Too many projects and not enough resources

How to identify and prioritize safety improvements

March 2013
Brian L. Ray, PE
Andrew Ooms

Presentation Overview

› Introduction and Background
› Principles and Resources
› US 12 Chehalis Safety Study
› Transferability to Other Projects
What has affected your resources?

- Each stage of the project development process taking on a life of its own
- Expensive mindsets:
  - When in doubt, bigger is better (or we must at least meet standards)
- Price is no object
  - There was plenty of money
  - Someone else was going to help pay for it
- Lots of staff available--(internal and consulting)
- Impacts are were often deemed secondary to the solution
  - Or the interpretation of what was an impact was disputed

Project Development Process

- Each step can take on a life of its own and become additive
- Tools and methods can become locked in their own stage

**PROJECT DEVELOPMENT PROCESS**

1. Concept Definition
2. Planning & Alternatives Development
3. Preliminary Design
4. Final Design
5. Construction & Maintenance

The Traditional Geometric Design Process generally occurs during these phases of project development.
Bigger just happens along the way

- When in doubt, bigger is better—or “We have to meet standards.”

TRADITIONAL GEOMETRIC DESIGN PROCESS

![Diagram of traditional geometric design process]

Source: Adapted from Figure 3.2 in Flexibility in Highway Design, FHWA.

There was plenty of money....

- Top line revenues kept coming
  - And could mask the resources it took to spend those funds.
  - When the revenue stream diminished, we could see the resource gaps

- Money provided by others is a blessing…and a curse
  "...Oregon must seize upon the unique opportunity to secure the $3.4 billion to replace the seismically unstable, congested Interstate 5 bridge." Oregonian (2/12/13)

  - We need to then devote resources to be sure to obtain those funds

- And at one time you likely had more staff….didn’t you?
How do we manage our resources?

- Right size projects to meet the project need—Not just code based
- Consider tools, methods, and principles needed at the time
- Consider performance based analysis and methods
- Recognize safety is a continuum
- Project solutions can take the form of a continuum
- Address project-specific safety performance

Right size our projects

- Manage diminishing returns
Consider the tools and methods you need...

- Apply whatever tools you need regardless of the stage
- Understand the principles and resources available to you

Project Development Process:
- Concept Definition
- Planning & Alternatives Development
- Preliminary Design
- Final Design
- Construction & Maintenance

The Traditional Geometric Design Process generally occurs during these phases of project development.

Performance based methods to optimize....

Roundabouts employ an iterative design process to optimize safety and operations.

Typical "linear" process
Safety is a continuum

Consider safety performance versus nominal dimensional values

- Nominal Safety is an Absolute
- Substantive Safety is a Continuum

Design Dimensions
(Lane Width, Radius of Curve, Stopping Sight Distance, etc.)

Source: NCHRP 480

Project solutions can be a continuum

- Consider projects from the top down...
  - Address long term needs
  - Phase and sequence projects

- …And from the bottom up
  - Immediate safety projects that reduce crash frequency and severity
  - Systematic improvements that can be implemented with other maintenance or development driven activities
  - Shared efforts with enforcement and other outreach

- Throw away the concept of “throw away”
  - Consider the value of your well considered investment

- “Not to preclude” could be your mantra
Address safety performance

- Apply tools that quantify safety performance (frequency and severity)
- Conduct objective safety analyses
- Focus on mitigations that best address contributing factors
- Spend your money wisely...be prepared for non-engineering solutions

...Engineering, Education, Enforcement, Emergency Response, & Evaluation....

Presentation Overview

- Introduction and Background
- Principles and Resources
- US 12 Chehalis Safety Study
- Transferability to Other Projects
Principles and Resources

- What problem are we trying to solve?
- What resources are available?
- When to use each resource?
- Prioritizing Projects

What problem are we solving?

- Quantify the problem
  - Use measures that quantify safety
    - Project-specific safety performance
  - Use data-driven, performance-based approach
    - HSM crash prediction
    - Crash frequency and severity

- Identify the contributing factors
  - Helps identify the problem…and prioritize the solutions

- Focus on the Principles
  - What are we trying to achieve in design?
    - Roadway characteristics
    - User characteristics
    - Vehicle characteristics
What resources are available?

- Transportation Safety Action Plan (TSAP)
  - Holistic approach to integrating the 5E’s with safety

- Apply tools that quantify safety performance (frequency and severity)
  - Highway Safety Manual (HSM)
    - HiSafe
    - iHSDM
    - SafetyAnalyst
    - FHWA CMF Clearinghouse

- HCM 2010 Multimodal Level-of-Service (MMLOS)

- NCHRP Report 613 *Guidelines for the Selection of Speed-Reduction Treatments at High Speed Intersections*

- FHWA *Two Low-Cost Safety Concepts for Two-Way STOP-Controlled, Rural Intersections on High-Speed Two-Lane, Two-Way Roadways*

Transportation Safety Action Plan (TSAP)

- TSAP is a tool for:
  - Comprehensively and proactively addressing safety
  - Coordinating efforts
  - Nurturing and growing a holistic safety culture
  - Integrating safety throughout transportation process
  - Reaching safety goals (e.g., zero transportation fatalities)

- Integrates the 5E’s

- TSAP Development:
  - Vision Development
  - Stakeholder Involvement
  - Data Analysis

- Outcomes:
  - Categorized action items
  - Coordinated efforts across multiple stakeholders
Highway Safety Manual (HSM)

Resource to quantify and predict expected crash frequency of elements considered in project development process:
- Planning, design, construction, operation, and maintenance

- Improved decision-making process for applying safety treatments
  - Potential cost savings to agencies

- System Planning
  - HSM Part B
- Project Planning & Preliminary Engineering
  - HSM Part B and Part C
- Design and Construction
  - HSM Part C and Part D
- Operations and Maintenance
  - HSM Part B, C and D

Source: http://safety.fhwa.dot.gov/hsm/

HSM Implementation Tools

- SafetyAnalyst
  - Implements Part B – Roadway Safety Management
- HiSafe
  - Implements Part C (Predictive Method) and elements of Part D (Crash Modification Factors)
- IHSDM
  - Implements Part C – Predictive Method
  - Includes most recent interchange and freeway crash prediction models
  - Includes other modules to support design decisions
- FHWA CMF Clearinghouse
  - Broader, living library of CMFs
- ADOT&PF HISP Handbook
  - CRFs derived from Alaska data
- FHWA Publication - Integrating the HSM into the Project Development Process
**Multimodal Level of Service (MMLOS)**

- 2010 Highway Capacity Manual
- Quality of service analysis for:
  - Pedestrians
  - Bicyclists
  - Transit passengers
  - Motorists
- Integrated methodology
  - LOS results reported by user type
  - Different scale - Intersection to corridor
- Strong companion to HSM analysis

**NCHRP Report 613**
*Guidelines for the Selection of Speed Reduction Treatments at High Speed Intersections*

- Identify treatments to reduce speeds at high speed intersections
  - High speed \( \geq 45 \text{mph} \)
  - Focus: Geometric treatments
  - Focus: Intersection “Influence Area”
- Relationship between speed and safety
  - Professional Myth: Speed is inherently unsafe
    - Little supporting data that speed itself is unsafe
    - Is speed itself inherently “unsafe”?
    - “Excessive” speed for the context is the concern
- Developed guidelines for implementing the treatments
  - Context-sensitive – not one-size-fits-all
FHWA Concepts

Two Low-Cost Safety Concepts for Two-Way STOP-Controlled, Rural Intersections on High-Speed Two-Lane, Two-Way Roadways

- FHWA-HRT-08-063

Two Key Concepts

- Concept 1: Lane Narrowing on Major Road
  - Purpose: Increase awareness on major road approaches

- Concept 2: Minor Road Splitter Island
  - Purpose: Increase intersection awareness on minor road approaches

Relatively low-cost countermeasures

When do we use these resources?

- Apply whatever tools you need regardless of the stage
  - Can be used to augment other project development activities

- Understand the principles and resources available to you

PROJECT DEVELOPMENT PROCESS

The Traditional Geometric Design Process generally occurs during these phases of project development.
How do we prioritize?

- Local Context
- Severity and Nature of the Problem
- Quantifying and Ranking Most Effective Solutions
- Prioritizing Projects
  - “Toolbox” of solutions
  - Consider projects from the top down…
  - ...And from the bottom up
- Community or Decision-Maker Support for a Solution
  - Get buy-in
- Available Funding
  - Use the solutions that best fit the problems – right size projects
  - Project solutions can take the form of a continuum
  - Manage diminishing returns

Presentation Overview

- Introduction and Background
- Principles and Resources
- US 12 Chehalis Safety Study
- Transferability to Other Projects
US 12 Chehalis Safety Study

- Project Background
- Project Approach
- Improvement Toolbox
- Recommendations

Project Background

- Purpose
  - Identify safety improvements for a 5-mile section of US 12
  - Quantify the effectiveness of potential improvements to inform prioritization
  - Develop the improvements to be consistent with surrounding context
Project Background

Context
- Previous safety study on a longer portion of US 12 had been conducted by WSDOT with preliminary suggestions
  - Passing Lanes and/or Wider Shoulders
  - Intersection Realignment
  - Alternative Intersection Traffic Control and/or Turn Restrictions
- Desire to develop specific improvements for the 5-mile section adjacent to their reservation

Project Approach

Building off of a previous WSDOT Study
- A set of initial improvements identified from WSDOT
- Evaluated these initial set of improvements within this project

Overarching Activities of this Project
- Reviewed and Assessed Crash Data from MP 36 to 41
- Identified Potential Improvements (in addition to WSDOT Improvements)
- Compared Estimated Safety Benefits and Costs
Project Approach

- Project Work Flow
  - Technical Component
  - Collaborative Work Sessions

Technical Work

- Existing Conditions Observations and Context
  - Corridor Wide Observations and Crash Data Review
  - Location Specific Observations and Crash Data Review

- Patterns and Trends in Crash Data
  - Roadway Segments
  - Intersections
Corridor-Wide Observations

- Centerline Rumble Strips Present
- Paved Shoulders 2 to 4 feet in Width
- Western Portion of Corridor
  Relatively Steep Roadside Slopes
- Standing Water in Roadside Ditches

Eastbound on US 12 from Sickman-Ford Rd

Eastbound along US 12 west of Blockhouse Road

Corridor-Wide Observations

- Limited Visibility of Minor Road Intersections
- Observed Logging and Aggregate Trucks

US 12 at Blockhouse Road

Westbound Approach to US 12/Blockhouse Road Intersection
Corridor-Wide Observations

85th Percentile Speeds

Location Specific Observations

Blockhouse Road
- Noticeable Grade Difference on Minor Road Approach
- Noticeable Lane Narrowing on Minor Road Approach
- Acute Northbound Right-Turn and Westbound Left-Turn
- Relatively Large Undefined Open Pavement

South and West Legs of SR US/Blockhouse Rd Intersection

Northbound Blockhouse Rd at US 12
Location Specific Observations

- Anderson Road and Moon Road Intersections
  - Valuable Improvements Previously Implemented (May 2003 to March 2004)
    - Left-Turn Lanes
    - Right-Turn Lanes (at Anderson Road Intersection)
    - Intersection Lighting

Patterns and Trends in Crash Data

- Identified about 8 focus locations based on crash data

- Reoccurring crash types are
  - Turning and/or Angle Crashes
  - Roadway or Lane Departure Crashes

- Reoccurring contributing factors are:
  - Excessive Speed
  - Failure to Yield Right-of-Way
  - Fatigue and/or Inattention
**Improvement Toolbox**

- Intersection and/or Driveway Awareness
  - Longitudinal or Approach Treatments
    - Major Road Approach Splitter Island and/or Curvature
    - Advanced Signs, Lighting, Curbing, and Medians
    - FHWA Concepts for Two-Way Stop-Controlled, Rural Intersections on High Speed Two-Lane Roadways
  - Gateway Treatments
  - Treatments at Intersection Proper

- Intersection Traffic Control
- Intersection Design Enhancements
- Speed Management
- Roadside or Edge Treatments

---

**Intersection and/or Driveway Awareness**

- Longitudinal or Approach Treatments
## Intersection and/or Driveway Awareness

- Longitudinal or Approach Treatments
  - Major Road Approach Splitter Islands and/or Curvature
  - Advanced Signs, Lighting, Curbing, and Medians
  - FHWA Concepts for Two-Way Stop-Controlled, Rural Intersections on High Speed Two-Lane Roadways

## Improvement Toolbox

### Connected Toolbox to US 12

<table>
<thead>
<tr>
<th>Site</th>
<th>Contributing Factors</th>
<th>Potential Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson Road</td>
<td>• Failure to Yield (40%)</td>
<td>• *Roundabout</td>
</tr>
<tr>
<td></td>
<td>• Excessive Speed (20%)</td>
<td>• *Signal</td>
</tr>
<tr>
<td></td>
<td>• Following Too Close (10%)</td>
<td>• Intersection Awareness – Gateway Treatments</td>
</tr>
<tr>
<td></td>
<td>• Improper Turn (10%)</td>
<td>• Minor Street Improvements</td>
</tr>
</tbody>
</table>
| Segment 7 Anderson to | • Following Too Close (29%)           | ![Image](image_url)
| Moon Rd               | • Excessive Speed (14%)               | ![Image](image_url)
|                       | • Fatigue/Inattention (14%)           | ![Image](image_url)
|                       | • Alcohol (14%)                       | ![Image](image_url)
| Moon Road             | • Failure to Yield (71%)              | • *Restrict Access                           |
|                       | • Fatigue/Inattention (14%)           | • Roundabout                                |
|                       | • Disregard Stop Sign (14%)           | • Signal                                    |

*Parentage: [Image](image_url)
Improvement Toolbox

Connected Toolbox to US 12

- Crash Data (2006 - 2010)
  - SR 12
  - SR 12 Improvement Improvements
  - Corridor-Wide Potential Improvements
    - Shoulder Rumble Strips
    - Median Rumble Strips
    - Educational Opportunities

Improvement Toolbox – Interim Improvements

- Delineation, Shoulder Rumble Strips, Wider Longitudinal Pavement Markings

Wider Longitudinal Pavement Markings
Delineation: Shoulder Rumble Strips

Roadside Elements

Kittel & Associates Inc.
Performance, Safety, and Security

Delineation, Shoulder Rumble Strips, Wider Longitudinal Pavement Markings
Improvement Toolbox – Longer-Term Improvements

- Widen Shoulders*
- Maintain Existing Side Slopes
- Decrease Side Slopes
- Increase Side Slopes
- Wider Foot Print
- Widest Foot Print

* Paved or Partial Paved

---

Improvement Toolbox – Longer-Term Improvements

Minimum Passing Lane Concept

Approx. 2000 ft

700 ft 1000 ft 300 ft

- Drop Passing Lane
- Minimum Passing Length
- Add Passing Lane
Improvement Toolbox – Longer-Term Improvements

- Passing Lanes

Recommendations

- Developed Near- and Long-Term Safety Plans
<table>
<thead>
<tr>
<th>Draft Priority</th>
<th>Time Frame</th>
<th>Location - Improvement</th>
<th>Expected Crashes/Yr</th>
<th>Estimated Percent Reduction</th>
<th>Planning Level Cost Estimate</th>
<th>$/Crash Mitigated Over Design Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N</td>
<td>Near-Term</td>
<td>Anderson Road Intersection- FHWA Lane Narrowing</td>
<td>2.2</td>
<td>31%</td>
<td>$45,000</td>
<td>$13,196</td>
</tr>
<tr>
<td>2N</td>
<td>Near-Term</td>
<td>Anderson Road Intersection- FHWA Splitter Island</td>
<td>2.2</td>
<td>68%</td>
<td>$112,500</td>
<td>$15,040</td>
</tr>
<tr>
<td>3N</td>
<td>Near-Term</td>
<td>Moon Road- FHWA Lane Narrowing</td>
<td>1.9</td>
<td>31%</td>
<td>$45,000</td>
<td>$15,280</td>
</tr>
<tr>
<td>4N</td>
<td>Near-Term</td>
<td>Moon Road- FHWA Splitter Island</td>
<td>1.9</td>
<td>68%</td>
<td>$112,500</td>
<td>$17,415</td>
</tr>
<tr>
<td>5N</td>
<td>Near-Term</td>
<td>Forstrom Road- FHWA Lane Narrowing</td>
<td>1.1</td>
<td>31%</td>
<td>$45,000</td>
<td>$26,393</td>
</tr>
<tr>
<td>6N</td>
<td>Near-Term</td>
<td>Forstrom Road- FHWA Splitter Island</td>
<td>1.1</td>
<td>68%</td>
<td>$112,500</td>
<td>$30,080</td>
</tr>
<tr>
<td>1L</td>
<td>Long-Term</td>
<td>Forstrom Road- Left Turn Lanes</td>
<td>1.1</td>
<td>48%</td>
<td>$330,000</td>
<td>$31,250</td>
</tr>
<tr>
<td>-</td>
<td>Near-Term</td>
<td>Blockhouse Road - FHWA Lane Narrowing</td>
<td>0.9</td>
<td>31%</td>
<td>$45,000</td>
<td>$32,258</td>
</tr>
<tr>
<td>-</td>
<td>Near-Term</td>
<td>Blockhouse Road - FHWA Splitter Island</td>
<td>0.9</td>
<td>68%</td>
<td>$112,500</td>
<td>$36,765</td>
</tr>
<tr>
<td>2L</td>
<td>Long-Term</td>
<td>Blockhouse Road - Left Turn Lanes</td>
<td>0.9</td>
<td>48%</td>
<td>$330,000</td>
<td>$38,194</td>
</tr>
<tr>
<td>3L</td>
<td>Long-Term</td>
<td>Moon Road- Access Restriction / Right Turn Lane</td>
<td>1.9</td>
<td>26%</td>
<td>$610,000</td>
<td>$61,741</td>
</tr>
<tr>
<td>4L</td>
<td>Long-Term</td>
<td>Anderson Road- Single Lane Roundabout</td>
<td>2.2</td>
<td>71%</td>
<td>$2.15 million</td>
<td>$100,832</td>
</tr>
<tr>
<td>-</td>
<td>Near-Term</td>
<td>Sickman- Ford Road - FHWA Lane Narrowing</td>
<td>0.2</td>
<td>31%</td>
<td>$45,000</td>
<td>$145,161</td>
</tr>
<tr>
<td>-</td>
<td>Near-Term</td>
<td>Sickman- Ford Road - FHWA Splitter Island</td>
<td>0.2</td>
<td>68%</td>
<td>$112,500</td>
<td>$165,441</td>
</tr>
<tr>
<td>-</td>
<td>Long-Term</td>
<td>Sickman- Ford Road - Left Turn Lane</td>
<td>0.2</td>
<td>43%</td>
<td>$330,000</td>
<td>$191,860</td>
</tr>
<tr>
<td>-</td>
<td>Long-Term</td>
<td>Anderson Road - Traffic Signal</td>
<td>2.2</td>
<td>36%</td>
<td>$5.61 million</td>
<td>$354,167</td>
</tr>
<tr>
<td>-</td>
<td>Long-Term</td>
<td>Blockhouse Road- Realign</td>
<td>0.9</td>
<td>19%</td>
<td>$1.5 million</td>
<td>$438,596</td>
</tr>
</tbody>
</table>

**Presentation Overview**

- Introduction and Background
- Principles and Resources
- US 12 Chehalis Safety Study
- Transferability to Other Projects
Transferability to Other Projects

- Understanding and applying performance-based tools
  - Analyze data at a higher level than historically
    - Importance of identifying contributing factors
  - Application of (the correct) tools at key points
  - Throw away the concept of throw-away

Continuum of Improvements

- Identify/prioritize improvements based on effectiveness

- “Not to preclude” can be your guide
  - Phasing of improvements
  - Phased improvements sometimes don’t go beyond Phase 1

Questions?

- Andrew Ooms
  - aooms@kittelson.com
  - 907-646-7995

- Brian L. Ray, PE
  - bray@kittelson.com
  - 503-228-5230