Next-Generation Pavement Performance Measures

Prashant Ram
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“Engineers are not entertaining. That’s not a thing the last time I checked.”

– Tracy Nowaczyk

Let’s prove her wrong over the next two days!

(or may be not)
Pavement Management Systems: The Impetus

Fred Finn
Karl Pister
Ron Hudson
Ralph Haas

Images stolen from Dr. Carl Monismith's presentation (2011)
## Humans and Pavement Management Systems

<table>
<thead>
<tr>
<th>Human Being Generations</th>
<th>PMS Generations</th>
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<tbody>
<tr>
<td>Traditionalists or Silent: b. 1945 &amp; before</td>
<td>1\textsuperscript{st} Gen – Databases</td>
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<tr>
<td>Baby Boomers: b. 1946-1964</td>
<td>2\textsuperscript{nd} Gen – Databases with heuristic decision tree, single period B-C analysis</td>
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<td>Gen X: b. 1965-1976</td>
<td>3\textsuperscript{rd} Gen – Arizona, 1982, Multi-Year optimization, decision trees, Markov models</td>
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<td>Millenials: b. 1977- 1995</td>
<td>4\textsuperscript{th} Gen – Web-based, enhanced optimization algorithms, GIS capabilities</td>
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<tr>
<td>Gen Z/iGen/Centennials: b. 1996-TBD</td>
<td>5\textsuperscript{th} Gen – Cross-asset trade-off analysis capabilities</td>
</tr>
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</table>
We’ve Come a Long Way but... The Best is Yet to Come!

Micro PAVER Version 1.0

ENTER OPTION: [ ]

(1) Data Entry & Modifications
(2) Database Related Reports
(3) Data Analysis Programs
(4) Database Administration
(5) System Utility
(6) Exit Micro PAVER

1986
Why? What? How?

• Why “cross-asset”?
  • Cannot operate in silos anymore

• What do you need?
  • Data!
  • Performance measures
  • Financials

• How do you do it?
  • Mature management systems
  • Analysis tools
Performance Measures

• Forward-looking
• Action-oriented
• Intuitive
• Verifiable
• Adaptable
• Easily Implementable

Are we making sound long-term decisions?
Life-Cycle Performance Measures
Consider Whole Life of Assets

- Consider longer analysis periods
- Use performance measures to monitor:
  - Asset Condition
  - Life-Cycle Efficiency
  - Financial Sustainability
  - Other Factors
    - Safety
    - Mobility
• Determine the lowest practical life-cycle cost strategy
• Traditional LCCA: treatment type/timing are inputs
• RSI Analysis: treatment type/timing are outputs
Remaining Service Interval (RSI) [2/2]

• Optimal Strategy: Lowest-life-cycle cost
• Sub-optimal Strategies: Higher overall life-cycle costs; may have lower costs for shorter “planning periods”
  • Useful in a fiscally-constrained analysis
• How to choose the best strategy?
  • Prioritize based on “best value” for available budget
  • Combination of optimal and sub-optimal strategies, considering each segment in the network
Life-Cycle Measures

- Life-Cycle Cost
  - Net Present Value (NPV)
  - Annualized Cost per Lane-Mile
- Cost Accrual Ratio: Compare NPV of costs incurred to date/projected vs. NPV of lowest-life cycle cost strategy

Sadasivam and Mallela (2016)
Financial Performance Measures

ONE MILLION DOLLARS!
It’s All About the Money!

• Are we investing adequately?
• Is our plan financially sustainable?

“Share it fairly but don’t take a slice of my pie”
-Roger Waters on funding allocation issues
b/w pavements and bridges

Fan: “Steffi, will you marry me?”
Ms. Graf: “How much money do you have?”
-1996 Wimbledon Ladies Semi-Final
Asset Sustainability Index

Asset Sustainability Index (ASI) = \frac{\text{Amount Budgeted}}{\text{AmountNeeded}}

- “Amount Budgeted” comes from agency’s financial planning process
- “Amount Needed” based on lowest life-cycle cost approach

FHWA (2012)

<table>
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Asset Sustainability Ratio

Asset Sustainability Ratio (ASR) = \( \frac{\text{Asset Renewal or Replacement Expenditure}}{\text{Asset Value Depreciation}} \)

• Are assets being renewed or replaced at the rate at which they are deteriorating?

Asset Consumption Ratio

\[ \text{Asset Consumption Ratio (ACR)} = \frac{\text{Depreciated Replacement Cost}}{\text{Current Replacement Cost}} \]

• What is the average proportion of as-built (or as new) condition left in the asset?
Backlog Reduction Ratio

• Monitor and track amount of backlog addressed during any fiscal period

• Challenges:
  • How do we define “backlog”?  
  • What’s an acceptable level of “backlog”?
WHAT IF I TOLD YOU

NEXT GEN IS CURRENT GEN

Next-Gen Asset Management Implementation
Implementing a Comprehensive TAMP

- Condition Measures
- Life-Cycle Measures
- Financial Measures

Asset Management Implementation
On-going FHWA Project

• Phase II of FHWA project on next-generation performance measures and asset management
• Idaho Transportation Department selected as first pilot state
  • Effort kicked-off Summer 2019
• Project Team:
  • FHWA COR: Siva
  • APTech, Paul Thompson, Iowa State
  • ITD Pilot Lead: Jim Poorbaugh
Thank You!

Prashant Ram

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Applied Pavement Technology, Inc.

One does not simply end a presentation without a meme.