Best Practices in Bridge Management
Decision-Making

Overview of Scan Results
Midwest Bridge Preservation Partnership
October 2010

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Bridge Maintenance Program Engineer
New York Department of Transportation
**Purpose**

**Discover** and collect information on how DOTs manage maintenance of highway bridges and how maintenance impacts the overall bridge program.

**Focus** on decision processes for maintenance programs;

*How Do Decisions Rely On:*
- Bridge Conditions
- Maintenance Needs
- Effectiveness of Maintenance
- Funding Availability
Inputs

- **Site Visit**
- **Scan Team**
- **Document Review**
KEY FINDINGS

Bridge Management Process

Preventive Maintenance

Agency Support
Bridge Management

- Maintenance Needs
- Prioritization
- Performance Measures
- Verification
**Maintenance Needs**

**Identified at the element level**

**Uniform, specific, and repeatable**

**Stated as standard work actions**

**Accessible throughout the agency**
**Element Level**

### TYPES
- Modified NBI
- Commonly Recognized (CoRe) Bridge Elements
- Own system

### SUPPORTS
- Detailed reports
- Maintenance decisions
- Treatment options
- Early intervention
- Minimize repair costs
<table>
<thead>
<tr>
<th>(58) DECK</th>
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<tr>
<td>(59) SUPERSTRUCTURE</td>
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<tr>
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<td>(61) CHANNEL &amp; CHANNEL PROTECTION</td>
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<tr>
<td>(62) CULVERTS</td>
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</table>
Uniform, Specific, & Repeatable

**METHODS**
- Inspectors recommend action
- Drop-down menu
- Actions prioritized
- Costs per action
- Stored in database
- Draft work order

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</table>

Applicable Condition States:

- [ ] 1
- [ ] 2
- [ ] 3
- [ ] 4

BENT12, GIRDER 14: REPLACED DECAYED GIRDER
Needs Database

NEW YORK

Red and Yellow Flags

- Section Loss
- Bearing/pedestal
- Footing
- Wingwall
- Steel (Other)
- Abutment/pier
- Joint
- Deck
- Concrete Cracks
- Concrete (Other)
- Steel Cracks
Bridge Maintenance Contract Funding and Backlog

Fiscal Year

Funding Level (Million $)

# of Bridges

Bridge Maintenance Program 2001 - 2005

Actual
Integrate objectives for deficiencies, preventive maintenance, network performance, and risk

Engage both central and regional DOT

Advance from network-level rankings to selection of specific projects
Prioritization Formulas

■ **Sufficiency Rating (NBI)**

Structural Adequacy and Safety (55% maximum); Serviceability and Functional Obsolescence (30% maximum); Essentiality for Public Use (15% maximum); Special Reductions

■ **Health Index (Pontis)**

Health Index (HI) = \(\left(\frac{\sum \text{CEV}}{\sum \text{TEV}}\right) \times 100\)

\[
\text{TEV} = \text{Total element quantity} \times \text{Failure cost of element (FC)}
\]

\[
\text{CEV} = (\sum \left[\text{Quantity in condition state i} \times \text{WF(i)}\right]) \times \text{FC}
\]
MAP = Maintenance Accountability Program
Priorities listed by Activity

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How Does Maintenance Measure Performance?

Service Level Outcome

- Preventive: Low
- Routine: Maintenance
- Corrective: High

- Low Life Cycle Costs: High
- Low Program Priorities: High
- More Degree of Risk: Less

- More Reliability

Service Level Numeric Scale

LEVEL OF INVESTMENT

LEVEL OF DELIVERY
Bridge inspections result in the “to-do list” of smaller-scale structural repairs for the Maintenance Program to complete. Examples of these repairs include:

- Bridge Cap Repair
- Bridge Column Repair
- Debris Removal
- Scour Repair
- Expansion Joint Repair

2007-09 M Program Budget: $9.2 million
The performance measurement for this activity focuses on Priority 1 repairs. A list of all repairs for maintenance to complete is compiled each year. The list is identified by either:

- the formal bridge inspection process, or
- maintenance personnel during daily work activities.

The Level of Service is based on the percentage of Priority 1 repairs completed.

- **A**: 90 -100% completed
- **B**: 80 - 89% completed
- **C**: 65 - 79% completed
- **D**: 50 – 64% completed
- **F**: Less than 50% completed

This activity is currently funded at $9.2 million for the 2007-09 biennium.

Level of Service target is a C

2008 Level of Service delivered is a D

The 2009-11 proposed budget includes an additional $1.5 million to catch up with this maintenance backlog and achieve the target.
What is LOS?

A simple scale that rates the outcomes of maintenance activities.

Service Level A
Service Level B
Service Level C
Service Level D
Service Level F

Pavement Patching & Repair
Performance Measures

Match objectives in bridge maintenance

Identify work to advance maintenance objectives

Provide simple indications of status of bridge networks
Bridge Condition Ratings

- **MICHIGAN**

![Graph showing bridge condition ratings for Michigan.](chart.png)

- **Serious or Critical** (red bars)
- **Poor** (yellow bars)
- **Fair** (brown bars)
- **Good** (green bars)

- **Number of Bridges**
  - NBI Rating: 1 2 3 4 5 6 7 8 9
  - Number of Bridges: 14 300 400 600 800

- **Legend**:
  - Good
  - Fair
  - Poor
  - Serious or Critical
Service Life Extension

NEW YORK

Typical Treatment Costs per Bridge

- 2370 Good
  - (~30%)
  - $5,000

- 4740 Fair
  - (~60%)
  - $250,000

- 790 Poor
  - (~10%)
  - $3,700,000

Major Rehab or Replacement Candidates

- Curve w/ Preservation Maintenance
- Curve w/o Preservation Maintenance
Goal: 100% of Priority 1 and 2 WOs completed on time
90% of all work orders completed on time

Over the last year 7476 of 7492 (99.8%) work orders
were completed on time with no delinquent priority
1s and 2s

Priority 1 Emergency 60 days to complete, paperwork may follow corrective action
Priority 2 Urgent 180 days to complete
Priority 3 Routine 365 days to complete
Priority 4 Informational no deadline
Deficient - Deck Area

NEW YORK

Statewide -- State Owned

Calendar Year Data

Square Area of Bridges

Non Deficient  Total deficient
Verification

Strategy is effective
Investment pays off

Needs are met
Level of Service indicators
  Needs – Accomplishment = Gap

Work completed
Report into BMS, MMS, Capital Program, ...
CALTRANS ‘05 –’09 Bridge Preservation

8,623 Bridges
Current - 69%
Goal – 85%

2,544 Bridges
Current - 20%
Goal 10%

1,333 Bridges
Current - 11%
Goal – 5%

- Maintenance Program
- Preservation Program (Major Maintenance)
- Rehab. Program (SHOPP)

9,122 Bridges
Current - 71%
Goal – 85%

2,835 Bridges
Current - 22%
Goal 10%

870 Bridges
Current - 7%
Goal – 5%

- Maintenance Program
- Preservation Program (Major Maintenance)
- Rehab. Program (SHOPP)
Preventive Maintenance

Significant part of program

Applied before bridges become deficient

Implements clear plans of action

Flexible allocation of resources
## Bridge Deck Preservation Matrix

### Michigan

<table>
<thead>
<tr>
<th>Condition State</th>
<th>Repair Options</th>
<th>Potential Result to NBI</th>
<th>Next Anticipated Evaluation</th>
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<tbody>
<tr>
<td><strong>Deck Surface NBI #58a</strong></td>
<td><strong>Deck Surface Deficiencies % (a)</strong></td>
<td><strong>Deck NBI #58</strong></td>
<td><strong>Deck Underside Deficiencies % (b)</strong></td>
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<tr>
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<td>N/A</td>
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<td>5% to 15%</td>
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<td>NBI = 3 or 4</td>
<td>10% to 30%</td>
<td>NBI now 8, 9</td>
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Cyclical Maintenance

Bridge Deck Washing (Concrete) – 1 Year
Bridge Deck Sweeping – 1 Year
Seats & Beam Ends Washing – 2 Years
Cutting & Removing Vegetation - 2 Years
Routine Maintenance of Timber Structures - 2 Years
Replacement of Compression Seal Joints – 10 years
Scheduled Replacement of Pourable Joints – 6 years
Cleaning and Lubricating Bearing Devices – 4 years
Scheduled Beam Ends Painting – 10 Years
Installation of Thin Epoxy Concrete Overlay – 15 Years
Removing Debris from Culverts – 5 Years
Agency Support

**LEGISLATURE:** gas tax, dedicated fund, MPO percentage

**DOT Executives:** Maintenance is not a episodic. ODOT – “Fix it First”

**DOT Central:** Use quantitative performance measures, Recognize districts’ first-hand knowledge

**District Engineers:** Evaluate needs and trends funds and projects

  - **Inspectors:** Identify needs, recommend actions
  - **Crews:** Execute work, take initiative
Key Recommendations

1. Require element-level inspection programs, and establish standard condition states, quantities, and recommended actions (maintenance, rehabilitation, replacement) to match the operational characteristics of the maintenance program of the agency

2. Establish national performance measures for all highway bridges for comparisons among bridge owners and owner-specific performance measures that can be used to allocate funding levels for a full range of actions to optimize bridge conditions
3. **Use owner-specific performance measures** to set overall funding levels for maintenance programs.

4. Determine bridge needs and treatment schedule based on owner-specific objectives, and utilize schedule to **develop needs-based funding mechanisms** (for the full range of recommended actions) that are consistent with network performance measures.
5. **Establish standards, and require implementation by bridge owners, of preventive maintenance programs** that are funded at levels set by analysis of performance measures. Programs must include the repair needs of 'cusp' bridges to keep them from becoming 'deficient' bridges. Experience in scan states has shown that preventive and minor maintenance must be a significant portion of bridge programs that optimize bridge conditions within limited budgets.
Key Recommendations

6. Develop work programs for maintenance that include the unit or crew level involvement (i.e. at the lowest level of management or supervision) when those positions are staffed by supervisors with extensive field maintenance experience. Avoid “blind” use of work programs from bridge management systems, and work programs dictated by goals to maximize performance measures (although both bridge management systems and performance measures provide useful information to maintenance crews).
FINAL REPORT

• Google: NCHRP Domestic Scan

• Look for: 07-05 Best Practices in Bridge Management Decision-Making
BRIDGE MAINTENANCE CREDO

We, the bridge maintenance engineers of NYSDOT hold these truths to be self-evident: all joints leak, all concrete cracks, and rust never sleeps. We will strive to capitalize our way out of maintenance and maintain our way out of capital. It is our endeavor to educate others that a bridge is as important to a highway as a diamond is to a ring.