Preservation as Part of a Bridge Management System (BMS)

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Milwaukee, Wisconsin
BMS Questions

- What is considered a Good Bridge Management System?
  - How much money do you need to spend on Preservation?
  - How do you prioritize your projects?
  - Is your strategy effective?
AASHTO Manual for Bridge Evaluation

- Update Chapter 3 – Bridge Management Systems

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Objectives of a BMS

- Meet strategic objectives by connecting inventory management and project selection to agency strategic goals through a data driven process.
- Meet the needs of both upper management, where it is a strategic planning tool, and technical decision makers, where it is an engineering tool.
- It strives to find the optimum use of funding by enabling decision-makers to understand the essential trade-offs.
National Goals and Performance Measures

MAP-21 (Moving Ahead for Progress in the 21st Century)

• **No more than 10% of the total bridge deck area in a State on the National Highway System can be classified as structurally deficient for a period of 3 years without a penalty being imposed.** Title 23, U.S.C. §1119(f)(2)(A)

• A State shall develop a **risk-based asset management plan** for the National Highway System to improve or preserve the condition of the assets and the performance of the system.

• **States must maintain the highway infrastructure asset system in a state of good repair.** Title 23, U.S.C. §1119(b)(2)
Ultimate Goal – Maintain Bridges in a “State of Good Repair”

Definition – State of Good Repair\(^1\): The existing physical conditions of bridge elements, components or entire bridges are such that the bridges (a) are functioning as designed and (b) are sustained through regular maintenance, preservation, and replacement programs.

\(^1\) – FHWA Bridge Preservation Guide
AASHTO SCOBS Recommended Performance Measure Based Upon Bridge Preservation Needs

Bridge Condition Diagram

Cyclic Maintenance Needs (CM) NBI 7 - 9
a Unchanged

Preventative Maintenance Needs (PM) NBI 5 - 6
b Unchanged

Replacement or Major Rehabilitation Needs (RR) NBI 0 - 4
c Unchanged

General Targets:
v \geq y
c u \geq x
u + v + w \geq x + y + z
Network or Program Level Assessment

Bridge Condition Forecast System - 2016 to 2025
All Roadway Bridges (MDOT and Local Agency)

2004 - 2011 Bridge Condition
All Roadway Bridges

% OF BRIDGES

0% 10% 20% 30% 40% 50% 60% 70%

Routine or Cyclic PM
Condition Based PM or Minor Rehab
Replacement or Major Rehab

Year

Percent Bridges in Good or Fair Condition


Measured
Projected
SECTION 3: BRIDGE MANAGEMENT SYSTEMS

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Talking about today
Objectives for Michigan DOT Bridge Management

- Deteriorate the network five years
- For every bridge not programmed
  - Tell what the bridge’s needs are
  - Provide and estimate of cost for the work

- What category of work does the bridge fall in
  - Preservation
  - Rehabilitation
  - Replacement
Agency Rules

- The intent of the rules is to translate agency practices and their effects on bridge, program, and network level recommendations into the system's modeling approach.

- Cyclic Rules
  - Action and Interval
  - Example - “Wash steel beam bridges once each year.”

- Conditional Rules
  - Action taken as the result of the condition of and element or component
  - Example - Replace seals in strip seal expansion joints when quantity in Condition State 2 (fair) exceeds 20%, or quantity in Condition State 3 is greater than 0%
  - Conditional rules most often need to be considered concurrently with related elements that could impact how the rules should be applied.
Imagine This Bridge
Different Analysis Approach / Decision Support

- **Bottom Up**
  - Inspector Driven Based on current data (work candidates)
Different Analysis Approach / Decision Support

- **Top Down**
  - Deteriorate the entire network over your programming time frame, and try to balance the best option for each bridge with the best option for your whole network, increasing or decreasing work on any one bridge in order to make the most progress toward your performance measures.
How to we Prioritize Preservation?
Different Analysis Approach / Decision Support

- Middle Out
  - Deteriorate Inspection data and evaluate multiple possible work activities (possibly including inspector recommendations) over your programming time frame to give you the best option for your bridge at a detailed level
Life Cycle Analysis

- Compare fixes to a bridge
- When to do the work
Program Level Risk Assessment

[Graph showing MDOT Scour Risk Assessment with vulnerability and criticality scores]
Multi-Objective Optimization

- Ability to compare many competing objectives
  - Preservation
  - Safety
    - Examples, seismic, scour, …
  - Modernization
  - Needs of the road program
  - …..
Decision Support

Bridges cannot be managed without the practical, experienced, and knowledgeable input of the Engineer/Manager. A BMS is never used in practice to find one best policy among the possible choices. Instead, Managers should use the BMS as a tool to evaluate various policy initiatives, often referred to as “what if” analysis. The available choices may relate to network-level decisions or project-level decisions.
Your BMS Tool Needs to be Flexible and Responsive

Analysis > LCCA

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<tr>
<th>Index</th>
<th>Date</th>
<th>Year</th>
<th>Action Name</th>
<th>Orig. Cost</th>
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Residual: $16,141,458, $1,966,849

Agency Life-Cycle Cost: $4,032,268

User Life-Cycle Cost: $0

Total Life-Cycle Cost: $2,165,419
MDOT - Increase our capacity to innovate!

Thank You!