I guarantee the next 25 minutes will be a first time experience for each of you.
We are going to talk about PennDOT Pub 638A or the Statewide Predictive Analysis Methods Manual.
Preparing for Warp Drive

• Who has tried SPAM?

“DON’T KNOCK IT ‘TIL YOU’VE FRIED IT”

• What does SPAM stand for?
Preparing for Warp Drive

- Who has never seen an episode of Star Trek?
- Who has ever opened the AASHTO Highway Safety Manual?
- Who has ever heard of the PennDOT Publication 638: District Highway Safety Guidance Manual?
The Bridge of the Starship USS Enterprise (i.e. Agenda)

• PA Highway Safety: Past, Present, Future
• Publication 638 Series Overview
• Safety Performance Functions?
• PA’s Safety Tools and Resources
• Uses/Limitations/Expectations
### Reactive Decision Making

- Audits, observed crashes, crash rates, and homogeneous comparisons

### Predictive Decision Making

- Statistics, baseline facilities, site specific adjustments, location calibrations, benefit comparisons, prioritizations

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**Table 1. Primary Analysis Application for Safety Assessment Methods**

<table>
<thead>
<tr>
<th>Application</th>
<th>Basic</th>
<th>Intermediate</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance of an Existing Road</td>
<td>1</td>
<td>1, 2</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Future Impact of Minor Geometric Changes to Existing Road</td>
<td>1, 2, 3</td>
<td>1, 3</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>Future Impact of Major Geometric Changes to Existing Road</td>
<td>1, 3, 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Future Performance for a New Facility</td>
<td>1, 4</td>
<td>1, 3, 4</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- AADT = average annual daily traffic.
- CMF = crash modification factor.
- SPF = safety performance function.

**Basis for Analysis:**
- 1 = site characteristics,
- 2 = crash history,
- 3 = CMF values,
- 4 = AADT.

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FHWA, Scale and Scope of Safety Assessment Methods in the Project Development Process, November 2016
PA Highway Safety: Past, Present, Future

District Highway Safety Guidance Manual

December, 2014

Regionalized Safety Performance Functions

FINAL REPORT
January 8, 2016

By Eric Donnel, Victor Grego, and Paul Javana

Pennsylvania Department of Transportation

70 mph Study

FINAL REPORT
June 30, 2016

By Eric T. Donnel, Bache Harling, and Lingyu Li, and Jonathan Woods

Pennsylvania Department of Transportation

Scale and Scope of Safety Assessment Methods in the Project Development Process

FHWA Safety Program
<table>
<thead>
<tr>
<th>Table of Contents (Today)</th>
<th>Table of Contents (Soon)</th>
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</thead>
<tbody>
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<td>• Chapter 1 – Introduction</td>
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<td>• Chapter 2 – Plans, Programs, Activities</td>
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<td>• Chapter 3 – Safety Related Functions</td>
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<td>• Chapter 4 – Crash Data</td>
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<td>• Chapter 5 – Studies and Countermeasures</td>
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<td>• Chapter 6 – Other Safety Topics</td>
<td>• Chapter 6 – HSIP Guidance</td>
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<td>• Appendix A – District Safety Plans</td>
<td>• Chapter 7 – District Safety Plans</td>
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<td>• Appendix B – Yield to Pedestrian Devices</td>
<td>• Chapter 8 – Other Safety Topics</td>
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<tr>
<td>• Appendix C – Crash Data Resources</td>
<td>• Appendix A – Yield to Pedestrian Devices</td>
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<tr>
<td>• Appendix D – Resources</td>
<td>• Appendix B – Safety POCs</td>
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<tr>
<td>• Appendix E – SPF Guide</td>
<td>• Appendix C – Resources</td>
</tr>
<tr>
<td>• Appendix F – Crash Modification Factors</td>
<td></td>
</tr>
</tbody>
</table>
Publication 638A Content Overview

• **Table of Contents**
  
  • Chapter 1 – Basics
    • Predictive Method
    • Empirical Bayes Method
    • PA vs. AASHTO Differences
    • Defining Analysis Sections
    • CMF Evaluations
  
  • Chapter 2 – Utilizing Pennsylvania Regionalized Safety Performance Functions for the HSM Part C Predictive Method
  
  • Appendices
    • A – Roadside Hazard Rating Determination
    • B – Degree of Curvature per Mile Determination
    • C – Example Calculations
Safety Performance Function (SPF): a statistically derived equation that estimates (or predicts) the average number of crashes per year likely to occur on a roadway of a particular type.

Penn State University developed Pennsylvania Regionalized SPFs. 90 total SPFs were developed for 15 (19) different intersection and segment types. 20 now in 638A to include rural freeway segment.

\[
\text{Predicted Number of Crashes using SPF} = \text{Short Preliminary Equation} \times \text{Base Condition Adjustment Factors}
\]

The PennDOT Regionalized SPF equations typically take the following form:

\[
N_{spf} = (e^{x \times \text{AADT}^x \times L}) \times e^{0.0115xRHR_4} \times e^{0.16xPZ_x} \times e^{0.01xAD} \ldots.
\]
Role of the SPF

Roadway/Intersection Type → Traffic Volumes → Segment Length → Site Specific Base Conditions → Historical Crash Data

Safety Performance Function → Predicted Number of Crashes

Observed Number of Crashes

Apply Overdispersion Factor

Expected Number of Crashes

Adjustment Factors (Independent Variables)
Why Regional Safety Performance Functions?

- There can be a major difference in values between the National, State, District, and County level SPFs.

Note: Calibration Factor for Venango County = .79. There is a decrease of 22% in the yearly crash rate with respect to District (1-0).
Supporting Safety Tools

https://www.penndot.gov/TravelInPA/Safety/Pages/default.aspx

https://crashinfo.penndot.gov/PCIT/welcome.html
Supporting Safety Tools

PA HSM tools & resources are available at:

- ECMS website’s references/file cabinet or
- PennDOT’s Safety Website

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Centerline, Edgeline and Shoulder Rumble Strips

Rumble strips are raised or grooved patterns that differ in texture from the road surface and produce a rumbling sound and cause the vehicle to vibrate when a vehicle’s tires pass over them. The noise and vibration produced by rumble strips are effective alarms for drivers who are leaving their lane of the roadway. The number of fatalities in head-on crashes has declined by 50 percent since 2000 thanks to the installation of more than 6,000 miles of centerline rumble strips.

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Warning of Curve Ahead

PennDOT enhances advanced curve warning through the use of pavement markings applied directly to the roadway, as well as signs indicating curve ahead.
Supporting Safety Tools

National Options
- CMF Clearinghouse
- IHSDM
- ISATe
- HSM Spreadsheets

Free & available at:
http://www.highwaysafetymanual.org/Pages/Tools.aspx
Uses & Limitations

- Not all facilities have a regionalized SPF or AASHTO SPF
- Freeways, ramps, and ramp terminals = 2014 HSM supplement
  - Currently working to have these SPFs calibrated for use (circa Feb. 2019)
- Definitions of ‘segment’ depending on HSM vs PA SPFs
- EB formulas differ because of differences calculating over-dispersion parameter (i.e. where ‘L’ is part of calculation)
- One-way facilities are excluded
- Developing Urban/Suburban Collector Facility SPFs (no other state nor AASHTO have these at this time)
- Adjustment Factors can change between counties (i.e. a passing zone adjustment factor)
- Urban area with tight intersection spacing can lead to inappropriate segment calculations
• HSM2 anticipated for release in 2020
  – The following measures will be removed:
    • Average Crash Frequency
    • Crash Rate
    • Equivalent Property Damage Only (EPDO) Average Crash Frequency
    • Relative Severity Index
  – The following will be changed in the HSM2
    • Level of Service of Safety
• Policy and guidance for when to use the HSM on projects is included Chapter 5 and Chapter 6.
Questions

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