Road Safety Audits and VE

Creating Cumulative Project Improvements

2009 AASHTO VE Conference – San Diego, CA

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Where you may have heard about Road Safety Audits …

- FHWA Highways for LIFE Program – Highlighted Technology
- AASHTO Technology Implementation Group (TIG) - Focus Technology
- FHWA “Market-Ready Technology and Innovation”
- NHI Training Course on RSA
- RSAs for Local Governments Workshop
- RSA Toolkit
Common myths and misunderstandings about road safety audits …

• “… a well done VE Study will accomplish the same thing.”
• “… implementing the recommendations from an RSA always increases the project cost.”
What is a Road Safety Audit (RSA)?

A Road Safety Audit is a **formal** safety performance examination of an existing or future road or intersection by an **independent** audit team.
A road safety audit …

- Considers safety of all road users (older users, pedestrians, bicyclists, transit users, etc.)
- Considers interactions at the borders or limits of the project
- Examines the interaction of project elements and harmony with desirable operating speeds
- Proactively considers mitigation measures
A road safety audit is NOT …

• a plan check for adherence to design criteria

• a VE Study

• an opportunity to revise the scope of the project
<table>
<thead>
<tr>
<th>Traditional Road Safety Review</th>
<th>Road Safety Audit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REACTIVE</strong></td>
<td><strong>PROACTIVE</strong></td>
</tr>
<tr>
<td>In-house review teams</td>
<td>Multidisciplinary teams that are totally independent of the project</td>
</tr>
<tr>
<td>Compliance with minimum standards</td>
<td>Looks beyond standards (address design consistency and potential areas of concern)</td>
</tr>
<tr>
<td>Human factors not emphasized</td>
<td>Considers human factors</td>
</tr>
<tr>
<td>Multimodal not emphasized</td>
<td>Multimodal emphasized</td>
</tr>
<tr>
<td>Emphasizes crash clusters, not crash potential –</td>
<td>Anticipates traffic conflicts and potential for crashes –</td>
</tr>
<tr>
<td>Oftentimes no field review</td>
<td><em>Field Reviews are a must !!!</em></td>
</tr>
</tbody>
</table>
When to conduct an RSA?

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

construction:
- work zones
- pre-opening

post-construction/operational:
- existing roads
When should we conduct RSAs?

- Planning / Feasibility
- Preliminary Design
- Detailed Design
- Pre-Opening

more major issues addressed by audit

less opportunity for design changes
**RSA Steps**

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

**RSA Team**

**Design Team / Project Owner**
Step 1 - Identify Projects for RSAs

Good Candidate Projects for RSAs

Complex designs
Unusual or new features
Interacting modes
High-profile (political or public interest)
High capital cost (such as projects having a VE analysis)
Projects involving context-sensitive solutions
High-collision sites
Sites at which traffic characteristics have changed
RSA Team should be:
- independent
- experienced
- interdisciplinary

Core skill set (every audit)
traffic operations
geometric design
road safety

Supplementary skills (some audits)
positive guidance/human factors
special skills (bridge, drainage; or user group expertise)
enforcement
maintenance
Step 3 – Conduct Start Up Meeting

Step 4 – Perform Field Reviews

Step 5 – Conduct Analysis and Prepare Report
Prioritization of Issues for Design Stage RSAs

<table>
<thead>
<tr>
<th>FREQUENCY RATING</th>
<th>SEVERITY RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Frequent</td>
<td>C</td>
</tr>
<tr>
<td>Occasional</td>
<td>B</td>
</tr>
<tr>
<td>Infrequent</td>
<td>A</td>
</tr>
<tr>
<td>Rare</td>
<td>A</td>
</tr>
</tbody>
</table>

Crash Risk Ratings:
- A: lowest risk level
- B: low risk level
- C: moderate-low risk level
- D: moderate-high risk level
- E: high risk level
- F: highest risk level
Prioritization of Issues for Design Stage RSAs

**TABLE 2 FREQUENCY RATING**

<table>
<thead>
<tr>
<th>EXPOSURE</th>
<th>PROBABILITY</th>
<th>EXPECTED CRASH FREQUENCY (per RSA item)</th>
<th>FREQUENCY RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>high</td>
<td>10 or more crashes per year</td>
<td>Frequent</td>
</tr>
<tr>
<td>medium</td>
<td>high</td>
<td>1 to 9 crashes per year</td>
<td>Occasional</td>
</tr>
<tr>
<td>high</td>
<td>medium</td>
<td>less than 1 crash per year, but more than 1 crash every 5 years</td>
<td>Infrequent</td>
</tr>
<tr>
<td>low</td>
<td>high</td>
<td>less than 1 crash every 5 years</td>
<td>Rare</td>
</tr>
<tr>
<td>low</td>
<td>medium</td>
<td>less than 1 crash every 5 years</td>
<td>Rare</td>
</tr>
</tbody>
</table>

**TABLE 3 SEVERITY RATING**

<table>
<thead>
<tr>
<th>TYPICAL CRASHES EXPECTED (per RSA item)</th>
<th>EXPECTED CRASH SEVERITY</th>
<th>SEVERITY RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>crashes involving high speeds or heavy vehicles, pedestrians, or bicycles</td>
<td>probable fatality or incapacitating injury</td>
<td>Extreme</td>
</tr>
<tr>
<td>crashes involving medium to high speed; head-on, crossing, or off-road crashes</td>
<td>moderate to severe injury</td>
<td>High</td>
</tr>
<tr>
<td>crashes involving medium to low speeds; left-turn and right-turn crashes</td>
<td>minor to moderate injury</td>
<td>Moderate</td>
</tr>
<tr>
<td>crashes involving low to medium speeds; rear-end or sideswipe crashes</td>
<td>property damage only or minor injury</td>
<td>Low</td>
</tr>
</tbody>
</table>
RSA Risk Assessment Framework

<table>
<thead>
<tr>
<th>Frequency of Crashes</th>
<th>PD</th>
<th>PD / Minor Injury</th>
<th>Injury</th>
<th>Major Injury / Fatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>Occasional</td>
<td>B</td>
<td>C</td>
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<td>A</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

Safety Issues with D, E or F ratings are considered more serious.
Step 7 – Prepare Formal Response

Step 8 – Incorporate Findings

Recommendation:
Accepted
Why do we need RSAs?

- Reduce the number and severity of crashes
- Promote awareness of safe design practices
- Process to consider human factors and design facilities that accommodate common driver errors
- Address safety issues from a multimodal perspective
- Cost savings - It is easier to change a drawing on a design plan than rebuild a roadway
RSA Benefits

“We view RSAs as a proactive low-cost approach to improve safety. The very first road safety audit conducted saved SCDOT thousands of dollars by correcting a design problem.”

Terecia Wilson
Director of Safety
South Carolina DOT
RSA Benefits

“The RSA process is valuable from a perspective of identifying deficiencies, developing mitigation strategies, improving public relations, and enhancing our agency’s credibility.”

Bernie Arseneau
Director, Office of Traffic, Security and Operations
Minnesota DOT
Will an RSA delay the project?

RSAs require a relatively short time (1 to 3 weeks from start-up meeting to submission of RSA report).

RSAs can occur concurrently with the agency’s review of the design drawings.
Will an RSA drive up project costs?

$$$

RSA suggestions:

• must be consistent with the project stage,
• can focus on low-cost safety improvements,
• It is easier and less costly to erase and re-draw lines on a set of plans than it is to remove steel and concrete to rebuild a project.
Do RSAs expose agencies to more legal liability?

Teams must carefully complete the RSA to a reasonable standard of care and professionalism.

Agencies can be taken to court with or without an RSA.

RSAs can be part of a safety management system.

Agencies are encouraged to coordinate with their legal departments.
Do RSAs expose agencies to more legal liability?

“Our attorneys say that once safety issues are identified, and if we have financial limitations on how much and how fast we can correct the issues, then the RSA will help us in defense of liability.”

Bottom Legal Line:
Do Your Job -
You have to look at yourself in the mirror every morning
RSA Case Study
YELLOWSTONE NATIONAL PARK
OLD FAITHFUL VISITOR CENTER
Safety Issue: Post-Eruption Traffic & Pedestrian Conflicts
Post-Eruption Traffic Conflicts
Post-Eruption Traffic Conflicts

Post-Eruption Vehicle Outflow Conflicts with:

- Pedestrians
- Un-Parking Operations

Mix of RVs and Buses with passenger cars and pedestrians add to the conflict severity
Safety Issue: Signage and Wayfinding
Signage and Wayfinding

Signs providing unclear directions
Too many signs that are not helpful
Critical information missing

• Where’s the geyser?
• Where’s my car?
• Where’s the highway / direction of travel / next destination?
Safety Issue: Overpass Geometry & Operations
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Overpass Geometry & Operations
Safety Issue: Overpass Geometry & Operations

Limited Curve Radii
Limited Lane Width (Buses, RVs)
Pavement Drop-Off
Lane Channelization / Function
Crest Curve Limits Visibility
Signing
Short Term Mitigation Measures

Total Less than $1 Million

Completion Within Two Years

Effective in Improving Safety Performance and Reducing Crash Risks
Short Term Mitigation Measures: 1
Reduce Post-Eruption Conflicts
Long Term Mitigation Measures
Reduce Post-Eruption Conflicts
Mitigation Measures:
Reduce Conflict Points

Vehicle / Pedestrian Conflicts
Vehicle / Vehicle Conflicts
Bus / RV Conflict Points

Improve Signing and Wayfinding
New signing plan for vehicles
New wayfinding plan for pedestrians
Focus on Visitors’ Perspective
Reduce choices, increase clarity

Quick Fixes at the Overpass
Fix the Pavement Drop-Off: Provide Shoulder
Review channelization: one lane through overpass, exclusive merge / diverge lanes
I-43, I-94, and I-794 meet at the Marquette Interchange in downtown Milwaukee. This interchange is considered the cornerstone of the southeastern Wisconsin freeway system and accommodates Milwaukee’s commuter traffic as well as long-distance interstate traffic traveling to and from Madison, Green Bay, and Chicago. Reconstruction of the original interchange (built in 1968) was required to address structural deterioration and operational concerns.

At the time of the RSA in December 2003, planning and design for the reconstructed interchange had been ongoing for several years, and construction was to commence in about six months. The RSA examined both the proposed changes and construction-stage plans, since the interchange was required to remain operational throughout the four-year construction period. The total cost of the interchange reconstruction was anticipated to be $800 million.
RSAs conducted late in the design process require a selective focus to be effective.

The Marquette Interchange RSA was conducted at an advanced stage in the interchange design, after the completion of the public involvement process, and was consequently limited in the range of items and suggested alternatives that could usefully and practically be identified and implemented. Fundamental design elements had to be taken as “given”, since changes to them were impractical at the advanced stage that the RSA was conducted. Consequently, the RSA team focused on elements of the design that could be amended or mitigated at the detailed design stage.
Specialists contribute valuable insight on the RSA team.

Members of the eight-person RSA team had a general knowledge of road safety, geometric design, and traffic operations, but several members also had specialized knowledge in various areas. The RSA team included an officer from the Milwaukee County Sheriff’s Office who had extensive experience as a patrol officer on the existing interchange. The insights offered by the officer regarding driver behavior helped the design team to realistically assess the risk associated with design elements and the effectiveness of suggested improvements.
Coordination of VE and RSAs in the Design Process

1) Conduct RSA in advance of the VE process
2) VE and RSA processes are conducted concurrently with interaction between the two
3) RSA conducted after the VE, ensuring that the VE recommendations are subjected to a RSA.
RSA Conducted Prior to the VE analysis

Pros:
- VE analysis team can evaluate design that includes recommended changes resulting from the RSA
- Member(s) of RSA Team can be part of VE team and will already be familiar with the design project, the various constraints of the project, and can respond to the VE Team concerning any safety issues that were generated in the RSA.
RSA Conducted Prior to the VE analysis

Cons:
- Another iteration of design (responding to various RSA recommendations) may be required before the VE analysis is conducted. This would add time to the design process.
- The VE team may recommend a design proposal in the interest of project value that may be contradictory to a RSA recommendation.
- Potential conflicting inputs from the RSA and the VE teams.
- The road safety audit does not have the opportunity to respond to the proposals that were generated from the VE analysis.
RSA and VE Conducted Concurrently

Pros:
- Reduces potential for contradictory results that could be produced if the RSA and VE were completed independently
- Allows opportunity for VE proposals to be evaluated from a safety perspective
- Efficiency gains by combining some of the common RSA and VE Tasks (project orientation and site visit)
- Input from other disciplines within the VE process can help identify important safety issues
- The RSA Team can be available to help the VE Team quantify the safety implications of VE proposals
- There is a potential to combine the RSA and VE efforts and generate a single report for both assignments (although logistically difficult).
RSA and VE Conducted Concurrently

Cons:

- Potential for more logistical problems associated with assembling the VE Team and the RSA Team at the same time and at the same location
- Potential for negative interactions among the teams in conducting the processes
- VE proposals may not be developed in sufficient detail that allow safety concerns to be identified by the RSA Team
Conduct RSA After the VE Analysis

Pros:
- Both the original design and the subsequent VE proposals can be subjected to a review in the RSA
- If the RSA is completed after the VE, the VE proposals will be further developed, allowing for more effective comments from the RSA Team
- The independence of the RSA process will not be jeopardized
Conduct RSA After the VE Analysis

Cons:
- Potential for VE proposals to not be adequately evaluated from a safety perspective and time could be wasted in the VE process by evaluating proposals that are considered unacceptable from a safety perspective.
- The life-cycle safety costs would not be considered in the evaluation of the VE proposals.
- Some of the common tasks, such as the project orientation and site visits would have to be completed separately.
- The RSA recommendations might contradict the recommendations that were generated as part of the VE analysis.
- The designer would be left with a quandary in attempting to consolidate the conflicting inputs that were generated from the RSA and the VE.
“Based on the road safety audit and value engineering experiences in British Columbia, Canada, it seems that the optimal process is to have the RSA and the VE conducted concurrently. The opportunity for the VE Team to understand the position of the RSA Team on issues that may contradict VE proposals can make the process significantly more efficient. Similarly, having the RSA Team audit the VE Proposals is critical to ensure that the design does not advance a proposal that may ultimately compromise safety.

Furthermore and based on the experience in British Columbia, it seems to be very useful to have a RSA Team member (or simply a safety specialist) on the VE Team. This would ensure that unacceptable VE Proposals (i.e., unacceptable from a safety perspective) do not advance within the design process. In fact, it is suggested that a RSA may not be required if a safety specialist is on the VE Team for the early stages of design (e.g., up until the 50% detailed design). After the 50% Detailed design stage, it is important that a RSA is completed to capture the specific details of the detailed design.”

Source: Integrating Road Safety Audits and Value Engineering; Paul de Leur, Ph.D., P.Eng.
RSA / VE Integration Issues to Consider

Within your agency, are there …?

Myths and misunderstandings about RSAs and Value Engineering?

Collaboration opportunities to advance the success of both programs?

Barriers to coordinating and/or integrating the processes?
RSA Resources

Website: www.roadwaysafetyaudits.org
RSA Toolkit (Guidelines and Prompt List)
RSA Case Studies

FHWA HQ Office of Safety
Rebecca Crowe (rebecca.crowe@dot.gov)

FHWA Resource Center Safety and Design Team
Craig Allred (craig.allred@dot.gov)

NHI Training Course (www.nhi.fhwa.dot.gov)