Integrating Pavement Preservation into Pavement Management Systems

Dr Roger E. Smith, P.E.
Dept. of Civil Engineering &
Texas Transportation Institute
Texas A&M University
Pavement Management is a Decision Making Process

- Find cost-effective treatments
- At designated times
- Give a desired level of service
Pavement Preservation Goals

- Preserve investment in pavements
- Enhance pavement performance
- Extend pavement life
- Meet customer needs
Pavement Preservation Concepts

- **Apply:**
  - the right treatment
  - to the right pavement
  - at the right time

- **Dedicate funds to preventive maintenance**
- **Gain long-term benefits**
- **Specific approach to pavement management**
Preventive Maintenance

- **Treatment applied**
  - To preserve the existing structure
  - To retard deterioration

- **Primarily prevents environmental caused deterioration**

- **PM Treatments**
  - Applied before major structural damage
  - Relatively inexpensive
  - Results long term
Network-Level PMS Elements

- Inventory
- Assess Condition
- Determine Needed Work & Funds
- Prioritize Candidate Projects
- Show Impacts of Alternatives
- Feedback

To Incorporate PPP Into PMS

- Each of the first five elements must be designed to address PPP
Needs Analysis

- Identify Sections Needing Work
  - Treatment Selection
  - Condition Prediction

- Estimate Funds Needed
  - Cost Estimates
Incorporating PPP in Needs Analysis

- Ability to select treatments
  - Most systems adequate for rehab
  - Need to identify appropriate sections for PM
  - Need to assign “best” or “right” treatments

- Many current condition assessment methods are not adequate to identify segments needing preventive maintenance
Condition To Identify Need for PM

- Generally need distress information

- Distress surveys MUST include
  - Type - What Is Wrong
  - Severity - How Bad
  - Density - How Much

- Windshield & driving surveys DO NOT identify the low severity distresses that indicate need for PM
Options

- Conduct distress survey on entire system that will identify segments that need PM

- Conduct distress survey on entire system that will identify segments for which PM is not appropriate – those that need rehab
  - Those not needing rehab are PM candidates
  - Complete more detailed analysis of PM candidates
Assign Treatment Based on Condition Assessment of Entire Network

- Low to Moderate W&R
- Low to Moderate L&T Crack
- Need Rehab

Seal Coat

Seal Cracks & Seal Coat

AC Moderate Traffic

Rehab Analysis
Identify PM Candidates

Preventive Maintenance
Light Rehabilitation
Heavy Rehabilitation
Reconstruction
Office Checks

- Check PM candidates sections for
  - Time since last treatment
  - Traffic levels
  - Other items considered important

- Final list of PM candidates
Future Needs

- Predict future work needed

- Need prediction models for
  - Rrehabilitation
    » and
  - PM
Projected Condition for Rehabilitation Treatments

CI

ESAL’s
Condition Prediction

- Many of the PM treatments not included in structural analysis & design
- They preserve the existing pavement – they do not add structural capacity
- Generally must use age instead of ESAL’s/traffic loadings
  - Loadings affect rate of deterioration
Ability to Predict Damage Appropriate for PM

- **W&R**
  - Seal Coat
  - Age

- **L&T Crack**
  - Seal Cracks
  - Age
Predict Repeated PM – With & Without Treatment

W&R

Age

Seal Coat

L&T Crack

Age

Seal Cracks
Predict PM Treatments for Candidates

AGE

PCI

7 Years

7 Years

7 Years

Minimum Acceptable

AGE

FP²
Network-Level Inventory (Data)

- Critical data for PM to support PPP
  - Date of construction
  - Layer information
  - Date & type of subsequent treatments - especially PM treatments
Prioritize Projects Needing Work

- Produce prioritized list of sections agency should consider funding

- Consider effect of available funds

- Goal - best pavement network over analysis period for available funds
Incorporating PP in Prioritization

- MUST look long-term
  - 20 years or more (30+ for PCC)
- Models must include impacts of PM
  - Generally time based
- Worst-First will not work
  - Adjusting for usage will not help
- Provide an approach where PM funding can be controlled
Must Know Costs and Some Estimate of Return on $’s Spent

CI

AGE

$14.00

$4.50

$1.20

$0.70
Economic Approaches

- Present value of treatment strategies
- Present value of total costs
  - Including vehicle operating and other user costs
Weighted Cost-Effectiveness Ratio = \( \frac{\text{AREA} / \text{SR}}{\text{EUAC} / \text{SY}} \times \text{WF} \)
Weighted Cost- Remaining Life Ratio

$\frac{EUAC}{SY} \times WF$

Minimum Acceptable Condition

Remaining Life WO Tmt

Remaining Life W Tmt

Weighted Cost-Life Ratio

$\frac{LIFE}{EUAC / SY} \times WF$
Impact Analysis

- Show impacts of alternatives
  - Different funding levels
  - Different allocation of funds
    - all rehab vs
    - rehab and PM

- Use several impacts
  - Condition alone generally not adequate
Compare Results - Future PCI

PCI

- Poor
- Good

Current Status
PM & Rehab-60%
Rehab Only-60%
Compare Projected Remaining Life

<table>
<thead>
<tr>
<th>Remaining Life</th>
<th>Poor</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM &amp; Rehab-60%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehab Only-60%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Deferred or Back-Logged

- Deferred Fund Needs
  - Needs Minus Spend

- Back-logged
  - Sections That Needed Work That Was Not Recommended
Backlogged Work Needs

% of Network Backlogged over the years from 2002 to 2012, showing the trend of Current Fund, Reduced Fund, and Increased Fund.
Pavement Management Is a Decision Making Process

- Find Cost-effective Treatments
- At Designated Times
- Give a Desired Level of Service
Pavement Preservation Principles

- It Costs the Maintaining Agencies Less to Have Good Roads Than Bad Roads

- Providing:
  - Reasonable Level of Service Provided
  - Pavements Will Respond to Preventive Maintenance
    » Structurally Adequate
Need Balance

- Keep Better Pavements in Good Condition
  - Preventive Maintenance

- Repair Those That Are Deficient
  - Rehabilitation or Reconstruction
Summary

- PP can/should be included in PMS philosophy
- PM can/should be in network-level PMS
- Must have the following:
  - Appropriate inventory data - dates & treatments
  - Appropriate distress types & severity levels
  - Method to identify PM candidates & tmt needs
  - Prioritization approach that considers PM treatments
  - Impact analysis that shows impact of PM over time