**TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

Lead Agency (FHWA or State DOT): \_\_Oregon DOT\_\_\_X\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

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| **Transportation Pooled Fund Program Project #**  *TPF-5(371)* | | **Transportation Pooled Fund Program - Report Period:**  □ Quarter 1 (January 1 – March 31)  X Quarter 2 (April 1 – June 30)  □ Quarter 3 (July 1 – September 30)  □ Quarter 4 (October 1 – December 31) | |
| **Project Title:** Developing "Hiqhway Capacity Manual" Capacity Adjustments for Agency Connected and Autonomous Vehicle Operational Planning Readiness under Varying Levels of Volume and Market  Penetration | | | |
| **Name of Project Manager(s):**  Tony Knudson | **Phone Number:**  (503)986-2848 | | **E-Mail**  Anthony.h.knudson@odot.state.or.us |
| **Lead Agency Project ID:**  EA# TPF5371-000-P15 | **Other Project ID (i.e., contract #):** | | **Project Start Date:**  8/14/2018 |
| **Original Project End Date:**  12/31/2019 | **Current Project End Date:**  12/31/2020 | | **Number of Extensions:** |

Project schedule status:

x On schedule □ On revised schedule □ Ahead of schedule □ Behind schedule

Overall Project Statistics:

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| **Total Project Budget** | **Total Cost to Date for Project** | **Percentage of Work**  **Completed to Date** |
| $309,990 | $109,573.37 | 35% |

***Quarterly*** Project Statistics:

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| **Total Project Expenses**  **and Percentage This Quarter** | **Total Amount of Funds**  **Expended This Quarter** | **Total Percentage of**  **Time Used to Date** |
| $30,149.40 / 10% | $30,149.40 | 38% |

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| **Project Description**:  The research objectives of this project are to develop the highway capacity adjustments for CAVs at different levels of volume and market penetration in order to adapt the use of HCM in analyzing CAV applications. The major highlight of this project is the project team working closely with Technical Advisory Committee (TAC) through an iteratively updating and revising process.  The major approach for this problem is through a scenario simulation planning framework and through simulation tools in which the CAV and non-CAV behavior are coded differently. The interactions among and beyond CAVs and non-CAVs are specified in details in the simulation scenarios. It is important to note that this research intends to focus on CAV and not Connected Vehicles (CV) nor Autonomous Vehicles (AV). This is because CV and AV on their own are not anticipated to greatly impact highway capacity. Significant capacity gains are only anticipated when both vehicles are automated (driven by computer) and connected (computer driven vehicles coordinating and optimizing with one another).  This project plans on testing market penetration at varying levels of volumes to see how market penetration impacts both throughput (maximum pre-breakdown flow rate) and recovery time after congestion subsides (breakdown flow rate and maximum discharge flow rate) under various conditions. This research also attempts to measure how incidents (crashes) and events (weather, local surges in entering or exiting volume) impact throughput and recovery time at varying levels of volume and market penetration.  The expected products of this research are highway capacity adjustment lookup tables and figures for different facilities (freeway, arterials) at different levels of CAV market penetration. This project is designed to address the limitations identified with respect to the CAV effects in HCM analysis procedures. It is anticipated that the project team and the project TAC will work closely regarding the iterative nature of assumptions and results associated with the defined scenarios to ensure the usefulness of the project products for agency operational and planning readiness. The project team is also expected to be receptive to relevant research elsewhere and what new CAV advancements could possibly emerge over the project period.  This project will benefit public agencies to accommodate highway capacity related analysis under the impacts of CAV for different levels of volumes and market penetrations. Specifically, it will inform agencies about how CAV market  penetration will affect capacity leading to better informed investment decisions in area freeways, new roundabouts and signals, and safety projects. This research will also put the HCM at the forefront of CAV research in terms of operational readiness of CAV applications and technologies. |

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| **Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**  The work for this project has been broken up into three phases  1 - Planning and development (lit. review, scenario identification, modeling framework)  2 – Simulation model execution and data analysis (scenario testing, develop outreach materials, create HCM adjustments)  3 – Technology transfer/deliverables (draft final report and draft HCM CAV guide appendix, final report and delivery)  Work to date was presented to the TRB HCQS Committee meeting in June as part of their mid-year meeting. Before the  meeting a report was sent to the TAC and a meeting was held for them before the HCQS meeting. As the initial  scenarios have been identified, the real work of doing the CAV simulations has started.  The report gave details about how the simulation has been set up in Vissim including the connected car module which had  to be created from scratch by the researchers. For these initial simulations, somewhat simple facilities were simulated,  the facilities were Basic Freeway Segments, Freeway Merge Segment, and a Freeway Weaving Segment. The primary  objective was to test the simulation software to make sure the results were consistent with previous simulations and to  conduct sensitivity testing to determine if models are stable.  For example, on the basic freeway segment the researchers looked at 2-lane versus 3-lane segments, which should not  show a difference in per lane capacity, which they didn’t. Other sensitivity tests were carried out with positive results  showing no major issues in the underlying assumptions and programming. |
| **Anticipated work next quarter**:  Work will continue with the basic freeway segments looking at various market penetration rates and creating capacity  adjustment factors for a variety of scenarios and assumptions. The work on the basic segments will wrap up later this  summer and then the TAC will meet to review the results and discuss the next round of simulations.  The next round will increase the complexity of the facilities by looking at Signalized Intersections, Roundabouts, and  TWSC Intersections. The TAC will determine what parameters and details those scenarios will have. |

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| **Significant Results:** Capacity adjustment factors based on CAV market penetration rate has been preliminarily  determined for basic freeway facilities, including merging and weaving segments. |
| **Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that**  **might affect the completion of the project within the time, scope and fiscal constraints set forth in the**  **agreement, along with recommended solutions to those problems).**  None |

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| **Potential Implementation:** Results will eventually be added to a section of the Highway Capacity Manual for planners  to use in long range planning efforts. |