Determining Preservation Needs Using Inspection & Bridge Management System Data

Paul Jensen P.E.
Agenda

- OODA Loop
- Development of Data
- Data Repository
OODA Loop (observe-orient-decide-act)

Looping Effect of Decision Making

The Components of Agency OODA Loop

- **Observe**
  - Inspections
- **Orient**
  - Data Analysis
- **Decide**
  - Program Development
- **Act**
  - Letting and Completing Projects
Observer - Inspections

Quality of the Data
• Visual Inspection
• Non Destructive Testing
• Destructive Testing

Quantity of the Data
• One Inspection
• Many Inspections
• Similar Bridges In the Inventory

Granularity of Data
• NBIS Component Level
• AASHTO Element Level (NBE)
• AASHTO Element Level (BME)
• Agency Defined Data
  • Elements
  • Other Items
Orient – Data Analysis

- Deterioration Models
  - Markov Chain
  - Weibull Curves
- Intervention Actions
  - Cost of the Action
  - Preservation/Capital Action
- Interaction Between Other Forces
  - Truck Traffic
  - Material Properties
  - Construction Practice
Decide – Program Development

- Review Data from the Bridge Management Process
- Review the Metrics
  - Return on Investment (ROI)
  - Expenditures Need to Achieve the Goal
Act – Completing Required Projects

- **Track Completed Projects**
  - Update Bridge Condition
  - Update Intervention Costs
- **Review Inventory Metrics For Goal and Objectives**
  - Condition (Elements)
  - Safety (NBIS)
Developing the Data

Condition Data

Cost Data

Performance Metrics

Safety Data
Data Collection

• Deterioration - From Field Observation
  • NBI Inspections
  • Element Inspections

• Cost Data
  • Contract Data

• Scheduled Contract Work
  • State Transportation Improvement Plan (STIP)

• Maintenance Work Records
Performance Measure

• Best Practice Is the Health Index
  • Range of Values More Reasonable Based on New Element Definitions
  • Elements for Preservation Can Be Separated from Capital Consideration
    • Painted Elements
    • Deck Overlay Elements (Asphalt, Polymer, Latex Overlays, …)

• Calculated by Equation 4.2.1 of Pontis Technical Manual

\[
\text{Health Index} = \frac{\sum_n \text{Element Cost} \times \text{Element Quantity} \times \text{Percent Condition State}}{\sum_n \text{Element Cost} \times \text{Total Element Quantity}} \times 100
\]
Reporting

- Development of “Indifference Curve”
- Report
  - By Bridge (by Year)
    - Recommended Action
    - Benefit / Cost Ratio
    - Health Index
    - Categorize by Good, Watch, Bad
  - By Route (Break on County and Year)
    - Average Health Index
    - Network Indifference Curve
    - Network Benefit / Cost Ratio
    - Network Cost to Improve
    - Count by Good, Fair, Poor Groupings
Groupings

- **Good Condition**
  - Hi Greater Than 70
  - No Defects
- **Watch (Fair Condition)**
  - Hi Between 50 and 69
  - Bridges Have Defects That Need Monitoring
- **Bad (Poor Condition)**
  - Hi Less Than 50
  - Defects Needing Corrective Action
Indifference Curve

- Need Cost or Bridge Count by Year
- Plot Cost (Bridge) and Year
- Take Action Before Going Near Vertical

Needing Work Before Input Into a Capital Program
Maximum PM Cost < Capital Cost

First Time to Consider Work (Lest Cost)
Field Review and Set Scope

- Rank Corridors From Worst to Best
- Review Recommended Action From Bridge Management System With Field Observations

**Kick Some Rocks**

- Develop Scopes for Each Bridge
- Detailed Estimate for Each Bridge in the Corridor
Check for Corridor Improvement

- Input Projects, Scopes and Cost Into the Bridge Management System
- Run the Scenario With Proposed Budgets
- Compare Network Level Results
  - Fulfill Performance Goals?
  - Budgets Adequate for Scope?
  - Peaks and Valleys of Needs Smooth Out?
Long Term Actions

• Compare Proposed and Actual Performance Measures
• Compare Performance Goals With Objectives for the Corridor or Area
• Update Models With Additional Data
• Update Cost Models As Bid Tabulations Change
Data Repository

- End User
- Interpreted Data
- Analyzed Data
- Conditioned Data
- Raw Data (Engineering Units)
Long Term Bridge Performance Program

Data Collection
- Inspection Reports
- Temperature
- Strain Gauge
- Traffic
- Wind
- NDE/NDT

Data Management
- Online Monitoring
- Data Mining
- Data Integration

Data Access
- Data Access
- Visualization
- Query

Element

Historical Databases
- GIS
- Weather
- Seismic
- NBI
- Element
- Safety Maintenance Cost
What The Portal Is Not

- Not a Bridge Management System
- On-line Service for Data Hosting

Portal Is A Toolbox

- Bridge Management Data Not Available to Agency Practitioners
- Develop Model Parameters For
  - Deterioration
  - Cost
  - Life Cycle Cost
Deterioration Models

Rollup Data Into Parameters For End Users (BMS)

- Deterioration Based on Elements
- Deterioration Based on Component
  - Rollup From Elements
  - Deterioration Based on Component
- Develop Model Development
  - Weibull Curve Shaping
  - Markov Chaining
- No Consideration of Intervention Activity (Do Nothing)
Life Cycle Cost Modeling
Rollup Data Into Parameters For End Users

(BMS)
Cost Models by Action Activity

- Maintenance
- Preservation
- Capital Program
Needing Help from the Community of Practice

- Upload of Inspection Data
- Upload of Intervention Actions
- Upload of Cost Data by Intervention Action Type
Questions

http://www.fhwa.dot.gov/research/tfhrc/programs/infrastructure/structures/ltbp/

Paul Jensen P.E.
p.jensen@bresnan.net