Outline

▷ Project Goals and Objectives
▷ Methodology
▷ Network Screening
▷ Countermeasures
▷ Implementation & Next Steps
Project Goals and Objectives

- Reduce **fatalities and severe injuries** resulting from pedestrian and bicycle crashes
- Data-**informed** approach
- **Systemic** improvements
  - Low-cost
  - Statewide, jurisdictionally blind
  - Crashes alone are not always sufficient
- Set framework for the future
  - Establish a repeatable process
  - Develop a toolbox of countermeasures
  - Identify opportunities for improvement (e.g., additional data needs)
- Develop potential sites for funding
  - $4 million Pedestrian/Bike safety funding in 2017 for all roads
Methodology

- Literature Review
  - FHWA Risk-Based Approach
  - Countermeasures

- Risk-Based Systemic Approach
  - Crash Analysis
  - Development of Risk Factors

- Stakeholder Input

- Network Screening
  - Risk-Based Approach
  - Traditional Approach

- Prioritization of Corridors
Two systemic methods to complement each other

1. Traditional
   1. Broad implementation of countermeasures on high-crash corridors

2. Risk-based
   1. Identify locations with factors that increase the risk of pedestrian or bike crashes
   2. Prioritize locations based on the presence of risk-factors
   3. Implementing agency reviews sites, selects countermeasure from list
Overview of Risk-Based Systemic Method

1. **Identify Risk Factors**
   - Traffic and geometric characteristics present at fatal and severe-injury crash sites

2. **Select and Prioritize Locations**
   - Intersections or segments exhibiting one or more risk factors

3. **Develop Systemic Safety Projects**
   - Apply counter-measures to address risk factors at specific locations
Crash Analysis - Statewide Reported Pedestrian Crashes (2007-2011)

Total: 3,505
Severe: 752 (21% of total)

State Highways
Total: 658 (19%)
Severe: 211 (28%)

- Intersection
  Total: 338 (10%)
  Severe: 70 (9%)

- Segment
  Total: 320 (9%)
  Severe: 139 (18%)

Non-State Highways
Total: 1,052 (30%)
Severe: 222 (30%)

- Intersection
  Total: 520 (15%)
  Severe: 77 (10%)

- Segment
  Total: 532 (15%)
  Severe: 145 (19%)

Portland Metro
Total: 1,795 (51%)
Severe: 319 (42%)

- Intersection
  Total: 1,098 (31%)
  Severe: 137 (18%)

- Segment
  Total: 697 (20%)
  Severe: 182 (24%)

Identify Risk Factors
Select and Prioritize Locations
Develop Systemic Safety Projects
Crash Analysis – Example Pedestrian Trend

Reported Crashes State Highway Segments in Urban Areas (2007-2011)

- Crossing between intersections: 46 crashes (41 severe, 14 non-severe)
- No error: 7 crashes (3 severe, 4 non-severe)
- Did not have right-of-way: 24 crashes (12 severe, 14 non-severe)
- Other: 22 crashes (11 severe, 14 non-severe)

Pedestrian Error

Identify Risk Factors
Select and Prioritize Locations
Develop Systemic Safety Projects
Crash Analysis – Example Bicycle Trend

Reported Crashes on State Highway Segments in Urban Areas (2007-2011)

Collision Type and Road Character

Identify Risk Factors  Select and Prioritize Locations  Develop Systemic Safety Projects
# Potential Risk Factors – Pedestrians

## Roadway Type

<table>
<thead>
<tr>
<th>Roadway Type</th>
<th>Area</th>
<th>Potential Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>State, Non-State, Intersection</td>
<td>Urban/ Suburban</td>
<td>✚ Signalized intersections with permitted or protected/permitted left-turn phases</td>
</tr>
<tr>
<td>METRO, Intersection</td>
<td>Urban/ Suburban</td>
<td>✚ Signalized intersections within 100’ of transit stop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✚ Intersections that have collector or arterial roadways with 4-lanes on at least one approach</td>
</tr>
<tr>
<td>State, Intersection</td>
<td>Rural</td>
<td>✚ Intersections with approach speed limits at or above 45 mph and no sidewalks</td>
</tr>
<tr>
<td>State, Segment</td>
<td>Urban/ Suburban</td>
<td>✚ Unlit streets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✚ Signal spacing greater than x/mile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✚ Roadway cross-sections without a median</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✚ No sidewalk and posted speed equal to or greater than 45 mph</td>
</tr>
<tr>
<td>Non-State, Segment</td>
<td>Urban, Suburban and Rural</td>
<td>✚ Number of liquor establishments within x feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✚ Streets that lack street lights and have speeds above 40 mph</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✚ Signal spacing less than x/mile</td>
</tr>
</tbody>
</table>
## Potential Risk Factors – Bicycles

<table>
<thead>
<tr>
<th>Roadway Type</th>
<th>Area</th>
<th>Potential Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>State: Intersection</td>
<td>Urban/Suburban</td>
<td>✅ Signalized intersections with at least four lanes on major street</td>
</tr>
<tr>
<td></td>
<td>Urban/Suburban</td>
<td>✅ Unsignalized intersections with two or four lanes*</td>
</tr>
<tr>
<td>Non-State, METRO: Intersection</td>
<td>Urban/Suburban</td>
<td>✅ Intersections with a bicycle facility on at least one approach</td>
</tr>
<tr>
<td>METRO: Intersection</td>
<td>Urban/Suburban</td>
<td>✅ Signalized intersections within 100 feet of transit stops</td>
</tr>
<tr>
<td>State and Non-state: Intersection</td>
<td>Rural</td>
<td>✅ Unsignalized intersections with two-lane approaches*</td>
</tr>
<tr>
<td>All: Segment</td>
<td>All</td>
<td>✅ Driveway density (number of driveways/ mile)</td>
</tr>
</tbody>
</table>
Risk Factors - Pedestrians

Due to data limitations, pedestrian risk factors limited to:

- Presence of transit stop
- Number of travel lanes along segments
- Presence of median on 4-lane roads
- Posted speed along segments
- Distance between signals or enhanced crossings (to extent that data is available)
- Average Daily Traffic volume
- Number of injuries resulting from a pedestrian crash (by severity)
Due to data limitations bicycle crash risk factors limited to:

- Number of driveways
- Number of lanes on major street at intersection
- Lack of bicycle facility on at least one approach at intersection
- Proximity to transit stop
- Average Daily Traffic volume
- Number of injuries resulting from a bicycle crash (by severity)
GIS data were aggregated into a linearly-referenced network

To provide a consistent scale, the network was subdivided into 1/10th of a mile segments

Separate networks were developed for three levels of the road system

- Due to data limitations, networks were separated to maximize data availability where possible
- Urban State Network (Risk-Based and Traditional)
- Rural State Network (Traditional)
- Non-state Network (Traditional)
Limited application to state highways in urban area

- Red dots: signalized intersections within 100 feet of transit stop
- Black dots: all other signalized intersections
Risk-Based Site Prioritization

Risk-based

- Segments were scored based on the number of risk factors present
  - Some risk factors carry higher point value than others
  - Scoring based on risk factors on the segment and within ½ mile
- Consecutive segments with high scores were aggregated into corridor projects
- Segments/corridors with the highest scores were prioritized
Traditional Method Site Prioritization

Traditional

- Identify corridors with highest frequency of severe-injury and fatal crashes for the entire state
- Scoring based on total number of severe-injury and fatalities along the segment and within ½ mile
- Segments were then aggregated into corridors based on proximity and prioritized by overall score
Prioritized Corridors – Region 4 Pedestrian Example

Inset 3. City of Bend

Inset 2. City of Redmond / City of Prinville

Identify Risk Factors
Select and Prioritize Locations
Develop Systemic Safety Projects
Systemic Countermeasures

- Countermeasures evaluated based on
  - Documented effectiveness
  - Ease of implementation
  - Relative cost

- Prioritized countermeasure toolbox developed with input from stakeholder workshop and project management team

- Used to develop potential safety improvement projects
### Example Countermeasures – Pedestrian

<table>
<thead>
<tr>
<th>Crash Countermeasures by Area Type and Traffic Control</th>
<th>Relative Construction Cost</th>
<th>Relative Ease of Implementation</th>
<th>Countermeasure Effectiveness*</th>
<th>Relative Reliability of CMF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Locations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Signalized</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting</td>
<td>2</td>
<td>2</td>
<td>0.58</td>
<td>1</td>
</tr>
<tr>
<td>Right-turn channelization island</td>
<td>2</td>
<td>2</td>
<td>Reduces conflict points</td>
<td>N/A</td>
</tr>
<tr>
<td>Signal Timing - Install countdown signals</td>
<td>1</td>
<td>1</td>
<td>0.45</td>
<td>2</td>
</tr>
<tr>
<td>Signal Timing - Leading pedestrian/bicyclist interval</td>
<td>1</td>
<td>1</td>
<td>0.63</td>
<td>2</td>
</tr>
<tr>
<td>Signal Timing - Modify left-turn phasing</td>
<td>1</td>
<td>1</td>
<td>Reduces conflict points</td>
<td>N/A</td>
</tr>
<tr>
<td>Vehicle turning movement restrictions</td>
<td>1</td>
<td>2</td>
<td>Reduces conflict points</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Unsignalized</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhanced crossing treatment</td>
<td>1</td>
<td>2</td>
<td>0.58</td>
<td>2</td>
</tr>
<tr>
<td>Lighting</td>
<td>2</td>
<td>2</td>
<td>0.58</td>
<td>1</td>
</tr>
<tr>
<td>Reduce curb radii</td>
<td>2</td>
<td>2</td>
<td>Reduces speed</td>
<td>N/A</td>
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<tr>
<td><strong>No Traffic Control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access control</td>
<td>3</td>
<td>3</td>
<td>0.75</td>
<td>1</td>
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<tr>
<td>Sidewalks</td>
<td>2</td>
<td>2</td>
<td>Reduces conflict points</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Effectiveness values are estimates and may vary based on local conditions.
### Example Countermeasures – Bicycle

<table>
<thead>
<tr>
<th>Crash Countermeasures by Area Type and Traffic Control</th>
<th>Relative Construction Cost</th>
<th>Relative Ease of Implementation</th>
<th>Countermeasure Effectiveness*</th>
<th>Relative Reliability of CMF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Locations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Signalized</strong></td>
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<td></td>
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<tr>
<td>Bike detection</td>
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<td>Accounts for human factors</td>
<td>N/A</td>
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<tr>
<td>Lighting</td>
<td>2</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Pavement markings</td>
<td>1</td>
<td>1</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Right-turn channelization island</td>
<td>2</td>
<td>2</td>
<td>Reduces conflict points</td>
<td>N/A</td>
</tr>
<tr>
<td>Signal Timing - Leading pedestrian interval</td>
<td>1</td>
<td>1</td>
<td>0.59</td>
<td>2</td>
</tr>
<tr>
<td>Signal Timing - Modify left-turn phasing</td>
<td>1</td>
<td>1</td>
<td>Reduces conflict points</td>
<td>N/A</td>
</tr>
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<td>Vehicle turning movement restrictions</td>
<td>1</td>
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<td>Lighting</td>
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<td>0.58</td>
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</tr>
<tr>
<td>Reduce curb radii</td>
<td>2</td>
<td>2</td>
<td>Reduces speed</td>
<td>N/A</td>
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<tr>
<td>Skip Striping</td>
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<td>Accounts for human factors</td>
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<tr>
<td>Supplemental signs and markings</td>
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<td>1</td>
<td>Accounts for human factors</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>No Traffic Control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access control</td>
<td>3</td>
<td>3</td>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td>Bicycle route signage</td>
<td>1</td>
<td>1</td>
<td>Accounts for human factors</td>
<td>N/A</td>
</tr>
<tr>
<td>Longitudinal bike stencil</td>
<td>1</td>
<td>1</td>
<td>Accounts for human factors</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Implementation Plan

Content

➤ Prioritizes bicycle and pedestrian corridors for safety improvements
  ▪ Risk-based prioritization for State Highways in urban areas
  ▪ Traditional prioritization for all roadways (State and Non-State)

➤ Countermeasure Toolbox to assist in determining safety improvements
How does this plan help local agencies and ODOT regions?

- Local agencies can identify and propose candidate corridors with defined set of risk factors on their own roadway networks
- Region staff can prioritize candidate corridors
- Assists in allocating funding between state/local roads based on distribution of severe-injury and fatal crash locations and risk factors
Project Limitations

- Limited crash data
- Limited low-cost countermeasure options
- Inconsistent inventory data across jurisdictional boundaries
  - State
  - Non-state (City, County, MPO)
  - Portland METRO
- Not unique to Oregon
  - NCHRP Synthesis 458, Roadway Safety Data Interoperability Between Local and State Agencies
Improving the Plan

Data Collection

- A consistent problem throughout the project was data limitations:
  - Inconsistencies
  - Limited spatial coverage
  - Lack of desired detail
- It would be best to indicate bicycle and pedestrian exposure using volumes

Evaluation of Implementation Effectiveness

- Evaluating the program will be critical for identifying problems and which countermeasures are most effective in which environments

Enforcement and Education
Questions?

Contact Us

- Project team
  - Doug Bish, ODOT – douglas.w.bish@odot.state.or.us
  - Casey Bergh, Kittelson – cbergh@kittelson.com
  - Ashleigh Griffin, Kittelson – agriffin@kittelson.com
  - Matt Braughton, Kittelson – mbraughton@kittelson.com
Crash Analysis - Statewide Reported Bicycle Crashes (2007-2011)

Total: 4,124
Severe: 363 (9% of total)

State Highways
Total: 607 (15%)
Severe: 64 (18%)

Non-State Highways
Total: 1,423 (35%)
Severe: 127 (35%)

Portland METRO
Total: 2,094 (51%)
Severe: 172 (47%)

Intersection
State Highways
Total: 402 (10%)
Severe: 37 (10%)

Non-State Highways
Total: 849 (21%)
Severe: 66 (18%)

Portland METRO
Total: 1,460 (35%)
Severe: 118 (33%)

Segment
State Highways
Total: 205 (5%)
Severe: 27 (7%)

Non-State Highways
Total: 574 (14%)
Severe: 61 (17%)

Portland METRO
Total: 634 (15%)
Severe: 54 (15%)

Identify Risk Factors
Select and Prioritize Locations
Develop Systemic Safety Projects