RoadSMART: Road Safety Mapping and Ranking Tool

New ways to see the traffic safety story

2012 Traffic Records Forum
Data Visualization Project
October 28–31, 2012
Minnesota Department of Transportation
Office of Traffic, Safety, and Technology

Your Destination...Our Priority
Minnesota’s Priority

- In 2003, Minnesota adopted **Toward Zero Deaths**
  - A partnership led by the Department of Public Safety, the Department of Transportation, and the Department of Health, in cooperation with the Minnesota State Patrol, the Federal Highway Administration, Minnesota county engineers, the Center for Transportation Studies at the University of Minnesota, and citizen organizations (i.e. MADD and AAA)

- Shifted the focus of safety from all severity crashes to *fatal and serious injury crashes*

- **RoadSMART** was developed to support TZD efforts and programs
Addressing the needs for Mn/DOT and Four “E” Partners

- Needed a tool that is objective and based on crash data rather than perceptions of crash problems
- Needed a tool that consistently measures and ranks the safety of a road segment against its own peers to assess safety in relative terms
- Flexible enough to identify the nuances of the safety story in order to show the specific crash issues within a system, corridor, or location
Using five years of crash report records, RoadSMART classifies crashes according to the MSHSP Emphasis Areas!

Aggregate Total Crashes Per One Mile by Crash Type
How is a segment ranked?

- Using **five years** of crash reports, crashes are categorized according to the Minnesota Strategic Highway Safety Plan *Emphasis Area crash type and diagram*
- This allows for highly detailed information to guide and support engineering countermeasure, law enforcement programing, education campaign decisions, public discourse on traffic safety issues, and safety investment planning
- All Minnesota Interstates, Trunk Highways, and County Road Systems are divided into one-mile segments
- For each crash category, crashes are summed to create a crash density by crash type
- Data are disaggregated by roadway type: RoadSMART users may select Interstates, US and Minnesota Trunk Highways, and County Road Systems
- Data are further disaggregated by rural–urban classifications: RoadSMART users may select, all rural and urban segments, rural segments, all urban segments, high density urban segments, or low–density urban segments
- Each segment is assigned a standardized score for crash density of a specific crash type or diagram
- Based on the number of standard deviations from the mean, the standardized score for each one-mile segment is grouped into one of five ranking classes
What do the standardized scores mean?

No score/color indicated implies a ranking of 1 (no crashes recorded for this segment)

1. Crash density of the given crash type is well below expected for the same rural–urban status and roadway type

2. Crash density of the given crash type is below expected for the same rural–urban status and roadway type

3. Crash density of the given crash type is slightly below or at expected for the same rural–urban status and roadway type

4. Crash density of the given crash type is above expected for the same rural–urban status and roadway type

5. Crash density of the given crash type is well above expected compared to same rural–urban status and roadway type
RoadSMART Supports Minnesota’s TZD Partners

Emergency Response Resource Allocation
- Train Related Crashes
- Overturn Crashes

Engineering Planning for Safety Investment and Countermeasures
- Bicyclists & Pedestrians Crashes
- Train-Related Crashes
- Lane Departure Crashes
  - Run-off -road Left or Right Crashes
  - Head-on Crashes
  - Sideswipe Opposing Crashes
- Roadway Departure by Objects Struck
- Intersection Crashes
- Cross Median Crashes
- Heavy Vehicles & Motorcycles

Enforcement Wave & Education Program Planning
- Younger Driver-Related Crashes
- Older Driver-Related Crashes
- Speed-Related Crashes
- Impairment-Related Crashes
- Distracted Driver-Related Crashes
- Riding/Driving unbelted
- Bicyclists & Pedestrian
- Heavy Vehicles & Motorcycles

RoadSMART Provides a Safety Ranking for Crash Type to Inform Public Discourse on Traffic Safety Issues and Support Program Planning, Intervention Planning, and Funding Decisions!
RoadSMART offers statewide network screening, regional screening, corridor screening, or site specific screening.

RoadSMART provides safety rankings throughout the state for Interstate System, Trunk Highways System, and County Road System.
Using an ESRI ArcMap™ interface, drop down menu allows the user to select the location and crash type of interest.

We will look at fatal and serious injury crashes (Severe) on the Rural Trunk Highway System.
How RoadSMART supports law enforcement site selection for enforcement and programing decisions!

This one-mile segment has a high ranking for impaired driving and may benefit from additional impaired driving enforcement or a preventative program.

The user may select up-to seven behavior related options. These options are particularly useful for to plan for enforcement and/or education campaigns.
The user may select two special vehicle-related options: motorcycle or heavy vehicle crashes.

Here are two locations which are performing below the safety expectation for Rural Trunk Highways. These two sites may be ideal locations for countermeasures that address heavy vehicles.

How RoadSMART supports engineering countermeasure decisions and identifies potential education needs.
Lane departure crashes include run-off-road right, run-off-road left, sideswipe opposing, or head-on crashes. The user may first screen for lane departure crashes, then assess precisely what vehicle action is the most problematic. This is important to determine the most effective countermeasure.

Here are two locations which are performing below the safety expectation (indicated by yellow line) for Rural Trunk Highways. These two sites warrant further investigation to determine the most appropriate countermeasure.
The user may drill-down further to identify the specific vehicle actions in order to identify and plan for the most appropriate countermeasure. Run-off-road left crashes is selected.

All segments are green, meaning segments are performing well above the safety expectation.

How RoadSMART supports engineering countermeasure decisions!
The user may drill-down further to identify the specific vehicle actions in order to identify and plan for the most appropriate countermeasure. Run-off-road right crashes is selected.

All segments are green or light green, meaning segments are performing well above and above the safety expectation.

How RoadSMART supports engineering countermeasure decisions!
This location is performing well below the safety expectation (indicated by red line) for Rural Trunk Highways. This segment is a candidate for countermeasures that address head-on crashes.

The user may drill-down further to identify the specific vehicle actions in order to identify and plan for the most appropriate countermeasure. Head-on crashes is selected.
The user may drill-down even further to identify the specific vehicle actions in order to identify and plan for the most appropriate countermeasure. Sideswipe opposing crashes is selected.

All segments are green or light green, meaning segments are performing well above and above the safety expectation.

How RoadSMART supports engineering countermeasure decisions!
The user may drill-down even further to identify the specific consequence of leaving the roadway: overturn vehicle or struck a tree, embankment, pole or guardrail. This allows the user to make informed action plans to improve crash survivability.

All segments are green or light green, meaning segments are performing well above and above the safety expectation.

How RoadSMART supports engineering countermeasure and emergency response decisions!
Operation of intersection is broken into interchanges and intersection crashes. Users may further drill-down to focus on right-angle and rear-end crashes. This is important in order to determine the most effective countermeasure to reduce intersection related crashes.

All segments are green or light green, meaning segments are performing well above and above the safety expectation.

How RoadSMART supports engineering countermeasure decisions!
The user may select cross-median crashes for divided roads in order to identify locations where a disproportionate number of vehicles cross the median. Or the user may select head-on crashes for undivided roads.

All segments are green meaning segments are performing well above the safety expectation.
In the near future, RoadSMART will be converted to a web base map interface!

Using RoadSMART we found that there is a head-on crash and heavy vehicle crash issue on this segment of Highway 14.

Over the next few years, Mn/DOT will invest several million dollars into this particular corridor.
What does RoadSMART offer?

- Holistic assessment of roadway safety that is in harmony with our State Highway Strategic Plan and TZD Goals
- An objective safety measurement against roadway inform public of true risk versus perceived risk
- Identify specific crash issues, even the rare crash types
- Support the decision making and planning process for traffic engineering safety countermeasures
- Support the decision making and planning process for TZD traffic safety partners
<table>
<thead>
<tr>
<th>Features of Typical Traffic Safety Analysis Tools</th>
<th>RoadSMAR T</th>
<th>Black Spot Analyses</th>
<th>Crash Rates</th>
<th>Crash Cost Rankings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informed by AASHTO Emphasis Areas found in the Minnesota Strategic Highway Safety Plan</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Map and tabular display</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Provides statewide network analyses</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>Rankings are provided on consistent segment lengths for consistent rankings and appropriate comparisons</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Safety rankings assessed against peer roadways</td>
<td>Yes</td>
<td>No</td>
<td>Somewhat</td>
<td>No</td>
</tr>
<tr>
<td>Rankings available for interstate, trunk highway, and county roadway systems</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>Disaggregate to compare: all segments within a system, rural, low-density urban, or high-density urban segments</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>Streamlined data source that requires no manipulation by the end-user</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Sensitive enough to identify segments with over representation of rare crash types i.e. train-related crashes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Provides a standardized score</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Utility of Typical Traffic Safety Analysis Tools</td>
<td>RoadSMART</td>
<td>Black Spot Analyses</td>
<td>Crash Rates</td>
<td>Crash Cost Rankings</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>------------</td>
<td>---------------------</td>
<td>-------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Appropriate for more advanced statistical modeling and evaluation analyses</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Appropriate to inform <em>Toward Zero Deaths</em> Initiative Projects</td>
<td>Yes</td>
<td>Somewhat</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Support &amp; inform efforts made by TZD Partners and traffic safety advocates</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>Educate local governments, TZD partners, and state and local representatives about the traffic safety issues relevant to their community</td>
<td>Yes</td>
<td>Somewhat</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Rank segments for driver behavior issues such as speeding, distracted driving, or impaired driving</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Support &amp; inform Law Enforcement program planning by targeting areas with the greatest need for behavior related intervention i.e. enforcement and/or education</td>
<td>Yes</td>
<td>Somewhat</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Rank segments for specific crash types such as lane departure, intersection related, head-on, or cross median crashes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Support &amp; inform traffic safety engineering countermeasure decisions</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>Support &amp; inform safety and investment planning for region, county, community or corridor</td>
<td>Yes</td>
<td>Somewhat</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Rank segments for specific events following a roadway departure such as overturn, crash into tree, or crash into embankment</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Support &amp; inform decision making process for countermeasures aimed at minimize the consequences of leaving the roadway</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Rank segments for vulnerable roadway users such as bicyclists and pedestrians</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Support &amp; inform bicyclist and pedestrian education and countermeasure planning</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>Rank segment for special vehicle types such as motorcycles and heavy vehicles</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Support &amp; inform motorcycle and heavy vehicle- related education and countermeasure planning</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>Rank segments for train-related crashes</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>Support &amp; inform train-related education and countermeasure planning</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
</tbody>
</table>
For Additional Information about RoadSMART, please contact:

Katie Fleming
Mn/DOT OTST
Katie.fleming@state.mn.us
651.234.7013

Brad Estochen
Mn/DOT OTS
Bradley.estochen@state.mn.us
651.234.7011