WSDOT’s Approach to Performance-Based Programming

Processes and Roles in Risk-based Asset Management

Lynn Peterson
Secretary of Transportation

Patrick Morin, PE
Operations & Asset Manager Capital Program Development & Management

Rocky Mtn West Pavement Preservation Partnership Conference
October 8-9th, 2013
Cost of Construction

- Averaged 4% between 1970 and 2006
- 1974 – OPEC Oil Embargo
- 1980 – 2nd OPEC Oil Crisis
- 2006 – 2009 Material Cost increase
Fuel-efficient vehicles, weak economy impact fuel sales

Fewer gallons sold = reduced gas tax revenue projections

- The state gas tax funds 76% of all transportation investments.
- Since March 2007, projected fuel tax revenues will fall by $3.6 billion over the 13-year period.
Gas tax purchasing power declines over time

Gas tax not indexed to inflation

...and compelling communication is more important than ever

Funding crisis
- Revenue significantly under projections
- Inflation increasing cost of maintenance and construction
- Challenge in getting another tax increase

Of the state’s current 37 1/2-cent fuel tax, approximately 8 cents* per gallon is available for maintenance, operations and debt service of state highways, bridges, ferry vessels and terminals.

* Includes maintenance, preservation, safety improvements, and other department operations.
** Less Debt Service.

Source: WSDOT
State Transportation Needs Exceed Future Funding

- Concrete Pavements – $1 B (10 years)
- Flexible Pavements – $1 B (10 years)
- Backlog of bridge painting – $0.4 B
- Seismic Retrofitting in high ground motion zones – $0.25 B
- Several large congestion issues

- Safety goal of no fatal/serious injury collisions – $1B (10 year)
- Federal law suit to replace blocked culverts for fish – $2.4 B (17 years)
- Storm water retrofit in Puget Sound
- Major Electrical Rehab of signals, ITS & lighting
- Ferry Boats & Terminals
The State Legislature finds that solutions to state highway deficiencies have become increasingly complex and diverse and that anticipated transportation revenues will fall substantially short of the amount required to satisfy all transportation needs. Difficult investment trade-offs will be required.

The Governor’s Office of Financial Management shall propose a comprehensive ten-year investment program for the preservation and improvement programs defined in this section, consistent with the policy goals described under RCW 47.04.280.
Legislative Guidance for Developing Strategic Investment Options (1993 Study)

- Legislative policy guidance
- Performance Outcome based on policy guidance
- Needs Criteria (based on lack of performance)
- Evaluate alternatives to restore performance
- Identify/evaluate risks
- Cost to restore (Important when capital is limited)
- Predict performance outcome
- Establish priorities (based on Engineering Economics)
- Recommend Investment Tradeoffs to Legislature
Purpose of Transportation Attainment Reports

Washington’s Transportation Attainment Reports provide a high-level assessment of the state's progress in achieving its transportation goals using key performance measures and data.

Statewide Transportation Goals

In 2007, the Washington State Legislature amended RCW 47.04.280 to establish five statewide transportation policy goals to guide the planning, operation, performance of, and investment in the state’s transportation system. They are not prioritized.

- **Safety:** To provide for and improve the safety and security of transportation customers and the transportation system.
- **Preservation:** To maintain, preserve and extend the life and utility of prior investments in transportation systems and services.
- **Mobility (addressing congestion):** To improve the predictable movement of goods and people throughout Washington state.
- **Environment:** To enhance Washington’s quality of life through transportation investments that promote energy conservation, enhance healthy communities and protect the environment.
- **Stewardship:** To continuously improve the quality, effectiveness and efficiency of the transportation system.

In 2010, the Legislature added a sixth goal:

- **Economic vitality:** To promote and develop transportation systems that stimulate, support and enhance the movement of people and goods to ensure a prosperous economy.
Highway Construction Program

**PRESERVATION (P)**
- Roadway (P1)
  - Paving
  - Preservation
  - Catastrophic Reduction
- Structures (P2)
  - Preservation
  - Catastrophic Reduction
- Other Facilities (P3)
  - Rest Areas
  - Weigh Stations
  - Safety Restoration
  - Unstable Slopes
  - Major Drainage & Electrical
- Program Support (P4)

**IMPROVEMENT (I)**
- Mobility (I1)
  - Urban
  - Rural
  - Urban Bicycle
  - Core HOV
- Safety (I2)
  - Collision Reduction
  - Collision Prevention
- Economic Initiatives (I3)
  - All Weather
  - 1995 2007 Rest Areas (In Safety)
  - Scenic Byways
  - Freight System
  - Restricted Bridges
  - Bicycle Touring
- Environmental Retrofit (I4)
  - Stormwater
  - Fish Barriers
  - Noise Reduction
  - Air Quality
- Program Support (I5)
  - Chronic Env Deficiency
  - Wildlife Connectivity
  - Mgmt of Environmental Mitigation Sites

**Washington State Department of Transportation**

Strategy no longer active
Federal Safety Stewardship Agreement

• Agreement with Federal Highways to qualify paving projects for federal aid without safety improvements

• Equivalent funding for safety improvements to standards on paving projects will be invested in the Safety Program

• Historical approach of HES reduction and prevention (network-wide strategies)

• Adopting SafetyAnalyst for the future (random occurrence of collisions due in large part to driver behavior in the last 18 years)
## 2012 Biennial Transportation Attainment Report

### Washington’s Transportation System:
#### Goals, Objectives and Performance Measures

## Goal 2. Preservation

To maintain, preserve and extend the life and utility of prior investments in transportation systems and services.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Objective</th>
<th>Status</th>
<th>Progress</th>
<th>Five-Year Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measure 2.1 Highway Pavement</strong></td>
<td>Extend the useful life of pavement</td>
<td>92.7% of state highway pavement in fair or better condition in 2011</td>
<td></td>
<td></td>
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<tr>
<td>Percent of state highway pavement in fair or better condition</td>
<td></td>
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</tr>
<tr>
<td><strong>Measure 2.2 Bridges</strong></td>
<td>Keep bridges safe and open to traffic</td>
<td>5% of bridges were rated SD in 2011, a 0.3% improvement from 2008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of state bridges rated structurally deficient (SD)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Measure 2.3 Ferry Terminals</strong></td>
<td>Extend the useful life of ferry terminals and vessels</td>
<td>86 % rated fair or better in 2011, a 2% increase from 2008</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of state ferry terminal systems in fair or better condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Asset Classes with Deficiency Criteria

• Pavements
  • Rutting – ½ inch
  • Cracking Index – 45/100
  • Ride – 220 " per mile

• Bridges
  • Painting – rusting > 2% surface area
  • Decks – delamination > 3% surface area

• Unstable Slopes – risk factors > 350 of 891

• Rest Areas
  • Sewer & Water
  • Building & Site

Classes with Criteria Under Development

• Drainage Features
  • Culverts
  • Enclosed Systems

• Electrical
  • Traffic Signals
  • Illumination Systems
  • Intelligent Transportation Systems

• Weigh Stations
  • Site
  • Buildings
  
• Safety Restoration
  • Guardrail
  • Median Barrier
Inventory & Condition Assessments

- Pavements
  - Mainline (1 lane/direction) - Yearly
  - Ramps & Other Auxiliary Lanes – As Needed
  - Remaining mainline Lanes (concrete) – Every 4 Years

- Bridges
  - Decks and Painting – Yearly/Biennial

- Unstable Slopes – Every two years

- Rest Areas – Every two years

- Electrical – Inventory Complete, Need Condition Data

- Drainage – Inventory almost complete, Maintenance gathering “Level 1 condition data” during cleaning

- Safety Restoration – Inventory complete except for Interstate guardrail. Discussing how to determine condition assessment

  - Policy Issue: Data versus Predictive Models
Restoring Performance and Minimizing Risk with Sustainable Initiatives

- Lower cost approaches
- To improve performance
- To become more efficient than full scale replacement or upgrade
- Lower risk and tradeoffs
- Meet multiple goals with limited budget
• Chip Seal Conversion
• Chip Seals in wetter & cooler climates
• Selective concrete panel replacement versus replacement
• Steel bridge washing
• Painting in segments
• 2nd gen bridge decks
• Timing of guardrail replacement
• Culvert lining
• Reduced lighting
• Replace signal with roundabout
Investment Tradeoff

Target Setting

• Started with goals and performance objectives
• Identified performance needs for 6-10 years (range of dollars)
• Developed cost effective solutions to maximize performance
• Determine investment amount to meet objective
• Allocate existing revenue amongst categories and predict performance

Tradeoff Risks

• Accuracy of 6-10 year needs
• How to hold needs for which there is no funding?
• How many additional projects should be designed as backup?
• How much weight should be given to a potential risk versus a known need such as:
  ▪ Seismic
  ▪ Guardrail upgrade versus new
Asphalt Pavement Preservation Decisions

- Do Nothing ??
- Maintenance (\$) ??
  - Preventive
  - Hold or Push Rehab
  - Reduce Emergent Need
- Rehab (\$\$\$) ??
- Reconstruction ?? (\$\$\$\$\$\$)

Years

Condition Indexes
Change in EUAC per Year Change in Pavement Life

extending pavement life 1 year (in year 16) results in 4.5% savings
Uses for Economic Performance Methodologies

• Evaluation of Pavement Management
  ▪ How efficiently are pavements performing?
  ▪ Are the most cost-effective decisions being implemented?

• Evaluation of Pavement Design
  ▪ Is pavement structure over designed or under designed?

• Evaluation of Freight Corridors
  ▪ Are freight corridors designed with the most efficient pavements?
Economic Performance Measures

• Historical Cost of Pavement Service
  ▪ EUAC ($ / lane-mile year spent)
    ▪ Equivalent Uniform Annualized Cost

• Expected Cost of Future Pavement Rehab
  ▪ LCCA ($ / lane-mile year gained)
    ▪ Life Cycle Cost Analysis

• ESAL Efficiency
  ▪ Divide EUAC by average ESALs per lane per year
    ▪ $ / ESAL
    ▪ Equivalent Single Axle Loadings
Decisions and Outcomes

- **Maint.** (what, when, where, how, why)
- **Rehab.** (what, when, where, how, why)
- **Reconst.** (what, when, where, how, why)
- **Cost** (minimize LCC)
- **Performance** (achieve minimum requirement)
Executive Decision Making

WSDOT will establish an executive level policy making group for asset management similar to safety.
Pavement Prioritization

**Flexible Pavements**
- Minimum Performance Standard
  - Rutting – ½ inch
  - Cracking Index – score of 45 out of 100
  - Ride – 220 inches per mile (lagging indicator)
- Alternative Analysis based on Lowest Life-cycle cost
  - Preventative Maintenance (strategic Crack Sealing)
  - Chip Seals on lower volume and lower truck loadings
- Prioritization
  - 70% of the analysis units within a paving job should be below the minimum performance standard to be included in program proposal

**Rigid Pavements**
- Minimum Performance Standard
  - Rutting – ½ inch
  - Faulting
  - Cracking
  - Ride – 220 inches per mile
- Alternative Analysis based on Lowest Life-cycle cost
  - Preventative Maintenance to replace isolated panels with significant cracking
  - Grind rutted panels with minimal faulting and rutting
  - Dowel-bar rehab faulted panels & grind
  - Replace concrete roadway that is beyond rehabilitation
Combined Pavement Condition

2011 Pavement Condition
- Very Good, 35%
- Fair, 15%
- Good, 40%
- Poor, 5%
- Very Poor, 4%

2023 Pavement Condition
- Very Good, 3%
- Good, 8%
- Fair, 36%
- Poor, 16%
- Very Poor, 37%

Planned Funding
- Very Good, 37%
- Good, 34%
- Fair, 28%

O&M Funding
- Very Good, 37%
- Good, 34%
- Poor and Very Poor, 1%

1 Due to reduced budget, Chip Seal roadways were not rated in 2011 and are excluded from the 2011 combined chart.
Seismic Ground Acceleration Zones
Bridge Pier Damage due to Vertical Acceleration

6.6 Magnitude, San Fernando 1971

6.8 Magnitude, Nisqually 2001

I-5 Beacon-Holgate Bridge in Seattle
## Status of Seismic Rehab Bridges

<table>
<thead>
<tr>
<th>1000-Year Zone</th>
<th>Complete</th>
<th>Partially Retrofitted</th>
<th>Retrofit Required</th>
<th>Under Contract</th>
<th>Grand Total</th>
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<tbody>
<tr>
<td>45</td>
<td>44</td>
<td>24</td>
<td>38</td>
<td>7</td>
<td>113</td>
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<td>40</td>
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<td>35</td>
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<tr>
<td>0</td>
<td>1</td>
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<td></td>
<td>1</td>
<td>2</td>
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<tr>
<td>Grand Total</td>
<td>272</td>
<td>134</td>
<td>485</td>
<td>10</td>
<td>901</td>
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</table>
WSDOT’s Three-Phase Seismic Plan

• Objective: Strengthen structural elements that are vulnerable to damage from ground motion (generally west of Moses Lake)

• Phase 1 – Secure superstructure to columns (potentially catastrophic)

• Phase 2 – Rehab single columns (has no redundant support)

• Phase 3 – Rehab multi-columns
### Total Cost of Key Seismic Rehab in Puget Sound

$678M of needs in Puget Sound with $10M per biennium identified in 10-Year Financial Plan would take until the end of this century

<table>
<thead>
<tr>
<th>Row Labels</th>
<th>Collector Distributor</th>
<th>Eastbound</th>
<th>Northbound</th>
<th>Northbound &amp; Southbound</th>
<th>Overcrossing &amp; Ramp</th>
<th>Reversible Lane</th>
<th>Southbound</th>
<th>Westbound</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-5/Lakewood to SR 18</td>
<td>$ 4,969,853</td>
<td>$ 13,421,259</td>
<td>$ 8,793,814</td>
<td>$ 27,184,926</td>
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<tr>
<td>I-5/SR 18 to I-405 and I-405 to SR 900</td>
<td>$ 17,065,026</td>
<td>$ 7,777,693</td>
<td>$ 12,632,455</td>
<td>$ 37,475,174</td>
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<tr>
<td>I-405/Seatac to I-90</td>
<td>$ 941,875</td>
<td>$ 4,324,661</td>
<td>$ 18,444,217</td>
<td>$ 24,974,620</td>
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<tr>
<td>I-405/I-90 to SR 520</td>
<td>$ 6,411,977</td>
<td>$ 732,743</td>
<td>$ 5,361,521</td>
<td>$ 12,506,241</td>
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<tr>
<td>I-405/SR 520 to Edmonds</td>
<td>$ 1,651,155</td>
<td>$ 4,783,537</td>
<td>$ 2,085,710</td>
<td>$ 12,876,732</td>
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<tr>
<td>I-5/Mercer Street to SR 522</td>
<td>$ 46,222,033</td>
<td>$ 33,464,915</td>
<td>$ 25,044,206</td>
<td>$ 191,158,693</td>
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<td>I-5/SR 522 to I-405</td>
<td>$ 728,002</td>
<td>$ 1,818,124</td>
<td>$ 3,964,873</td>
<td>$ 8,209,465</td>
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<tr>
<td>I-5/SR 900 to I-90</td>
<td>$ 74,810,307</td>
<td>$ 29,033,763</td>
<td>$ 77,597,179</td>
<td>$ 181,441,249</td>
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<tr>
<td>I-90/Puget Sound</td>
<td>$ 20,017,459</td>
<td>$ 45,345,828</td>
<td>$ 48,437,708</td>
<td>$ 113,800,995</td>
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<tr>
<td>SR 518</td>
<td>$ 800,734</td>
<td>$ 1,134,133</td>
<td>$ 1,934,867</td>
<td>$ 4,611,365</td>
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<tr>
<td>SR 526</td>
<td></td>
<td>$ 4,611,365</td>
<td></td>
<td>$ 4,611,365</td>
<td></td>
<td></td>
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<tr>
<td><strong>Grand Total</strong></td>
<td><strong>$ 40,725,652</strong></td>
<td><strong>$ 46,146,562</strong></td>
<td><strong>$ 180,443,866</strong></td>
<td><strong>$ 678,691,837</strong></td>
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</table>
WSDOT’s pavement technology innovations help offset declining investments

WSDOT uses pavement technology to make the state’s roads last longer and cost less. Efficiencies include:

- Dowel bar retrofits on concrete pavements
- Selective panel replacement and diamond grinding on concrete pavements
- Converting higher cost asphalt pavements to lower cost chip seal pavements ($151 million saved as of December 2011)

State highway pavement trends, 1990–2010
All pavement types; good/fair or poor condition; Pavement preservation expenditures in millions of 2011 dollars

Data source: WSDOT Materials Lab.
### 1990-2010: Changes in Pavement Asset Management

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Worst first</td>
<td>Lowest life cycle cost</td>
</tr>
<tr>
<td>Allocation funding</td>
<td>Need based funding</td>
</tr>
<tr>
<td>WSPMS as sideline</td>
<td>WSPMS as key decision making tool</td>
</tr>
<tr>
<td>Hveem mix design protocol</td>
<td>Superpave mix design</td>
</tr>
<tr>
<td>Volumetrics in the lab</td>
<td>Volumetrics in the field</td>
</tr>
<tr>
<td>Concrete Total Replacement</td>
<td>Dowel bar retrofit</td>
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<tr>
<td>Dowel bar retrofit</td>
<td>Triage protocol</td>
</tr>
<tr>
<td>Thick overlays (&gt;2&quot;+)</td>
<td>P-1 protocol (2&quot; overlays for all HMA)</td>
</tr>
<tr>
<td>No westside BST</td>
<td>All west side regions doing BST</td>
</tr>
<tr>
<td>BST only if ADT &lt;2000 ADT</td>
<td>BST on all routes under 5,000 ADT and consideration for routes between 5,000-10,000</td>
</tr>
<tr>
<td>No RAP</td>
<td>Consuming all the RAP produced in the state</td>
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<tr>
<td>No RAS</td>
<td>Test project with RAS</td>
</tr>
<tr>
<td>No clear pavement selection</td>
<td>Pavement Type Selection Protocol</td>
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<tr>
<td>No dowel bar selection</td>
<td>Dowel Bar Selection Protocol</td>
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</tbody>
</table>
Contact Info:

PATRICK MORIN, PE
OPERATIONS MGR, CAPITAL PGM DEVELOPMENT & MGMT
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
360-705-7141
MORINP@WSDOT.WA.GOV