Center for Safety Equity in Transportation
If you have a right to get there, you have a right to get there safely.
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Semi-Annual Progress Report for University Transportation Centers

Submitted to:	Office of the Assistant Secretary for Research and Technology U.S. Department of Transportation 1200 New Jersey Avenue, SE Washington, DC 20590
Project Title:	**Tier 1 University Transportation Center for Safety Equity in Transportation (CSET)**
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Signature:	

Billy Connor
CSET, Director

Abbreviations

- AKDOT&PF – Alaska Department of Transportation and Public Facilities
- ANTHC – Alaska Native Tribal Health Consortium
- AUTC – Alaska University Transportation Center
- CSET – Center for Safety Equity in Transportation
- GIS – Geographic Information System
- ORCiD – Open Researcher and Contributor ID
- PI – Principle Investigator
- PPPR – Program Progress Performance Report
- RiP – Research in Progress
- RITI – Rural, Isolated, Tribal, Indigenous
- UAF – University of Alaska Fairbanks
- UHM – University of Hawai'i Manoa
- UI – University of Idaho
- UW – University of Washington

1. Accomplishments

What are the major goals and objectives of the program?

The goal of CSET is to develop context-sensitive transportation solutions that address the safety needs of RITI communities. The Center will develop safety approaches that are sensitive to heritage, traditional ways of knowing and learning, and the preservation of culture. The mission of the Center for Safety Equity in Transportation (CSET) is to provide everyone with fair and equitable access to a safe transportation system.

What was accomplished under these goals?

During the past six months of the project:

- *Email list, website, and social media*

The official CSET email, cset.utc@alaska.edu, has been used to communicate with Executive and Advisory Board members as well as project PIs. A contact list is being maintained for the duration of the project. Center announcements are distributed through emails and social media posts to various audiences and stakeholders. Activities are posted to the website in a timely fashion.

- *Communication*

Zoom is being used for meetings and webinars. The access to Zoom is provided by the University of Alaska Fairbanks at no cost to the Center. CSET initiated a webinar series that has presented 4 webinars during the reporting period. Plans are in progress to continue the series on a monthly basis until the end of the center.

- *E-newsletters*

The Center distributed a newsletter in November 2021. All issues of the newsletter are available under the *Publications* section of the website. http://cset.uaf.edu/publications/

- *Research projects*

Thirty projects were active during this reporting period. Four final reports were submitted to TRID during the reporting period.

- *Training programs*

- *Active student internships*

None developed during this period.

- *Teacher training and curriculum development activities*
  - The project, *Community-embedded Drone Program for Improving Traffic Safety of RITI Communities in Washington State*, held weekly meetings with the staff of the Ocosta High School in Westport, Washington, the local community and after-school volunteers to discuss course content for an after-school drone program. The group developed a draft program overview, education plan and recruiting materials.

- *Data collection tools developed*
- The UI CSET project, *Promoting Positive Traffic Safety Culture in RITI Communities through Active Engagement: Barriers and Opportunities*, developed a survey tool that is being used for in-depth interviews with community leaders. The project used it to conduct several in-depth interviews (via zoom video conference and in person) with community leaders from several tribal communities during the period covered by this report.
- The UW project, *Developing Pedestrian Safety Data Visualization and Analysis Tool for RITI Communities*, is actively engaged in creating the pedestrian safety tool. The data management and visualization functions have been designed and developed. Improvements are being made based on input from the Yakama Nation Engineering team.
- The UAF project, *Development of a Tabletop Dustfall Column and Test Procedure for Chemical Dust Suppressant Performance Testing*, is in the final stages of testing the mini-column that is the focus of the project. A new system for introducing the dust into the chamber has been developed along with the sample size. The new system uses compressed air rather than air introduced by a pump. This eliminates problems with air being sucked into the system from the bottom by the DustTrak which caused particles to remain lofted indefinitely. The system has been tested to ensure repeatable results.
- The UI project, *The Perception of Autonomous Driving in Rural Communities*, developed and administered a survey on autonomous and self-driving vehicles to rural and urban citizens in Idaho.

- *Sponsorship*

Nothing to report for this period.

How have the results been disseminated?

CSET staff and researchers have been actively seeking out opportunities to interact with the public, stakeholders and the transportation community. COVID-19 measures have hampered these efforts, resulting in most activities occurring virtually.

Professional Meetings

During this reporting period in-person meetings were canceled or turned into virtual meetings via online tools due to COVID-19. CSET representatives participated in the following professional events:

- The 2021 Region 10 Transportation Conference (Virtual), October 15, 18-21, 2021.
- The 2022 Transportation Research Board Annual Conference, Jan. 7-13, 2022. Washington D.C.

Outreach

- The project, *Community-embedded Drone Program for Improving Traffic Safety of RITI Communities in Washington State*, conducted an after-school program at

the Ocosta Junior-Senior High School in Westport, Washington during the Fall and Spring semesters. The program educated students on drone-related technology, regulations and operation skills and had the students conduct drone-related case studies, including two water tower inspections, and search and rescue training. Due to weather and COVID concerns some weeks did not have meetings, as a result the plan intended for one semester was spread out across both Fall and Spring. The detailed plan is:

- Week 1. Introduction and project presentation
- presentation on drone applications for Westport
- Week 2. Drone assembly
- Week 3. Drone regulation (complete FAA test for recreational users)
- Week 4. Drone operation and knowledge
- Week 5. Fly the drones
- Week 6. Drone operation (vertical evacuation structure inspection)
- Week 7. King tides events (costal erosion presentation and king tides photography)
- Week 8. Drone operation (flying in square)
- Week 9. Water tower inspection (South)
- Week 10. Search and rescue training
- Week 11. Water tower and S well inspection (North)

What do you plan to do during the next reporting period to accomplish the goals and objectives?

We will follow the implementation plan to ensure that all the CSET's funded research, education, and outreach activities move forward as scheduled.

- The Center website, social media presence, and emailing contact lists will be regularly updated and used to promote the Center and its activities.
- CSET's quarterly newsletters will be distributed during the months of April, June, and August 2022. The newsletters will highlight Center progress, such as projects starting/concluding, new calls for proposals, STIs, etc.
- Steps will be taken to continue bringing students on as research assistants.
- Steps will be taken to develop training programs, curriculum development activities, outreach, and sponsorship opportunities.
- CSET's webinar series will continue to sponsor monthly presentations on the results of the research performed by the Center.

2. Participants & Collaborating Organizations

What organizations have been involved as partners?

- *Collaborative research and financial support*

Newtok Village Council, Newtok Alaska,
Kawarek, Inc., Nome, Alaska
Yakama Nation, Washington

- *Technology Transfer Expert Task Groups*

CSET projects have established advisory groups for improving technology transfer from the project to interested stakeholders. Each project has met with members of the groups either individually or in a group during the period covered by this report.

Have other collaborators or contacts been involved?
Email correspondence has been exchanged during the reporting period to discuss research ideas and broad collaborations on research, education, workforce development, and outreach activities between CSET and various collaborators.

3. Outputs

Publications, conference papers, presentations, websites, lectures, seminars, workshops, invited talks

Publications

- *Journal Publications*
  - Pu, Z., Cui, Z., Tang, J., Wang, S. and Wang, Y., 2021. Multi-Modal Traffic Speed Monitoring: A Real-Time System Based on Passive Wi-Fi and Bluetooth Sensing Technology. *IEEE Internet of Things Journal*.
  - Zhu, M., Du, S.S., Wang, X., Pu, Z. and Wang, Y., 2022. TransFollower: Long-Sequence Car-Following Trajectory Prediction through Transformer. *arXiv preprint arXiv:2202.03183*.
  - Yang, H., Cai, J., Zhu, M., Liu, C. and Wang, Y., 2022. Traffic-Informed Multi-Camera Sensing (TIMS) System Based on Vehicle Re-Identification. *IEEE Transactions on Intelligent Transportation Systems*.
  - Zhang, Z., Lin, X., Li, M. and Wang, Y., 2021. A customized deep learning approach to integrate network-scale online traffic data imputation and prediction. *Transportation Research Part C: Emerging Technologies*, *132*, p.103372.

- *Reports*
  - Wang, Yinhai, Wei Sun, Sam Ricord, Cesar Maia de Souza, Shuyi Yin and Meng-Ju Tsai, *Developing a Data-Driven Safety Assessment Framework for RITI Communities in Washington State*. CSET Final Report, September 2021.
  - Lowry, Michael and Kevin Chang, *Barriers and Opportunities for Using Rail-Trail for Safe Travel in Rural, isolated, and Tribal Communities*. CSET Final Report. November 2021.
  - Prevedouros, Panos and Abdulrahman Alghamdi, *Evaluation of Delivery Service in Rural Areas with CAV.* CSET Final Report. March 2022.

- Lowry, Michael, Skye Swoboda-Colberg, Logan Prescott and Ahmed Abdel-Rahim. *Improving Safety for RITI Communities in Idaho:Documenting Crash Rates and Possible Intervention Measures*. CSET Final Report. March 2022.

- *Conference papers*

- *Presentations*
  - Suwan Shen, Karl Kim, Dingyi Liu. *Aging in Place or Moving to Higher Ground: Older Adults and Adaptation to Sea Level Rise in Honolulu, Hawaii*. Transportation Research Board 101th Annual Meeting, January 09-13, 2022, Washington, D.C.
  - Alghamdi, Abdulrahman and Panos D. Prevedouros, *Evaluation of Delivery Service in Rural Areas with CAV*, Paper 22-00205, 101st Annual Meeting of TRB, 2022.
  - Arun Bala Subramaniyan, Chieh (Ross) Wang, Yunli Shao, Wan Li, Hong Wang, Guohui Zhang, Tianwei Ma. *Hybrid Recurrent Neural Network Modeling for Traffic Delay Prediction Along Signalized Intersections: A Case Study in Hawaii*. Transportation Research Board Annual Conference, Jan. 7-13, 2022. Washington D.C.
  - Hanyi Yang, Lili Du, Guohui Zhang, Tianwei Ma. *A Traffic Speed Evolution Prediction Approach Based on A Deep Learning Model Considering Network Topology Knowledge*. Transportation Research Board Annual Conference, Jan. 7-13, 2022. Washington D.C.
  - Mohan Putluru, Qian Zhang, Guohui Zhang, Tianwei Ma, Yunpeng Zhang. *A Semi-supervised Machine Learning-based Cyber Attack Detection Framework for Intelligent Transportation Systems (ITS) Data*. Transportation Research Board Annual Conference, Jan. 7-13, 2022. Washington D.C.
  - Shanglian Zhou, Hao Xu, Guohui Zhang, Tianwei Ma, Yin Yang. *Transferring Machine Learning Approach to Harmonize LiDAR Data Heterogeneity for Seamless Vehicle Sensing and Tracking*. Transportation Research Board Annual Conference, Jan. 7-13, 2022. Washington D.C.
  - Runze Yuan, Ningshou Xu, Hao Yu, Guohui Zhang, Tianwei Ma. *Internal Model Kalman Filter-based Hybrid Optimal Feedforward/ Feedback Control Strategy for Traffic Platoon Control Coordination Enabled by Partially Automated Vehicles*. Transportation Research Board Annual Conference, Jan. 7-13, 2022. Washington D.C.
  - Sun, Wei. *Low-Cost Technology Implementations for Data Collection and Visualization in Tribal Areas*. Transportation Research Board Annual Conference, Jan. 7-13, 2022. Washington D.C.
  - LittleBull, HollyAnna, Wei Sun and Samuel Ricord. *Comprehensive Roadway Safety Data Visualization and Evaluation Platform*. 2021 Highway Safety Information System (HSIS) Annual Liaison Meeting, Tuesday, October 12, 2021, Big Data & Application of Innovative/New Datasets.
  - McKnight, Sean. *Improving Safety of ATV trails in Remote Areas of Alaska*. 2021 Region 10 Transportation Conference (Virtual), October 15, 18-21, 2021.

- *Other Products*

- *Website Updates*
  - The CSET website is live at cset.uaf.edu.
  - Final reports are added to the website once submitted to TRID.
  - The CSET webinar series is available on YouTube at: https://youtube.com/playlist?list=PL5Mnj-QQMwFpEx0W5pc90VW9gp8HrePpR

- *Lectures/Seminars/Workshops/Invited Talks*
  - Panos Prevedouros, *Near-Crash Events from Naturalistic Driving Data*. Presented and recorded as a CSET Webinar on November 16, 2021. https://www.youtube.com/watch?v=vw4e7_0rhk8
  - Kevin Chang and Michael Lowry. *Exploring Rail-trails in Our Communities*. Presented and recorded as a CSET Webinar on December 8, 2021. https://youtu.be/iw4FUpmwV5E
  - Suwan Shen. *Where Would the At-Risk Roads Lead to? Exploring Community Concerns and Priorities to Sea Level Rise*. Presented and recorded as a CSET Webinar on January 27, 2022. https://youtu.be/ZRlOvkA0viI
  - Vinod Vasudevan. *Tracking Non-Motorized Road Users Using LIDAR*. Presented and recorded as a CSET Webinar on March 17, 2022. https://youtu.be/SeAiBxH91_M

- *New methodologies, technologies or techniques*
  - The UAF project, *Development of a Tabletop Dustfall Column and Test Procedure for Chemical Dust Suppressant Performance Testing*, is in the final stages of testing the mini-column that is the focus of the project. Redesign of the sample input has improved result consistency. However, resolution of testing is not as expected so additional testing is required.
  - The UHM project, *Safe Reinforcement Learning for Intersection Management in RITI Communities Under Rare Extreme Events*, developed a new safe proximal policy optimization (PPO)), a deep reinforcement learning algorithm, to solve the problem of intelligent traffic signal control under rare extreme events. The algorithm has been designed to use distributed computational resources, improving efficiency.

- *Inventions, patents and/or licenses*
  - None this reporting period

4. Outcomes

- *What outcomes has the program produced? How are the research outputs described in section 3 being used to create outcomes?*

The CSET project, *Assessing the Transportation Adaptation Options to Sea Level Rise for Safety Enhancement in RITI Communities through a Structured Decision-Making Framework*, used spatial network analysis to identify communities currently with

limited and reduced accessibility under a scenario of an extreme high tide (1.4 ft above the mean high-water level) on Oahu Island, Hawai'i. The vulnerability analysis reveals that compared to the do-nothing scenario, relocation would significantly improve vulnerable population access to emergency and health care services even without transportation and infrastructure improvements. Relocating to high density areas would improve service access more than relocating to low density areas, demonstrating the potential benefits of infill development and transit-oriented development in reducing hazard risk. Adaptation strategies should include not only analysis of risks and vulnerabilities for physical infrastructure, but also understanding of land use and population change and integration of housing and transportation options to support age-friendly adaptation to climate change.

The CSET project, *Improved Safety for Winter Travel along Minimally Improved Routes,* installed prototype trail markers along several trails between Nome and Council, Alaksa on the Seward Peninsula. The trail markers are having a positive impact on trail users. The project is also working with other jurisdictions including Bethel and the North Slope Borough on trail systems. There is a growing desire among the tribes to increase the trail system with the intent to use these systems to create transportation corridors. The project is working with these groups with the expectation that others will join to establish trail standards and identify the process required to establish corridors.

The CSET project, *Barriers and Opportunities for Using Rail-Trails for Safe Travel in Rural, Isolated and Tribal Communities*, investigated the potential for using Strava data to estimate bicycle Annual Average Daily Traffic (AADT) on rail-trails. The standard procedure is the installation of permanent traffic recorders (PTR) but that is expensive. Strava is a fitness app used by millions of people worldwide to record their recreation activity. The fitness app automatically uploads the user's location data as they run, bike, or hike providing crowdsourced data with lower costs that the PTRs. Unfortunately, the results suggest less than ideal potential for the proposed method. For 10 locations the method seemed to work, but for 19 locations the method was not satisfactory. Future research could investigate the reasons for this outcome. Additionally, future research could identify characteristics of locations where the approach seems to indeed work, as was shown for 10 locations.

5. Impact

- *What is the impact on the development of the principal discipline(s) of the program?*

- *Other Disciplines –*

CSET is a multidisciplinary Center, and will therefore have an impact in fields outside of the traditional areas of transportation research. In future reports, this section will serve to answer the following questions.

- *What is the impact on the development of transportation workforce development?*

- *What is the impact on safety in RITI communities?*

The CSET project, *Improved Safety for Winter Travel along Minimally Improved Routes*, installed prototype trail markers along several trails between communities on the Seward Peninsula. The trail markers are having a positive impact on trail users, decreasing the possibility of missing the trail and getting lost or into areas of poor conditions for travel.

- *What is the impact on physical, institutional, and information resources at the university or other partner institutions and communities?*

- *What is the impact on technology transfer?*

The UAF project, *Development of a Tabletop Dustfall Column and Test Procedure for Chemical Dust Suppressant Performance Testing*, has discussed the mini-column with the Alaska DOT&PF. They are planning to include the testing procedure in the Alaska Test Methods document used by the department. Industry representatives have expressed interest in the device and procedures as well and are currently waiting for the testing to be completed and a device provided for their use.

- *What is the impact on society beyond science and technology?*

- *In what ways have researchers and students who are part of or who focus on native or federally recognized tribes and communities been involved?*

CSET projects at UAF are working closely with Native Alaskans on the trail markings and transportation corridor development in their rural and isolated communities. In addition, transportation safety-issues related to subsistence activities are being explored with Native Alaska communities.

CSET projects at the University of Washington continue to work closely with tribal leaders in the state, including the Yakima Nation, on issues of concern to the tribal leaders.

6. Changes/Problems

- Impacts on the Center from COVID-19
    - Supply-chain issues that have been attributed to the COVID slowdown and recovery have impacted the development of trail markers for the UAF project, *Improved Safety for Winter Travel along Minimally Improved Routes.* The project has been unable to get the reflective tape that they planned to add to the next version of trail markers.
    - Multiple projects requested no-cost extensions due to COVID impacts. The reasons included lack of access to lab facilities due to campus closures, delays in the arrival of graduate students, difficulty recruiting undergraduate students and inability to conduct field work for data collection. The ripple effects of the COVID delays continue as work planned for the fall and winter of 2021 has been pushed out to 2022.

7. CSET Technology Transfer Plan Metrics

Research Output

- Number of completed projects - 4
- Number of papers and reports directly resulting from research collaborations - 19
- Number of conference presentations from collaborations - 13

Research Outcomes

- Number of collaborative training programs established and number of attendees – 1 (CSET Webinar series, attendance variable ranging from 2 to 30+)
- Number of seminars, meetings, and workshops organized with state, tribal, and local agencies and the number of attendees – 18 events, 110+ attendees across all events
- Number of implementable work products (e.g., manuals, specifications, and toolkits) - 2

Research Impacts

- Number of organizations/partners actively working with CSET to achieve the strategic RITI-focused goals – 14
- Number of student research internships granted - 13