Intersection Control Evaluation
A type-selection framework & tool
for Roundabouts & Alternative Intersections

Jerry Champa | GHD (formerly Omni-Means)
Kamesh Vedula | Omni-Means, A GHD Company

Today’s Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenters</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:10</td>
<td>INTRODUCING: GHD: When two become one Interchange Control Evaluation (ICE)?</td>
<td>Kamesh Vedula, Jerry Champa</td>
</tr>
<tr>
<td>12:15</td>
<td>Welcome to the Modern ICE Age</td>
<td>Jerry Champa</td>
</tr>
<tr>
<td>12:25</td>
<td>ICE Formula: Policy, Tools &amp; Resources</td>
<td>Jerry Champa</td>
</tr>
<tr>
<td>12:35</td>
<td>Case Studies</td>
<td>Jerry Champa, Kamesh Vedula</td>
</tr>
<tr>
<td>12:50</td>
<td>Question &amp; Answer Session</td>
<td>All</td>
</tr>
</tbody>
</table>
Intersection Control Evaluation:
Welcome to the Modern ICE Age & Solutions

Jerry Champa | GHD, Presenter

Restricted-Crossing U-Turn (RCUT)

These solutions reduce severe crashes while enhancing efficiency

What is ICE?
Direction, Tool & Framework for Critical Decisions

Stage 1: high-level assessment, considers all possibilities, filters down to a short list of practical & viable solutions

Stage 2: Design, Traffic & Economic studies to estimate / predict performance & allow for comparison of short-listed alts

Stage 1 Screening to Identify Alts + Stage 2 Performance & Economic Analysis = Optimal Solution

Goal: Well-informed investment decisions
Why is ICE needed?

• To overcome barriers to use of new, innovative / evolved and highly effective solutions with wide range of applications
• Ensure routine, objective and consistent consideration of emerging & creative concepts
• Accelerate deployment of proven (best) safety countermeasure
• Complements performance-oriented program framework and value-based project delivery

Intent of ICE

• To provide a performance-based type-selection tool for proposals to add, modify, expand, and fully control intersections
• To integrate data-driven safety performance analysis into the identification of the optimal access solution
• Provide a framework (flexible) to allow for objective and strategic evaluation & comparison of all practical solutions, especially those which are newer, creative and proven - but under-utilized:
  • roundabouts, U-turn based intersections, continuous flow intersections, diverging diamond interchanges, etc.
• Requires data-driven safety performance analysis
**Intent of ICE**

- Creates a transparent & consistent approach **to identify optimal solution (investment)** based on modern performance metrics: crash severity, travel time, queuing that blocks driveways, ped & bike conflict, cost-effectiveness, and impacts to land, community and health (e.g. air & water quality).

- Provides decision-makers with a “scorecard” (i.e. a summary performance matrix) to inform the selection of the most critical (vulnerable) infrastructure – access points which connect system of streets, highways & freeways; and the scorecard serves as documentation.

**Benefits of Innovative Intersections**

**SAFETY**
- Fewer, less severe conflict points
- Speed management potential
- Significant crash reductions

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

**VALUE**
- Smaller footprints
- Less ROW
- Less $
- Quicker construction
- Multiple Advantages
ICE and FHWA Safety PM Final Rule

Final Rule establishes 5 performance measures to carry out HSIP (5-year rolling averages):

- (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)!

ICE Performance Criteria

- Safety (substantive, not nominal)
- Operations (core MOEs, not LOS)
- Right-of-Way Impacts
- Costs
- Practical Feasibility (i.e., local posture)
- Pedestrians and Bicycles
- Freight Network (incl. OSOW)
- Environmental Impacts
- Others depend on community values (context)
Benefits of ICE Process

• Determine the optimal and “best value” combination of geometric design and traffic control strategy

• **Safety**, operational, multimodal, environmental, ROW, cost and political *impacts and advantages compared*

• All viable alternatives receive preliminary screening, i.e. “do they work?” and “are they practical?” litmus test

• Efficiency: Only alternatives with highest potential effectiveness are carried forward for comparative analysis of impacts, performance & cost-effectiveness

Where ICE Fits

• ICE should be customized to align with range of project planning & approval phases (studies)

• Stage 1 should occur as early as possible (preferably as a Scoping exercise)

• When development (Land Use) projects will invest, involve, affect, include **access**
INTERSECTION CONTROL EVALUATION (ICE) POLICY

STAGE 1

STAGE 2

ICE Process Steps, Activities & Outcomes

CA

Process Steps

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

#2. DESIGN & TRAFFIC ANALYSIS ²
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 ³
ICE Formula: Policy, Tools & Resources

Before the modern ICE Age ...

... a What If Case Study
Before the modern ICE Age ...

**BEFORE Interchange**

Opened in 2014

$20 Million

Before the modern ICE Age ...

**INVESTMENT Decision** Partial Cloverleaf Interchange (with signals)

Opened in 2014

$20 Million
Before the modern ICE Age ...

Where are we?

Before the modern ICE Age ...

Why build a Partial Cloverleaf here?

And why $20 million?
What if ICE Existed ...

ICE applies to Selection of I/C Type & Ramp Terminal Control

Cross-Section through Interchange
Structure is 4x wider than approach roadbeds

Width > 130’
Note “Extra” Pavement

Alternative with RBTs at I / C Ramps
$13 Million
SAVINGS = $7 M
Roundabouts: Pre-ICE Policy

* 

DOT Perspective (Caltrans)

What is ICE?

Engineering Policy Directive & Type-Selection TOOL
- Brings much needed focus to access-related decisions

Flexible Framework comprised of 2 General Steps (+ activities):
1. SCREENING eliminates impractical solution alternatives
2. ANALYSES produce key findings to inform decisions

Mechanism which accelerates implementation of innovation
State DOT Perspective (Caltrans)

Roundabout Approvals: Pre-ICE Policy

Design Information Bulletin 80-01
RBT Conceptual Approval Report (CAR)
District Review
  • HQ Approval
Roundabouts: Pre-ICE Policy

Deschutes Road Roundabout

Concept to construction 9 years

Twin Cities Roundabouts

Concept to construction 6 years
State DOT Perspective (Caltrans)

**WHAT did the ICE Policy change?**

Specific to RBTs:

- Recognized RBTs as a standard intersection “type”
- Required (data-driven) Safety Performance Analysis
- Streamlined Approval Process

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Roundabouts: **POST-ICE Policy**

DID 86-01 (replaced by *ICE Policy & Framework*)

- Roundabout Conceptual Approval Report
- District Review
- HQ Approval

- **Added Technical Assistance to:**
  - Support Implementation
  - Take Advantage of flexibility provided by roundabouts
  - Support Use of analytical tools
State DOT Perspective (Caltrans)

What has improved as a result of ICE?

- Decision-making (when makers are well-informed)
- Decisions are being driven by:
  - Performance Advantages of Roundabouts
  - Higher ROI (instead of lowest cost Alternative)
- More RBTs have been selected for implementation, and RBTs less often dropped due to bias, opinion, confusion
- Less Effort (time, resources) expended
- Quality of End Product (Design)

State DOT Perspective (Caltrans)

Roundabouts: Post-ICE Policy

*
State DOT Perspective (CA)

Roundabouts: Post-ICE Policy

Concept to construction in 3 years

ICE Lessons Learned

Keys to Objective: Evaluation & Comparison of Roundabouts

• Safety Performance Analysis
  • Will recognize or emphasize advantage of RBT
  • State & National Methodologies & Tools Available
ICE Lessons Learned

Keys to Objective: Evaluation & Comparison of Roundabouts

• Safety Performance Analysis

• Optimum Siting & SIZING (to define the build footprint)
  – Design Flexibility needs to be understood & applied
  – Sizing starts and relies upon:
    • Capacity Assessment (to complete Step 1 – Screening)
    • Capacity & Operational Analysis (to complete Step 2)
  – Sizing determines cost and R/W impacts (practical?)

ICE Framework (California)

ICE Steps

#1. SCREENING Engineering Assessment of Intersection Control Strategies & Alternative Intersections

#2. Detailed Studies & Analysis
• Traffic Studies
• Preliminary Design
• Performance Analysis

Outcomes

Elimination of options & strategies that fail to meet the established need, or that are impractical to implement; identify alternatives for next Step
### Capacity Tool Examples

http://www.trb.org/Main/Blurbs/172267.aspx

### Planning Level Peak Hour Volumes

<table>
<thead>
<tr>
<th>Volume Range, entry + circulating (pcephpl)</th>
<th>Number of Lanes Required / Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1,100</td>
<td>Single-lane entry is sufficient</td>
</tr>
<tr>
<td>1,100 to 1,400</td>
<td>Single-lane may be sufficient</td>
</tr>
<tr>
<td>1,400 to 1,900</td>
<td>Two-lane entry likely to be sufficient</td>
</tr>
<tr>
<td>1,900 to 2,300</td>
<td>Two-lane entry may be sufficient</td>
</tr>
<tr>
<td>2,300 to 2,900</td>
<td>Three-lane entry may be sufficient</td>
</tr>
</tbody>
</table>

Source: McCollough
FHWA Calibration & HCM 6th Edition

Figure 2. Scatter Plot. Regression models for single-lane roundabout sites with calibration to follow-up time.

<table>
<thead>
<tr>
<th>Lane Configuration and Entry Lane</th>
<th>Model Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x1</td>
<td>$v_s = 1380 \exp(1.000262 \times u_s)$</td>
</tr>
<tr>
<td>2x2, right lane</td>
<td>$v_s = 1420 \exp(-0.00085 \times u_s)$</td>
</tr>
<tr>
<td>2x2, left lane</td>
<td>$v_s = 1350 \exp(0.00092 \times u_s)$</td>
</tr>
<tr>
<td>2x1, both lanes</td>
<td>$v_s = 1420 \exp(0.00091 \times u_s)$</td>
</tr>
<tr>
<td>2x2</td>
<td>Use 2x2 right lane model</td>
</tr>
</tbody>
</table>

HCM 6th Edition

Capacity of each lane entry or right lane of two lane entry against two conflicting lanes

Capacity of left lane of two lane entry against one conflicting lane

Capacity of right lane of two lane entry against one conflicting lane

Conflicting Flow Rate (pc/h)
**FHWA Calibrated Capacity Model (HCM 6th Edition)- SLR**

Figure 27. Scatter Plot. Regression models for single-lane roundabout sites with calibration to follow-up time.


Figure 42. Scatter Plot. Regression models for multilane 2x2 roundabout sites, right entry lane with calibration to follow-up time.
Intersection Control Evaluation:
Case Studies
Kamesh Vedula | GHD (Principal)
Jerry Champa | GHD (ICE & Safety Performance Specialist)

La Novia Roundabout

Caltrans ICE Framework:
Steps, Activities & Outcomes

Steps & Activities

#1. SCREENING

#2. TRAFFIC ANALYSIS & DESIGN STUDIES
(Performance & Cost Analysis)
of practical control alternatives

Outcomes / Products

Elimination of options & strategies that fail to meet the established need, or that are impractical to implement

Product: Short List of Alternatives (1 or more)

Performance Analysis Findings
- Safety: est. cost / savings
- Mobility: est. delay cost / savings
- Design (RBT Performance Checks)

Cost / Economic Analysis Findings
- Estimating
- Service Life (estimated years)
- Benefit / Cost Index

San Juan Capistrano, CA

Source: Gary Warkentin, Michael Baker

Intersection Control Evaluation (ICE)

Traffic Operations Policy Directive 14.02 (PDF) - Intersection Control Evaluation (ICE)

Intersection Control Evaluation refers to the process and framework for the growing number of transportation agencies adopting a more balanced and holistic approach to the consideration and selection of access strategies and concepts during transportation planning, project identification and evaluation processes that contemplate the addition, expansion or full control of major intersections (including interchange ramp terminals). “Full control” involves the use of signal, stop or yield controls on each of the through and most major movements.

- Insurance Memorandum, dated August 22, 2013 (PDF)

ICE Resources:
- Alternative Intersection/Interchanges: Informational Report (AIR) (PDF)
- FHWA Roundabouts Website
- ICE: TOPD Implementation (PDF)
- ICE Process Information Guide, Version 1.9 (PDF)
- Fact Sheet on ICE: TOPD (PDF)
- List of Access Strategies & Configurations (PDF)

Traffic Performance Analysis Methodologies & Tools:
- Roundabout Capacity and Operational Analysis
- Safety Performance / Collision Cost Analysis Tool (Excel spreadsheet)
  - For general information, please contact a District ICE Coordinator or a Technical Assistance Program Coordinator (listed in the next sections).

http://dot.ca.gov/trafficops/ice.html
ICE Performance Matrix  (Alternatives Comparison)

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Alt 2: Signalize Existing I/S</th>
<th>Alt 3: Relign &amp; Signalize</th>
<th>Alternative 4 Roundabout</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Existing AM/PM Average Delay (seconds per vehicle)</td>
<td>29.6/29.1</td>
<td>28.6/28.7</td>
<td>7.9/9.6</td>
</tr>
<tr>
<td>2. Existing AM/PM Volume Level of Service (LOS)</td>
<td>C/C</td>
<td>C/C</td>
<td>A/A</td>
</tr>
<tr>
<td>3. 2035 AM/PM Average Delay (seconds per vehicle)</td>
<td>44.3/46.8</td>
<td>35.7/35.5</td>
<td>24.2/24.4</td>
</tr>
<tr>
<td>4. 2035 AM/PM Volume Level of Service (LOS)</td>
<td>D/D</td>
<td>D/D</td>
<td>C/C</td>
</tr>
<tr>
<td>5. Longest Vehicle Queue (2035 pm)</td>
<td>25 cars</td>
<td>17 cars</td>
<td>18 cars</td>
</tr>
<tr>
<td>6. Right-of-Way Requirement</td>
<td>None</td>
<td>3.500 ft²</td>
<td>40 ft²</td>
</tr>
<tr>
<td>7. Construction Traffic Control</td>
<td>$39,100</td>
<td>$108,400</td>
<td>$98,800</td>
</tr>
<tr>
<td>8. Retaining Wall</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>9. Project Cost</td>
<td>$940,000</td>
<td>$2,891,000</td>
<td>$1,682,000</td>
</tr>
<tr>
<td>10. Benefit (Delay Savings) / Cost Ratio</td>
<td>2.61</td>
<td>0.7</td>
<td>6.18</td>
</tr>
<tr>
<td>11. Environmental Document</td>
<td>Mitigated Negative Declaration</td>
<td>Mitigated Negative Declaration</td>
<td>Mitigated Negative Declaration</td>
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<tr>
<td>12. Collision Cost Savings (Lifc of Project)</td>
<td>$2,026,000</td>
<td>$1,170,000</td>
<td>$9,537,000</td>
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<tr>
<td>13. Safety Performance 0/C Ratio</td>
<td>2.16</td>
<td>0.4</td>
<td>5.68</td>
</tr>
</tbody>
</table>

* The existing average delay (s/veh) based on 2012 traffic volumes is 23.4 (AM) & 59.0 (PM)
Roundabout Alternative Selected

Photo Source: Gary Warkentin, Michael Baker

Photo source: Brad Orien, MUROW|CM
Case Study: Holman Highway Roundabout

Pre-Project Conditions

Case Study: Holman Highway Roundabout

Process

• 2009 Project Report & Environmental Document
• Roundabout Alternative Rejected
• Signalize Alternative Approved

Ramp Variations - Roundabout

This ramp variation is characterized as a roundabout that would result in one-way circular traffic flow at the intersection of SR 68 and the SR 1 on- and offramps. Traffic would enter this circle in a free-flowing movement with yield at the point of entry into the circle. The southbound offramp right-turn movement would bypass the roundabout.

Roundabout variation was rejected by PDM because a one lane roundabout could not provide acceptable level of service and a two lane roundabout could not be constructed given the geometric constraints of the two lane structure over SR 1.
**Case Study:** Holman Highway Roundabout

**Process**

Original Approved Project Alternative (2009)

- Traffic Signal
- Retaining Walls
- New Bridge
- 4 Through Lanes

Total Estimated Cost = $21,170,000 (2009)

---

**Case Study:** Holman Highway Roundabout

**Process**

- 2009 Project Report & Environmental Document
  - Roundabout Alternative Rejected
  - Signalize Alternative Approved
- Funding not available – Project Shelved
- 2013 Caltrans Adopts ICE
- The project is revisited through ICE
  - The Roundabout Alternative returns
Case Study: Holman Highway Roundabout

Revised Project Alternative (2013)

- Maintained Old Bridge
- Maintained Two-Lane Section
- No Immediate Improvements Needed to Western Intersection

Total Cost: $7.7mil (2017)
Case Study: Holman Highway Roundabout

Process

- Roundabout Alternative Selected Because:
**Case Study:** California Blvd Roundabouts

**Project Facts**

- Safety Concerns
- High congestion area
- Reversal of one way streets
- Entrance to Downtown Napa
- City and State involvement
- Strong cycling community
- Technically challenging

**Pre-Project Conditions**

Image of Pre-Project Conditions showing California Blvd Roundabouts.
Case Study: California Blvd Roundabouts

Process

- 2012 City Project:
  - Two roundabouts along California Blvd
  - Reduce Congestion
  - Improve pedestrian and cyclists mobility
  - Reverse one way couplet
  - Improve safety
Case Study: California Blvd Roundabouts

Process

- 2012 City Project:
  - 2 Roundabouts + Modification
- 2012 State Programmed Signal Project:
  - Fully signalized intersection impacts adjacent roundabout operations.

Signal at Ramps = Significant Queue Spillback into Roundabout
Case Study: California Blvd Roundabouts

Process

• 2012 City Project
  • 2 Roundabouts + Modification
• 2012 State Programmed Signal Project
  • Signal
• Back to the drawing board
  • Develop new alternatives
    • Continuous green signal westbound
    • Met Operations
    • Safety concerns still remain
Case Study: California Blvd Roundabouts

Process

- Solution
  - Add a 3rd roundabout

<table>
<thead>
<tr>
<th>Cost Estimate Scenarios</th>
<th>Total Cost (Sup. + Cap.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013 City Project</td>
<td>$6.6M</td>
</tr>
<tr>
<td>2013 State Project</td>
<td>$1.4M</td>
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<tr>
<td>Total Cost</td>
<td>$8.0M</td>
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</table>

<table>
<thead>
<tr>
<th>Cost Estimate Scenarios</th>
<th>Total Cost (Sup. + Cap.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013 City Project</td>
<td>$6.6M</td>
</tr>
<tr>
<td>State Roundabout</td>
<td>$5.8M</td>
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<tr>
<td>Total Cost</td>
<td>$12.4M</td>
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<table>
<thead>
<tr>
<th>Cost Estimate Scenarios</th>
<th>Total Cost (Sup. + Cap.)</th>
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<tbody>
<tr>
<td>Combined Project Delivered</td>
<td>$11.5M</td>
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ICE Case Studies for 2018 Western/Texas ITE Annual Conference
### Case Study: California Blvd Roundabouts

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Traffic Signal</th>
<th>Roundabout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pavement Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Striping Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landscaping Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Response Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accident Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delay Costs (Time, Fuel and Emissions)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Life Cycle Costs - Relative Costs

ICE Case Studies for 2018 Western/Texas ITE Annual Conference
Case Study: Interstate 5 / South Bonnyview

ICE Case Studies for 2018 Western/Texas ITE Annual Conference

Case Study: Interstate 5 / South Bonnyview

ICE Case Studies for 2018 Western/Texas ITE Annual Conference
Case Study: Interstate 5 / South Bonnyview
Case Study: Twin Cities Road/State Route 99 Roundabout Interchange

Project Facts

• Pre-ICE
• Unacceptable Levels of Service and Queues
• Two State Highways
• State, City, County, and Private property owner involvement
• Signal Alternative was $32 Million more than roundabouts

Case Study: Twin Cities/SR 99 Interchange
Case Study: Twin Cities/SR 99 Interchange

Existing Conditions

Case Study 3: Twin Cities/SR 99 Interchange

Signal Alternative
Case Study 3: Twin Cities/SR 99 Interchange

Roundabout Alternative

Case Study: Twin Cities/SR 99 Interchange

Process

ICE Case Studies for 2018 Western/Texas ITE Annual Conference
Case Study: Twin Cities/SR 99 Interchange

Project Facts
- Pre-ICE/During ICE Implementation
- High congestion area
- High profile area
- Environmentally sensitive & scenic location
- Junction of two State Highways
- Only access to peninsula’s community hospital
- Multiple stakeholders – public and private
- Technically challenging
- Public-private partnership

Case Study: Holman Highway Roundabout
Innovative Intersections as a Solution: Under-utilized or Resisted

Proven as an effective solution:

- ~25 RNDBT VS 8,000 Signals (Caltrans)
- Nationally??
- has not been tried (locally, regionally or statewide)
- viewed as unconventional, controversial, or inappropriate (risky)

Under-utilized or Resisted

We Need Champions
Why?

Resistance at local/state level
~50% of the States missing out on benefits
Medium for promoting innovative intersections
Raise Awareness among DOT’s
• Peer-Peer Exchanges
TRB Webinars

Case Study Acknowledgements

Roundabout Concept Design/ Optimization/ Peer Review Services on:
• Twin Cities/SR 99
• Holman Highway Roundabout
• California Blvd. Roundabouts
Questions?
Case Study: Rocklin Road Roundabout Corridor

Project Facts

- Poor traffic operations in existing condition
- Originally planned 6 lane corridor
- Originally required acquisition of multiple properties
- Adjacent to a fire station
- Adjacent to police department
- Adjacent to a school
- Part of a 5 roundabout corridor
**Case Study:** Rocklin Road Roundabout Corridor

**Case Study 3:** Rocklin Road Roundabout Corridor

Before

After
**Case Study**: State Route 49/Main Street Roundabout

**Project Facts**

- Higher than average collision rates
- High speed approach
- Sight distance issues
- Gateway to local wine region
- Publicly sensitive project

---

**Case Study**: State Route 49/Main Street Roundabout

**Project Alternative Study**

Alternative 1
Existing Condition (at time of study):

**No Build - Partial Stop Control**
**Case Study**: State Route 49/Main Street Roundabout

**Project Alternative Study**

Alternative 2:
Roundabout Control

Alternative 3:
Signalized Intersection
**Case Study:** State Route 49/Main Street Roundabout

**Project Alternative Study**

<table>
<thead>
<tr>
<th></th>
<th>Roundabout</th>
<th>Traffic Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 2</td>
<td>$2,200,000</td>
<td>$4,200,000</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Roadway Construction</td>
<td>$500,000</td>
<td>$600,000</td>
</tr>
<tr>
<td>Structures Construction</td>
<td>$2,700,000</td>
<td>$4,800,000</td>
</tr>
<tr>
<td>Right of Way / Utilities</td>
<td>$656,000</td>
<td>$656,000</td>
</tr>
<tr>
<td>Preliminary Engineering</td>
<td>$85,000</td>
<td>$85,000</td>
</tr>
<tr>
<td>Construction Engineering</td>
<td>$252,000</td>
<td>$480,000</td>
</tr>
<tr>
<td>Support Cost Subtotal</td>
<td>$993,000</td>
<td>$1,221,000</td>
</tr>
<tr>
<td><strong>Project Total Cost</strong></td>
<td><strong>$3,693,000</strong></td>
<td><strong>$6,021,000</strong></td>
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</table>

**Case Study:** State Route 49/Main Street Roundabout

![Roundabout Diagram]
**Case Study:** State Route 49/Main Street Roundabout

**Why?** Cost Effective

**Real Project Example: Lifecycle Cost Analysis**

<table>
<thead>
<tr>
<th>Life Cycle Costs (Interim design)</th>
<th>Roundabouts</th>
<th>Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits - due to reduced Collision and Mobility Costs (Roundabout VS Signals)</td>
<td>$4,450,000</td>
<td>$15,520,000</td>
</tr>
<tr>
<td>Delay Costs</td>
<td>$899,343</td>
<td>$2,476,819</td>
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<tr>
<td>Fuel and GHG Costs</td>
<td>$1,753,112</td>
<td>$2,275,501</td>
</tr>
<tr>
<td>Total Benefit (due to reduced costs)</td>
<td>$7,602,454</td>
<td>$20,272,120</td>
</tr>
</tbody>
</table>

| Project Costs including design, construction and maintenance (Roundabouts VS Signal) |
|-----------------------------------|------------|---------|
| Operations and Maintenance Costs | $18,250 | $32,444 |
| Project Costs (including soft costs) | $8,250,000 | $7,112,000 |
| Total Costs | $8,268,250 | $7,144,444 |

<table>
<thead>
<tr>
<th>Total Life Cycle Costs (Opening Year 5)</th>
<th>$15,870,704</th>
<th>$27,418,564</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Life Cycle Benefit/Cost Ratio</th>
<th>$12,609,060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs (Total Costs Roundabout - Signal)</td>
<td>$1,123,808</td>
</tr>
<tr>
<td>B/C Ratio (Roundabout to Signal)</td>
<td>11.3</td>
</tr>
</tbody>
</table>
**Case Study:** Holman Highway Roundabout

Hybrid Roundabout: Two lanes in EB direction only
Case Study: Holman Highway Roundabout
Case Study: Twin Cities/SR 99 Interchange

Process
ICE Screening Example: *Intersection Crash Concentration*

Location: State Route 616 at Welsoa Road (minor)

Existing Control: 2-Way Stop Only
Operating Speed = 65 to 70 MPH
Volumes (AADT)
* SR 616 = 27,000 AADT
* Welsoa = 800 AADT
Collision History (3 years)
Fatal: 3 (2 crossing & 1 left turn)
Injury: 10
Total: 15

State Route 616
Preparation for ICE Step 1

Identify Potential Safety Countermeasures for consideration  *(what do you suggest?)*

Alternative Solution: **Traffic Signal**
Alternative Solution: **ROUNDABOUT** *(Size / Type?)*

Operating Speed = *65 to 70 MPH*
Volumes (AADT)
* SR 616 = 27,000
* Welona = 800

Alternative Solution: **Restricted Crossing U-Turn (RCUT)**
Preparation for ICE Step 1

List of Potential Safety Countermeasures:

- Convert to Multi-Way Stop Control
- Install Traffic Signal
- Convert to Roundabout
- Restrict Crossing and/or Turning Movements
- Other?

KEYS:
1. Do “partners” agree on countermeasures that can be dropped based on collective engineering judgment?
2. Which partners matter?

Interchange Alternative
ICE Step 1: Screening **RESULTS**

Which Potential Countermeasures can be discarded?

- Multi-Way Stop Control
- Traffic Signal
- Roundabout
- Restricted Crossing U-Turn (RCUT)
- Other?
  - **Interchange Concept (yes, but ....)**

NOTE: Principals need to agree on RESULTS

---

ICE Step 1: Cost Assessment

**Traffic Signal:**
- Roundabout: $3 M (approximate for multi-lane)
- RCUT: $1 M (approximate)
- Interchange: $11 M (approximate)
ICE Step One: Safety Assessment

Safety Performance Analysis estimates the:
* Reduction in crashes
* Crash cost savings ($)

Analytical Tools
* State DOT Crash Prediction Spreadsheet

Methodology & Tools
* Highway Safety Manual Methodology
  - High-level examples

Replace with a Roundabout

<table>
<thead>
<tr>
<th>Setting (Intersection type)</th>
<th>Traffic Volume</th>
<th>Crash Type (Severity)</th>
<th>CMF</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>All settings (One or two lanes)</td>
<td></td>
<td>All types (All severities)</td>
<td>0.56</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All types (Injury)</td>
<td>0.18</td>
<td>0.04</td>
</tr>
<tr>
<td>Rural (One lane)</td>
<td></td>
<td>All types (All severities)</td>
<td>0.29</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All types (Injury)</td>
<td>0.13</td>
<td>0.04</td>
</tr>
</tbody>
</table>
How do we estimate / predict collisions frequency & severity for:

- Interchange Alternative
How will an “Interchange” change this crash type?

Where are crashes most expected to occur?
ICE Safety Performance Assessment

For Interchange Alternative:
• All crossing & left-turn crashes will be eliminated or converted to fewer & lower speed (severity) crashes at ramp intersections
  → Crash Cost Savings per year …?

Ultimately, a Safety Benefit / Cost Ratio can be calculated for each Alternative

Tools to Support ICE

National Resources
• CAP-X (UPDATED Coming Summer 2018!)
• SPICE (NEW Coming Summer 2018!)
• LCCET (via NCHRP 03-110)

State Resources
• Kentucky (IDAT)
• Georgia (ICE Tool)
• Virginia (V-JuST)
• Florida, Pennsylvania
Pre-ICE Control Options

• Mostly (“de facto”) minor route stop (TWSC), All Way Stop (AWSC) or Traffic Signal
• Largely viewed through a mainline operations lens (i.e., volume-based warrants, no explicit safety screening)
• Separate and involved process(es) for vetting “other”, non-conventional alternatives
  – Some recent state policies require roundabout “consideration” but lack performance-based metrics

Lead State Lessons Learned

ICE helped meet the following needs:

• advancement of alternative intersections
• Consideration of data-driven safety performance analysis
• Addresses concerns about the sufficiency and consistency of documentation
• Provides a framework for early assessment of non-motorized travel options
Long Term Vision for IIG

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

aka Intersection Control Evaluation (ICE) Policies/Procedures

**Today’s Agenda**

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenters</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:30</td>
<td>Welcome Introduction of Presentation Team</td>
<td>Jerry Champa</td>
</tr>
<tr>
<td>2:35</td>
<td>Welcome to the Modern ICE Age Why Policy Matters Modern Solutions for Access Needs &amp; Problems</td>
<td>Jeff Shaw</td>
</tr>
<tr>
<td>2:50</td>
<td>ICE Formula: Policy, Tools &amp; Key Resources How to Predict Size &amp; Performance How ICE is Saving Lives, the Planet, Marriages, etc.</td>
<td>Jerry Champa Hillary Isebrands</td>
</tr>
<tr>
<td>3:20</td>
<td>Case Studies How ICE changed project decisions &amp; outcomes: Traffic &amp; Safety Analysis Methodologies and Tools</td>
<td>Hillary Isebrands Kamesh Vedula Lindsey Van Parys</td>
</tr>
<tr>
<td>4:10</td>
<td>Question &amp; Answer Session All Presenters &amp; Special Guests</td>
<td></td>
</tr>
</tbody>
</table>

2018 Western/Texas ITE Annual Conference
Traffic circle to bring relief to San Juan Capistrano drivers

San Juan Capistrano is set to open its first traffic circle later this month, a new roundabout at the intersection of Calle Real and La Playa Avenue.

The circle is intended to reduce congestion and improve safety at the busy intersection, which has seen a significant increase in traffic over the past few years. The original plan was for the circle to be completed by this summer, but due to delays in construction, it has been pushed back to late September.

The circle is part of a larger plan to improve transportation throughout the city, and is expected to benefit both residents and visitors.

Intersection Control Evaluation:
Case Studies

Kamesh Vedula, PE, TE | Presenter
Lindsey Van Parys, PE, QSD/QSP | Presenter