Research Project Work Plan

for

MULTI-MODAL INTERSECTIONS: RESOLVING CONFLICTS BETWEEN TRAINS, MOTOR VEHICLES, BICYCLISTS AND PEDESTRIANS

SPR-794

Submitted by

Anne Goodchild
Associate Professor

University of Washington
121E More Hall
Seattle, WA 98195

for

Oregon Department of Transportation
Research Unit
555 13th St. NE, Ste 2
Salem, OR 97301-6867

November 2015

Research Project Work Plan
for

MULTI-MODAL INTERSECTIONS: RESOLVING CONFLICTS BETWEEN TRAINS, MOTOR VEHICLES, BICYCLISTS AND PEDESTRIANS

1.0 Identification

1.1 Organizations Sponsoring Research

Oregon Department of Transportation (ODOT)
Research Section
555 13th Street NE
Salem, OR 97301 Phone: (503) 986-2700

Federal Highway Administration (FHWA)
Washington, D.C. 20590

1.2 Principal Investigator

Anne Goodchild, Associate Professor
Civil and Environmental Engineering
University of Washington
121E More Hall
Seattle, WA 98195 Phone: (206) 543 3747

1.3 Technical Advisory Committee (TAC) Members

Rick Shankle, ODOT Rail Crossing Safety Section Manager
David Smith, ODOT Rail Crossing Safety Section
John Brown, ODOT Rail Crossing Safety Section
Katie Johnson, Traffic Signal QC Engineer, ODOT Traffic-Roadway Section
Sheila Lyons, ODOT Bicycle & Pedestrian Program Manager
Xiugang (Joe) Li, Research Coordinator, ODOT Research Section
Julie Yip, ODOT Transportation Safety Division
Bruce Moody, FHWA Oregon Division

1.4 Friends of the Committee

Michael Kimlinger, ODOT Traffic Standards Engineer

1.5 Research Coordinator

Xiugang (Joe) Li, ODOT Research Section, Phone: 503-986-4115

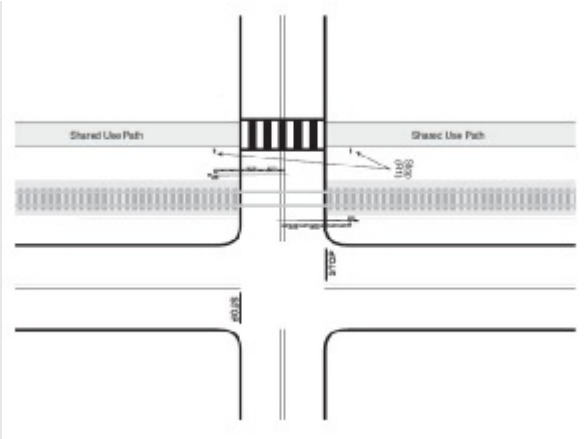
1.6 Project Champion

Rick Shankle, ODOT Crossing Safety Section Manager, Rail & Public Transit Division

2.0 Problem Statement

The Oregon Department of Transportation works to provide a safe, efficient transportation system that supports economic opportunity and livable communities for Oregonians. Increased cycling rates, rail shipments, and the establishment of multi-use paths has led to numerous complex and unsafe intersections where road, rail, and multiuse paths intersect. The safety hazards presented by these intersections threatens to prevent ODOT from delivering on this promise and therefore must be addressed. The question is, what is the best approach to balance safety concerns, reduce delay, maximize the use of limited resources, and protect quality of life?

As an example, when a multiuse facility, taking advantage of a railroad right of way, runs parallel to that right of way, there comes a time when the multiuse facility and railroad must cross the roadway. In many cases unclear priorities between cyclists, vehicles, and pedestrians, and travelers find themselves unclear as how to navigate the intersection safely.



At the same time, Oregon has considerably tightened the laws regarding driver responsibilities to pedestrians at crosswalks. According to Oregon law, once a pedestrian moves onto the roadway in the crosswalk with the intent to proceed, vehicles approaching from both directions must stop and remain stopped until the pedestrian clears the driver's lane, plus the adjacent lane. Crosswalks connected to multi use paths can carry a variety of the vulnerable travelers, including walkers, bicycles, tricycles, strollers, and runners. In locations near railroad tracks this queue of vehicles can spill back across the tracks, putting drivers that obey the law and stop for trail users, in danger of collisions with oncoming trains. With marked crosswalks parallel to tracks at a distance of 15 feet, or greater, Oregon's laws have set up a situation where drivers may unexpectedly find themselves in a situation where they may have to break one law (do not stop on tracks) in order to obey another law (stop for pedestrians in crosswalk or pathway). Not only is this a safety

concern, but Oregon has long had a law in the vehicle code prohibiting a vehicle from stopping, standing, or parking on a grade crossing or otherwise interfering with rail operations.

While FHWA, AASHTO, and numerous interest groups, provide guidance as to intersection design at midblock trail crossings, detailed guidance is not provided for the design of trail crossings near rail crossings. Lack of design options results in confusion, muddled priorities, and a missed opportunity to address potential conflicts.

An important issue when designing a multi-use pathway road crossing, adjacent to a railroad crossing, is ensuring that drivers of motor vehicles, who usually control the fastest and heaviest vehicles involved in the pathway crossing, are aware of the presence of trail users, either through appropriate sight distance, a warning device, or some combination of the two. Infrastructure design should also ensure that the vehicles do not block the railroad crossing when the pathway crossing is occupied. Trail users, especially cyclists and joggers, also should be provided with adequate sight distance to observe vehicles, as they have a responsibility to slow or stop before crossing the road to ensure the safety of themselves and others. This work will provide transportation engineers and planners with more practical guidance than exists in the current literature, providing them with a framework for designing site-specific solutions.

3.0 Objectives of the Study

This project will fill the gap identified by providing background, information, and guidance for infrastructure designers, planners, and interested parties, when faced with complex and problematic intersection design. To do so, we will identify a set of at least 5 case study locations in Oregon. For each location considered, we will, through field case studies, seek to understand driver and trail user behavior. We will develop a methodology for how complex intersections are to be evaluated and propose improvements. This will allow practitioners to identify, for example, the best location for a crosswalk in relationship to railroad tracks, and the most effective traffic control devices for each location. In addition to presenting recommended solutions for the at least 5 case studies, the project will produce a methodology for evaluating solutions to complex intersections more broadly.

3.1 Benefits

This research has the potential to save lives, reduce injuries, and improve quality of life. With ODOT's commitment to multimodal transportation, growing rail traffic, and increasing traffic intensity, guidance is needed to ensure the safety of all users at increasingly complex intersections. The project will produce a methodology for evaluating complex intersections in communities across the state and the nation. By developing a safer design for a facility that handles all modes of transportation we can increase safety and lessen conflicts with all modes. This will support livable communities, efficient freight movement, and a healthy economy. Without this work, significant safety concerns remain.

4.0 Implementation

The project will conclude with a final report documenting the project activity and outcomes. The purpose of this report is primarily to document project effort. The report will provide a range of solutions according to different modes of transportation and the complexity of the intersection. This procedure will also be written up in a journal paper, and submitted for presentation and publication with the Transportation Research Board. In addition, the procedure will be shared via the PacTrans UTC website, reaching a much larger audience connected through the University Transportation Center community.

The report will serve as a resource for ODOT Rail & Public Transit Division, ODOT Traffic management, ODOT Planning, ODOT Safety, ODOT Bicycle & Pedestrian, ADA community. This document will be circulated widely within ODOT, and additional formats can be produced on request, such as a presentation of project findings, or Research Note.

5.0 Research Tasks

Task 1: TAC Meeting #1

Project kick off meeting. The objective of Task 1 is to make sure that the research team clearly understands what ODOT expects from this research, primarily in terms of project objectives and scope. The PI will present work plan including tasks and schedule, and preliminary literature review results at this meeting. Any questions regarding project goals or any new developments that might have occurred between proposal submission and beginning the work will be discussed/clarified at this meeting.

Time Frame: January 2016
Responsible Party: PI, ODOT Research Coordinator, TAC
Cost:$1,000
Deliverable: TAC meeting attendance, TAC meeting presentation, TAC Meeting Minutes
TAC Action: Review and understand project research problem statement, research question, the limits of the research, and the project schedule. Advise ODOT Research Coordinator regarding any critical issues with the project's scope or schedule. Advise PI's regarding related professional practices, standards, methods and context for the project.
ODOT Action or Decision: Review TAC advice, discuss with PI, and if necessary direct PI to make changes to project documents.

Task 2: Literature Review

The related literature primarily focuses on pedestrian and cyclist behavior at typical at-grade crossings and related design guidelines. While this literature will be reviewed for relevance to the project, the literature review will also include a review

of:

1. Oregon legal statutes
2. Policy documents such as those produced by the Institute for Transportation Engineers, FHWA, and ODOT
3. Proposed solutions and concerns documented in communications between Oregon Department of Transportation (ODOT), City of Corvallis, the Federal Highway Administration (FHWA), County of Benton, Union Pacific Railroad, Portland and Western Railroad, and the Oregon Traffic Control Devices Committee,
4. Academic publications
5. Popular media such as newspaper articles
6. International policy documents and recommendations
7. Recorded comments from past public meetings addressing similar issues

Time Frame: January through March, 2016
Responsible Party: PI
Cost:$10,000
Deliverable: Draft Literature Review
TAC Action: Read Draft Literature Review and advise ODOT Research Coordinator regarding any gaps in the literature.
ODOT Action or Decision: Review TAC advice, discuss with PI, and if necessary direct PI to make changes to project documents.

Task 3: Conduct Field Studies.

In order to observe driver and pedestrian behavior and identify current conflicts and hazards, at least 24 hours of behavioral observations will be made at 5 to 8 locations in Oregon. These locations will be identified in conjunction with ODOT staff. Observation may be conducted through installation of video cameras and review of video recordings, and/or through on-site visits by research staff. These hours will not be consecutive, but will be selected to cover peak travel periods where consistently repeated behaviors can be observed. Traffic flow diagrams will be created and frequency of conflicts or near conflicts estimated. The intersection features, such as sight distance and signal timing will be described.

Suggested candidate locations for field studies include but not limited to:

- NE Walnut Blvd (City of Corvallis, Benton County, CK-700.90/916556A, Portland & Western RR)
- NW Conifer Blvd (City of Corvallis, Benton County, CK-700.20/759203E, Portland & Western RR)
- Mill St SE (City of Salem, Marion County, C-718.30/759677P, Union Pacific RR/AMTRAK)
- SE Spokane St (City of Portland, Multnomah County, 46A-3.58/862961L, Oregon Pacific RR)

Time Frame: April – August 2016
Responsible Party: PI

Cost: $28,500
Deliverable: Summary report of field study outcomes including traffic flow diagrams
TAC Action: Review summary report. May have conference call to discuss the report and provide feedback.

Task 4: Stakeholder Outreach.

It is important to capture many perspectives on the points of conflict. To this end, the fourth task of the project is to reach out to individuals and communities to whom the intersection is relevant. Namely:

1. users of the trail and roadway including frequent users of the route (e.g. transit drivers)
2. train drivers
3. ODOT divisions
4. County representatives
5. City planners
6. Regional FHWA representatives
7. Railroad representatives, including shortline & mainline (such as PW & UP)

A maximum of 10 1-1 interviews lasting between 30 minutes and 1 hour will be conducted over the phone by the research team.
Time Frame: June – August 2016
Responsible Party: PI
Cost: $15,000
Deliverable: Summary report of stakeholder input
TAC Action: Review summary report. May have conference call to discuss the report and provide feedback.

Task 5: Definition of Evaluation Criteria.

In order to compare and contrast solutions, evaluation criteria will be determined. These could be quantitative criteria such as vehicle delay, or qualitative criteria, such as impact on ease of use of the trail. Given input from the results of previous tasks, the research team will propose evaluation criteria for the project. These will be reviewed, modified as necessary, and approved by the TAC (Technical Advisory Committee) at the second TAC meeting.

Candidate criteria, include cost of treatment application, as well as the change in:

1. expected travel time
2. probability of stopping
3. sight distance
4. presence of stopping locations
5. level of safety improvement

Time Frame: September - October 2016
Responsible Party: PI
Cost: $7,500
Deliverable: List of evaluation metrics and definitions

TAC Action: Review previous project deliverables in preparation for TAC Meeting # 2.
ODOT Action or Decision: Schedule TAC Meeting #2

Task 6: TAC Meeting #2

This TAC meeting is intended to set the course for the completion of the project. On high risk and exploratory projects this is the point where ODOT will consider authorizing future work.
Time Frame: November 2016
Responsible Party: PI, ODOT Research Coordinator, TAC
Cost: $1,500
Deliverable: TAC meeting attendance, TAC meeting presentation, TAC Meeting Minutes, meeting agenda
TAC Action: TAC review of previous project deliverables. Advise ODOT Research Coordinator regarding any critical issues with the project's research design.
ODOT Action or Decision: Review TAC advice. Assess project potential for successful completion. If necessary direct PI to make changes to project documents. Provide formal acceptance of project deliverables. Authorize PI to proceed with subsequent steps, notify by memo or email.

Task 7: Development and Analysis of Proposed Solutions

For each location, at least 2 solutions will be suggested by the research team. The research team will evaluate each of solutions using the evaluation criteria. For each case study, base case values of the evaluation criteria will be compared to an estimate of the evaluation criteria following application of the solution. For each case study and solution, a table, such as the one shown below, will be generated.

Case Study Intersection Treatment A

Evaluation Criteria	**Base Case**	**After Application**
Expected Travel Time	80 seconds	90 seconds
Evaluation Criteria 2	**	**
**	**	**

Time Frame: September 2016 – February 2017
Responsible Party: PI
Cost:$50,000
Deliverable: Report summarizing the performance of the candidate solutions at the field study locations along the evaluation criteria. Report will include quantitative outcomes as well as specific recommendations as to the best solution for each case study intersection. A complete discussion of the rationale behind the selection of the best solution will be provided.
TAC Action: Review of report

Task 8: Produce Guidebook

For those interested in resolving intersection conflicts, a guidebook will be produced that can be used to guide decision-making. The specific evaluation criteria and methods for estimating each criteria will be provided. In addition, qualitative guidance for prioritizing or weighing criteria based on local condition, will be given.

Time Frame: February – April 2017
Responsible Party: PI
Cost: $20,000
Deliverable: Draft guidebook
TAC Action: Review and comment
ODOT Action or Decision: Review

Task 9: Draft Final Report

Publication ready Draft Final Report in the prescribed ODOT report format. (Formatting includes correct fonts, spacing, citations and graphics) Contents include: an updated abstract, acknowledgement, disclaimer, introduction, updated lit review, proposed guidebook, results of field studies and stakeholder outreach, evaluation metrics, and field study applications, discussion of results, conclusions, and potential for future research, application, or technology transfer, and other sections as appropriate.
Time Frame: May 2017
Responsible Party: PI
Cost:$5,000
Deliverable: Draft Final Report using ODOT's report template
TAC Action: TAC review and feedback to the ODOT Research Coordinator
ODOT Action or Decision: Review and counsel prior to TAC meeting

Task 10: Draft ODOT Research Note

Write 1000 to 1500 word summary of the research project. The summary will concisely document the research findings, value of the research to the agency, science and society, and any limitations on the use of the findings.
Time Frame: May 2017
Responsible Party: PI
Cost: $2,000
Deliverable: Draft ODOT Research Note using ODOT's report template
TAC Action: None
ODOT Action or Decision: Review and advise

Task 11: TAC Meeting #3.

This TAC meeting will include a review of the Draft Final Report, and Draft Research Note prior to the TAC meeting. The TAC will offer advice on the content and clarity of these work products. The TAC will also advise on post research implementation.
Responsible Party: PI, assisted by the ODOT Research Coordinator, TAC
Cost:$1,500
Deliverable: TAC meeting attendance, TAC meeting presentation, TAC Meeting Minutes

TAC Action: TAC review of Draft Final Report, and Draft Research Note. Advise ODOT Research Coordinator regarding any critical issues with the project's research design. Advise ODOT Research Coordinator regarding any required final edits to the Draft Final Report, and Draft Research Note.
ODOT Action or Decision: Review TAC advice. If necessary direct PI to make changes to project documents.

Task 12: Final Report

Edit Draft Final Report to incorporate edits identified by the ODOT research Coordinator after the last TAC meeting
Time Frame: June 2017
Responsible Party: PI
Cost:$6,000
Deliverable: Final Report
TAC Action: None
ODOT Action or Decision: Review. Provide formal acceptance of Final Report. Publish Final Report on ODOT's research website

Task 13: Final Research Note

Edit Draft Research Note to incorporate edits identified by the ODOT research Coordinator after the last TAC meeting
Time Frame: June 2017
Responsible Party: PI
Cost: $2,000
Deliverable: Final Research Note
TAC Action: None
ODOT Action or Decision: Review. Provide formal acceptance of Research Note. . Publish Final Report on ODOT's research website

5.1 Reporting

All reports shall be produced in the standard ODOT Research Section report format provided to the Project Investigator by the Research Coordinator unless some other format is deemed to be more appropriate. The Project Investigator shall be responsible for submitting deliverables as professional-level written composition equivalent to the writing standards of peer-reviewed journals. These writing considerations include grammar, spelling, syntax, organization, and conciseness.

The Project Investigator, in consultation with the TAC and Research Coordinator, shall deliver to ODOT in electronic format the data produced during the project. The Project Investigator shall ensure the data is labeled and organized to facilitate future access. ODOT shall warehouse the data.

5.2 Safety and Related Training

Prior to accessing ODOT right-of-way (ROW), all personnel who will work on ODOT ROW shall complete safety training appropriate to the work to be performed within the ROW. The Project Investigator shall notify Project Coordinator in writing (email accepted) prior to the first day of work within the ROW that all project personnel who will access ODOT ROW have been trained. Until all ROW work is completed, the Project Investigator shall notify Project Coordinator in writing (email accepted) annually that an active safety training appropriate to the work to be performed within the ROW has been completed by all personnel who will work on ODOT ROW.

6.0 Time Schedule

This section specifies the time line for the project, listing the task headings and showing monthly and/or quarterly time blocks in which each task will be accomplished. Also shown are interim and final deliverables.

Task	2016--												2017--					
	FY--																	
	Jan - Mar			Apr - Jun			Jul - Sep			Oct - Dec			Jan - Mar			Apr - Jun		
1:TAC Mtg 1																		
2:Literature Review			*															
3:Conduct Field Studies							*											
4:Stakeholder Outreach							*											
5: Evaluation Criteria									*									
6:TAC Mtg 2																		
7: Proposed Solutions													*					
8: Produce Guidebook																*		
9: Draft Final Report																		
10: Draft Research Note																		
11: TAC Mtg 3																		
12: Final Report																		
13: Final Research Note																		F

*Deliverables

R - Draft report submitted for ODOT review.

F - Revised report submitted to ODOT for publication. End of contract.

7.0 Budget Estimate

An itemized budget for the project is included here showing expenditures for each task by fiscal year and in total.

Task	FY--16	FY-- 17	Total
1:TAC Mtg 1	$1,000		$1,000
2:Literature Review	$10,000		$10,000
3:Conduct Field Studies	$28,500		$28,500
4:Stakeholder Outreach	$15,000		$15,000
5: Evaluation Criteria	$7,500		$7,500

6:TAC Mtg 2	$1,500		$1,500
7: Proposed Solutions	$30,000	$20,000	$50,000
8: Produce Guidebook		$20,000	$20,000
9: Draft Final Report		$5,000	$5,000
10: Draft Research Note		$2,000	$2,000
11: TAC Mtg 3		$1,500	$1,500
12: Final Report		$6,000	$6,000
13: Final Research Note		$2,000	$2,000
Total for tasks (Contract amount)	**$93,500**	**$56,500**	$150,000
Support/management (ODOT completes)	$10,000	$10,000	$20,000
Total for ODOT (ODOT completes)	$103,500	$66,500	$170,000

References

Oregon Pedestrian and Bicycle Plan: An Element of the Oregon Transportation Plan (1995) Oregon Department of Transportation

Designing Sidewalks and Trails for Access Part 2, Best Practices Design Guide (2001), Federal Highway Administration

Characteristics of Emerging Road and Trail Users and their Safety (2004), Federal Highway Administration

Rails-with-Trails: Lessons Learned (2002), Federal Highway Administration

Conor, Reynolds, Harris, Teschke, Cripton and Winters (2009) The impact of transportation infrastructure on bicycling injuries and crashes: a review of the literature, Environmental Health

Khattak, Aemal; Luo, Zheng (2011) Pedestrian and Bicyclist Violations at Highway–Rail Grade Crossings, Transportation Research Record 2250 (76-82)

NCHRP Report 470 Traffic-Control Devices for Passive Railroad-Highway Grade Crossings

Transportation Research Record: Journal of the Transportation Research Board, No. 2122 (2009) Traffic Control Devices, Visibility, and Highway–Rail Grade Crossings