Mission

To provide a safe, efficient, environmentally sound and fiscally responsible transportation system that delivers economic opportunity and enhances the quality of life in Kentucky.
DDSA Implementation Plan

- Version 1 Released Late Aug.
- Living Document
- Roadmap for how Data Driven Safety is happening in Kentucky
- Data, Project Development, PD&P, Tools, Training, Marketing
Planning
- Identify needs and program projects
  - Identify sites most likely to benefit from safety improvements
  - Identify targeted crash patterns for the network
  - Prioritize expenditures for efficiency

Construction
- Build projects
  - Evaluate how performance measures are impacted by design changes and construction
  - Assess potential change in crash frequency in work zone

Design
- Identify alternatives, choose and design preferred solutions
  - Identify targeted crash patterns for projects
  - Evaluate countermeasures’ costs and effectiveness
  - Compare change in crash frequency to predict safety effect of alternatives

Maintenance and Operations
- Modify existing conditions to maintain and improve safety and efficient operations
  - Identify crash patterns at existing locations
  - Evaluate safety effectiveness of potential countermeasures
  - Modify policies and design criteria for future planning and design
Excess Expected Crashes
Planning Focuses

- Network Screening
- Project Prioritization (SHIFT)
- Draft Purpose & Need / Project Types
- Planning Studies
  - Examples
- Implementation Timeline
Network Screening

- GIS-based tool developed in tandem with SHIFT 2020
- Shows EEC and VHD (congestion) values
- Working on online GIS-based tool
MIDDLETOWN to SIMPSONVILLE
NEEDS ANALYSIS STUDY

FINAL REPORT
JULY 2019
Study initiated in September 2019 with Qk4

Prioritize existing projects and aid in decision-making process

Used network screening tool as part of existing conditions and gap analysis
Network Screening - Future

- Identify gaps not covered by ongoing projects before SHIFT 2022
- Work with HDOs, ADDs, and MPOs to develop improvement options
Continuous Highway Analysis Framework (CHAF)

- Successor to PIF
- Much more interactive, dynamic tool
- Interfaces with HIS, SHIFT, other databases
- Will pull CDAT outputs automatically, and update when SPFs are updated
Prioritization

- Incorporate DDSA into SHIFT Process
- Use EEC instead of CRF for Safety Measure
- Benefit/Cost using Safety Benefit Factors
Crash History Formulas

Statewide: 15%  Regional: 15%

$$\sum (\text{EECs})^{\text{scaled}}$$

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
<th>Summary Method</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEC</td>
<td>Excess Expected Crashes</td>
<td>Expected Crashes – Predicted Crashes</td>
<td>Crash Database</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HIS</td>
</tr>
</tbody>
</table>

$^{\text{Scaled}}$ - The percentile rank of the value. Converts value to score of 0 to 100.
Statewide Score = 20% \times (Benefit / Cost) Measure (BCM) :

Regional Score = 15% \times (Benefit / Cost) Measure (BCM) :

\[ 0.5 \times \left( \frac{BTTS}{C_{PROJ}} \right)^{\dagger}_{\text{Scaled}} + 0.5 \times \left( \frac{BSAF}{C_{PROJ}} \right)^{\dagger}_{\text{Scaled}} \]

<table>
<thead>
<tr>
<th>Measure</th>
<th>Summary Method</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTTS: Travel Time Savings Benefit $</td>
<td>(<strong>Travel Time Savings</strong>) \times (sum of delay costs by vehicle type)</td>
<td>KY Statewide Model</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HCM Method</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jackelope</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HIS</td>
</tr>
<tr>
<td>BSAF: Safety Benefit $</td>
<td>(Safety Benefit Factor of improvement type) \times (crash costs over last 5 yrs, 2013-2017)</td>
<td>Crash Database</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHAF</td>
</tr>
<tr>
<td>CPROJ: Family Project Cost Phases R,U &amp; C</td>
<td>Summary</td>
<td>SYP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHAF</td>
</tr>
</tbody>
</table>

\dagger_{\text{Scaled}} - The percentile rank of the value. Converts value to score of 0 to 100.

\dagger\dagger \text{Travel Time Savings for major improvements were calculated using the Kentucky Statewide Model. Travel Time Savings for smaller improvements are calculated via HCM iterative formulas.}
Safety Benefit Factors

- Derived from Kentucky-specific Crash Modification Factors (CMFs)
- Tied to improvement type in CHAF
- No data for constructing new roadways

\[ CMF_{PL} = \frac{(1 - SBF)}{100} \]

<table>
<thead>
<tr>
<th>Improvement Type</th>
<th>CMF Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install Two-Way Left Turn Lane</td>
<td>0.72</td>
</tr>
<tr>
<td>Install Two-Way Left Turn Lane Road Diet (4-Lanes to 2-lanes plus TWLTL)</td>
<td>0.63</td>
</tr>
</tbody>
</table>
Level of Service of Safety (LOSS)
Let the data drive the process

“Safety” included immediately at LOSS 3 and 4

Reduction of specific crash type/situation called out if prevalent

Draft until environmental document – more data can always change things!
Planning Studies

- Initiate the Project Development Process
- Can range from small DNA to large IJS
- ~2.5 Levels of Safety Analysis
Use of CDAT to derive EEC and crash type information

Every study and every potential project gets this look

Included for all CHAFs and DNA Studies.
Data Needs Analysis (DNA)

- High-level planning document
- Typically completed before design advertisements with no prior planning
- Preliminary Purpose & Need defined, with “safety” included at LOSS 3 or 4.
Planning Level 2

- Uses CDAT to derive EEC and crash type information
- Uses EEC as a screening tool to hone in on potential issues
- Uses CMFs/SBFs for basic benefit-cost analysis of potential improvement options
- Scoping/Corridor Studies, SUAs, SWCP
### Basic Benefit-Cost

- Use KY Comprehensive Costs by Crash Severity and Crash Reduction Factors
- All-phase planning-level cost estimate
- Travel Time Savings if applicable
- No Discount rate

The **COMPREHENSIVE COST** ($18.9 billion) was derived from the following formula:

<table>
<thead>
<tr>
<th></th>
<th>COST PER</th>
<th>NUMBER REPORTED</th>
<th>ESTIMATED COST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fatalities</strong></td>
<td>$10,080,000</td>
<td>763</td>
<td>$7,691,040,000</td>
</tr>
<tr>
<td><strong>Incapacitating Injuries</strong></td>
<td>$1,100,000</td>
<td>3,114</td>
<td>$3,425,400,000</td>
</tr>
<tr>
<td><strong>Non-Incapacitating Injuries</strong></td>
<td>$304,000</td>
<td>12,493</td>
<td>$3,797,872,000</td>
</tr>
<tr>
<td><strong>Possible Injuries</strong></td>
<td>$140,000</td>
<td>21,740</td>
<td>$3,043,600,000</td>
</tr>
<tr>
<td><strong>Property Damage Only</strong></td>
<td>$8,500</td>
<td>114,780</td>
<td>$975,630,000</td>
</tr>
<tr>
<td><strong>TOTAL COMPREHENSIVE COST ESTIMATE</strong></td>
<td></td>
<td></td>
<td><strong>$18,933,542,000</strong></td>
</tr>
</tbody>
</table>
Scoping/Corridor Studies

- In-depth examination of potential project area
- Existing Conditions, Environmental Analysis, Improvement Options, Public Involvement
- EEC for screening and CMF/SBF for benefit-cost of improvement options
Small Urban Area (SUA) Study

- Thorough examination of network serving population between 5k and 50k
- Long- and short-term improvements on state, local, private roadways
- Network screening with EEC, and basic benefit-cost for improvement options
EEC Replacing CRF Example
# EEC Replacing CRF Example

## Crash Analysis

<table>
<thead>
<tr>
<th>Segment</th>
<th>County</th>
<th>Type</th>
<th>Beg MP</th>
<th>End MP</th>
<th>Existing AADT</th>
<th>3-year Observed Crashes</th>
<th>KY SPF*</th>
<th>Estimate of Expected Crashes</th>
<th>Excess Expected Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>South of Exit 105</td>
<td>Bullitt</td>
<td>Rural</td>
<td>103.3</td>
<td>105</td>
<td>65,779</td>
<td>37</td>
<td>45</td>
<td>40</td>
<td>-3</td>
</tr>
<tr>
<td>Between Exits 105 &amp; 112</td>
<td>Bullitt</td>
<td>Rural</td>
<td>105</td>
<td>112</td>
<td>64,018</td>
<td>197</td>
<td>182</td>
<td>208</td>
<td>-11</td>
</tr>
<tr>
<td>Between Exits 112 &amp; 116</td>
<td>Bullitt</td>
<td>Rural</td>
<td>112</td>
<td>116</td>
<td>81,054</td>
<td>244</td>
<td>128</td>
<td>247</td>
<td>-3</td>
</tr>
<tr>
<td>Between Exits 116 &amp; 117</td>
<td>Bullitt</td>
<td>Urban</td>
<td>116</td>
<td>117</td>
<td>95,760</td>
<td>91</td>
<td>37</td>
<td>91</td>
<td>0</td>
</tr>
<tr>
<td>Between Exits 117 &amp; 121</td>
<td>Bullitt</td>
<td>Urban</td>
<td>117</td>
<td>121</td>
<td>94,062</td>
<td>257</td>
<td>310</td>
<td>262</td>
<td>-5</td>
</tr>
<tr>
<td>North of Exit 121</td>
<td>Jefferson</td>
<td>Urban</td>
<td>121</td>
<td>124.7</td>
<td>110,103</td>
<td>250</td>
<td>352</td>
<td>255</td>
<td>-5</td>
</tr>
</tbody>
</table>

* KTC SHIFT Safety Performance Functions (SPFs) and Adjustment Factors

Positive Excess Expected Crashes (EEC) indicates a potential for improvement:
- Because we are getting negative EEC’s, this section of I-65 is experiencing fewer crashes than the model predicts.
CMF and Benefit-Cost Example

Kentucky Transportation Cabinet

Russellville Road (US 68X and US 231X) Planning Study, Bowling Green, KY

KYTC wants your input! See online survey on back.

Study Area Roads Highlighted in Yellow

Avenue of Champions
Douglas Keen Hall
W.R. McNeill Elementary
Jones Jaggar Hall
Nick Denes Baseball Field

WKU Supply Services
Creason Parking Lot
WKU Parking Structure 3
Amy Tudor Softball Campus
WKU Soccer Complex
WKU Russellville Lot
Waffle House
Arby’s
Taco Bell
Huck’s Gas Station
Holly Dr
Morgantown Rd
Creason St
Robinson Ave
Sumpter Ave

Holley Performance Product

University Blvd
Intersection Improvements at University Boulevard Intersection

New Right-Turn Lane
Vehicle CMF = 0.92
Crash Type All
Crash Severity All
Bike/Ped CMF = N/A

New Left-Turn Lane
Vehicle CMF = 0.76
Crash Type All
Crash Severity All
Bike/Ped CMF = N/A
Relevant Crash History For Improvement Type

New Right-Turn Lane
- Rear End = 6
- Sideswipe Same Direction = 1
- Angle = 3
- Total Crashes = 10
- Crash Severity = 1 Injury, 9 PDO

New Left-Turn Lane
- Rear End = 7
- Sideswipe Same Direction = 6
- Angle = 6
- Total Crashes = 19
- Crash Severity = 19 PDO

Crash Analysis (2014-2016)
- Crash Type:
  - Angle
  - Backing
  - Head On
  - Opposing Left Turn
  - Rear End
  - Rear to Rear
  - Sideswipe
  - Single Vehicle

Source: Kentucky State Police
Roundabout Improvement at University Boulevard Intersection

Convert Signalized Intersection to Roundabout
CMF = 0.52
Crash Type All
Crash Severity Injury
Bike/Ped CMF = No Reliable CMF
Relevant Crash History For Improvement Type

Convert Signalized Intersection to Roundabout
Total Crashes = 86
Crash Severity = 8 Injury, 78 PDO
### CMF and Benefit Cost Example

#### Intersection Improvements:

<table>
<thead>
<tr>
<th>Location</th>
<th>Improvement</th>
<th>CMF</th>
<th>Crashes (2008-2017)</th>
<th>Cost per Crash</th>
<th>10-Yr Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University Blvd. Intersection</td>
<td>New left-turn lane</td>
<td>0.76</td>
<td>0 3 49 52</td>
<td>$10,080,000 $274,905 $8,500</td>
<td>$297,900</td>
</tr>
<tr>
<td></td>
<td>New right-turn lane</td>
<td>0.92</td>
<td>0 2 19 21</td>
<td>$10,080,000 $274,905 $8,500</td>
<td>$56,900</td>
</tr>
<tr>
<td>Russellville Rd.</td>
<td>Install sidewalk (to avoid walking along roadway)</td>
<td>0.35</td>
<td>0 2 1 3</td>
<td>$10,080,000 $274,905 $8,500</td>
<td>$362,900</td>
</tr>
</tbody>
</table>

Total 10-Yr Benefit: $717,700

#### Roundabout Improvement:

<table>
<thead>
<tr>
<th>Location</th>
<th>Improvement</th>
<th>CMF</th>
<th>Crashes (2008-2017)</th>
<th>Cost per Crash</th>
<th>10-Yr Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University Blvd. intersection</td>
<td>Convert signalized intersection</td>
<td>0.52</td>
<td>0 17 192 209</td>
<td>$10,080,000 $274,905 $8,500</td>
<td>$3,026,600</td>
</tr>
<tr>
<td>Russellville Rd.</td>
<td>Install sidewalk (to avoid walking along roadway)</td>
<td>0.35</td>
<td>0 2 1 3</td>
<td>$10,080,000 $274,905 $8,500</td>
<td>$362,900</td>
</tr>
</tbody>
</table>

Total 10-Yr Benefit: $3,389,500
## Russellville Road (US 68X and US 231X) Planning Study
### Evaluation Matrix and Cost Estimates

<table>
<thead>
<tr>
<th>Alternative Description</th>
<th>Year 2018 PM Peak Hour</th>
<th>Year 2040 PM Peak Hour</th>
<th>Bike/Ped Facilities on Russellville Road</th>
<th>2018 Cost Estimates (millions)</th>
<th>10 Year Benefit-Cost Ratio (BCR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intersection Delay (sec)</td>
<td>Intersecion LOS¹</td>
<td>Intersection Delay (sec)</td>
<td>Intersecion LOS¹</td>
<td>Pedestrian Accomodations</td>
</tr>
<tr>
<td>No-Build</td>
<td>76 E</td>
<td>117 F</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>36 D</td>
<td>74 F</td>
<td>Yes</td>
<td>No</td>
<td>$0.2</td>
</tr>
<tr>
<td>Roundabout at University Boulevard and Sidewalk on Russellville Road</td>
<td>27 D</td>
<td>50 E</td>
<td>Yes</td>
<td>No</td>
<td>$0.3</td>
</tr>
</tbody>
</table>

¹ LOS: Level of Service

² Benefit-Cost Ratio (BCR): The ratio of the present value of benefits to the present value of costs.
Statewide Corridor Plan (SWCP)

- New initiative to identify and examine KY’s significant corridors, with a future plan for each
- Focus on mobility and accessibility
- EECs for each corridor identified
- Benefit-Cost for high priority corridors
Planning Level 2+

- Further planning phase analysis
- Interchange studies (IJS/IMR)
- IHSDM, ISATe tools used
- Predictive safety and benefit-cost
Timeline for Delivery

- **EEC Interactive GIS Tool:** Late Fall 2019
- **Purpose and Need Guidelines:** End of September, 2019
Timeline for Delivery

**SHIFT:**
Completed for SHIFT 2020, Adjustments by Summer 2021 for next cycle

**Planning Studies:**
Implemented
Questions?

Stephen G. De Witte, P.E.
KYTC Central Office Planning

Stephen.DeWitte@ky.gov

(502) 782-5056