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PLANNING IT SAFE: Navigating Data-Driven Safety Analysis (DDSA)

Derek Troyer, PE
Kendra Schenk, PE, PTOE
Ohio has experienced four years of rising traffic deaths.
DATA DRIVEN SAFETY ANALYSIS

Safety Analysis for All Projects

- Process developed to right size the level of safety analysis based on project type

More Informed Decision Making

Better Targeted Investments

Fewer Fatalities & Serious Injuries
• Day 1
  • Roundabouts and Humans (A223-225)
  • Data Driven Safety Analysis (A223-225)
  • Emerging Trends in Safety (A110-112)

• Day 2
  • Tackling Emerging Safety Trends (B131-132)
  • Proven Safety Countermeasures (A123-125)
  • Performance Based (Safety) Project Development (B130)
WHY DOES IT MATTER?
UNDERSTANDING EXISTING SITE PERFORMANCE

- Review statewide or regional priority list
- Previous safety reviews of the location or project
- Review of observed crash trends
- Use analysis procedures included in the AASHTO Highway Safety Manual

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USES FOR DDSA

- Evaluate safety performance to know how it compares to peer sites or other alternatives being evaluated
- Targeting investments where there is a potential to reduce crashes
WHAT ARE THE IMPACTS?
Added Crash Analysis requirement in 2016

✓ Review state and regional priority list

✓ Research previous safety analysis

✓ Review observed crash data
  o Document Crash Patterns that exist
Requires the Crash Analysis be completed prior to scoping the project
- Improved Scoping
- Identify potential funding sources

Elements included in the Project Initiation Package (PIP)
Purpose and Need statements are important

- Only include safety considerations when there is a documented crash pattern or site is performing worse than its peers
- Additional analysis will be required if safety is included in the P&N
Quantify your safety performance

Mirroring the capacity analysis process

- Analyze existing conditions
- Analyze each build alternative
- Compare results
PROJECT DESIGN

Use knowledge gained from the feasibility study

Identify project elements sensitive to crash frequency variation

- Offsets to barrier
- Signal operation
- Lane width
LOCAL GOVERNMENTS

Can apply same procedures on local projects

- Alternatives evaluation
- Potential for cost savings
- Implement countermeasures as part of project
BREAKING DOWN THE CHARTS
BREAKING DOWN THE CHARTS

- PDP Paths 1 and 2
  (No Alternative Analysis)
BREAKING DOWN THE CHARTS

- PDP Paths 3, 4, & 5
  (Alternatives Analysis)

  For projects **without** the explicit reference to “Safety” in the purpose and need.
  AND
  For projects not requesting safety funding.

- PDP Paths 3, 4, & 5
  (Alternatives Analysis)

  For projects with “Safety” considerations in the purpose and need.
  AND / OR
  For projects with intended safety funding requests.
MINIMAL SAFETY ASSESSMENT

1. Obtain applicable studies for project area (including safety studies)
2. Determine if location is on ODOT SIP Map
3. Determine ranking on ODOT or local safety priority list or within a Local Road Safety Plan (LRSP)
4. Analyze Historical/Observed Crash Data
OBTAIN APPLICABLE STUDIES

- Feasibility Studies
- Corridor Studies
- Traffic Impact Studies
- SAFETY STUDIES

**No Build Configuration**
- US 42 bridge needs to be replaced.
- LOS F for 2035 PM peak hour.
- 41 crashes from 2008 – 2010 with 33 (83%) rear-end crashes.
- Crash Rate = 18.7 crashes/yr

**Alternative 2 Reconfigure Ramps**
- Reconfigure ramp movements.
- Move the signal on US 250.
- Add a signal on US 42.
- Widen US 250.
- Limit Davis Rd to right-in/right-out.
- Crash Rate = 12.2 crashes/yr
- Total Cost = $9.3M
MINIMAL SAFETY ASSESSMENT

Obtain applicable studies for project area (including safety studies)

Determine if location is on ODOT SIP Map

Determine ranking on ODOT or local safety priority list or within a Local Road Safety Plan (LRSP)

Analyze Historical/Observed Crash Data
DETERMINE IF LOCATION IS ON ODOT SIP MAP

Highway Safety

These maps provide Ohio's safety and priority locations. They are mapped statewide. However, you can retrieve the maps for specific regions by typing the desired ODOT District Number, County Name, or Township Name into the filter below.

### ODOT District Filter
- Type District Number

### County Name Filter
- Type County Name

### Township Name Filter
- Type Township Name

#### Safety Related PDF Maps
- **MapList:** Congested Segment Locations (12)
- **MapList:** County Fact Sheets (88)
- **MapList:** County Road Safety Locations (88)
- **MapList:** HRRR Safety Locations (88)
- **MapList:** HSIP Priority List (88)
- **MapList:** Safety Integrated Project (SIP) Maps (176)

#### Statewide PDF Maps
- **StatewideList:** Congested Segment Locations (1)
- **StatewideList:** HSIP Priority List (1)
- **StatewideList:** State Thematic Map (4)

#### Township Tree Diagrams
Township tree diagrams can be used in conjunction with the maps to better understand crash trend in rural townships. County Level Tree Diagrams could be found on the 3rd and 4th pages of the County Fact Sheets to the left.

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MINIMAL SAFETY ASSESSMENT

Obtain applicable studies for project area (including safety studies)

Determine if location is on ODOT SIP Map

Analyze Historical/Observed Crash Data

Determine ranking on ODOT or local safety priority list or within a Local Road Safety Plan (LRSP)
### DETERMINE RANKING ON SAFETY PRIORITY LISTS

#### ODOT District Filter
- **Type District Number**

#### County Name Filter
- **Type County Name**

#### Township Name Filter
- **Type Township Name**

#### Safety Related PDF Maps
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- **MapList : Township Road Crash Locations (1309)**

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#### Google Map Apps
- [Safety Priority List Google Map Application](#)
- Congestion Priority List Google Map Application
- High Risk Rural Road Google Map Application

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DETERMINE RANKING ON SAFETY PRIORITY LISTS

Highway Safety Improvement Program

Safety Priority List Google Map...

Use the Google Map application to geographically place safety list priority locations. Click on the colored dots to bring up a pop-up box of information.
<table>
<thead>
<tr>
<th>Full Name</th>
<th>Worksheet/Tab Link</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Analyst Background Information</td>
<td>Background</td>
<td>Background information about Safety Analyst and the procedure for developing the Highway Safety Program Lists.</td>
</tr>
<tr>
<td>Attribute Definitions</td>
<td>Definitions</td>
<td>Definitions of attributes contained in the safety lists.</td>
</tr>
<tr>
<td>2016 Rural Intersection Peak Searching Excess Locations (2014-2016)</td>
<td>RuralInt</td>
<td>These locations were selected because they have a higher-than-predicted crash frequency for each intersection. Approximately, the Top 50 locations will be studied. The remainder of the locations listed have a higher-than-predicted frequency of crashes and can be used as a reference.</td>
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<tr>
<td>2016 Rural Non-Freeway Peak Searching Excess Segment Locations (2014-2016)</td>
<td>RuralNonFwy</td>
<td>These locations were selected because they have a higher-than-predicted crash frequency for this roadway type or interchange location. Approximately, the Top 50 locations will be studied. The remainder of the locations listed have a higher-than-predicted frequency of crashes and can be used as a reference. Only crashes indicated on the OH-1 as being non-intersection crashes were included in this analysis.</td>
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<td>UrbanInt</td>
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<td>1</td>
<td>E Livingston Ave @ High Point Rd / SR 365</td>
<td>Columbus</td>
</tr>
<tr>
<td>2</td>
<td>Frank St / SR 16 @ James Rd</td>
<td>Columbus</td>
</tr>
<tr>
<td>3</td>
<td>Cleveland Ave @ Iris Rd</td>
<td>Franklin County</td>
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<td>4</td>
<td>East 4th St @ Morse Rd</td>
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<td>Morse Rd @ Westerville Rd / SR 3</td>
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<td>E Livingston Ave / US 33 @ Alum Creek Dr</td>
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<td>10</td>
<td>Cleveland Ave / SR 3 &amp; E Francis St</td>
<td>Columbus</td>
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<td>11</td>
<td>Central Ave @ Oakwood Park</td>
<td>Columbus</td>
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<td>12</td>
<td>E Main St / US 60 @ Meigs Terrace Rd</td>
<td>Columbus</td>
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<td>Orange Grove Rd / SR 161 @ Meade Driving Dr</td>
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<td>16</td>
<td>Towne Rd / SR 141 / Rehg Ave Rd / Worthington Pkwy</td>
<td>Columbus</td>
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<tr>
<td>17</td>
<td>S Central Ave / Harigans Pkwy @ W McCorkle Rd</td>
<td>Columbus</td>
</tr>
<tr>
<td>18</td>
<td>Cleveland Ave @ Morse Rd</td>
<td>Columbus</td>
</tr>
</tbody>
</table>

**BURGESS & NIPLE**
MINIMAL SAFETY ASSESSMENT

Obtain applicable studies for project area (including safety studies)

Determine if location is on ODOT SIP Map

Determine ranking on ODOT or local safety priority list or within a Local Road Safety Plan (LRSP)

Analyze Historical/Observed Crash Data
2.2 Safety Study Analysis Resources and Tools

2.2.1 GIS Crash Analysis Tool (GCAT)

ODOT’s GIS Crash Analysis Tool (GCAT) is an easy-to-use tool that provides a convenient way for qualified agencies to search statewide crash data. Once searched, this data can then be downloaded and analyzed using the ODOT CAM Tool (Crash Analysis Module) or Economic Crash Analysis Tool (ECAT). The purpose of GCAT is to provide a convenient highway safety crash analysis tool for ODOT, MPOs, and county engineers. The tool includes both state system and local system crash data that is spatially located and unincorporated. The tool allows for viewing of the crash data to enable download of crash data (located or unlocated) meeting parameters established by the user. For queries of located crashes, the GIS Crash Analysis Tool uses SDE (Geographic Information Systems) to produce data that is spatially located (with valid latitude/longitude).

While the crash data provided by GCAT is not official, it has been provided by the Ohio Department of Public Safety and modified by ODOT for use in engineering and analysis such that it performed to complete safety studies. Original crash data reports can be obtained from the law enforcement agency handling the crash or the Department of Public Safety Ohio Traffic Safety Office Crash Data site.

2.2.2 Crash Analysis Module (CAM) Tool

The CAM tool is a useful resource when preparing safety studies. Crash summaries, graphs, and charts can be created that assist with diagnosis safety issues and defining safety issues through crash statistics. Users are also able to create simple collision diagrams through the tool. The ODOT Crash Analysis Module (CAM) tool is currently the recommended tool used by Local Public Agencies for their identification and evaluation of safety issues within their communities and in preparation of safety studies for Ohio roadway facilities not included in the state system databases. ODOT is in the process of incorporating all Ohio roads into their databases will continue to work with local public agencies to update data and roadway inventory systems with the intent of transition the GCAT for use in safety study analysis for all Ohio roadways. These tools will continue to be made available for use in evaluating proposed safety countermeasures on the local system until such time as ODOT has determined it is appropriate.

ODOT has updated the Crash Analysis Module (CAM) Tool Rate of Return (ROR) Tool as of August 2012 to incorporate Crash Modification Factors (CMF) / Crash Reduction Factors (CRF) from the NCM Parts C and Part D.

2.2.3 Transportation Information Mapping System (TIMS)

ODOT’s Transportation Information Mapping System (TIMS) is a web-mapping portal where users can query information about Ohio’s transportation system, create maps, and share information. TIMS is a multi-functional application available for use by the public and ODOT employees. The intent of TIMS is to provide employees and the public easy access to data about Ohio’s transportation system.

Data/information in TIMS includes the following:

Most Recent 3-Years of Crash Data
ANALYZE HISTORICAL/OBSERVED CRASH DATA

Total Rear End Crashes
Injury Rear End Crashes
(Compared to Injury % for Multi-Vehicle Crashes)
Angle Crashes
(Including Left-Turn Crashes)
Sideswipe Crashes

Below Statewide Average
Statewide Average
Above Statewide Average

OHIO SHSP
EMPHASIS AREAS (Total Crashes)

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<th>Target Group</th>
<th>2016 Total Crashes</th>
<th>2016 % of Total</th>
<th>2015 Total Crashes</th>
<th>2015 % of Total</th>
<th>2014 Total Crashes</th>
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# Minimal Safety Assessment

## Project Safety Analysis Checklist

### Non-Complex Projects

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<th>B</th>
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<td>Priority List Rankings</td>
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<td>Historical Crash Data</td>
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**odot**

BURGESS & NIPLE
o Very little analysis

o “If it ain’t broke, don’t fix it”

o Could mitigate lower-ranking safety hot spots
PDP PATHS 3, 4, & 5 (NO SAFETY COMPONENT)

Will any alternative use SPF's that differ from the existing conditions?

- Yes
  - Estimate the change in predicted crashes (with CMFs) for the major project components for each alternative
  - Use results in conjunction with Environmental, Right-of-Way, Operation, Geometrics, and Cost components to select preferred alternative that fulfills the purpose and need.
  - Use existing crash data in alternatives HSM analysis
  - End

- No
  - Do not use existing crash data in alternatives HSM analysis
PDP PATHS 3, 4, & 5 (SAFETY COMPONENT)

Perform HSM analysis to establish baseline conditions

Estimate expected crashes (with CMFs) for the existing conditions

Will any alternative use SPFs that differ from the existing conditions?

Yes

Estimate the change predicted crashes (with CMFs) for the major project components for each alternative

No

Estimate the change expected crashes (with CMFs) for the major project components for each alternative

Do not use existing crash data in alternatives HSM analysis

Use existing crash data in alternatives HSM analysis

Does at least one alternative reduce crashes or crash severity?

Does at least one alternative reduce crashes or crash severity?
INTERPRETING RESULTS
## INTERPRETING RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Alternative A</th>
<th>Alternative B</th>
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<tbody>
<tr>
<td>LOS</td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>Queue Length Reductions</td>
<td>10%</td>
<td>40%</td>
</tr>
<tr>
<td>R/W Impacts</td>
<td>None</td>
<td>2 parcels</td>
</tr>
<tr>
<td>Construction Costs</td>
<td>$300,000</td>
<td>$750,000</td>
</tr>
<tr>
<td>Crash Reductions</td>
<td>2 crashes/year</td>
<td>6 crashes/year</td>
</tr>
<tr>
<td></td>
<td>1 injury crash/year</td>
<td>0.5 injury crash/year</td>
</tr>
</tbody>
</table>
INTERPRETING RESULTS
I-670/I-270 INTERCHANGE ANALYSIS

ALTERNATIVE 1

TO DOWNTOWN

TO EASTON

NORTH
INTERPRETING RESULTS
I-670/I-270 INTERCHANGE ANALYSIS
INTERPRETING RESULTS
I-670/I-270 INTERCHANGE ANALYSIS

- **No Build**
  - 9 freeway segments
  - 3 ramp segments
  - 5.69 miles

- **Build**
  - 14 freeway segments
  - 3 ramp segments
  - 8.00 miles
INTERPRETING RESULTS
I-670/I-270 INTERCHANGE ANALYSIS
INTERPRETING RESULTS
I-670/I-270 INTERCHANGE ANALYSIS

Predicted Crash Frequency per Year

KA  B  C  O  TOTAL

No Build  Alt 2  Alt 3

3.62  4.90  4.65  12.01  14.39  13.76  13.86  15.89  15.20  66.05  84.89  80.65  95.54  120.06  114.27

BURGESS & NIPLE
INTERPRETING RESULTS
I-670/I-270 INTERCHANGE ANALYSIS

Predicted Crash Frequency per Year per Mile

KA B C O TOTAL

0.64 2.11 2.44 11.61
0.61 1.80 1.99 10.61
0.58 1.72 1.90 10.08

No Build  Alt 2  Alt 3

TOTAL

16.79 15.01 14.28
INTERPRETING RESULTS
I-670 SMARTLANE

I-670 SMARTLANE

Westbound A.M. Traffic Flow: 450 Cars
### Initial HSM Analysis Results

<table>
<thead>
<tr>
<th></th>
<th>KA</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Build</td>
<td>6.5</td>
<td>22.0</td>
<td>23.2</td>
<td>137.1</td>
<td>188.9</td>
</tr>
<tr>
<td>Build</td>
<td>7.1</td>
<td>23.1</td>
<td>24.3</td>
<td>142.0</td>
<td>196.5</td>
</tr>
<tr>
<td>Difference</td>
<td>+0.6</td>
<td>+1.1</td>
<td>+1.1</td>
<td>+4.9</td>
<td>+7.6</td>
</tr>
</tbody>
</table>

*BASED ON WEIGHTED VOLUME ANALYSIS OF WHEN SMARTLANE IS OPERATIONAL AND WHEN IT IS CLOSED*
Countermeasures to prevent fixed object crashes

- **Rumble Strips**
- **Wider Edge Line**
## Final HSM Analysis Results (With Countermeasures)

<table>
<thead>
<tr>
<th></th>
<th>KA</th>
<th>B</th>
<th>C</th>
<th>O</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Build</td>
<td>6.5</td>
<td>22.0</td>
<td>23.2</td>
<td>137.1</td>
<td>188.9</td>
</tr>
<tr>
<td>Build</td>
<td>5.7</td>
<td>18.5</td>
<td>19.5</td>
<td>142.0</td>
<td>185.7</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.8</td>
<td>-3.5</td>
<td>-3.7</td>
<td>+4.9</td>
<td>-3.2</td>
</tr>
<tr>
<td></td>
<td>(13%)</td>
<td>(16%)</td>
<td>(16%)</td>
<td>(4%)</td>
<td>(2%)</td>
</tr>
</tbody>
</table>

*Based on weighted volume analysis of when Smartlane is operational and when it is closed.*
INTERPRETING RESULTS
I-71 ANALYSIS

EXISTING

ALTERNATIVE 1
ALT 1 - MAINLINE PAVEMENT WIDENING TO FULL LANE AND SHOULDER WIDTH

ALTERNATIVE 2
ALT 2 - UTILIZE EXISTING MAINLINE PAVEMENT WIDTH (REDUCE LANE AND SHOULDER WIDTH)

ALTERNATIVE 3
ALT 3 - UTILIZE EXISTING MAINLINE PAVEMENT WIDTH (REDUCE SHOULDER WIDTH)
# INTERPRETING RESULTS
## I-71 ANALYSIS

<table>
<thead>
<tr>
<th></th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal and Serious Injury</td>
<td>-1.00</td>
<td>-0.89</td>
<td>-0.85</td>
</tr>
<tr>
<td>Injury</td>
<td>-8.48</td>
<td>-7.67</td>
<td>-7.31</td>
</tr>
<tr>
<td>Total Crashes</td>
<td>-46.35</td>
<td>-44.98</td>
<td>-43.44</td>
</tr>
<tr>
<td>Safety B/C</td>
<td>2.75</td>
<td>3.53</td>
<td>3.29</td>
</tr>
</tbody>
</table>

## DRAFT RESULTS

### ALTERNATIVE 1
![Alternative 1 Diagram]

### ALTERNATIVE 2
![Alternative 2 Diagram]

### ALTERNATIVE 3
![Alternative 3 Diagram]
Safety is just one metric to help make the best decision

More to the results than meets the eye
SUMMARY

- Safety should be incorporated into all projects - ODOT policy changes
- Cost savings could be identified from safety analysis
- Safety can be used as a qualitative metric to evaluate alternatives
QUESTIONS?

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