2017 Texas Traffic Safety Conference

Intersection Control Evaluation (ICE) Policies & Procedures Overview

Jeffrey Shaw
FHWA Office of Safety
Innovative Intersections

Key characteristics:

• Improve the way **people** move across intersections
• Eliminate, relocate or modify conflict points
• Strategically optimize traffic control

“cho·re·o·gra·phy”

Source: Missouri Department of Transportation
These designs reduce severe crashes while enhancing efficiency.
SAFETY
- Fewer, less severe conflict points
- Speed management potential
- Significant crash reductions

MOBILITY
- Less delay
- Reduced congestion
- New/more pedestrian and bike opportunities

VALUE
- All Users
- Less ROW
- Decreased costs
- Quicker construction
- Balanced solutions
Innovative Intersections Resources

http://www.youtube.com/USDOTFHWA
Long Term Vision

Agencies include these EDC intersection designs in their evaluation processes or policies in a manner that ensures they are considered and evaluated alongside other improvement alternatives, and implemented when appropriate.

Intersection Control Evaluation

Policies/Procedures
Why is ICE needed?

• Sustain IIIG progress achieved through EDC2
• Ensure routine, objective and consistent consideration
• Complements performance-oriented program framework and value-based project delivery
• Overcome inertia of past practice...
Intersection Control Inertia

• Mostly “de facto” minor route stop (TWSC), All Way Stop (AWSC) or Traffic Signal

• Viewed through a mainline operations lens (i.e., volumes-based warrants)

• Separate and involved process(es) for “other”, non-conventional alternatives
  – Some policies require roundabout “consideration”
ICE Policies & Procedures

A performance-based framework that utilizes a consistent process and objective metrics to vet intersection geometry and control alternatives.

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ICE Process Steps, Activities & Outcomes

**Process Steps**

1. **SCREENING**
   Engineering Assessment of Interception Control Strategies and/or Interchange Configurations

2. **DESIGN & TRAFFIC ANALYSIS**
   of practical control alternatives
   Via technical studies:
   - Traffic & Economic Analysis
   - Preliminary Design

**Outcomes / Products**

- **Elimination of strategies**
  that fail to meet the established need, or that are impractical

- **Performance Analysis Findings**
  - Safety: estimated cost / savings
  - Mobility: est. delay cost / savings

- **Life-Cycle / Economic Analysis Findings**
  - Service Life (estimated years)
  - Benefit / Cost Index
  - Future Investment Needed
Generally, ICE is...

- A **policy** and a **process**

**POLICY**
Establishes the general applicability and future effect; sets forth a course of action, plan or procedure; expectation that it will be implemented and adhered to without deviation

**PROCESS**
Describes the framework and methodologies by which a Policy can be successfully implemented; details the actions or steps to be taken to achieve a particular end; facilitates consistency of effort and results
Attributes of ICE

• Determine the “best value” geometric design and traffic control for a given intersection
• Safety, operational, multimodal, environmental, ROW, cost and political impacts weighed
• All design alternatives receive preliminary screening, i.e. “do they work?” litmus test
• Short list of alternatives with highest potential effectiveness are carried forward to help shape an appropriate project scope
ICE Performance Criteria

• Safety (substantive HSM-based)
• Operations (core MOEs)
• Non-Motorized (Peds/Bikes)
• Freight Network (incl. OSOW)
• Right-of-Way Impacts
• Practical Feasibility (i.e., local posture)
• Environmental Impacts
• Costs (Initial and lifecycle)
Core Benefits of ICE

- Quantification, documentation of decision
- Process breeds consistency, familiarity
- Important criteria analyzed form basis of defensible decision
  - **Multimodal Safety** (quantitative)
  - Multimodal Operations (quantitative)
  - Environmental, Construction, ROW and Maintenance Costs (quantitative)
  - Political and Public acceptability (qualitative)
ICE Lead States & Lessons

• California (2013)

• Indiana (2014)
  http://www.in.gov/indot/files/ROP_IntersectionDecisionGuide.pdf

• Minnesota (2007)
  http://www.dot.state.mn.us/trafficeng/safety/ice/

• Washington (2015)

• Wisconsin (2008)
  http://roadwaystandards.dot.wi.gov/standards/fdm/11-25.pdf#fd11-25-3.1
ICE Policies & Procedures

Existing ICE Policies
2012
ICE Policies & Procedures

2017

Existing ICE Policies & Procedures

DC
PR
FLH

Existing ICE Policies
Lead State Lessons Learned

• ICE helped meet the following needs:
  – Helped advance alternative intersections
  – Incorporates safety performance in to scoping stage
  – Helped vet possibilities for context and risk
  – Addressed concerns about documentation sufficiency and consistency
  – Provides a basis for early non-motorized (ped/bike) assessment
Lead State Approaches

• Typically a 2-Stage Screening Process
• Stage 1 is a high-level assessment that considers all possibilities but quickly filters down to a short list
• Stage 2 is a more rigorous assessment of the selected performance criteria
**Phase I**

- Identify intersections to be analyzed by ICE
  - Collect Traffic Data
  - Warrant Analysis
  - Analyze Alternatives:
    * Safety
    * Capacity
    * Other factors
  - Recommend Alternative(s)

**Phase II**

- Prepare concept designs for recommended alternative(s)
- Identify ROW needs and other factors to be part of evaluation
- Develop cost estimates for recommended alternatives
- Re-evaluate and select preferred alternative

- Is detailed analysis required?
  - Yes: Further steps
  - No: Write formal ICE Report*

- DTE Approval
- Approve staff layout

* In some instances, a full report is not required and a memorandum may be acceptable.
**ICE Process Steps, Activities & Outcomes**

**Process Steps**

#1. Screening
Engineering Assessment of Intersection Control Strategies and/or Interchange Configurations

#2. Design & Traffic Analysis
of practical control alternatives
Via technical studies:
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**Outcomes / Products**

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- Mobility: est. delay cost / savings

Life-Cycle / Economic Analysis Findings
- Service Life (estimated years)
- Benefit / Cost Index
- Future Investment Needed

CA
STAGE 1 SCREENING QUESTION AND DETERMINATION (Y/N)

Q1: Is it feasible and reasonable given site and geometric characteristics; notably right-of-way constraints, sheer nature of the junction (3 vs. 4 legs), and presence or absence of median potential?

Yes →

No → Infeasible alternative
# Appendix A

Record Sheet for Stage 1: Initial, Feasibility Screening

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Answer to Question #1</th>
<th>Answer to Question #2</th>
<th>Answer to Question #3</th>
<th>Answer to Question #4</th>
<th>Feasible or Infeasible?</th>
<th>Specific Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Intersection</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>○ No</td>
<td>○ No</td>
<td>○ No</td>
<td>○ Yes</td>
<td>○ No</td>
<td></td>
</tr>
<tr>
<td>Median U-Turn Intersection</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td></td>
</tr>
<tr>
<td>Boulevard Left</td>
<td>○ No</td>
<td>○ No</td>
<td>○ No</td>
<td>○ Yes</td>
<td>○ No</td>
<td></td>
</tr>
<tr>
<td>J-Turn or RCUT</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td></td>
</tr>
<tr>
<td>Roundabout Intersection</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td>○ Yes</td>
<td></td>
</tr>
</tbody>
</table>

The table above outlines the decision process for different alternatives at an intersection, including questions that need to be answered (Yes/No) and whether the alternative is feasible or not. Each row represents a different alternative, and the columns show the results of the feasibility questions and the final decision on feasibility. The specific notes column is blank for now, awaiting further information or discussion.
ICE Screening Tools

FHWA CAP-X Spreadsheet Tool

- [http://www.fhwa.dot.gov/software/research/operations/cap-x/](http://www.fhwa.dot.gov/software/research/operations/cap-x/)

### Capacity Analysis for Planning of Junctions

#### Input Worksheet

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>&quot;Enter the Project Title here (Input worksheet)&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Number:</td>
<td>&quot;Enter the Project Number here (Input worksheet)&quot;</td>
</tr>
<tr>
<td>Location</td>
<td>&quot;Enter the Project Location here (Input worksheet)&quot;</td>
</tr>
<tr>
<td>Date</td>
<td>&quot;Enter the date here (Input worksheet)&quot;</td>
</tr>
</tbody>
</table>

#### Traffic Volume Demand

<table>
<thead>
<tr>
<th></th>
<th>Volume (Veh/ht)</th>
<th>Percent (%)</th>
<th></th>
<th>Volume Growth</th>
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<tbody>
<tr>
<td></td>
<td>U-Turn</td>
<td>Left</td>
<td>Thru</td>
<td>Right</td>
</tr>
<tr>
<td>Eastbound</td>
<td>0</td>
<td>630</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Westbound</td>
<td>0</td>
<td>175</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Southbound</td>
<td>0</td>
<td>225</td>
<td>1220</td>
<td>730</td>
</tr>
<tr>
<td>Northbound</td>
<td>0</td>
<td>420</td>
<td>1645</td>
<td>350</td>
</tr>
<tr>
<td>Adjustment Factor</td>
<td>0.80</td>
<td>0.95</td>
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<tr>
<td>Suggested</td>
<td>0.80</td>
<td>0.95</td>
<td>0.85</td>
<td></td>
</tr>
</tbody>
</table>

- Truck to PCE Factor: Suggested = 2.00
- Critical Lane Volume: 1600
# Capacity Analysis for Planning of Junctions

## Input Worksheet

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>&quot;Enter the Project Title here (Input worksheet)&quot;</th>
<th>Critical Lane Volume Sum</th>
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</thead>
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<tr>
<td>Project Number:</td>
<td>&quot;Enter the Project Number here (Input worksheet)&quot;</td>
<td>Acceptable Configurations</td>
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<tr>
<td>Location</td>
<td>&quot;Enter the Project Location here (Input worksheet)&quot;</td>
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</tr>
<tr>
<td>Date</td>
<td>&quot;Enter the date here (Input worksheet)&quot;</td>
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</table>

## Critical Lane Volume Sum

<table>
<thead>
<tr>
<th>Range</th>
<th>6</th>
<th>4</th>
<th>4</th>
<th>18</th>
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<tr>
<td>1200</td>
<td></td>
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</tr>
<tr>
<td>200 – 1394</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>400 – 159</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td></td>
<td></td>
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</tbody>
</table>

## Results for Intersections

<table>
<thead>
<tr>
<th>#</th>
<th>TYPE OF INTERSECTION</th>
<th>Sheet</th>
<th>Zone 1 (North)</th>
<th>Zone 2 (South)</th>
<th>Zone 3 (East)</th>
<th>Zone 4 (West)</th>
<th>Zone 5 (Center)</th>
<th>Overall w/c Ratio</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Conventional</td>
<td>FULL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Conventional Shared RT LN</td>
<td>CSRL</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Quadrant Roadway</td>
<td>S–W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Quadrant Roadway</td>
<td>N–E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>3.3</td>
<td>Quadrant Roadway</td>
<td>S–E</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td>Quadrant Roadway</td>
<td>N–W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Partial Displaced Left Turn</td>
<td>N–S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Partial Displaced Left Turn</td>
<td>E–W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td>Displaced Left Turn</td>
<td>FULL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>6.1</td>
<td>Restricted Crossing U–Turn</td>
<td>N–S</td>
<td></td>
<td></td>
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<td>6.2</td>
<td>Restricted Crossing U–Turn</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>7.1</td>
<td>Median U–Turn</td>
<td>N–S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.2</td>
<td>Median U–Turn</td>
<td>E–W</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.1</td>
<td>Partial Median U–Turn</td>
<td>N–S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.2</td>
<td>Partial Median U–Turn</td>
<td>E–W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Kentucky IDAT Spreadsheet Tool**

<table>
<thead>
<tr>
<th>Peak Hour Vehicular Turn Movements</th>
<th>INTERSECTION ALTERNATIVE</th>
<th>OPERATION EVALUATION</th>
<th>MINIMUM LANE CONFIGURATION</th>
<th>ROWV</th>
<th>SAFETY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RT 100 0 100 Main Street</td>
<td>2-Way Stop Control</td>
<td>Feasible</td>
<td></td>
<td>3.75</td>
<td>5.0</td>
</tr>
<tr>
<td>LT 50 0</td>
<td>4-Way Stop Control</td>
<td>Feasible</td>
<td></td>
<td>3.75</td>
<td>5.0</td>
</tr>
<tr>
<td>Th 50 0</td>
<td>Signalized Intersection (1 lanes)</td>
<td>Feasible</td>
<td></td>
<td>3.75</td>
<td>5.0</td>
</tr>
<tr>
<td>RT 0 0</td>
<td>Signalized Intersection (2 lanes)</td>
<td>Not Recommended</td>
<td></td>
<td>3.25</td>
<td>5.0</td>
</tr>
<tr>
<td>St 0 0 0</td>
<td>Signalized Intersection (3 lanes)</td>
<td>Not Recommended</td>
<td></td>
<td>2.75</td>
<td>5.0</td>
</tr>
<tr>
<td>LT 0 0</td>
<td>Jughandle A EB (1 Lanes)</td>
<td>Feasible</td>
<td></td>
<td>1.75</td>
<td>5.0</td>
</tr>
<tr>
<td>Th 0 0</td>
<td>Jughandle A EB (2 Lanes)</td>
<td>Not Recommended</td>
<td></td>
<td>1.25</td>
<td>5.0</td>
</tr>
<tr>
<td>RT 0 0</td>
<td>Jughandle A EB (3 Lanes)</td>
<td>Not Recommended</td>
<td></td>
<td>0.75</td>
<td>5.0</td>
</tr>
<tr>
<td>Peak Hour Pedestrian Crossing Movements</td>
<td>Jughandle A WB (1 Lanes)</td>
<td>Feasible</td>
<td></td>
<td>1.75</td>
<td>5.0</td>
</tr>
<tr>
<td>Leg 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RT 0 0</td>
<td>Jughandle A WB (2 Lanes)</td>
<td>Not Recommended</td>
<td></td>
<td>1.25</td>
<td>5.0</td>
</tr>
<tr>
<td>Th 0 0</td>
<td>Jughandle A WB (3 Lanes)</td>
<td>Not Recommended</td>
<td></td>
<td>0.75</td>
<td>5.0</td>
</tr>
<tr>
<td>LT 0 0</td>
<td>Jughandle A EB-WB (1 Lanes)</td>
<td>Feasible</td>
<td></td>
<td>1.75</td>
<td>5.0</td>
</tr>
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</table>
SPICE Tool (Safety Performance for ICE)

- Joint project with HSMI-PFS
- Under development, scheduled for completion in 2018 (beta testing 2017)
- Contractor is KLS Engineering and Kittelson & Associates

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Time Period</th>
<th>Total Crashes</th>
<th>Fatal-Injury Crashes</th>
</tr>
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<tr>
<td>Alternative 1</td>
<td>Opening Year</td>
<td>42697</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Design Year</td>
<td>42697</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Total Project Life Cycle</td>
<td>42697</td>
<td>0</td>
</tr>
</tbody>
</table>

Federal Highway Administration (FHWA) Safety Performance for Intersection Control Evaluation Tool

Summary of crash prediction results for each alternative
Life-Cycle Cost Estimation Tool (LCCET)

• Product of NCHRP Project 03-110
• Developed by Kittelson
• Examples and Case Studies Developed
• More info at http://www.trb.org/Main/Blurbs/173928.aspx
ICE and Other DOT Policies/Programs

- Protocol(s) for New Traffic Signal Requests
- State Highway Access Permits (i.e., for new developments)
- Congestion Mitigation Projects (corridor or intersection)
- HSIP Intersection Projects (B/C basis?)
- Locally-initiated Projects affecting State Highways
- Roundabouts Consideration Requirements or Guidance
Applicability of ICE

• New Intersection (Any Control)

• Modification to an Intersection
  — Reconstruction, Major Rehabilitation/Modernization
  — Expansion (add-lanes, aux-lanes, widening, etc.)
  — Warrant-based Control Change
    (TWSC-AWSC, TWSC-SIGNAL, AWSC-SIGNAL)
  — Change in Basic Geometry
    (Conventional-Roundabout, SLR-MLR, Conventional-U-Turn, Roundabout-??)
Wide Applicability = Leverage!

ICE is cross-cutting and can link SHSP to all facets of highway program (not just HSIP)

**PERFORMANCE MEASURES**
- Number of intersection-related fatalities
- Number of intersection-related serious injuries

**STRATEGIES**
1. Implement geometric improvements
2. Use appropriate traffic controls to reduce conflicts
3. Improve sight distance and traffic control visibility
4. Improve access management to reduce conflicts
5. Improve behavior at intersections through the use of education and enforcement

*SHSP: Strategic Highway Safety Plan [https://safety.fhwa.dot.gov/shsp/]
^HSIP: Highway Safety Improvement Program [https://safety.fhwa.dot.gov/hsip/hsip.cfm]
SERIOUS CRASH TYPE

The serious crash type task team addresses intersection safety and roadway departure safety.

i. Intersection Safety

Nationally, intersection fatalities comprise 21 percent of all fatalities and approximately 50% of serious injuries. The Intersection Safety Task Team’s Vision is to reduce the frequency and severity of intersection crashes along all routes in the state of Georgia by implementing proven safety countermeasures. The performance goal is to reduce fatalities occurring at intersections from 547 in calendar year 2013 to 465 in calendar year 2015.

The Intersection Safety Task Team is comprised of Georgia Department of Transportation (GDOT) safety personnel along with other GDOT safety partners. The purpose of this team is to identify and implement safety strategies using engineering, education, enforcement, and emergency medical services.

Reduce 547 to 465 in 2 years = 15% reduction

82 LIVES SAVED
EXEMPLARY

Funding by Category
2015 - 2018
Total Funds $8.62 Billion

- Debt Service for GARVEE $749,672
- Intermodal/Transit $1,062,112
- Other $892,317
- Environmental Improvements $3,600
- Bridge Rehab - Added Capacity $807
- Bridge Replacement - Added Capacity $150,202
- Major Widening $1,439,336
- Relocation - Added Capacity $33,262
- Reconstruction - No Added Capacity $44,525
- Restoration, Rehab & Resurfacing $608,138
- Minor Widening $86,609
- Bridge Replacement - No Added Capacity $532,004
- Bridge Rehab - No Added Capacity $614,308
- Traffic Management/Engineering $283,142
- $351,513 Construction - New Roads
- $140,223 Construction - New Bridges

Safety Improvements $56,023

$ in Thousands
ICE is Complementary with PBPD*

• Emphasis on objective, measurable, performance-based solutions
• Leveraging and adapting existing conditions to something better
• Engineered solutions – intersection “choreography”

* PBPD = Performance-Based Practical Design
“Practical” IIG Outcomes

• Build more *good* projects (intersections) rather than fewer *great* ones – steady, incremental and measurable system improvement

• Approach grounded in performance management – project, corridor & system

• Considers present, interim and long term goals

• Innovative intersections/interchanges become mainstream, common solutions
Transportation Performance Management

Defined as a strategic approach that uses system information to make investment and policy decisions to achieve national performance goals.
National Goals

- Safety
- Infrastructure condition
- Congestion reduction
- System reliability
- Freight movement and economic vitality
- Environmental sustainability
- Reduced project delivery delays
ICE and Safety PM Final Rule

• Safety PM Final Rule establishes 5 performance measures to carry out HSIP (5-year rolling avgs):
  – (1) Number of Fatalities
  – (2) Rate of Fatalities per 100 million VMT
  – (3) Number of Serious Injuries
  – (4) Rate of Serious Injuries per 100 million VMT
  – (5) Number of Non-motorized Fatalities and Serious Injuries

• States establish and report on targets; annual evaluation on meeting or making significant progress toward targets

**ICE Policies/Procedures can help achieve Safety PM targets across entire highway program (Not limited to HSIP)!**
For More Information

• Transportation Performance Management
  www.fhwa.dot.gov/TPM/

• Safety Performance Management
  http://safety.fhwa.dot.gov/hsip/spm/

• Every Day Counts
  https://www.fhwa.dot.gov/innovation/everydaycounts/

• Innovative Intersections
  https://safety.fhwa.dot.gov/intersection/

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