International Symposium
of the 32nd Japan Road Conference

Management of Pavement Assets in Virginia

Gerardo W. Flintsch
Center for Sustainable Transportation Infrastructure, VTTI
10/31/2017
Content

1. VDOT’s Needs-Based Budgeting Process
2. Pavement Data Collection
3. Pavement Investment Decision Process
   → Network-level optimization
   → Project Selection
4. Performance Management
5. Concluding Remarks
1. VDOT’s Needs-Based Budgeting Process

✔ VDOT maintains and operates over 128,000 lane miles of pavements
  → Interstate: ~5,500 lane-miles
  → Primary: ~22,000 lane-miles
  → Secondary: ~100,000 lane-miles

✔ 3rd largest network of state maintained highways in the US
Annual Pavement Needs Methodology

✓ VDOT pavement management business processes use established asset management principles and policies

→ Annual condition assessment
  • 100% interstate & primary pavements + 20% secondary

→ Set performance targets and goals

→ Optimization of available funds using pavement management software

→ Performance monitoring and reporting
VDOT Needs

✓ Performance targets for pavements and bridges:
  → Pavement Performance
    • Interstate – 82%
    • Primary – 82%
    • Secondary – 65%
  → Bridge Performance
    • All Systems - 92%

✓ Calculate funding needs to meet performance measures/targets for a sustained program

✓ VDOT must also perform services such as
  → Snow Removal and Emergency Operations
  → Routine Maintenance
  → Incident Response
  → Drainage
  → Traffic Operations Center – 24 hour service
  → Mowing
## VDOT Needs and Budget

**FY 2016 VDOT Annual Needs and Preliminary Proposed Allocations For Existing Infrastructure ($ Millions)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Annual VDOT Needs</th>
<th>Preliminary Proposed M&amp;O Allocations</th>
<th>Preliminary Proposed Construction Allocations*</th>
<th>Total Preliminary Proposed Funding</th>
<th>Difference between Needs and Allocations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads</td>
<td>876</td>
<td>398</td>
<td>78</td>
<td>476</td>
<td>(400)</td>
</tr>
<tr>
<td>Bridges</td>
<td>832</td>
<td>187</td>
<td>145</td>
<td>332</td>
<td>(500)</td>
</tr>
<tr>
<td>Other Services and Repairs</td>
<td>1,380</td>
<td>973</td>
<td>7</td>
<td>979</td>
<td>(401)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$3,088</strong></td>
<td><strong>$1,558</strong></td>
<td><strong>$229</strong></td>
<td><strong>$1,788</strong></td>
<td><strong>($1,301)</strong></td>
</tr>
</tbody>
</table>
VDOT Anticipated FY 2016 Funding Distribution ($ Millions)
2. Pavement Management Data Collection

- Automated data collection contracted out
- Yearly data collection scope (VDOT Maintained):
  - 100% of interstate pavements
  - 100% of primary pavements
  - Approx. 20% of secondary pavements
- Primary Extensions (maintained by towns and localities) since 2014
- All NHS routes (required for Federal Reporting)
- High focus on quality data – Independent verifications
Data Collection Vehicle

**Photolog**
- Single view
- Panoramic view
- 1300 x 1030 pixel
- 1920 x 1080 (HDTV)
- Direct-to-digital
- Custom angles

**Geometry & Spatial**
- Inertial measurement unit
- HPMS curve type
- Long. Grade
- Cross slope
- Centerline mapping
- Spatial referencing for GIS integration

**Assets**
- Inventory from imagery
- Location determined
- Offset measured
- Height and width measured
- Sign code recorded
- Condition assessment

**Pavement**
- Image recognition software
- Strobe-lit pavement video
- Roughness
- Texture
- Rutting
- Surface Distress
- Ground Penetrating Radar
Ongoing Enhancements

Traffic Speed Deflectometer (TSD)
- Continuous deflections for the Interstate and primary roads
- Enhanced project selection decision tree

Continuous Friction Measurement Equipment
- FHWA Pavement Friction Management Support Program
- \( SPF_i = e^{\beta_0 + \sum_j (\beta_j X_{ij}) + \epsilon} \)
- Empirical Bayes Estimation
- B/C Estimations
3. Pavement Investment Decision Process

Central office
✓ Network level decision making
✓ **Network optimization**
✓ Allocates funding
✓ Sets paving targets
✓ Condition data collection
✓ LRS management

Maintenance Districts
✓ Project level decision making
✓ **Project selection**
✓ Rehabilitation design
✓ Recording pavement work
✓ Homogeneous sectioning
✓ Develop paving schedules – work program
✓ Construction management
## Pavement Condition Assessment

**Pavement Condition Category based on CCI**

- Excellent ($\geq 90$)
- Good (Between 70 and 89)
- Fair (Between 60 and 69)
- Poor (Between 50 and 59)
- Very Poor ($\leq 49$)

**Based on International Roughness Index (IRI)**

- Excellent ($< 60$)
- Good (Between 60 and 99)
- Fair (Between 100 and 139)
- Poor (Between 140 and 199)
- Very Poor ($\leq 200$)

*‘Poor’ and ‘Very Poor’ pavements are termed as ‘Deficient’*

**Sufficient**
Pavement Performance Targets:

- Interstate: at least 82% sufficient
- Primary: at least 82% sufficient
- Secondary: at least 65% sufficient

VDOT currently meets performance targets on the interstate and primary systems but not on the secondary system.
Repair Categories

Preventive Maintenance (PM)
- Minor Patching <= 2” Depth
  - < 5% pavement area
- Surface Treatment
- Thin Overlays up to 1”

Corrective Maintenance (CM)
- Moderate Patching <= 6” Depth
  - < 10% of pavement area
- PDP and thin (<= 2”) Overlay
- <= 2” Milling and <= 2”Overlay

Restorative Maintenance (RM)
- Heavy Patching <= 9” Depth
  - < 20% of pavement area
- FDP and up to 4” Overlay
- Milling and up to 4” Overlay

Reconstruction (RC)
- Mill, Break and Seat and Thick Overlay
- Reconstruction
- FDR
Unconstrained Needs Analysis

- Decision matrix rules for triggering treatments
- Provides section-by-section treatment and cost regardless of available funds
- Assists districts in making project level selections
- Factors include:
  - Distresses Collected (Pavement Condition)
  - Pavement Age, Pavement Structure, Traffic Levels
Optimization Analysis

✓ Network Level Scenarios (Multi-Constraint)
  → Maximize benefit objective
  → Budgetary & condition (CCI) constraints
  → Multi year,
  → Multi objective
✓ District Specific
✓ Route Classification Specific
  (Interstate, Primary, Secondary)
Project Selection

- Decentralized to the district level
- District pavement manager work with residency engineers to select specific sections and interventions
  - Often differ from network-level recommendation
- Must meet “optimized” performance targets
4. Performance Measures
District Level Performance Reporting Process

✓ Based on Optimization, set Baseline Targets
  → % Sufficient
  → Repair Category Lane Miles

✓ Compare Planned Projects vs. Actual Targets
  → Optimization Results vs. District Planned Projects
  → Unconstrained Results vs District Planned Projects

✓ Report differences in results
✓ Provide Districts with opportunities for course correction
✓ Finalize Project Lists and Performance Reports
Sample Report

Center for Sustainable Transportation Infrastructure

Hampton Roads Condition Summary

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstate</td>
<td>81.0%</td>
<td>82.0%</td>
<td>83.0%</td>
<td>84.3%</td>
</tr>
<tr>
<td>Primary</td>
<td>75.0%</td>
<td>80.0%</td>
<td>9.0%</td>
<td>8.4%</td>
</tr>
</tbody>
</table>

District Project Selections

Optimization Analysis Results

Differences Between 2013 Predicted and Targeted % Sufficient

<table>
<thead>
<tr>
<th>System</th>
<th>2013 Predicted % Sufficient</th>
<th>2013 Targeted % Sufficient</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstate</td>
<td>84.3%</td>
<td>83.0%</td>
<td>+1.3%</td>
</tr>
<tr>
<td>Primary</td>
<td>78.4%</td>
<td>79.0%</td>
<td>-0.6%</td>
</tr>
</tbody>
</table>
5. Concluding Remarks

- Adopted Asset Management practices in the 1990’s
- Clearly defined **performance targets**
- Clearly defined business processes (for decision support)
- **High quality data**
  - Pavements → bridges → other assets
- Two stage decision making process (supported by state of the art software)
  - Network optimization (central) → **Project selection** (decentralized)
- Emphasis on **communication** of performance targets and measures to “all” stakeholders
Credits

**Virginia DOT**
- Garrett Moore, Chief Engineer
- Tanveer Chowdhury
- Raja Shekharan
- Matthew Ayotte
- Akyiaa Morrison
- Brian Diefenderfer

- Aaron D. Gerber, Kercher Engineering
- Eric Perrone, AgileAssets
- Samer Katicha, VTTI
- Edgar de Leon, VTTI
International Symposium
of the 32nd Japan Road Conference

Management of Pavement Assets in Virginia

Gerardo W. Flintsch
flintsch@vt.edu