitation strategies for the City roads
- Recommend multi-year rehabilitation plans for different budget scenarios

### **Research Methods:**

The research methods include four fundamental elements: data collection, condition evaluation, performance modeling, and maintenance plan. Basic pavement inventory, condition, maintenance and cost information will be first collected. The condition survey will identify the type of distresses present on all pavement sections, and determine their severity and measure their quantities. Pavement performance family curves, maintenance strategies and costs will be developed based on the inventory and condition survey data. Network level analysis programs will be used to assign the various maintenance strategies to the pavement sections in the database, develop optimum budgets and prioritize the work. Particularly, multi-year, network-level budget analysis will provide answers to a number of "What If" questions that offer valuable insight needed to cost-effectively manage a large pavement network.

### **Expected Outcomes:**

This project is expected to develop a pavement management system capable to predict what will happen with the city roadway system, to manage the funds to maintain it, to anticipate changes in city system, and to clearly show the needs to boards, councils and taxpayers. The study will provide an illustration of how pavement management system can address the City's needs for pavement maintenance and rehabilitation and provide educational training. The results can be directly incorporated into the City's road improvement plan and have an immediate impact. The training will educate the city staff the concepts of inventory, condition assessment, performance modeling, and economic analysis, in the long-term, the concept of asset management system can be applied to all the city's assets including roads, bridges, traffic signals, lighting, storm and sanitary sewers, water distribution, and building facilities, etc.

### **Relevance to Strategic Goals:**

This project will directly benefit small communities by preserving their transportation infrastructure, i.e. pavement, in state of good repair with limited municipal budget. Timely and cost-effective maintenance, rehabilitation activities will extend the service life of highway and street pavement, help small communities to save money from pavement reconstructions for other infrastructure improvements and economic development.

### **Educational Benefits:**

This research project will involve graduate students and undergraduate students in inventory data collection, pavement performance evaluation and recommendation of maintenance plans. It will

provide first-hand research experience for students to master analytical techniques and practice their communication skills.

**Work Plan:**

The work plan is composed by the following eight tasks.

**Task 1:**     *Kickoff Meeting and Identification of Data Needs*

The research team will meet with City staff to discuss the expected capability of PMS and the technical specifications of PMS database including the inputs, outputs, analysis, and reports capabilities. The data needs in PMS and the available data sources in City of Madison will be identified, including road network inventory, historical data, previous pavement condition survey data, and others.

**Task 2:**     *Selection of Pavement Management Software*

In this task, the available PMS software will be compared in terms of features, capabilities, limitations, suitability for City of Madison network size, technical support, cost, and other aspects. The search will include, but not limited to, some software such as, MicroPAVER, CarteGraph, StreetSaver, and etc. Strong consideration will be given to systems which could utilize the City of Madison GIS system/database.

**Task 3:**     *Pavement Condition Survey and Evaluation*

The research team will collect pavement condition data through pavement condition survey. The pavement condition survey will start during the summer of 2014 for recording detailed pavement distresses in the whole city road network. It is expected that the survey will be assisted by City staff. Pavement Condition Index (PCI) will be used to generate the current pavement condition rating based on survey results.

**Task 4:**     *Pavement Performance Prediction*

The common practice of pavement performance prediction is to identify and group pavements having similar attributes (pavement structure, traffic, weather, and other factors), which are expected to have similar performance deterioration trends ("family" modeling). The historical data on pavement condition will be used to build a model that can accurately predict the future performance of a pavement family. If the historic data is not available, the performance models will be determined based on engineering judgment and common models for different pavement families.

**Task 5:**     *Identification of Rehabilitation Treatments*

This task will identify the maintenance and rehabilitation techniques, cost, specifications, etc. Maintenance and rehabilitation (M&R) alternatives will be grouped into a number of sequent activities for the selection of the most feasible M&R strategies. The cost of every maintenance and rehabilitation strategy will be estimated.

**Task 6:**     *Recommendation of Maintenance Plan*

In this task, the selected pavement management software will be used to assign various maintenance strategies to the pavement sections in the database, develop optimum budgets, and prioritize the work plan. The analysis will be conducted at

different budget scenarios to maintain the road network condition in the City at a desired level.

**Task 7: Final Report and Presentation**

This task will prepare a final report documenting the project results, findings, conclusions, and recommendations. The final report will be submitted to City of Madison for review and comments, and will then be revised to incorporate these comments. The research team will present the project findings and recommendations at the meeting to the City of Madison after submitting the final report.

**Task 8: Implementation and Training**

The research team will provide training and support to City staff on the implementation of the developed pavement management system. The project outcome will be also disseminated to the city staff related to public works management and city planning for better work coordination.

Project schedule is as follows:

Task	Quarter									
	1	2	3	4	5	6	7	8	9	10
Task 1: Kickoff Meeting										
Task 2: Selection of PMS Software										
Task 3: Pavement Condition Survey and Evaluation										
Task 4: Pavement Performance Modeling										
Task 5: Identification of Rehabilitation Treatments										
Task 6: Recommendation of Maintenance Plan										
Task 7: Final Report and Presentation										
Task 8: Implementation and Training										

**Project Cost:**

Total Project Costs: \$85,000

MPC Funds Requested: \$33,861

Matching Funds: \$51139

Source of Matching Funds: City of Madison, SD

**TRB Keywords:** Pavement Management System, Condition Evaluation, Performance Modeling