Agenda

- Welcome/Introductions
- Project Background/Purpose
- Review and Application of Systemic Safety Process
- Discussion/Feedback on Process
- Closeout
Project Team

- ODOT
- NCHRP Staff and Panel
- Consultant Team
  - Kittelson & Associates, Inc.
  - DKS
  - Chris Monsere, PhD, PE
Project Background and Purpose
- ODOT’s current plan was completed in 2014
- Since then:
  - ODOT’s data has improved
  - Recommended systemic analysis methods have been published in NCHRP Research Report 893
- ODOT applied for and was awarded NCHRP implementation funds to apply the results of NCHRP Research Report 893 to update the 2014 plan.
This slide shows the project objectives.

The emphasis is that this project is not a typical plan with resulting in projects, but rather it provides a framework for how to conduct analyses, what risk factors ODOT Regions and local agencies can use to identify locations for treatments, and provides example applications.
Pedestrian and Bicycle Systemic Safety Process
This slide shows Fatal and Injury A bike crashes in the Portland Metro area from 2015.
- This slide shows Fatal and Injury A bike crashes in the Portland Metro area from 2016
- Note how the locations have shifted since 2015
- This slide shows Fatal and Injury A bike crashes in the Portland Metro area from 2017
- Note how the locations have shifted since 2015 and 2016
- This slide shows Fatal and Injury A pedestrian crashes in the Salem area from 2015
- This slide shows Fatal and Injury A pedestrian crashes in the Salem area from 2016
- Note how the locations have shifted since 2015
- This slide shows Fatal and Injury A pedestrian crashes in the Salem area from 2017
- Note how the locations have shifted since 2015 and 2016
- This slide describes what the systemic safety approach is.
- The key takeaway is emphasized in italicized text. These crash types are spread around the network, so it appears that the locations are random but the factors that contribute to these factors are predictable so these crashes can be effectively prevented.
- This slide presents the 7-step process from NCHRP Research Report 893.
- It is an iterative process
- We will discuss each of the seven steps in more detail in the coming slides
- This project focused on steps 1-5
Systemic Safety Benefits

- Comprehensive Decision-making Basis
- Cost-effective
  - Typically Low-cost Treatments at Similar Sites
- Data-driven
- Proactive
- Consistency

- This slide presents the benefits of a systemic approach
- Comprehensive decision making – accounts for factors that a hot-spot type of approach does not, including randomness
- It’s important to note that since it’s a data-driven process, it is approved for use in the HSIP project selection process
Step 1 – Define Study Scope

- Study Area
  - Jurisdiction, sub-area, etc.
- Target Facility/Location Types
  - Intersections, segments, functional class, etc.
- Target Crash Types
  - Pedestrian, bicycle, roadway departure, etc.

This slide presents the elements that go into Step 1 in the NCHRP Research Report 893 process. A crash tree or other analysis can help determine how the study scope should be focused.
- This slide presents the crash tree completed for pedestrian crashes
- Most pedestrian crashes occur in urban areas
  - And within urban areas, at intersections
- Crashes are more prevalent in-between intersections in rural areas
- Crashes in rural areas and along segments tend to be more severe than at intersections or driveways
- Many of the segment crashes are mid-block crossing crashes
- This slide presents the crash tree completed for bicycle crashes
- Most bicycle crashes occur in urban areas
  - And within urban areas, at intersections
- Crashes are more evenly split between segments and intersections in rural areas
- Crashes in rural areas and along segments tend to be more severe than at intersections or driveways
- Difference from peds – more crashes at driveways and fewer at segments – generally, fewer midblock crossing crashes.
Step 1 – Define Study Scope – ODOT Plan

- Study Area – *Statewide*
- Target Facility/Location Types – *State Highways*
  - *Emphasis on Urban Areas (population >5,000)*
- Target Crash Types
  - *Pedestrian*
  - *Bicycle*

- This slide presents how the study scope was defined for the ODOT plan
- Urban areas are emphasized, but rural areas are still considered so as to show a variety of applications
- Bicycle and pedestrian crashes are analyzed separately
Step 2 – Compile Data

- GIS/Linear Referenced Format
- Roadway
  - Functional Class, Speed, Signals, Sidewalks, etc.
- Land-use/Demographic Data
  - Zoning, Parks, Schools, Mode Split, Transit Stops, etc.
- Crash
- Exposure (Count)

- This slide presents the elements that go into Step 2 in the NCHRP Research Report 893 process
- Ideally, all data is available in GIS or other linear referenced format
- There are four categories of data
  - Roadway
  - Land-use/demographic
  - Crash
  - Exposure/Count
Step 2 – Compile Data – ODOT Plan

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Eugene</th>
<th>Portland</th>
<th>Bend</th>
<th>ODOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ped Counts</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Vehicle Counts</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
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<td>Zoning</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Parks</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Schools</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Transit Stops</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Functional Class</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ped Facility</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bike Facility</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Trails/Shared-use Paths</td>
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<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Road Centerlines</td>
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<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Road Lanes</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Road Shoulders</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Road Speed</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Traffic Signals</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Enhanced Crossings</td>
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<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Crashes 2007 - 2017</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SPIS Data 2009 – 2015</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

- This slide presents the data compiled for the ODOT plan
- ODOT’s dataset was the most complete
- The datasets from the larger three metro areas were used to augment the analysis for some factors
  - These three metro areas were selected since they had count programs and relatively complete infrastructure datasets
Step 3 – Determine Risk Factors

Possible Approaches

- Crash Prediction Models/Safety Performance Functions
- Research/Local Judgment
- Crash Frequency-Based

- This slide presents three possible approaches to Step 3 in the NCHRP Research Report 893 process
- Crash prediction models/safety performance functions are ideal, but they are data intensive and many jurisdictions may not have the necessary data to develop them
- Research/Local Judgment is simple and could be particularly good for smaller jurisdictions
- Crash Frequency is intuitive and can provide some local data backing for choosing risk factors, but it has its holes, too, especially if working with a smaller dataset.
Step 3 – Determine Risk Factors – ODOT Plan Approach

- Possible Approaches
  - Crash Prediction Models/Safety Performance Functions
  - Research/Local Judgment
  - Crash Frequency-Based

- This slide presents the chosen approach for the ODOT plan
- It is primarily crash frequency-based, but it’s also augmented with research on factors for which the data was not available or the analysis was inconclusive
- This slide presents an example of how functional classification was analyzed with respect to bicycle crashes.
- Notably, about 62% of all bicycle crashes occur on Urban Principal and Minor Arterials, which collectively make up about 8% of Oregon roadways based on mileage.
Step 3 – Determine Risk Factors – ODOT Plan Results - Pedestrian

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Facility Type</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principal Arterial</td>
<td>General</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Number of Lanes (&gt;= 4 Lanes)</td>
<td>Segment</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>High-Access Density</td>
<td>Segment</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>No Sidewalks (or Only One Side)</td>
<td>Segment</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Posted Speed (&gt;=35 mph)</td>
<td>Segment</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Context</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed Use Zoning</td>
<td>General</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Other Zoning</td>
<td>General</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Proximity to Schools (1 Mile)</td>
<td>General</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Proximity to Transit Stops (1/4 Mile)</td>
<td>General</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Population over the Age of 64</td>
<td>General</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Other Risk Factors (Not Used in Screening Due to Data Availability)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-turning Volumes at Intersections</td>
<td>Intersection</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Left-turn Signal Phasing (Permissive)</td>
<td>Intersection</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lighting</td>
<td>Intersection</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Propensity for Mid-block Crossings</td>
<td>Intersection/Mid-block</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Exposure</td>
<td>Intersection</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

- This slide presents the identified risk factors for pedestrian crashes
- Data and research backs these up – used a combination to determine which to select.
- There are different urban and rural factors
- These can be used for screening or site analysis
- There is overlap across certain variables
- This slide presents the identified risk factors for bicycle crashes
- Data and research backs these up – used a combination to determine which to select.
- There are different urban and rural factors
- These can be used for screening or site analysis
- There is overlap across certain variables

### Step 3 – Determine Risk Factors – ODOT Plan Results - Bicycle

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Facility Type</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principal Arterial</td>
<td>General</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>General</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Number of Lanes (&gt;= 4 Lanes)</td>
<td>Segment</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>High-Access Density</td>
<td>Segment</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>No Bike Lanes</td>
<td>Segment</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Posted Speed (&gt;=35 mph)</td>
<td>Segment</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Context</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed Use Zoning</td>
<td>General</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Proximity to Schools (1 Mile)</td>
<td>General</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Proximity to Transit Stops (1/4 Mile)</td>
<td>General</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Population over the Age of 64</td>
<td>General</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Other Risk Factors (Not Used in Screening Due to Data Availability)</td>
<td>Intersection</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Other Risk Factors:**
- High-turning Volumes of Intersections
- Left-turn Signal Phasing (Permissive)
- Time of Day/Lighting
- Scenic Bikeways
- Exposure

Data and research backs these up – used a combination to determine which to select.
These can be used for screening or site analysis.
- This slide presents what goes into Step 4 of the NCHRP Research Report 893 process.
- There are three ways to evaluate the network according to the risk factors:
  - Basic count = 1 point per risk factor
  - Weighted = Different points are assigned for the presence of different risk factors based on some type of weighting
  - All sites with a certain factor = This is typically chosen if there is a countermeasure an agency wants to deploy that is valid for a certain type of factor (e.g., installing pedestrian logic at flashing yellow arrow installation sites)
- There are a number of factors that can go into selecting white sites to move forward with, including an agency’s budget and whether there are pre-selected countermeasures and if they apply to a site.
Step 4 – Identify Potential Treatment Sites – ODOT Plan Approach

- GIS-based Screening
- Weighted Risk Factors
- Manual Corridor Review

- This slide presents ODOT’s approach to Step 4
- Risk factors were weighted based on their correlation with crash severity
- After the initial analysis was completed, the project team manually reviewed the segments to create corridors with logical start/end points
Step 4 – Identify Potential Treatment Sites – Bicycle Results

- This slide presents the results of the bicycle screening.
- Sites were generally selected from the two highest scoring quintiles.
- The same process was completed for pedestrian sites.
Step 4 – Identify Potential Treatment Sites – Example Bicycle Sites

- This slide presents the 25 sites selected for example applications for bicycles.
- These are sites for examples and they were picked to be representative of a range of conditions. They are not selected for projects, necessarily.
- The same process was completed for pedestrian sites.
Step 5 – Select Potential Countermeasures

- Establish a Selection Framework
  - Effectiveness
  - Program/Crash Type Relationship
  - Cost
  - Feasibility
- Develop Potential Countermeasure List
- Select Countermeasures

- This slide presents what goes into Step 5 of the NCHRP Research Report 893 process
- This project focuses on the first two steps
Step 5 – Select Potential Countermeasures – ODOT Plan Process

- Review Existing Site Conditions
  - Physical/geometric Conditions
  - Risk Factor Presence
  - Traffic Data
  - Land-use Context
  - Crash History
- Identify Initial Countermeasure List
- Assess Feasibility of Initial List

- This slide presents the process followed for Step 5 for the ODOT plan
- The resulting countermeasures list for each site is wide ranging. Each site would need to be investigated further to determine which countermeasures are the most cost effective and feasible
Step 5 – Select Potential Countermeasures – Example Sites – OR 58 (Oakridge)

- This slide presents the first page of each site. It shows:
  - Context
  - Location
Step 5 – Select Potential Countermeasures – Example Sites – OR 58 (Oakridge)

- This slide shows how crash data is shown for each site, including:
  - Crash history, if there is any
  - The risk factors that are present
- This slide shows an example of how countermeasures are presented.
- For each countermeasure, the following information is presented:
  - Its crash reduction factor (CRF)
  - Its ARTS #
  - Where it might be applicable
  - What crash types/risk factors it addresses
  - Implementation considerations
  - Planning-level cost estimates
Step 6 – Refine & Implement Treatment Plan

- Consider Additional Community Priorities
  - Planned Projects, Additional Data, Diversity, etc.
- Perform Additional Diagnostics
  - Field Visit, Other User Effects, etc.
- Perform Economic Assessments
  - ARTS – Cost-Effectiveness Index
- Allocate Funding and Implement Projects
  - ARTS has Pedestrian/Bicycle Systemic Funding

- This slide presents what goes into Step 6 of the NCHRP Research Report 893 process
- This step was not completed for this project
Step 6 – Refine & Implement Treatment Plan – ODOT Approach

► Roll out Plan
  ► Regions – ARTS Subcommittee
  ► Pedestrian and Bicycle Program Liaisons
► Work with ARTS Consultant to Inform Local Agency projects
► Publish Plan on ODOT Websites

- This slide presents how ODOT plans to implement the plan
- Note that two webinars have already been conducted with ODOT and local agency staff
- This slide presents what goes into Step 7 of the NCHRP Research Report 893 process
- This step was not completed for this project
- The first set of measures evaluate whether/how the program is being implemented
Step 7 – Evaluating Program and Project Impacts (cont.)

- Program Outcome Measures
  - # of Pedestrian/Bicycle Fatalities and/or Serious Injuries and F/SI Crashes
  - Functional Class
  - Segments vs. Intersections
  - Posted Speed
  - Population 65 Years+
  - Roadway Ownership
  - Urban vs. Rural

- Refine Program Based on Results

- This slide presents what goes into Step 7 of the NCHRP Research Report 893 process
- This step was not completed for this project
- The second set of measures evaluate the program’s outcome
- The performance measures shown here are those selected by ODOT
  - They will be evaluated separately for pedestrian and bicycle crashes
Discussion