Doing more with less: economically-efficient management of pavement networks

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Asset management allocation tools are critical to economically-efficient infrastructure

Solutions to Raise the Grade

Fix the federal Highway Trust Fund by raising the federal motor fuels tax, and explore alternative, long-term funding mechanisms.

Increase investment at all levels of government to reduce the backlog of rehabilitation needs.

Use asset management best practices to prioritize projects and improve the condition, security, and safety of assets while minimizing costs over its entire life span.
FHWA has issued new performance management rules due to MAP-21

FHWA motivation for performance management:

• Provide the **most efficient investment** of Federal transportation funds
• Refocus on **national transportation goals**
• Increase **accountability and transparency**
• **Improve decision-making** through performance-based planning and programming
Pavement network performance management process

Set targets

Measure performance

Implement strategies to meet targets

% Good
% Poor

Pavement Management System

Which strategies?
At what cost?

How to allocate funds to obtain best performance at lowest cost?
Many approaches to allocate funds

<table>
<thead>
<tr>
<th>Pavement Segment</th>
<th>Pavement Condition Index</th>
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<tbody>
<tr>
<td>A</td>
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<td>B</td>
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<td>C</td>
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<td>F</td>
<td>62</td>
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<td>G</td>
<td>67</td>
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• How to prioritize which segments to repair?
• Will targets be met?
• Which strategies should be used?
  • Many short term fixes?
  • Few long-term fixes?

An optimization modeling approach is required to answer these questions: Performance-Based Planning
Goal of MIT asset management research: improve allocation decisions

Key elements of pavement management systems for performance-based planning

**Objective:** prioritize projects that maximize performance and minimize cost

- **Current & historical pavement network data**
- **Projection of network performance**
- **Allocation of resources**

**Key Considerations**

- Analysis period
- Available maintenance, rehabilitation, and reconstruction activities
- Uncertainty in prices and deterioration
- Optimization algorithm
- Optimization metrics
- Scale of network
### Key elements of the MIT allocation model

<table>
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<th>Key Considerations</th>
<th>Conventional models</th>
<th>MIT model</th>
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<td>Analysis Period</td>
<td>Short analysis periods (~5 yr)</td>
<td>Long analysis period (20+ yr)</td>
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<tr>
<td>Available MRR activities</td>
<td>Prescriptive decision rules for limited MRR alternatives</td>
<td>Dynamic decision rules for diverse set of MRR alternatives</td>
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<td>Uncertainty in prices &amp; deterioration</td>
<td>Deterministic data &amp; analysis</td>
<td>Risk analysis including uncertainty</td>
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Example with VA interstate network

Expected roadway expenditures over 50 year analysis period

Budget=$67m/yr

MRR activities including concrete overlays

Objective: minimize traffic-weighted roughness

Low expenditures per unit area
Medium expenditures per unit area
High expenditures per unit area
Allocation strategy diversifies after 50 years

Current Composition of System

- AC
- PCC

Expected Composition in Year 50

- AC
- PCC

Fixed budget ($67m)
Diversity of MRR alternatives is a means to enhance network performance

Single material network performs worse than a diversified network

Key Considerations:
- Analysis period
- Available maintenance, rehabilitation, and reconstruction activities
- Uncertainty in prices and deterioration

($67m budget for scenarios)
Longer analysis period improves network performance

Analysis period influences mix of fixes
Key considerations for performance-based planning

Analysis period

• Explore impacts of longer segment and network analysis periods

Cost and deterioration data

• Include uncertainty
  • Evaluate data pedigree (time period and source of training data)

MRR alternatives

• Include concrete overlays
Thank you

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