THEME 1
PROBLEM STATEMENTS

Theme 1 – Use of Existing Technology and Tools
Problem statements in theme 1 include recommendations for technology and tools that can support traditional pavement management applications. In general, this theme includes technology and tools that are currently available today, but are in need of additional review, analysis, and/or updating prior to their implementation.

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Best Practices for Pavement Management

II. RESEARCH PROBLEM STATEMENT
There is a significant need to assemble and prepare a best practices document for the operational and functional aspects of pavement management. This guide will build upon the existing AASHTO *Pavement Management Guide* and include a broad range of topics that include (but are not limited to):

- **Asset Management Principles.** Asset management and pavement management procedures and benefits.
- **Referencing Systems**. Establishing and maintaining linear referencing system, merging several linear referencing methods into a single system, and addressing alignment and boundary changes.
- **Data Collection**. Type and extent of data; data collection procedures; data collection frequency; sampling rates; data needed for network-level, project-level, forensic investigations, and research; quality control/quality assurance procedures; equipment types and capabilities; equipment specifications; and equipment certification.
- **Data Storage and Integration.** Storage requirements, needed costs, maintenance issues related to storage, storage needs and formats to maximum integration, communication, data links, and technology/system availability.
- **Data Analysis.** Procedures and processes for analyzing data to meet agency needs.
- **Performance Modeling.** What level of detail is needed (both in data collection and model development), describe when model updates are necessary (e.g., due to improvements in measurement accuracy and changes in design principles, materials, or construction practices), quantify the impacts of measurement accuracy (e.g., windshield, automated, or semi-automated), how to conduct a sensitivity analysis on the model inputs and resulting performance prediction, catalog of available performance prediction models, and how to develop, calibrate/validate, implement, and maintain prediction models.
- **Treatment Selection.** Pavement preservation and rehabilitation treatments, benefits, and limitations.
- **Presenting and Communicating Results.** Discuss recommendations for presenting pavement management results and methodologies used for communicating pavement management data to stakeholders.
- **Supporting Agency Decisions.** Use of pavement management information to support planning activities (e.g., STIP and strategic planning), allocate resources, linking network and project-level treatment recommendations, identify organizational components that lead to successful pavement management, and provide recommendations for addressing barriers to the use of pavement management and improving agency business processes that are needed to support pavement management.

- **New Technologies.** Methodologies and procedures for evaluating and implementing emerging technologies, and coordination with and considering IT capabilities.

Tasks: The research will include the following tasks:
1. Literature search (domestic and international) on pavement management procedures and practices.
2. Develop detailed outline.
3. Develop pavement management best practices.

Final Product:
The final product of the research is a best practice guide for pavement management. Not only will this be a reference for all things related to pavement management, but it will also act as a "desk guide" for practitioners. To enhance access and implementation, it is envisioned that this guide will be developed and available through an electronic web-based format.

III. RESEARCH OBJECTIVE
The objective of this research is to provide a best practices guide for pavement management for reference, use, promotion, and to further the implementation of pavement management procedures.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $500,000
Estimated Project Duration: 36 months

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Development of Pavement Distress Standards

II. RESEARCH PROBLEM STATEMENT
Pavement distresses are defined, measured, and categorized differently between many state highway agencies (possibly excluding IRI). Pavement condition standards would assist in improving data quality checks for comparing performance measures, and provide guidance to equipment manufacturers and data collection service providers. AASHTO has established a number of distress protocols, but the widespread use of these protocols is uncertain. This study will identify distress to be measured, review current state practice, compare state procedures to current AASHTO protocols, identify areas not currently covered by an AASHTO protocol, develop preliminary protocols, conduct webinars or workshops to obtain state buy-in, and finalize protocol for AASHTO balloting.

Tasks: The research will include the following tasks:

1. Survey and review current state highway agency (SHA) practices regarding pavement condition standards utilized.
2. Compare SHA pavement condition standards relative to AASHTO distress protocols.
3. Identify gaps in AASHTO protocols and draft provisional standard accordingly.
4. Develop guidelines for getting the most out of contracted pavement management systems.

Final Product:
The final product of the research is a set of provisional AASHTO standards addressing SHA's needs regarding distress identification and measurement.

III. RESEARCH OBJECTIVE
The primary objective of this research is to better address SHA's needs from standardized pavement condition protocols.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $350,000
Estimated Project Duration: 24 months

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Development of Improved Methodologies for Evaluating Data Quality

II. RESEARCH PROBLEM STATEMENT
Pavement management recommendations are impacted by the quality of the data collected. Most agencies have recognized this issue but struggle with the lack of sophisticated methodologies to effectively and efficiently evaluate data quality and the resulting impact on pavement management decisions. The objective of this study is to develop a standard methodology that can be applied to a wide range of pavement condition data to assess quality in terms of accuracy and repeatability. The study will also demonstrate the use of the results to establish data collection guidelines (to specify required levels of accuracy) and to evaluate the impact of variability on pavement management recommendations.

Tasks: The research will include the following tasks:

1. Identify and evaluate quality control/quality assurance procedures for various pavement management data collection practices.
2. Define viable methodologies based on data precision and repeatability, collection efficiency, and cost effectiveness.
3. Develop guidelines so that an agency can apply viable methodologies into its pavement management system practices.

Final Product:
The final product of the research is development of guidelines to improve data quality in terms of collection, processing, and reporting.

III. RESEARCH OBJECTIVE
There are two specific objectives for this research. First, the research will develop standard quality control/quality assurance criteria for pavement management data collection practices. The second objective will determine how to incorporate QC/QA practices into pavement management systems.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $350,000
Estimated Project Duration: 24 months

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Establish and Develop Equipment Calibration Centers and Guidelines

II. RESEARCH PROBLEM STATEMENT
National calibration centers or well-established protocols or guidelines for calibrating profile, texture, noise, or ground penetrating radar (GPR) data collection are either limited or nonexistent. Strategically located calibration centers would allow for large-scale consistency in data collection and greatly improve reliability of data comparisons between equipment types and vehicles. This study will identify potential calibration sites (strategic locations and resources for establishment, maintenance, and operation), recommended equipment calibration frequencies, equipment calibration procedures, and precision and bias requirements. In the area of calibration centers, this study should reference the work and efforts developed for the FWD calibration centers.

Tasks: The research will include the following tasks:

1. Survey practitioners regarding current quality assurance/equipment calibration procedures.
2. Conduct sample size analyses to recommend how many test sections/regional test sites should be established.
3. Determine details of equipment calibration, operator certification, and amount of data to collect and review.
4. Develop practices/guidelines/specifications for equipment calibration and operator certification.

Final Product:
The final product of the research is identifying the location of regional calibration centers, calibration procedures for data collection equipment, and an operator certification program.

III. RESEARCH OBJECTIVE
There are two specific objectives for the research. First, the research will provide a synthesis of current quality assurance/equipment calibration procedures being used by practitioners in regards their data collection equipment. The second objective is establishing an equipment calibration and operator certification/training program.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $250,000
Estimated Project Duration: 12 months

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Comprehensive Study to Guide the Integration of Pavement Preservation and Pavement Management

II. RESEARCH PROBLEM STATEMENT
In most agencies, pavement management data collection and analysis tools were established before pavement preservation techniques were extensively used. As a result, the data that is currently collected and the project selection processes are not necessarily easily modified to include preventive maintenance treatments. However, the importance of tracking pavement preservation treatments is critical to predicting pavement performance, identifying needs, and establishing budgets. In addition, data related to pavement preservation treatments (e.g., pavement condition prior to treatment application, treatment type and thickness, and, if applicable, material type) is critical for developing performance prediction models for preservation treatments.

Tasks: The research will include the following tasks:

1. Conduct a survey of state agencies regarding best practices for integrating pavement preservation into pavement management.
2. Identify data needed to support the integration of pavement preservation into pavement management.
3. Identify levels of integration, including cost and benefits associated with each level.
4. Develop guidelines for integrating preventive maintenance into pavement management according to each level.

Final Product:
The final product of the research is guidelines for adapting pavement management systems to fully support pavement preservation activities.

III. RESEARCH OBJECTIVE
There are three specific objectives for the research. First, the research will develop a synthesis of best practices regarding how agencies integrate preventive maintenance into pavement management, identifying successful case studies and lessons learned. The second objective is to define basic levels of integration according to the state of the practice in terms of both preventive maintenance activities and pavement management practices at an agency. The final research objective is to develop guidelines that transportation agencies can use to begin integrating their preventive maintenance and pavement preservation activities.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $350,000
Estimated Project Duration: 24 months

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Independent Technical Assessments of Pavement Management

II. RESEARCH PROBLEM STATEMENT
The Federal Highway Association (FHWA) is a strong supporter of pavement management tools in SHAs, but the use of these tools is optional. Furthermore, there are diverse approaches being used for data collection, reporting, and analysis within those agencies using pavement management. There is also a lack of established appraisal methods for determining whether pavement management practices comply with "good practice." At the same time, agencies are facing funding constraints that limit the resources available to support pavement management.

Tasks: The research will include the following tasks:

1. Identify baseline capabilities for pavement management.
2. Survey SHAs regarding their pavement management system practices. Determine whether the baseline capabilities are being met, and if not, how any deficiencies can be addressed.
3. Develop a framework for assessing pavement management practices, including development of means to assess risk associated with specific pavement management practices relative to best practices, and recommend funding needs to address pavement management deficiencies.

Final Product:
The final product of the research is a framework for assessing pavement management practices according to an agency's activities relative to best practices.

III. RESEARCH OBJECTIVE
The primary objective of this research is to develop a means of assessing an agency's pavement management practices relative to best practices, including assessing the risk associated with specific practices so as to communicate need for improvement where applicable.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $250,000
Estimated Project Duration: 12 months

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Pavement Management Clearinghouse

II. RESEARCH PROBLEM STATEMENT
Technology advances in pavement distress data collection are often difficult to for an agency to monitor, evaluate, and determine implementation appropriateness. In addition, there are many resources that are of value to pavement management practitioners, but a great deal of time can be spent trying to locate the information. It would also be beneficial for transportation agencies to have a readily available list of local, regional, and national contractors and their capability of constructing the vast array of pavement preservation and rehabilitation treatments. In this manner, an agency looking to apply a specific treatment (e.g., microsurfacing or hot in-place recycling) can access a web-based clearinghouse to determine contractor capabilities. A centralized repository of equipment availability, technology advancements, resources, and contractor availability and capability is necessary.

Tasks: The research will include the following tasks:

1. Survey SHAs, equipment suppliers, and contractors regarding distress data collection equipment, contractors/supplier capabilities, and prequalification procedures.
2. Prepare a synthesis of available data collection equipment and qualified contractors.
3. Survey equipment suppliers regarding equipment capabilities for accurately measuring pavement distress.
4. Survey qualified contractors regarding capabilities specific to common pavement preservation/rehabilitation treatments.
5. Develop an online database of contractors and capabilities, allowing for a sort of vetting process for new additions.

Final Product:
The research will result in the development of an online database of equipment suppliers and treatment contractor capabilities, allowing for a sort of vetting process for new additions.

III. RESEARCH OBJECTIVE
The primary objective of this research is to develop a central resource for SHAs regarding availability of pavement condition equipment and qualified contractors in relation to their capabilities specific to pavement preservation/rehabilitation applications.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $100,000
Estimated Project Duration: 12 months

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Synthesis of External Issues Driving Pavement Management

II. RESEARCH PROBLEM STATEMENT
There are many factors that impact pavement management that are beyond the control of agency staff or administrators. With changes in available transportation funds, agencies have to adapt to new approaches for funding, contracting, and/or project acceptance. These external forces have undoubtedly influenced pavement management needs and priorities.

Tasks: The research will include the following tasks:

1. Conduct a survey of pavement management practitioners to determine what factors have impacted pavement management practices, as well as if and how these factors have been addressed.
2. Identify SHAs to be case studies in a more detailed assessment.
3. Develop a synthesis of findings.

Final Product:
The final product of the research is development of a synthesis of factors that impact pavement management practices, including case studies that demonstrate how state agencies have been able to address these impacts.

III. RESEARCH OBJECTIVE
Research objectives include identification of factors that impact pavement management practices at various levels (e.g., municipal, county, and state), and identification of how, and how well, these impacts are being addressed by practitioners.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $30,000
Estimated Project Duration: 9 months

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Methods of Defining and Calculating the Effect of Pavement Preservation Treatments on Pavement Life

II. RESEARCH PROBLEM STATEMENT
There is little information available to assist pavement managers with quantifying the effect of pavement preservation treatments on pavement life. This is especially true in light of the fact that the same treatment can be used in a preventive manner or as a stop-gap treatment. The extent of existing pavement distress, traffic level, climatic condition, treatment type, materials, and other factors can significantly impact treatment performance.

Tasks: The research will include the following tasks:

1. Conduct a survey of state of the practice regarding quantifying pavement preservation impacts on pavement life.
2. Identify roadway sections that have historical data concerning pretreatment conditions (e.g., pavement condition, pavement structure, and traffic levels), as well as construction and condition information regarding treatment type.
3. Develop pavement condition performance according to existing condition, treatment type, climate, traffic levels, and other factors.
4. Prepare a report detailing treatment performance.

Final Product:
The final product of this research will be a report documenting research findings.

III. RESEARCH OBJECTIVE
The research will quantify the impacts that pavement preservation treatments have on pavement performance, using measured field data from various geographic regions of the country.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $500,000
Estimated Project Duration: 36 months

RESEARCH PROBLEM STATEMENT

I. PROBLEM TITLE
Investigation into the Risk, Uncertainty, and Variability in Pavement Management Decisions

II. RESEARCH PROBLEM STATEMENT
Pavement management systems are based on collected data (e.g., condition data, traffic data, existing layer types and thickness, and past preservation and rehabilitation treatments) that have the potential for associated errors. The analysis methods themselves are conducted using performance models that also have an associated error. Yet results of these analyses do not usually estimate the errors associated with data collection and performance prediction. The impact (or risk) associated with errors in the data collection and performance prediction processes are not well quantified. Procedures are needed to help agencies determine the amount of data needed to provide credible recommendations and to determine what level of risk (or uncertainty) is considered acceptable, in an attempt to improve levels of accountability and confidence in the performance prediction outputs from the pavement management system.

Tasks: The research will include the following tasks:

1. Identify the critical pavement management system outputs (e.g., network condition, program recommendations, and so on) that impact performance prediction.
2. Determine data and analysis needs to improve performance prediction. Identify the associated risk based on data availability and steps needed to reduce the potential of data error.
3. Develop guidelines for data collection needs and analysis for improving performance prediction.
4. Develop software tools to assess errors in the data collection and analysis procedures.

Final Product:
The final product of the research includes guidelines and software tools for assessing data quality and improving the reliability of pavement management outputs and recommendations.

III. RESEARCH OBJECTIVE
The objective of this research is to investigate the various forms of variability affecting pavement management recommendations and to develop a process for evaluating this impact and the overall effectiveness of pavement management recommendations.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Budget: $350,000
Estimated Project Duration: 24 months