Network Safety Screening for Developing Projects in Virginia

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Highway Safety Improvement Program

- A core Federal aid program under FAST Act
- Purpose is to achieve a significant reduction of traffic fatalities and serious injuries on all public roads.
  - Avg. $2.4 billion/year
  - Funding Allocation formula
    > 33.3% based on lane-mile of federal-aid highway
    > 33.3% based on vehicle mile traveled on lanes on federal-aid highway
    > 33.3% based on number of fatalities on the federal-aid system
  - Requires a data-driven and strategic approach
- Virginia HSIP receives $45~60 million/year
HSIP Project Management Process
Network Screening

Purpose
For identifying and prioritizing “sites” needed for further safety assessment and targeted improvements.

Approach Methods
1) Crash Frequency (CF)
2) Crash Rate (CR)
3) Safety Performance Functions (SPFs)

Traditional > HSM
(1) Crash Frequency

\[ CF_i = \sum \# \text{ of crashes} \]
Network Screening: CR

(2) Crash Rate - Intersections

\[ CR_i = \frac{\sum \text{# of crashes}}{MEV_i} \]

\[ MEV_i = \frac{TEV_i \times \text{# of years} \times 365}{100,000,000} \]
(3) Safety Performance Function
Mathematical relationship between crash frequency and traffic volume for same facility type

\[ N_{\text{seg},i} = \exp(\alpha + \beta \cdot \ln AADT_i + \text{Length}_i) \]
\[ N_{\text{int},i} = \exp(\alpha + \beta_1 \cdot \ln AADT_{i,\text{maj}} + \beta_2 \cdot \ln AADT_{i,\text{min}}) \]
How to best define Potential for Safety Improvement?

- Crash Frequency (CF)
- Crash Rate (CF)
- SPF

\[ \text{PSI} = \text{Count} - \text{SPF Value} \]
National vs. VA Specific SPFs
### Development: VA-SPFVs

#### 16 Segment Types

<table>
<thead>
<tr>
<th>Segment Type</th>
<th>$\alpha$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural two-lane highway</td>
<td>-5.71</td>
<td>0.74</td>
</tr>
<tr>
<td>Rural multilane undivided highway</td>
<td>-6.91</td>
<td>0.82</td>
</tr>
<tr>
<td>Rural multilane divided highway</td>
<td>-7.47</td>
<td>0.88</td>
</tr>
<tr>
<td>Rural freeway – 4 lanes</td>
<td>-6.75</td>
<td>0.80</td>
</tr>
<tr>
<td>Rural freeway – 6+ lanes</td>
<td>-12.65</td>
<td>1.36</td>
</tr>
<tr>
<td>Rural freeway within an interchange – 4 lanes</td>
<td>-7.56</td>
<td>0.93</td>
</tr>
<tr>
<td>Rural freeway within an interchange – 6+ lanes</td>
<td>-13.11</td>
<td>1.45</td>
</tr>
<tr>
<td>Urban two-lane arterial</td>
<td>-6.11</td>
<td>0.80</td>
</tr>
<tr>
<td>Urban multilane undivided arterial</td>
<td>-7.88</td>
<td>0.94</td>
</tr>
<tr>
<td>Urban multilane divided arterial</td>
<td>-9.41</td>
<td>1.07</td>
</tr>
<tr>
<td>Urban freeway – 4 lanes</td>
<td>-18.05</td>
<td>1.98</td>
</tr>
<tr>
<td>Urban freeway – 6 lanes</td>
<td>-12.85</td>
<td>1.45</td>
</tr>
<tr>
<td>Urban freeways – 8+ lanes</td>
<td>-2.17</td>
<td>0.48</td>
</tr>
<tr>
<td>Urban freeway within an interchange – 4 lanes</td>
<td>-12.05</td>
<td>1.43</td>
</tr>
<tr>
<td>Urban freeway within an interchange – 6 lanes</td>
<td>-11.87</td>
<td>1.40</td>
</tr>
<tr>
<td>Urban freeway within an interchange – 8 lanes</td>
<td>-13.59</td>
<td>1.54</td>
</tr>
</tbody>
</table>

#### 8 Intersection Types

<table>
<thead>
<tr>
<th>Intersection Type</th>
<th>$\alpha$</th>
<th>$\beta_1$</th>
<th>$\beta_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural 3-leg with 2-way stop</td>
<td>-4.33</td>
<td>0.34</td>
<td>0.21</td>
</tr>
<tr>
<td>Rural 3-leg with traffic signal</td>
<td>-7.58</td>
<td>0.65</td>
<td>0.33</td>
</tr>
<tr>
<td>Rural 4-leg with 2-way stop</td>
<td>-5.49</td>
<td>0.35</td>
<td>0.39</td>
</tr>
<tr>
<td>Rural 4-leg with traffic signal</td>
<td>-6.96</td>
<td>0.68</td>
<td>0.25</td>
</tr>
<tr>
<td>Urban 3-leg with 2-way stop</td>
<td>-5.47</td>
<td>0.49</td>
<td>0.20</td>
</tr>
<tr>
<td>Urban 3-leg with traffic signal</td>
<td>-6.54</td>
<td>0.66</td>
<td>0.21</td>
</tr>
<tr>
<td>Urban 4-leg with 2-way stop</td>
<td>-6.07</td>
<td>0.46</td>
<td>0.35</td>
</tr>
<tr>
<td>Urban 4-leg with traffic signal</td>
<td>-7.62</td>
<td>0.67</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Evaluate 98% of VA roads!!
VDOT’s Network Screening (NS) using VA-SPFs
Annual NS: Annual

2011: 8,014.6 miles
2012: 8,302.1 miles
2013: 8,410.1 miles
2014: 8,196.6 miles
2015: 8,331.1 miles
Overall NS: Five Years

- Single Year: 12,553.9 miles
- Two Years: 6,181.0 miles
- Three Years: 2,760.0 miles
- Four Years: 1,254.9 miles
- Five Years: 607.8 miles
Target Safety Need (TSN)

- Single Year: 12,553.9 miles
- Two Years: 6,181.0 miles
- Three Years: 2,760.0 miles
- Four Years: 1,254.9 miles
- Five Years: 607.8 miles
About 2,500 intersections and 3,000 miles of segments were identified as **Target Safety Need (TSN)**

- Distribute **top 100 lists of intersections and segments** to VDOT Districts for developing HSIP projects.
- Used for **SMART SCALE** project identification and screening
- VDOT is the **First and Lead** state who implements local SPF for statewide roadway network screening.
Next Steps

- Publish annual intersection and segment Potential for Safety Improvement (PSI) >1
- Publish Target Safety Need (TSN) based on 3 of 5 years PSI
- Develop level of safety condition rating for TSN
- Use ArcGIS Online and OutsideVDOT SharePoint to distribute
- Continued development of SPFs for emphasis areas of Roadway Departure and Intersections
2015 National Roadway Safety Awards

Program Planning, Development, and Evaluation Category

Virginia: Deployment of HSIP Projects Using Virginia Specific Safety Performance Functions

Winner

Where safety improvements are concerned, one size definitely does not fit all.

The nature of crashes tends to be rather varied and somewhat unpredictable. In this context, engineers from the Virginia Department of Transportation (VDOT) started to notice that it is not as simple as deploying Safety Performance Functions (SPFs) for highways in their state. An SPF is a mathematical model that provides the existing level of performance. Since the SPF is tailored to a specific area, it has unique characteristics.

In this case, the SPF for Virginia is different from other states. To understand the performance that is observed, a model known as the Potential Safety Improvement (PSI) is used to identify the highest priority for highway safety improvements.

Limited safety funding is not used on improving safety results with an analysis of all of the state's miles of highway on an annual basis and maps of both the 100 and 1000 mile safety critical sections are created.

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2015 NATIONAL ROADWAY SAFETY AWARDS • NATIONAL TRANSPORTATION COUNCIL
2016 ITE Safety Awards

Transportation Achievement Awards

Operations

Implementation of an Adaptive Traffic Signal System in Bellevue, Washington, USA

Planning

City of San Luis Obispo Circulation Element Update
San Luis Obispo, California, USA

ITE’s 2016 Transportation Achievement Award for Planning is presented to the City of San Luis Obispo. The City studied its new Circulation Element and Multimodal Transportation Impacts Study Guidelines with bold multimodal policies, programs, and goals as well as added 2010 Highway Capacity Manual Multimodal Service Standards. Worth of recognition are vitally innovative policy area already starting large circulation within the City; an aggressive split objectives with matching budgeting policy with the level of service standards with a priority system for various street types. These achievements establish unique and meaningful actions for reaching the City’s mode split objectives.

City

Development of Virginia MSP Projects Using Virginia-Specific Safety Performance Functions
Richmond, Virginia, USA

2016 ITE Excellence in Transportation Awards

Expanding WYDOT's Truck Enforcement Opportunities
2016 International Annual Meeting & Exhibition, August 21-24, 2016, Anchorage, AK

ITE Excellence in Transportation Awards 2016