Research Project Work Plan

for

A METHOD TO ESTIMATE ANNUAL AVERAGE DAILY TRAFFIC FOR MINOR FACILITIES FOR MAP-21 REPORTING AND STATEWIDE SAFETY ANALYSIS

SPR-804

Submitted by

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for

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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

(If federal funds are used)
Federal Highway Administration (FHWA)
Washington, D.C. 20590

1.2 Principal Investigator (ODOT requests only one per institution or firm)

Avinash Unnikrishnan, Ph.D., Associate Professor (PI)
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Portland State University
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Portland, OR 97201 Phone: 503 725 2872

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Department of Civil and Environmental Engineering
Portland State University
Engineering Building, 301H, 1930 SW 4th Avenue,
Portland, OR 97201 Phone: 503 725 2836

1.1 Associate Investigator(s)

ODOT Research Coordinator

1.2 Technical Advisory Committee (TAC) Members

Tony Knudson, ODOT, Chair
Nick Fortey, FHWA
Christina McDaniel-Wilson, ODOT TPAU
Zahidul Siddique, ODOT Highway Safety
Jennifer Campbell, ODOT HPMS Coordinator
Don Crownover, ODOT TSMU Lead

[Names, Affiliations] [*indicate which member is Chair, research proposer*]

1.3 Friends of the Committee (if any)

[Names, Affiliations]

1.4 Research Coordinator

Tony Knudson, ODOT, 503-986-2848

1.5 Project Champion

Doug Bish, ODOT 503-986-3594
Dave Ringeisen, ODOT-503-986 4171

2.0 Problem Statement

The Moving Ahead for Progress in the 21st Century Act (MAP-21) identifies Average Annual Daily Traffic (AADT) as a fundamental data element (FDE) required for a state's safety data system for all public roads. The Oregon Department of Transportation (ODOT) will have to report AADT for every highway facility across the state, *whether it is owned by the state, county or city*. The new Fixing America's Surface Transportation (FAST) act emphasizes data collection and applications for prioritizing transportation investments and safety studies and is expected to have similar reporting requirements. ODOT generates AADT estimates for major state facilities but not minor state facilities. Also, counties and cities typically have scant traffic count data. There is a clear need to develop methods to estimate traffic volumes on highway facilities that are not available through the Highway Performance Monitoring Systems (HPMS) or other state data collection programs. AADT for minor roads is also needed to measure crash rates, for predictive-level safety analysis.

2.1 Background and Significance of Work

Accurately determining AADT is critical to many transportation planning, operational, and design decisions. AADT is a key input to geometric design of highways, design of pavements, safety analysis, emissions and air quality studies, and validation of traffic forecasting models. . The most accurate way to determine AADT is from long term traffic counts obtained from Automatic Traffic Recorders (ATR) which count traffic volumes throughout the year. The state of Oregon has 177 ATR sites. The AADT at other roadway segments is estimated from short term traffic counts which are then scaled up using daily, weekly, or monthly adjustment factors. Traffic counts are expensive and labor intensive; extending short-term counts to cover all highway links will not be economical or practical.

Traffic engineers have developed different approaches to impute the missing AADT information on roadway networks; existing approaches can be categorized as regression models, travel demand models, geospatial interpolation, and heuristics such as neural networks. Regression based approaches estimate AADT based on independent variables such as employment, population, functional classification, income, and other land use and socio-demographic variables using either geographically weighted or multiple linear regression models. Travel demand modeling approaches determine the AADT based on volumes obtained from the four step planning process. Geospatial approaches use spatial interpolation techniques such as Kriging which predicts AADT in missing locations using weights obtained from distances of the location from the nearest AADT count location and other independent variables such as functional class and population. Heuristic approaches use techniques such as neural networks in place of regression models to predict the AADT from independent variables. These approaches have not been yet tested, adapted or applied to meet the new MAP-21's requirements.

ODOT must devise a least-cost methodology to meet the MAP-21 and FAST reporting requirement for AADT for every highway facility, regardless of jurisdiction. Tradeoffs between estimation accuracy and complexity are expected.

3.0 Objectives of the Study

This research will develop and recommend practical methods to estimate AADT for minor roads to meet MAP-21 and FAST reporting requirements and a statewide evaluation for safety. This research may benefit from a previous research project, SPR 756 "Improved Safety Performance Functions for Signalized Intersections," completed in August 2015. SPR 756 devised methods to estimate minor road traffic volumes used for intersection-related crash analysis.

The objectives of this project are to: (i) identify data needs for estimating missing AADT information, (ii) develop a cost-effective method to estimate AADT for minor facilities across the state of Oregon, regardless of jurisdictional ownership, (iii) conduct a pilot demonstration of the method to estimate missing AADT information in ODOT Region 2, and (iv) analyze the performance of the method and provide recommendations on future research directions and potential data collection efforts.

3.1 Benefits

ODOT currently has no methods for developing AADT data for minor roads without the need to collect expensive traffic counts. Understanding trends in AADT plays a significant role in effective infrastructure investments and policy decisions. This

research will develop methodologies to estimate AADT for roadway segments which have no count data. Additional potential benefits include reduction in costs associated with traffic count data collection in support of implementing the Highway Safety Manual methods for Oregon's statewide evaluation for safety, Transportation System Plan analyses, and meeting MAP-21 and FAST reporting requirements.

4.0 Implementation

The methodology will be implemented by ODOT Traffic Services, who conduct traffic safety analysis. Technical specifications of how to apply the methodology using ODOT data will be implemented by Traffic Services to conduct safety analysis involving minor roads. The technical methodology will also be implemented by the ODOT Transportation Data Section for reporting AADT across the state of Oregon.

5.0 Research Tasks

The project is estimated to cost $160,000 with an 18-month schedule. Some of the task durations will overlap.

5.1 Expected tasks:

Task 1: TAC Meeting #1

The researchers and ODOT will hold a project kick-off meeting with TAC to outline the project and review the work plan.
Time Frame: 1 Month after NTP
Responsible Party: PI, ODOT Research Coordinator, TAC
Cost: 0
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 and TAC 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 and discuss with PIs if necessary.

Task 2: Literature Review

Researchers shall understand how other states determine missing AADT data and synthesize the latest techniques available in the literature to predict AADT data. The review will summarize and categorize the various methodological approaches (regression based, travel demand model approaches, geospatial, heuristic approaches) and identify the data needs for each approach. Any studies which compare the effectiveness or estimation errors from the different approaches will be specifically highlighted. The researchers will also survey best practices from other states.
Time Frame: 3 Months

Responsible Party: Research team
Cost: 15863
Deliverable: The literature review will be combined with Task 3 deliverable (data sources).
TAC Action: None
ODOT Action or Decision: None.

Task 3: Determining existing data sources in Oregon

The researchers shall identify the various potential data sources available in Oregon and analyze them in terms of coverage and quality. The potential data sources could include traffic counts by county, existing AADT data, land use, demographic, and economic activity information, network data, population forecasts, statewide planning model outputs, traffic signal data, and private sector traffic data. The research team will map the existing data sources and data gaps.
Time Frame: 3 Months
Responsible Party: Research team
Cost: 15727
Deliverable: Literature review (Task 2) plus list of all data sources in Oregon along with coverage and quality analysis
TAC Action: Read documents and provide feedback to the PI if necessary.
ODOT Action or Decision: Review TAC advice and discuss with PIs if necessary.

Task 4: Develop a method to predict missing AADT information in Oregon

The research team will develop a method to estimate missing AADT information based on existing data sources available in Oregon. The research team envisions the method to be either a regression based approach with existing traffic counts, land use, demographic, or a travel demand based network modeling approach or a combination of several variables.
Time Frame: 5 Months
Responsible Party: Research team
Cost: 39545
Deliverable: Description of methodology to be included in final report, TAC Meeting and presentation to review current progress and finalize the testbed to be used in task 5.
TAC Action: Review, comment and provide guidance on appropriate testbed for pilot demonstration of the methodology.
ODOT Action or Decision: None

Task 5: TAC Meeting #2

The researchers will hold a project meeting with the TAC to review data collection, methods to predict missing AADT, and discuss the upcoming pilot demonstration.
Time Frame: Near the time that Task 4 is finishing up, ~June 2017.
Responsible Party: PI, ODOT Research Coordinator, TAC
Cost: 0

Deliverable: TAC meeting attendance, TAC meeting presentation, TAC Meeting Minutes
TAC Action: Review and understand research done to date. Advise researchers on model work done so far as well as the upcoming task of conducting a pilot demonstration in Region 2.
ODOT Action or Decision: Review TAC advice and discuss with PIs if necessary.

Task 6: Conduct a pilot demonstration and implement the methodology in ODOT Region 2

Based on the outputs of Tasks 2, 3, and 4, the research team and the TAC will select a study area or a subset of highways in Region 2. The research team will implement the proposed model(s) and compare the predictions accuracy by utilizing roadways in which AADT information is available. The prediction accuracy will be analyzed by various factors such as functional classification, distance from nearest ATR station etc.
Time Frame: 5 Months
Responsible Party: Research Team
Cost: 49545
Deliverable: Description of the data available for the test area, implementation details, and summary of analysis suitable for inclusion in final report as a separate chapter.
TAC Action: Review and comment as appropriate.
ODOT Action or Decision: None

Task 7: Provide recommendations on future data needs to improve AADT estimation accuracy

The research team will identify existing data gaps and needs and provide recommendations on potential data to be collected to improve the accuracy of the AADT estimation models.
Time Frame: 2 Months
Responsible Party: Research Team
Cost: 15864
Deliverable: Draft document listing recommendations on future data needs suitable for inclusion in final report as a separate chapter.
TAC Action: None.
ODOT Action or Decision: None

Task 8: Draft Final Report

The research team shall prepare and submit a draft final report documenting the research study, conclusions, and recommendations for future data collection. The report will also describe the methods developed along with implementation instructions. 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 (Task 2), Final Research Methodology (Task 4), Draft Analysis Report Section (Task 6), discussion of results, conclusions, and potential for future research, application, or technology transfer, and other sections as appropriate.

Time Frame: 2 Months
Responsible Party: Research Team
Cost: 18636
Deliverable: TAC Meeting and Draft Final Report in ODOT Final Report format incorporating feedback from TAC in previous reports.
TAC Action: Review and comment as appropriate.
ODOT Action or Decision: Review and comment as appropriate. Provide formal acceptance of Final Report. Publish Final Report on ODOT's research website

Task 9: 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: 1 month
Responsible Party: PI
Cost: 800
Deliverable: Draft ODOT Research Note using ODOT's report template
TAC Action: None
ODOT Action or Decision: Review and advise

Task 10: TAC Meeting #3

The researchers will hold a project meeting with the TAC to discuss work done to date, including the pilot project and final recommendations. Discussion will then look at future data collection and possible follow-on research projects.
Responsible Party: PI, ODOT Research Coordinator, TAC
Cost: 0
Deliverable: TAC meeting attendance, TAC meeting presentation, TAC Meeting Minutes
TAC Action: Review and understand research done to date. Collaborate with researchers to determine future data needs and follow-on research ideas.
ODOT Action or Decision: Review TAC advice and discuss with PIs if necessary.

Task 11: Final Report

Edit Draft Final Report to incorporate edits identified by the ODOT research Coordinator after the last TAC meeting
*Time Frame:*1-2 months
Responsible Party: PI
Cost: 4,000
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 12: Final Research Note

Edit Draft Research Note to incorporate edits identified by the ODOT research Coordinator after the last TAC meeting
*Time Frame:*1 month
Responsible Party: PI
Cost: 200
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

5.2 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.

5.3 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

Task	2016						2017												2018					
	FY16												FY17											
	Jul - Sep			Oct - Dec			Jan - Mar			Apr - Jun			Jul - Sep			Oct - Dec			Jan - Mar			Apr - Jun		
1: TAC Meeting #1				T																				
2: Literature review																								
3: Identify data sources								P *																
4: Model development													*											
5: TAC Meeting #2												T												
6: Pilot implementation																	P *							
7: Future data needs																								
8: Draft Final Report																				R				
9: Draft ODOT Note																								
10: TAC Meeting #3																				T				
11: Final Report																					F			
12: Final Note																					F			

*Deliverables
R - Draft report submitted for ODOT review.
F - Revised report submitted to ODOT for publication.
T- TAC Meeting
P - Phone conference call
F - 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	FY16	FY17	Total
1: TAC Meeting #1	0	0	0
2: Literature review	15683	0	15683
3: Data Sources	15727	0	15727
4: Model Development	24545	15000	39545
5: TAC Meeting #2	0	0	0
6: Pilot Demonstration	5000	44545	49545
7: Future Data needs	0	15864	15864
8: Draft Final Report	0	18636	18636
9: Draft ODOT Note	0	800	800
10: TAC Meeting #3	0	0	0
11: Final Report	0	4000	4000
12: Final Note	0	200	200
Total for tasks (Contract amount)	**60955**	**99045**	**160000**
Support/management (ODOT completes)	6,000	6,000	12,000
Total for ODOT (ODOT completes)	**66,955**	**105,045**	**172,000**