Promoting the Use of Pavement Management Through Cost Analyses

Katie Zimmerman, P.E.
Applied Pavement Technology, Inc.
KZimmerman@pavementsolutions.com
Factors Influencing the Use of Pavement Management - Past

- Technology Changes
- Policies/Guidelines/Legislation
  - AASHTO Guidelines
  - FHWA Policy
  - ISTEA
Factors Influencing the Use of Pavement Management - Present

- Retirement of Trained Personnel
- Lack of “Push”
- Focus on Asset Management
It’s time to get back into the business of promoting Pavement Management …

… as a way of doing business that makes “cents”…

…and cost analysis tools can help us accomplish this.
Cost Analysis Tools Used and Supported by Pavement Management

- Equivalent Annual Cost
- Benefit Cost Analysis
- Reduction in Life Cycle Costs
- Maintenance Cost Effectiveness Evaluation
- Cost Evaluations to Achieve Agency Goals
- Impact Analysis Results
Analysis Type 1: Equivalent Annual Cost

- Evaluate the cost associated with a given pavement strategy on an annual basis
- Needs
  - Total costs
  - Years of service
Equivalent Annual Cost Example

- **Strategy 1: Overlay**
  - Expected Cost: $200,000
  - Expected Life: 10 years

\[
EAC = \frac{\$200,000}{10 \text{ years}} = \$20,000/\text{year}
\]
Equivalent Annual Cost Example (cont.)

- Strategy 2: Overlay followed by Seal Coat in year 9
  - Expected Cost: $200,000 + $77,500
  - Expected Life: 15 years

\[
EAC = \frac{\$277,500}{15 \text{ years}} = \$18,500/\text{year}
\]
<table>
<thead>
<tr>
<th>Strategy</th>
<th>EAC ($/year)</th>
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<tbody>
<tr>
<td>Strategy 1: Overlay</td>
<td>$20,000</td>
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<tr>
<td>Strategy 2: Overlay with Slurry Seal</td>
<td>$18,500</td>
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Note: This analysis ignores the time value of money

Extrapolated over the entire network, an agency can realize large savings by reducing the annual cost of preservation.
Analysis Type 2: Benefit Cost

- Similar to the type of analysis conducted in most pavement management systems
- The application of a treatment results in a “benefit”
- Each treatment also has a cost
- The treatment with the highest benefit cost ratio provides the best bang for the buck
Which Is Better For the Agency?

- Scenario 1: Let a pavement continue to deteriorate for several years before applying an overlay.
- Scenario 2: Apply a series of 3 preventive maintenance treatments beginning immediately.
Comparison of Alternatives

Condition vs. Benefit over Time

Analysis Point

Cost: $$$

Cost: $$$
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<tr>
<th>Strategy</th>
<th>Benefit (condition*age)</th>
<th>Cost, $M</th>
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<tr>
<td>Rehabilitation</td>
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<td>Preventive Maint.</td>
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Rehab Strategy: \[
\frac{B/C}{3.5} = \frac{1000}{3.5} = 286
\]

PM Strategy: \[
\frac{B/C}{0.5} = \frac{250}{0.5} = 500
\]
Analysis Type 3: Reduction in Life Cycle Costs

- By reducing the life cycle cost associated with each road, we can reduce the costs associated with the preservation of the system.
- Life cycle costing allows you to consider all costs in an analysis period on an equivalent basis.
- Pavement management can help establish the treatment strategies and treatment timing.
Define Cost Streams
Strategy A

Cost Stream Summary
- Initial Construction = $400,000 (yr 0)
- Treatment 1 = $80,000 (yrs 8 & 16)
- Routine Maintenance = $500/yr (yrs 1-19)
- Salvage Value = $(4/8) * $80,000 = $40,000 (yr 20)
Define Cost Streams
Strategy B

Cost Stream Summary
Initial Construction = $400,000 (yr 0)
Treatments = $12,000 (yrs 4, 8, 12, & 16)
Routine Maintenance = $800/yr (yrs 1-19)
Salvage Value = $0
PW (initial) = $400,000
PW (routine maint.) = $6,567
PW (treatment 1) = $58,455
PW (treatment 2) = $42,713
PW (salvage value) = $-18,255
Total PW = $489,480

Discount Rate = 4%, Analysis Period = 20 yrs
Compute Costs
Strategy B

PW (initial) = $ 400,000
PW (routine maint.) = $ 10,507
PW (all 4 applications) = $ 32,928
PW (salvage value) = $ 0

Total PW = $ 443,435

Discount Rate = 4%, Analysis Period = 20 yrs
Strategy B reduces the life cycle cost associated with the maintenance of the facility approximately $2,302/per year. Across an entire network, the cumulative effect can be dramatic.
Analysis Type 4: Maintenance Cost Effectiveness Evaluations

Rehabilitation Costs

Maintenance Costs

Point at which maintenance is no longer cost effective
• Agencies are establishing performance standards
  – Michigan: 95% of the expressways and 85% of the trunk highways in good to fair condition within 10 years
  – Is this achievable without increasing funds? If not, how much more money is needed?
Achieving the Goal

Pavement Conditions

Targeted Conditions

Average Network Conditions

Additional Funds Needed (millions)

$0    $200    $400    $600    $800    $1,000
Most common use of pavement management systems

Allows an agency to compare various rehabilitation strategies to determine the most effective approach to pavement preservation
Example of Impact Analysis

- Small agency with a total of 80 miles of roads
- 20 miles are in each of the 4 condition categories (Excellent, Good, Fair, Poor)
- 20% of the network deteriorates to the next condition level each year
- It costs $100 to repair a road in poor condition
- It costs $25 to repair a road in fair condition
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Ttl Year 3
Comparison of Results in Year 3

Percent of Network

61%
50%

Worst First
Alternate Strategy
NC Simulation

• Impact Analysis
  – 1000 mile example
  – Conditions distributed based on actual data
  – Compared worst first to a strategy with pavement preservation
  – Resurfaced 50 miles per year in the worst first scenario (poor roads)
  – Fixed 100 miles of roads in fair condition in the preservation scenario
NC Simulation

Average Network Conditions

![Graph showing average network conditions over years with lines for WF and Preservation.]
Pavement management systems are a valuable tool to help manage facilities effectively.

The capabilities of a pavement management system need to be better used to demonstrate the effectiveness of our programs.

Cost analysis tools can be used to demonstrate cost-effectiveness.

Pavement Management Makes Cents!