Road Safety Audits/Assessments
ROAD SAFETY AUDITS:

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Ground Rules

• Please Mute Line
• Schedule
• Participate through the Chat or Raised
Outline of Briefing

1. Why RSAs?
2. Basic Concepts
3. RSA Procedures
4. Common Issues and Challenges
5. Examples
Goals and Objectives

• introduce road safety audits as a useful tool to reduce traffic injuries and fatalities
Dead Rat Theory
Theory of the Dead Rat

1. Smell It
2. Find It
3. Fix It
SWIM

• Say What It Means
ADT

• An Alarm Company

• Average Daily Travel/Traffic

• Atomic Demolition Tech
Warrant

• Going to see the Judge/Jail

• Meeting the Criteria
Safety
Safety
Basic Concepts

• What is a road safety audit?
• Why do we need RSAs?
• When do we conduct RSAs?
Why RSAs?

- Consistent & Comprehensive Approach to Design Process
- Stewardship
- Cost Effective
- Vital Few
Road Safety Audits (RSAs)

- Formal safety performance examination
- Existing or Future Road Segment or Intersection
- Independent, multidisciplinary team
Road Safety Audits (RSAs)

- *Formal* safety performance examination
- Existing or Future Road Segment or Intersection
- Independent, multidisciplinary team
Road Safety Audits (RSAs)

• **Formal** safety performance examination
• Existing or Future Road Segment or Intersection
• **Independent, multidisciplinary** team
A road safety audit also...

- considers the safety of all road users
- considers interactions at the borders or limits of the project
- examines the interaction of project elements
- may proactively consider mitigation measures
A road safety audit is NOT....

... a simple standards check for adherence to design guidelines.

... an opportunity to redesign the project.
Why do we need RSAs?

TYPICAL REPORTED CRASH CAUSES

Road Environment Factors (28%)

Human Factors (95%)

Vehicle Factors (8%)
Clusters/Hot Spots

- A Lot of Stupid People
- Road Issues or Challenges
ALMOST CORRECT

Th!$$@tp@$$
Locals

+ Tend to be more aggressive
+ Know the area
  - Problems
  - Law
  - Enforcement

Non Locals

+ Tend to drive slower
  - Sight seeing
  - Unsure of area (confused)
  - My be the 1st and last time in the area
LOCAL VS NON-LOCAL

Locals

+ Education?
+ Enforcement?
+ Engineering?
+ EMS?

Non-Locals

+ Education?
+ Enforcement?
+ Engineering?
+ EMS?
RSA Benefits

- Reduce the number and severity of crashes
- Promote awareness of safe practices
- Process to identify and address problems
- Considers human factors and multimodal issues
- Low cost
HIKERS and BIKERS
Move to the side of the road when a vehicle approaches.
Office of Safety
Proven Safety Countermeasures

These nine countermeasures address crashes that occur in the focus areas of intersections, pedestrians, and roadway departure.

- Roundabouts
- Corridor Access Management
- Backplates with Retroreflective Borders
- Longitudinal Rumble Strips and Stripes on Two-Lane Roads
- Enhanced Delineation and Friction for Horizontal Curves
- Safety Edges®
- Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
- Pedestrian Hybrid Beacon
- Road Diet
YOU CAN'T FIX STUPID
Why do we need RSAs?

There are many competing interests at play in road projects:
- cost
- right of way
- environment
- topographic and geotechnical conditions
- socio-economic issues
- capacity / efficiency
- politics
- safety
Why do we need RSAs?

- Compromises and constraints are a normal part of transportation budgeting.
- RSAs demonstrate the safety implications of roadway elements.
- RSAs ensure that safety is an explicit consideration, and that safety does not “fall through the cracks”.
When do we conduct RSAs?

- **pre-construction:**
  - planning / feasibility
  - preliminary (draft) design
  - detailed design

- **construction:**
  - work zones
  - pre-opening

- **post-construction/operational:**
  - existing roads
Road Safety: Gore

- Geometry
- Operations
- Road Users
- Environment
Road Safety: Geometry

- Curve
- Gradient
- Cross Section
- Clearance
- Sight distance
- Clear zone
Road Safety: Geometry Example 1
Road Safety: Geometry Example 2
Congestion
Signal operation
Speeding
Queuing
Turning movements
Road Safety: Operations Example 1
Road Safety: Road Users/Human Factor

- Motorists
- Bicyclists
- Pedestrians
Road Safety: Motorists
Road Safety: Bicyclists
ROADWAY USERS OUTSIDE OF VEHICLES ACCOUNT FOR AN INCREASING SHARE OF ROADWAY FATALITIES

Over the last two decades, the percentage of roadway fatalities occurring outside the vehicle— including pedestrians, pedalcyclists, and motorcyclists— has risen from 20% to 34%.

Percentage of fatalities inside/outside vehicle, 1999 – 2018

Note: People inside the vehicle includes occupants of cars, light trucks, large trucks, buses, and other vehicles. Roadway users outside the motor vehicle include pedestrians, pedalcyclists, motorcyclists, and other “nonoccupants.”

For more information on the Safety Data Initiative, visit: https://www.transportation.gov/SafetyDataInitiative
Road Safety: Road Users
Road Safety: Environment

E
Road Safety: Environment

Weather

Lighting Conditions
Procedures

The Eight Step RSA Process
## Responsibilities

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<th>RSA Team</th>
<th>Design Team / Project Owner</th>
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<td>Identify project</td>
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<td>Select RSA team</td>
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<td>5</td>
<td>Conduct analysis and prepare report</td>
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<td>Prepare formal response</td>
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<tr>
<td>8</td>
<td>Incorporate findings</td>
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Responsibilities

1. Identify project
2. Select RSA team
3. Conduct a start-up meeting
4. Conduct field reviews under various conditions
5. Conduct audit analysis and prepare report of findings
6. Present findings to Project Owner
7. Prepare formal response
8. Incorporate findings

RSA Team
Design Team / Project Owner
Step 1: Identify the Project

Design stage project

In-service project
Candidates for In-service RSAs

High-crash sites

High-profile sites

Development

Construction

Changed traffic characteristics
Candidates for Design-stage RSAs

- Safety-oriented
- High-profile
- Complex design
"I believe that [RSAs] are an excellent tool for evaluating and improving the safety of our highway system. In the projects we've done, we've seen the most benefit in doing an RSA during conceptual and preliminary design, when any improvements can be incorporated into our project estimates and final design."

Beth Wright  
District Engineer  
Missouri DOT
RSAs: Design Stage

- Make structural changes on paper instead of in concrete.

- Optimize crash and conflict prevention.
Responsibilities

RSA Team
Design Team/Project Owner

1. Identify project or
2. Select RSA team
3. Conduct start-up meeting
4. Perform field reviews under various conditions
5. Conduct audit analysis and prepare report of findings
6. Present RSA findings to Project Owner
7. Prepare formal response
8. Incorporate findings
Select RSA Team

- Independent
- Experienced
- Multi-disciplinary
Select the RSA Team: Core Skills

Operations

Geometric

Road users/human factors
Select RSA Team: Supplementary Skills

- Human factors
- Specialists
- Enforcement
- Maintenance
Interdisciplinary RSA Team: Composition and Size

- local agency staff
- exchange staff from another local agency
- consultants
- combination of above

3-5 member audit team
Focused RSAs

- Pedestrians
- Cyclists
- Older/younger drivers
- Special situations
Select the RSA Team: Team Planning

- Meet informally or by phone
- Discuss RSA schedule
- Communicate schedule to project owner
Responsibilities

RSA Team
Design Team / Project Owner

1. Identify project
2. Select RSA team
3. Conduct a start-up meeting
4. Perform field reviews under various conditions
5. Conduct audit analysis and prepare report of findings
6. Present RSA findings to Project Owner
7. Prepare formal response
8. Incorporate findings
The Start-up Meeting

- Identify individual roles
- Communicate information
- Communicate RSA process
- Discuss constraints and limitations
The Start-up Meeting: Provide Project Information

- Crash history
- Traffic volumes
- Aerial photographs
- Design drawings
- Background reports
- Design criteria
The Start-up Meeting

- Communicate project concerns
- Review steps in RSA
- Review safety concerns with similar projects
- Discuss schedule
- Provide contact info
Responsibilities

1. Identify project
2. Select RSA team
3. Conduct a start-up meeting
4. Perform field reviews
5. Conduct audit analysis and prepare report of findings
6. Present RSA findings to Project Owner
7. Prepare formal response
8. Incorporate findings
Step 4: Perform Field Reviews

- Design-stage
- In-Service
Team in One Vehicle
Perform Field Review: Preparation for the Field Review

- Review available crash data
- Arrange transportation
- Designate a secretary and photographer
(2) Field Reviews

- Observe road user characteristics.
- Observe surrounding land uses.
- Observe link points to the adjacent transportation network.
Perform Field Review: Common Items to Look For

- Sight distance obstructions
- Pedestrian and cyclist conflicts
- Visual clutter
18 Fatals ?????

18 Months

50 Foot Length of Road
Pedestrian/Bicycle Counts

- Pedestrian Counts Conducted at Nine Locations
  - Zones Determined by Observations
  - Weekday & Weekend
    - 2 Hours AM Peak
    - 2 Hours PM Peak

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Qualitative Assessment

• During Peak Hours During Harvest Season
  – January 16th & 18th
    • 5:00 AM – 8:00 AM
    • 4:00 PM – 7:00 PM

• Summarize Observations & Recommendations
  – Improve Pedestrian & Bicyclist Safety
Recommendations

RECOMMENDATION

- Install Fence/Railing in Median to Direct Pedestrians to Crosswalk/Median Openings
Qualitative Assessment

OBSERVATION
- Street Planters & Trees Limit Motorists Visibility of Pedestrians
Lighting and Pedestrian Channelization

- Install new LED lighting through corridor
- Install pedestrian channelization in the median
ADA, Signing, and Pavement Markings

- High Emphasis Crosswalks
- ADA upgrades
- RRFBs (Rectangular Rapid Flashing Beacons)
(2) Field Review

- Drawing, aerial photographs
- Camera still/video
- Measuring wheel, stopwatch
- High-visibility vests
(2) Field Review

Look for:

- sight distance obstructions
- roadside hazards
- driveway issues
Perform Field Review:
Variable Conditions to Observe

- Peak and off-peak traffic periods
- Dry and wet weather conditions
- Day and night conditions
Perform Field Review: Up Close and Personal

Walk the site!
Perform Field Review: Note the Positive

- Good safety design features
- Safety mitigation features already in place
(2) Field Review

Prompt list:

• may provide structure to the site visit

• remind the team what to look for, and help ensure that nothing is overlooked
Five KPH per Hour Difference
Responsibilities

1. Identify project
2. Select RSA team
3. Conduct a start-up meeting
4. Perform field reviews under various conditions
5. Conduct RSA analysis
6. Present RSA findings to Project Owner
7. Prepare formal response
8. Incorporate findings

RSA Team
Design Team / Project Owner
Step 5: Conduct RSA Analysis

- Identify and prioritize safety concerns
- Develop suggestions for reducing the degree of risk
- Compose presentation of early findings
RSA Analysis:

- Schedule work sessions
- Assemble RSA information
- Gather references
- Appoint a coordinator and secretary
Resources and References

- Pedestrian Road Safety Audit Guidelines and Prompt Lists
- FHWA Road Safety Audit Guidelines
- A Policy on Geometric Design of Highways and Streets
- Roadside Design Guide
- Manual on Uniform Traffic Control Devices for Streets and Highways
- Your State’s Geometric Design Guide

Step 5
Analysis: The Process

1. Inventory information
2. Review information
3. Identify safety concerns
4. Prioritize safety concerns
5. Mitigate safety concerns
6. Compose preliminary findings
Analysis: Phase 2
Systematically Review Information

- Thoroughly review all data
- Think in terms of GORE
- Crash history (existing roads)
- Expected crashes (design-stage)
Analysis: Crash History
The RSA team must ask how often each safety issue may contribute to a crash.

**Prioritize Safety Issues: Crash Frequency**

- **Frequent (C)**
- **Occasional (B)**
- **Rare (A)**

**RISK CATEGORY**
- A = Lowest priority
- F = Highest priority
The RSA team must ask how severe the crashes related to the safety issue may be.

Prioritize Safety Issues: Crash Severity

<table>
<thead>
<tr>
<th>Negligible (A)</th>
<th>Low (A)</th>
<th>Medium (B)</th>
<th>High (C)</th>
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</table>

Crash Severity
Prioritize Safety Issues: Risk Matrix

RISK CATEGORY
A = Lowest priority
F = Highest priority

Crash Frequency
- Frequent
- Occasional
- Rare

Crash Severity
- Negligible
- Low
- Med
- High

Step 5
Mitigate Safety Concerns: Suggestions Appropriate to Project Stage

- **Short term solutions include:** maintenance, vegetation, changing signage or pavement markings, **Enforcement & Education**

- **Long term solutions include:** flattening a curve or modifying a roadway’s vertical alignment, **Enforcement & Education**
Mitigate Safety Concerns: Design-Stage

Early design stage: alignment changes

Later design stage: signing improvements
Prepare Preliminary Findings Presentation

- Identify safety successes
- Briefly describe safety concerns
- Identify potential conflicts
- Suggest mitigation
Responsibilities

1. Identify project
2. Select RSA team
3. Conduct a start-up meeting
4. Perform field reviews under various conditions
5. Conduct audit analysis and prepare report of findings
6. Present preliminary RSA findings to Project Owner
7. Prepare formal response
8. Incorporate findings
The RSA Findings Presentation

- Discuss safety concerns
- Discussion of safety concerns
- Clarify findings and suggestions
- Assist project owner in making best choices
The RSA Findings Presentation: Factor in the Feedback

- Review and revise findings where appropriate
- Initiate formal report
The RSA Findings: Formal Report

- Summarizes the project
- Identifies team
- Documents site visits
- Documents results
- Identifies and prioritizes safety concerns
- May include suggestions for improvements
Sample Road Safety Audit
Issue 1: Closely-spaced Sample Street Intersections

Safety Issues: During peak periods, left-turn queues may extend into or past adjacent closely-spaced intersections on Sample Street.

Safety Issue Description:
Opposing through and right-turn traffic volumes can be expected to cause peak-period delays to traffic turning left at two intersections:
- Sample Street and the northbound entrance to I-XX, which has limited (70-foot) left-turn storage lane;
- Sample Street and Example Street, which has no left-turn lane.

If left-turn movements experience a long delay, queued left-turn traffic may obstruct through traffic on Sample Street. Queued or obstructed traffic may queue back and affect operations at upstream intersections, increasing the risk of all types of intersection collisions.

Expected Crash Types: intersection (left-turn, rear-end, and crossing)
Expected Frequency: occasional
Expected Severity: medium
Risk Rating: D (moderate-high risk level)

Suggestions: If micro-simulation modelling or post-construction observations show congestion related to left-turn queues, the following measures may be considered:
- Signalize the ramp intersection, and coordinate the ramp signal with those at Sample Street and Example Street to clear traffic when queues approach the adjacent upstream intersection.
The RSA Findings Presentation: Formal Report

Step 6

Safety concerns

The presence of left-turn vehicles in the shared lane reduces visibility of opposing through vehicles, resulting in left-turn head-on and secondary rear-end and sideswipe collisions.

Vacant corner lots and faded pavement markings render the intersection inconspicuous. Drivers fail to anticipate the intersection and enter during the red phase, causing angle collisions.

Vehicles are unable to clear the intersection in time due to the lack of an all-red interval, resulting in angle collisions.

Suggestions

Restripe all pavement markings, including crosswalks.

Provide eastbound and westbound left-turn lanes and phases.

Correct westbound secondary signal head alignment.

Restrict parking near intersection to accommodate left turn lanes.

Remove turn restriction signs.

Provide signal ahead sign (W3-3) at eastbound and westbound approaches.

Provide lane markings at North-South Road

CORRIDOR-WIDE ISSUES:
1. Visibility of signal heads is limited by the use of 8-inch signal lenses, diagonal span wires, and the absence of low-level signal heads.
2. Faded pavement markings provide limited guidance to drivers.

CORRIDOR-WIDE COUNTERMEASURES:
1. Install 12-inch lenses on primary signal heads.
2. Mount primary signal heads with reflective yellow backboards in a box span configuration.
3. Provide far-left low-level signal heads on all approaches.
Responsibilities

1 Identify project
2 Select RSA team
3 Conduct a start-up meeting
4 Perform field reviews under various conditions
5 Conduct audit analysis and prepare report of findings
6 Present RSA findings to Project Owner
7 Prepare formal response
8 Incorporate findings

RSA Team
Design Team / Project Owner
Responses

- Short Range
  - Paint, Signage
- Mid-Range
  - Contour Bank
- Long-Range
  - Realign Skewed Intersection
Inadequate Response

“We will not realign the intersection at Jefferson Road. We do not feel that it is needed.”
“While we agree with the need to realign the skewed intersection, the realignment cannot be achieved within the existing right-of-way. **Realignment will require the purchase of property at a cost of about $500,000, representing about 15 percent of the total annual transportation budget.** The acquisition of the required property may be considered in future budgets.”
Response Letter

• prepared by the local road agency (with possible input from designer)

• for each audit issue, identifies what action will (or will not) be taken with a brief explanation

• part of the project record
Responsibilities

1. Identify project
2. Select RSA team
3. Conduct a start-up meeting
4. Perform field reviews under various conditions
5. Conduct audit analysis and prepare report of findings
6. Present RSA findings to Project Owner
7. Prepare formal response
8. Incorporate findings into the project
Step 8: Implementation of Improvements

Implementation - may depend on policy, manpower, and/or funding.
Implementation of Improvements

Pre-construction

Post-construction RSAs:

Changes to design drawings

Incorporate improvements in operating budgets or maintenance programs
RSAs: Conclusions

Making Your Roads Safer