Bridge Management Systems

Bridge Analyst™
Why Use BMS?

• Are you achieving the best or optimum performance (LOS) across the network at the current level of funding?
• Are you performing the right mix of activities, projects, strategies to achieve the best long term performance for your bridges?
• Do you have the capability to perform short and long term scenario analysis?
• Can you readily determine the level of investment needed across all assets to achieve agency performance targets? Can you conduct trade-off analysis?
• Can you readily meet MAP 21 reporting requirements?
Bridge Analyst Overview

• Agency-specific deterioration models and decision trees

• Comprehensive Analyses:
  – Level-of-Service Maintenance Analysis (Network Level) - Markov Chains (Probabilistic approach)

  – Single-Objective Multi-Constraints Optimization Analysis (Project-Level – Network Analysis)

  – Short-Term Maintenance Needs Project Ranking Analysis (Project Level – Network Analysis)

• Integration between Bridge, Maintenance et al.
Modular Framework

Core AgileAssets Functions
- Asset Inventory
- LRS/GIS
- Security
- User Organization
- Terminology
- Data Management
- Reporting
- Graphing
- Communications
- System Utilities

Common Data Model

Pavement Analyst
Bridge Analyst
Asset Trade-Off Analyst
External Data and Models

Maintenance Manager
- Fleet
- Equipment
- Materials
- Labor

Safety Analyst
Network Data Manager
Mobile Data Collection
Mobility Analyst

External Systems
(e.g., SAP, Advantage, PeopleSoft, etc.)
Bridge Manager Features

- **Element Level Deterioration Modeling**
  - Deck, Superstructure, Substructure Deterioration Modeling
  - Library of Deterioration Models
  - Assign Deterioration Models by User-Defined performance categories
Bridge Manager Features

- **Element Level Decision Trees & Treatment Assignment**
  - Deck, Superstructure, Substructure, Expansion Joints, Railings, Girders, etc.
  - Allow preservation activities as a consideration
  - Recommend replacement of structure if cost of a project exceeds **X% of Replacement Cost**
Bridge Manager Features

Life Cycle Scenario Analysis & Economic Analysis

- Determine Least Cost to Maintain Network at certain condition
- Analyze Impact of Deferred Maintenance
- Evaluate Influence of a work plan on a Structure / Element’s Life Cycle
- Optimize Network Condition given Budget Constraints
Bridge Manager Features

Life Cycle Scenario Analysis & Economic Analysis

**STRUCTURE LIFE CYCLE ANALYSIS REPORT**

**STRUCTURE #: 140021**

**SCENARIO NAME**: Maximize Network Condition given Budget (LC: 35 Years)

**2011 TO 2046**

- Remaining Service Life
- (RHB) DC – Patch Spalls. Epoxy Injection. Guniting (condition 4)
- (RHB) SUPERST – ST – Restore Cross Section. Repair Bearing Area (condition 4)
- (RHB) SUBST-T – Replace Affected members (condition 5)
- (PRS) SUPERST – ST – Spot Clean and Paint (condition 6)
- (PRS) DC – Minor Patching. Crack Sealing (condition 6)
- (PRS) DC – Deck Sealing/Joints (conditions 7–8)
- (RHB) SUPERST – ST – Restore Cross Section. Repair Bearing Area (condition 5)

**ECONOMIC ANALYSIS RESULTS**

<table>
<thead>
<tr>
<th>SCENARIO ID: 760</th>
<th>SCENARIO NAME: Maximize Network Condition given Budget (LC: 35 Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net Present Worth of Costs by Work &amp; Element</strong></td>
<td><strong>Cost Analysis</strong></td>
</tr>
<tr>
<td><strong>Preserve</strong></td>
<td><strong>Rehab.</strong></td>
</tr>
<tr>
<td>Deck</td>
<td>$285,426</td>
</tr>
<tr>
<td>SubSt</td>
<td>$0</td>
</tr>
<tr>
<td>SuperSt</td>
<td>$237,215</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$522,641</td>
</tr>
</tbody>
</table>
## Bridge Manager Features

- **Compare Economic Analysis Results**
- **Associated with Alternative Element / Structure / Network Life Cycle Scenarios**

### Comparison of Economic Analysis Results

<table>
<thead>
<tr>
<th>Net Present Worth of Costs by Work &amp; Element</th>
<th>Cost Analysis</th>
<th>Benefit Analysis - Structure Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCENARIO ID: 760</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Years in Analysis: 35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Interest Rate: 3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Inflation Rate: 1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Present Worth of all Costs (NPW): $1,442,538</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalent Uniform Annual Cost (EUAC): $57,135</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual User Cost Savings (EUUAC): See NM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deck: $285,428</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SubSt.: $0</td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total: $622,841</td>
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<td></td>
</tr>
</tbody>
</table>

<table>
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</thead>
<tbody>
<tr>
<td>SCENARIO ID: 783</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Years in Analysis: 35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Interest Rate: 3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Inflation Rate: 1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Present Worth of all Costs (NPW): $1,050,705</td>
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</tr>
<tr>
<td>Equivalent Uniform Annual Cost (EUAC): $48,699</td>
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</tr>
<tr>
<td>Annual User Cost Savings (EUUAC): See NM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deck: $61,647</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SubSt.: $0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SuperSt.: $11,091</td>
<td></td>
<td></td>
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<tr>
<td>Total: $72,738</td>
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<td></td>
</tr>
</tbody>
</table>
Bridge Manager Features

Analyze Impact of Deferred Maintenance
At Network, Structure, Element level

Substructure Life Cycle Analysis
SCENARIO NAME: Least Cost to Maintain Network at CS-5 (LC-35 Years) 2011 TO 2046

Substructure Life Cycle Analysis
SCENARIO NAME: Deferring Work on Struct’s 140020 & 140021 for 5 Years (LC:40) 2011 TO 2051

Legend:
- Red: Condition Rating
- Blue: See Recommended Superstructure/Deck Treatments
- Green: (RHB) SUBST-T – Replace Affected members (condition 5)
Bridge Manager Features

- Integrated GIS Framework
Bridge Manager Features

- Integrated with Maintenance
- Track Maintenance history of each structure on the map
Bridge Manager Features

- **Integrated Maintenance Module**
  - Share Bridge Work Plans with Maintenance Team
  - Allowing Maintenance Team to Issue Work Orders from Bridge Work Plans
  - Drill down Maintenance Costs associated with a structure down to the resource level
Bridge Manager Features

❖ Reports

<table>
<thead>
<tr>
<th>Substructure Material (Det)</th>
<th>Deck Condition (#)</th>
<th>Substructure Condition (#)</th>
<th>SuperStructure Condition (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - Other</td>
<td>6.8640</td>
<td>6.0327</td>
<td>6.6810</td>
</tr>
<tr>
<td>1 - Concrete</td>
<td>6.4822</td>
<td>6.7564</td>
<td>6.9105</td>
</tr>
<tr>
<td>2 - Steel</td>
<td>7.0296</td>
<td>6.8480</td>
<td>7.0790</td>
</tr>
<tr>
<td>5 - Prestressed Concrete</td>
<td>6.2794</td>
<td>6.4741</td>
<td>6.5620</td>
</tr>
<tr>
<td>7 - Wood or Timber</td>
<td>6.0361</td>
<td>5.0704</td>
<td>5.8063</td>
</tr>
<tr>
<td>8 - Masonry</td>
<td>6.4600</td>
<td>5.8400</td>
<td>6.3000</td>
</tr>
</tbody>
</table>
**Analyze Recommended Strategy**

### STRUCTURE LIFE CYCLE ANALYSIS REPORT

**STRUCTURE #: 140021**

**SCENARIO NAME**: Maximize Network Condition given Budget (LC: 35 Years)  
2011 TO 2046

#### ECONOMIC ANALYSIS RESULTS

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<td></td>
<td></td>
</tr>
</tbody>
</table>

| Work & Element | Total  | Preserve | Rehab. |  |  |  |
|----------------|--------|----------|--------|  |  |  |
| Deck           | $447,235 | $295,426 | $161,809 |  |  |  |
| SubSt.         | $368,000 | $0       | $366,000 |  |  |  |
| SuperSt.       | $629,301 | $237,215 | $392,086 |  |  |  |
| **Total**      | $1,442,536 | $522,641 | $919,895 |  |  |  |

- **Number of Years in Analysis**: 35
- **Average Interest Rate**: 3%
- **Average Inflation Rate**: 1%
- **Net Present Worth of all Costs (NPW)**: $1,442,536
- **Equivalent Uniform Annual Cost (EUAC)**: $67,135
- **Annual User Cost Savings (EUUAC)**: See NM

<table>
<thead>
<tr>
<th>Element</th>
<th>Latest Inspection</th>
<th>During Life Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIN</td>
<td>AVG</td>
</tr>
<tr>
<td>Deck</td>
<td>4.00</td>
<td>6.36</td>
</tr>
<tr>
<td>SuperSt</td>
<td>4.00</td>
<td>5.22</td>
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<tr>
<td>SubSt</td>
<td>5.00</td>
<td>5.55</td>
</tr>
<tr>
<td>RSL</td>
<td>8.00</td>
<td>11.47</td>
</tr>
</tbody>
</table>
Modeling & Analysis Capabilities

1. Compare Least Cost Approach to Maintain Structure at Different Potential Levels of Service

2. Analyze Impact of Treatments
Performance Management

Evaluate Impact of Bridge Maintenance / Preservation Activities on Bridge Element Condition Rating (Project / Bridge Level)

STRUCTURE NO: 700016

- Cond - With Maint
- Cond - W/O Maint
- No Maint. Trt
- 3338-Moveable Bridges (Operations) (DOL)
- 3354-Maintain Steel Substructure Components (LFT)
- 3336-Moveable Bridges (Maintenance) (HR)
- 3314-Maintain Steel Superstructure Components (LFT)
- 6040-CONSTR/MAINT OF FACILITY (HR)
- 4701-BRIDGE DMGS DUE TO ACCID (HR)
- 3362-Maintenance and Repair of Fender System (LFT)
- 5905-C SWEEPING/WASHING RDWYS (SHM)
- 3132-Sweep / Wash Roadway (SHM)
- 3318-Maint to Concrete Handrail (LFT)
- 3324-Maint / Repair / Replace Timber Deck Components (SFT)
Thank You!

Jim Edgerton
919-573-5219
jedgerton@agileassets.com