Semi Annual Progress Report for University Transportation Centers

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Project title: **Pacific Northwest Transportation Consortium (PacTrans): Providing Data-Driven Solutions for the Diverse Mobility Challenges of the Pacific Northwest**

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Report Term: Semi-Annual

Accomplishments

What are the major goals and objectives of the program?

Pacific Northwest Transportation Consortium (PacTrans) consists of institutions from all four states in our region with the University of Washington (UW) as the lead and Oregon State University (OSU), University of Alaska Fairbanks (UAF), University of Idaho (UI), and Washington State University (WSU) as research partners, as well as Boise State University (BSU) and Gonzaga University (GU) as education partners. PacTrans' theme centers on "Developing Data Driven Solutions for the Diverse Mobility Needs of People and Goods in the Pacific Northwest". PacTrans serves as a focal point within Region 10 to develop initiatives and facilitate collaborative activities with regional partners to maximize the effectiveness of their collective services and programs toward the U.S. Department of Transportation (USDOT) strategic goal of mobility. Major goals and objectives of PacTrans include:

Research – Serving as Region 10's research engine, PacTrans is committed to funding research in both the categories of advanced and, more importantly, applied research.

Technology Transfer – PacTrans strives to be an applied technology showcase, providing additional funds to projects that are deemed as "Success Stories" to ensure dissemination of results to policy makers, educators, practitioners, other transportation professionals, and the general public.

Education – As a consortium of seven prestigious universities, PacTrans is devoted to being an education leader. This involves continued evaluation and evolution of our transportation engineering programs as well as providing state-of-the-art research laboratories, student conferences and seminars, mentoring, and scholarship opportunities for our students and future workforce trainees.

Workforce Development – PacTrans endeavors to be a workforce development base: hosting activities that focus on the development of transportation professionals, building strong partnerships with transportation agencies and companies in our region, and designing training programs to address the workforce development needs, while connecting our students with quality jobs where they can implement the knowledge they gained through their education.

Outreach – Throughout all of these other goals and objectives, PacTrans seeks to be in a continual process of outreach: promoting and building the educational student base, making new industry and agency partners, attracting new research, and providing opportunities to share and learn about key outcomes and achievements that have been learned through research and education activities.

Collaboration – PacTrans desires to be a platform for participation and is always on the lookout for potential new partner and new opportunities with current partners to collaborate on transportation related endeavors.

What was accomplished under these goals?

During the period from October 1, 2020 – March 31, 2021, PacTrans was actively engaged in each goal and objective identified above. This was achieved through a breadth of activities that were conducted to ensure our transportation expertise contributes to the advancement of the region's transportation

research, technology transfer, education, workforce development, outreach, and collaboration.

Research

As Region 10's research engine, PacTrans has been actively engaged in two broader categories of research projects. We engage in multi-institutional research projects that require participation from at least two consortium universities, and typically have a larger budget. Such projects include multi-institutional general research projects, as well as a multi-institutional educational project, and a multi-institutional outreach project. We also engage in single institutional projects (referred to as small research projects) that only require participation from a single consortium university and typically have smaller budgets. Both categories of research are geared towards the goal of advancing the region's transportation mobility research.

PacTrans endeavors to begin research performance periods of new projects in coordination with the academic school year. However, with the FAST Act Grant originally scheduled to close by September 2022, the PacTrans Board elected to expedite the fifth Request for Proposals (year 5: 2021 - 2022) in order to give researchers maximum performance time to complete their research. Thus, during this reporting period, PacTrans completed our RFP and selection process. Year 5 projects and subawards were initiated beginning on March 15, 2021, and the performance period will conclude in March of 2022.

During this reporting period we collected research project progress reports from all active PIs with Year 4 (2020 – 2022) and Year 3 (2019 – 2021) funding, as well as any PIs with Year 2 (2018 – 2020) projects who required a no cost extension that went beyond this reporting period. The majority of Year 2 (2018 – 2020) projects, however, have been submitted and all of those technical reports are either already published on our website and submitted to the various required repositories, or are currently going through the process of peer and technical review. Several Year 3 (2019 – 2021) projects have also submitted their draft technical reports which are currently going through the same process. PacTrans funded three additional small projects to specifically address urgent research needs due to COVID-19. Those projects began in June of 2020 and had a twelve-month reporting period. Thus, those projects are currently wrapping up and PacTrans staff is putting those project reports through our research management procedure before publication.

Technology Transfer

During this past reporting period, PacTrans PIs and staff have been working to finish wrapping up the last of the seven success story projects that were originally funded at the beginning of 2020. We have also been monitoring the progress of four 2021 success story projects that began in January. These projects are extensions of research that merit additional funding for the creation of outputs specifically geared toward industry in an attempt to make implementation one step closer for meaningful research results.

PacTrans and its PIs engaged in a number of great conferences, workshops, and symposiums during this reporting period that offered a great platform for us to showcase our research to a broader audience.

In early October, PacTrans hosted our annual Region 10 Transportation Conference and continued its

partnership with the Center for Safety Equity in Transportation (CSET) Tier 1 University Transportation Center (UTC). Due to restrictions caused by COVID-19, this activity was hosted in a fully virtual format for the first time. It began with an opening ceremony, keynote, and plenary session on Friday, October 9, 2020, and proceeded the following week with a single webinar each day to substantiate the technical breakout session component of the conference. We had 329 people registered for our Region 10 Transportation Conference and this set up a new record. This event covered topics on COVID-19, micromobility, freight/logistics, and classical and emerging issues in transportation safety. The conference also facilitated a virtual poster session where thirteen PacTrans funded projects had the opportunity to showcase their great work to the larger audience.

In early January, PacTrans investigators and student researchers presented at over 75 lecturns, poster sessions, workshops, committees, and subcommittees, and had over 100 papers accepted to the Transportation Research Board (TRB) 100th Annual Virtual Meeting. This meeting continues to be a great outlet for disseminating PacTrans funded research to practitioners and public agencies.

Finally, during this reporting period, PacTrans hosted a total of three webinars focused on technology transfer. PacTrans Technology Transfer Advisory Board member, Hamed Benouar and one of his colleagues, presented their experiences with moving academic research to industry through patenting and startups. The other two technology transfer webinars were presentations on results of PacTrans funded research, one by OSU's Michael Scott on tsunami loading on bridges, and the other by UW's Ed McCormack and OSU's Hisham Jashami on commercial vehicle parking envelopes. These three webinars had a total of over 300 participants.

Education

During this past six-month performance period, PacTrans has been actively engaging students with a wide variety of activities and opportunities to further their education, experience, knowledge, and networks.

In March, PacTrans launched a new PhD Student Webinar series. This webinar series has an advisory committee comprised of students from several consortium partner universities with our Associate Director for Education being the faculty mentor. This series is meant to provide students the opportunity to present their personal research to an audience of their peers. The first webinar featured OSU PhD student Chen Chen.

This past January, PacTrans supported over seventy students from consortium universities to participate in the 100th Transportation Research Board (TRB) Annual Meeting. In concert with the TRB Annual Meeting, PacTrans has the opportunity to present two annual outstanding student-of-the-year awards: The Region 10 Michael Kyte Student of the Year award and the USDOT UTC Outstanding Student of the Year Award. This year's Michael Kyte Outstanding Student of the Year award went to OSU PhD student, Mohammad Rayeedul Kalam Siam, and the PacTrans USDOT UTC Outstanding Student of the Year award went to OSU PhD student Amy Wyman.

PacTrans also hosted our annual Region 10 Student Conference. This event was also co-organized by CSET and hosted virtually in concert with our main Region 10 Transportation Conference. This event

spanned two half-day installments and featured activities that included three speaker presentations, a career development panel, and two competitions: the annual student poster competition and the first ever hackathon competition.

Several other student related highlights from this reporting period included:

- Three PacTrans student researchers were award Dwight D. Eisenhower Transportation Fellowship Program fellowships
- Two PhD students from UW made the finals of the MetroLab student cup, winning the mobility track
- OSU's ITE Student Chapter took 3rd place in the National Traffic Bowl
- UI clean snow mobile team won first place in several of the competition categories
- OSU Master's Student, Eileen Chai Received the 2020-2021 Beverly Swaim Leadership Legacy Graduate Scholarship

Workforce Development

PacTrans had a number of activities geared at workforce development during this reporting period.

Most notably, in March, PacTrans was excited to launch the PacTrans Workforce Development Institute (WDI). The launching ceremony occurred in concert with the first WDI training course in partnership with the Washington State Department of Transportation (WSDOT). The first course focused on the Manual for Uniform Traffic Control Devises (MUTCD), and we have several other courses under development at present. PacTrans WDI conducted two surveys to understand how the first course is going, one during the course and the other after the course, and received very positive feedback from participants. The PacTrans education research team is analyzing the survey data for further improvements of the WDI course platform and contents.

Continuing to operate remotely, PacTrans also hosted a number of great webinars during this reporting period to offer students the opportunity to hear from academic researchers and working professionals from public agencies and the private sector:

1. In December, PacTrans hosted a webinar featuring Tom Stiles, Executive Vice President of Q-Free ATMS to make a presentation titled, *The Modern Landscape of Traffic Signal Systems.*
2. In March, PacTrans hosted a leadership development webinar featuring ASCE President and Texas A&M Professor Jean-Louis Briaud. His presentation was titled, *Leadership Development with Emphasis on Technical Communications*.

What opportunities for training and professional development have the program provided?

Many of the specific details of these opportunities have been discussed above. The PacTrans WDI will be a base to support more training and professional development activities. PacTrans will issue a call for collaborations to raise attention of transportation agencies and private companies on this platform. In addition, PacTrans provides training and professional development opportunities through multiple other channels:

Research: Through the lifespan of this grant, PacTrans annually selects research projects that offer faculty and student researchers funding to conduct cutting edge research in a variety of areas directly tied to the USDOT strategic goals.

Education: PacTrans consortium partners offer a variety of other on-campus and online courses designed for professional development in addition to the regular degree programs. The online programs, such as the online master's program of sustainable transportation, are particularly good for working professionals because of the flexibility in schedule and location. PacTrans student also perform quite competitively and strongly encouraged to pursue various accolades with national recognition. For example, this year three PacTrans student researchers, Amy Wyman, Cole Kopca, and Brian Staes, received fellowships through the Dwight D. Eisenhower Transportation Fellowship Program.

Internships: PacTrans regularly posts internship opportunities on our website as a student resource. During this reporting period for example, PacTrans circulated twelve separate announcements for internship opportunities. Further, we regularly work with our external partners to develop internship programs for our students. With the WSDOT for example, we have set up internship opportunities both with their traffic management center and their tolling operations group.

Outreach: PacTrans offers training and educational opportunities to K-12 students through its outreach activities. Examples include: UW engineering discovery days, OSU Summer Transportation Institute. PacTrans is also currently in discussion with UW Teen and Youth Summer Programs about setting up several transportation related course offerings.

Funding assistance: PacTrans has supported student education and research activities. Beyond our PacTrans fellows, for whom we fund tuition, we also give a significant amount of assistance to students to participate in competitions, conferences, and seminars such as the Transportation Research Board Annual Meeting, the ITE Traffic Bowl Competition, the Traffic Control Devises Challenge; and also, student competition teams such as the UW Hyperloop team, the UI Clean Snowmobile team, and the UAF Steel Bridge team. This provides them with funds for presentation materials, travel expenses, and registration fees.

Seminars, workshops, and conferences: As outlined above, PacTrans offers many opportunities for training and professional development through its seminar series and various workshops. Furthermore, PacTrans also uses its Region 10 Transportation Conference and Region 10 Student Conference as important opportunities for training and professional development.

Partnerships: PacTrans has developed strong partnerships with many agencies, companies, and non-profit organizations. For example, PacTrans has developed strong partnerships with local ITE chapters in student mentoring and training. ITE Washington has a mentor program for university students. They offer student fellowships and also host events for student training. PacTrans is also in a strong partnership with Idaho Transportation Department to co-organize next year's National Travel Monitoring Exposition and Conference (NaTMEC).

How have the results been disseminated? If so, in what way/s?

PacTrans has a strong outreach program to local and state transportation agencies and private partners

in the region, where PacTrans research outcomes are presented and demonstrated. Research outcomes are posted on the PacTrans website, distributed through our monthly newsletter and annual reports, and promoted through social media such as Facebook, LinkedIn, and Twitter and the University of Washington press media. We also disseminate news, events and results via our website at www.pactrans.org.

Another avenue for dissemination that PacTrans leans on heavily is presentations at conferences, workshops, and symposia. Each year we send roughly one hundred PIs and students (about 70 students) to the TRB annual meeting where we participate in over 120 committee meetings, poster presentations, workshops, and lecterns. Our annual conference each October also provides an invaluable platform for our researchers to present work either through presentation or poster.

As has been mentioned above, PacTrans also encourages new, innovative dissemination materials through the identification of success stories, where PacTrans offers limited additional funds to projects that have results with potentially strong impacts. These funds can then be used to explore new and innovative opportunities to get knowledge, methods, and products gained, into the hands of practitioners. This year these funds have been used to host workshops/training, produce informational videos, build online tools and procedure manuals, etc.

Finally, per our obligation as a UTC, research results are posted on our website and are disseminated to all of the required repositories that include, TRID, USDOT, Transportation Library, Volpe National Transportation Systems Center, Federal Highway Administration Research Library and the US Department of Commerce National Technical Information Service.

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

PacTrans is excited for the busy season ahead. Below are the center's identified plans and strategies for accomplishing its goals and objectives over the next reporting period.

Research

During this next reporting period PacTrans will wrap up any remaining Year 2 (2018 – 2020) and Year 3 (2019 – 2021) funded projects, and monitor Year 4 (2020 – 2022) and Year 5 (2021 – 2022) funded projects, and conduct an RFP for Year 6 (2022 – 2023) projects. As Year 2 (2018 – 2020) and Year 3 (2019 – 2021) project technical reports are submitted, we will send them out for peer review, and then to a technical editor before considering them complete. We will then post the reports on our website and send them to TRID and Research Hub. Year 5 (2021 – 2022) projects will have profiles created on our website and they will also be uploaded to RiP.

Technology Transfer

PacTrans will release an RFP for success stories based upon our completed year 3 (2019 – 2021) projects. This RFP will likely be released in September or October and those projects will begin in early 2021.

Also, during this next reporting period, PacTrans has several great opportunities for technology transfer,

the most prominent of which will be the 2021 International Conference on Transportation and Development (ICTD) and the 2021 IEEE International Smart Cities Conference (ISC2), which will be held virtually and our director, Dr. Yinhai Wang, is actively involved.

As discussed in previous semi-annual reports, PacTrans has begun to require, as a deliverable of each of our funded projects, a webinar, seminar, training, or workshop with practitioners. Attendees are to include partners who provided match for the work, potential implementers of the outputs of the work, and others who might take specific interest in the research results. These activities will begin during this next reporting period.

Education

During this next reporting period PacTrans will be very busy with education endeavors. Each consortium partner receives some money each year for education and outreach activities. Those funds are at the discretion of the Associate Director (PI of the subaward) from each of the partner institutions. Those funds tend to be used to support activities such as the following:

1. Offering extra transportation courses, such as CEE 412 Transportation Data Management and Visualization and CEE 590 Traffic System Operations at the UW, at our consortium universities.
2. We support professional organization student chapters, such as the Institute of Transportation Engineers, and student competition teams, such UI's clean snowmobile team, and UW's Hyperloop team. Most of these teams have regional and national competitions during the spring.
3. Fund the PacTrans Undergraduate Fellowship program to attract undergraduate students to transportation through conducting interesting research with transportation professors.
4. Some of these funds are historically used to support the travel of students to conferences such as the Regional Transportation Conference and the TRB Annual Meeting to present their work.

Two consortium partner universities have partnerships developed with our Civil Engineering Departments to offer PacTrans Fellowship. Both UW and OSU will be welcoming a new cohort of fellows along with the incoming class starting in the early fall.

Finally, PacTrans will continue to enhance and refine our newly launch PhD Student Webinar Series.

Workforce Development

The recently launched PacTrans WDI will continue identifying and cultivating new partnerships with agencies and industry to identify continuing education needs. We are currently developing courses on human factors, data analytics and tools, GIS in transportation, leadership development, project management, and others.

We will also continue hosting webinars the provide insights as to the current state of the industry and emerging researching needs and cutting-edge technologies and techniques. For example, we have an upcoming webinar on Tuesday, April 13, featuring Amanda Holland, Acting Commissioner of Alaska Department of Administration, who will present findings from a recent NCHRP scan of best practices for Workforce Management in Transportation.

Participant and Collaborating Organizations: Who has been involved?

What individuals have worked on the program?

- PacTrans Director, **Yinhai Wang**, Ph.D., Professor of Civil and Environmental Engineering at the UW, devotes 50 percent of his time directing PacTrans. Dr. Wang has overall responsibility for program management, oversight of PacTrans operations, including the Research Committee, the Education and Workforce Development Committee, and the Outreach and Technology Transfer Committee, and Student Leadership Council. He is the regional and national leadership for PacTrans, and the contact person for management relationships with USDOT Research and Innovative Administration (RITA) and other USDOT organizations.
- PacTrans Associate Director in Research, **Jeff Ban**, Ph.D., Associate Professor of Transportation Engineering in Civil and Environmental Engineering at the UW spends 10 percent of her time managing the research program for PacTrans and coordinates the research collaboration across the five partner institutions.
- PacTrans Associate Director in Education and Workforce Development, **Anne Vernez-Moudon**, Dr. es SC, Professor of Architecture, Landscape Architecture, and Urban Design and Planning, Adjunct Professor of Epidemiology and in Civil and Environmental Engineering, devotes 10 percent of her time leading the Education and Workforce Development Committee. She is involved in curriculum changes, training program development, and educational enhancements among the partner institutions.
- PacTrans Associate Director in Oregon State University (OSU), **David Hurwitz**, Ph.D., Professor of Civil and Construction Engineering at OSU, devotes 10 percent of his time to managing and organizing the education, outreach, and research activities within OSU. He coordinates all results and outcomes with the UW on a regular basis.
- PacTrans Associate Director in the University of Alaska Fairbanks (UAF), **Billy Connor**, Director of the Alaska University Transportation Center (AUTC), devotes 10 percent of his time to managing and organizing the education, outreach, and research activities within UAF. He coordinates all results and outcomes with the UW on a regular basis.
- PacTrans Associate Director in University of Idaho (UI), **Ahmed Abdel-Rahim**, Ph.D., Associate Professor of Civil Engineering at UI, devotes 10 percent of his time to managing and organizing the education, outreach, and research activities within UI. He coordinates all results and outcomes with the UW on a regular basis.
- PacTrans Associate Director in Washington State University (WSU), **Eric Jessup**, Ph.D., Associate Professor and Transportation Economist in the School of Economic Sciences at Washington State University (WSU), devotes 10 percent of his time to managing and organizing the education, outreach, and research activities within WSU. He coordinates all results and outcomes with the UW on a regular basis.
- Assistant Director, **Cole Kopca**, devoted 75 percent of his time to the day-to-day operations in support of the PacTrans mission. His responsibilities include project management, grant management, events coordination and outreach, and managing the PacTrans operations team.
- PacTrans full-time Finance, Grants, and Research Manager, **Christina Yarbrough**, devoted 100 percent

of her time to the Center's budget, expenditure, and research management.

- PacTrans part-time Program Coordinator, **Melanie Paredes**, devoted 40 percent of her time to the Center's fiscal matters, support with events coordination and outreach and day to day administration.
- **Wei Sun**, Ph.D., Research Associate in the PacTrans STAR Lab at the University of Washington, devotes 30 percent of his time in providing research, outreach, and workforce development support and oversight.
- PacTrans has 28 fulltime faculty at the UW engaged in transportation research. Our consortium partners (OSU, UI, WSU, UAF, GU, BSU) have 41 fulltime faculty directly involved in PacTrans research.

What other organizations have been involved as partners?

The following table highlights the institutions, organizations, agencies, and industry partners who have partnered with current PacTrans funded research projects to provide match, either cash or in-kind.

Partner	Type
Washington State Department of Transportation	Government
Alaska Department of Transportation and Public Facilities	Government
Idaho Transportation Department	Government
Oregon Department of Transportation	Government
Puget Sound Regional Council	Government
King County Metro	Government

Further, PacTrans has continuing relationships with many partners that have been cultivated over the years. The table below highlights the many partnerships that PacTrans has built over the duration of the center:

Partner	**Type**
Alaska Department of Transportation and Public Facilities	Government
Idaho Transportation Department	Government
Oregon State Department of Transportation	Government
Washington State Department of Transportation	Government
City of Bellingham	Government
City of Seattle	Government
City of Lynnwood	Government
City of Bellevue	Government
City of Everett	Government
King County	Government
Snohomish County	Government
Pierce County	Government
Sound Transit	Government Agency
Washington Traffic Safety Commission	Government Agency
Washington State Transportation Insurance Pool	Government Agency

University of Alaska, Anchorage	Educational Institution
University of Washington Transportation Services	Educational Institution
Washington State Department of Ecology	Government
Puget Sound Regional Council	Government
Washington State Transportation Investment Board	Government Agency
American Society of Civil Engineers	Professional Association
Institute of Electrical and Electronics Engineers	Professional Association
Institute of Transportation Engineers	Professional Association
ITS Washington	Professional Association
HDR Engineering	Private Industry
Port of Portland	Government
BMW Group	Private Industry
Western Trailers	Private Industry
Coral Sales Co.	Private Industry
National Institute for Transportation and Communities	University Transportation Center
Transportation for Livability by Integrating Vehicles and the Environment	University Transportation Center
Center for Environmentally Sustainable Transportation in Cold Climates	University Transportation Center
Aichele and Associates	Private Industry
Alstom Grid Inc.	Private Industry
Alta Planning and Design	Private Industry
Battelle	Private Industry
Cascade Bicycle Club	Non-profit/ Foundation
Feet First	Non-profit/ Foundation
DENSO	Private Industry
T Mobile	Private Industry
DKS Associates	Private Industry
Fehr and Peers	Private Industry
FLIR	Private Industry
Inrix Inc.	Private Industry
Nokia	Private Industry
Transpo Group	Private Industry
Intelligent Transportation Systems of Washington	Professional Association
Luum	Private Industry
Kittelson and Associates	Private Industry
Microsoft	Private Industry
BlackBerry	Private Industry
Verizon	Private Industry
Q-Free	Private Industry
PACCAR, Inc.	Private Industry
West Salem High School	Educational Institution
The Bush School	Educational Institution

Outputs

	Total	UW	WSU	UI	OSU	UAF	GU	BSU
Publications: peer reviewed journal articles	**98**	35	9	4	47	0	0	3
Publications: Book chapters and other edited manuscripts	**4**	1	1	0	1	1	0	0
Conference papers	**55**	21	5	2	24	2	0	1
Conference presentations	**97**	50	4	4	33	5	0	1
Lectures/Seminars /Workshops/ Invited Talks	**90**	25	10	0	46	9	0	0
Policy Papers	**1**	0	0	0	0	1	0	0
Websites or Other Internet Sites	**14**	10	1	1	1	1	0	0
New Methodologies, Technologies or Techniques	**17**	9	1	3	3	1	0	0
Inventions, patent applications, and/or licenses	**0**	0	0	0	0	0	0	0
Other products: data or databases, physical collections, audio or video products, software or NetWare, models, educational aids or curricula, instruments, or equipment	**24**	8	1	1	11	3	0	0

OUTPUTS: Technology Transfer Plan Output Metrics	Annual Targets	Numbers for Reporting Period
Number of publications, presentations, and posters made at conferences or workshops explaining or promoting the research outputs	200	340
Number of software tools and technologies made available to practitioners	10	16

Examples of peer reviewed journal articles

Maged, M., Abdel-Rahim, A., Kassem, E., Chang, K. and Armando G. McDonald. (2020) "Laboratory-Based Evaluation of Pavement Marking Characteristics." Journal of Transportation Engineering, Part B: Pavements 146, no. 2: 04020016

Khanal, M., Hasan, M, Sterbentz, N, Johnson, R. and J. Weatherly. (2020) “Accuracy Comparison of Aerial Lidar, Mobile-Terrestrial Lidar, and UAV Photogrammetric Capture Data Elevations over Different Terrain Types.” Infrastructures 2020, 5(8), 65; https://doi.org/10.3390/infrastructures5080065 -Published

Khanal, M., Hasan, M. (2021) "Assessment of the Highway Safety Manual’s Empirical Bayes Method." Technology Interface International Journal - Accepted for publication.

Shi, X., Moudon, A.V., Lee, B.H. Y., Shen, Q., and Xuegang (Jeff) Ban. (2020) “Factors Influencing Teleworking Productivity – a Natural Experiment during the COVID-19 Pandemic.” Findings, December. https://doi.org/10.32866/001c.18195.

Hisham, J., Cobb, D., Hurwitz, D., McCormack, E., Goodchild, A., and Sheth, M. (2020) “The Impact of Commercial Parking Utilization on Cyclist Behavior in Urban Environments.” Transportation Research Part F Traffic Psychology and Behaviour, Volume 74, Pages 67-80.

Hisham, J., Cobb, D., Hurwitz, D., McCormack, E., Goodchild, A., and Sheth, M. (2020) “Developing Design Guidelines for Commercial Vehicles Envelopes on Urban Streets.” Transportation Research Part F

Pu, Z., Li, Z., Ke, R., Hua, X., and Wang, Y.. (2020) “Evaluating the nonlinear correlation between vertical curve features and crash frequency on highways using random forests.” Journal of transportation engineering, Part A: Systems Volume: 146.

Examples of Book Chapters and Manuscripts

Richards, E., 2021. An Evaluation of GPR techniques for analyzing the safety of interior Alaskan ice roads under varying river ice and environmental conditions, M.Sc. thesis, University of Alaska Fairbanks.

Examples of conference papers and presentations

Stuefer, S., Richards, E. (2020) "River Ice Measurements for Transportation Safety in Rural Communities." 2020 PacTrans | CSET Regional Transportation Conference. Video Poster Presentation.

Parrish, C.E. (2020) “Fundamentals of Direct Georeferencing (GNSS-aided INS.” Oregon UAS Summit, Virtual Workshop. Online: https://www.oregon.gov/odot/ETA/Documents_Geometronics/UAS1-5-Fundamentals-of-Direct-Georeferencing-Parrish.pdf

McCormack, E., Goodchild, A. (2021) “Design Guidelines for Commercial Vehicle Envelopes on Urban Streets.” 4th VREF Conference on Urban Freight

McCormack, E., Goodchild, A. (2021) “Design Guidelines for Commercial Vehicle Envelopes on Urban Streets.” 100th Annual Meeting of the Transportation Research Board

Ashour, L., Shen, Q., Okazaki, D., Trenhaile, J. (2020) "Incorporating Ride-Sourcing Service into ADA Paratransit: Opportunities and Challenges for Public Transit Agencies". Paper presented at the Annual Conference of ACSP.

Wang, Y., Moudon, A., Shen, Q. (2021) "How Does Ride-Hailing Influence Individual Mode Choice? An Examination Using Longitudinal Trip Data from Seattle Region." Poster presented at the TRB Annual Conference.

McCabe, D., Ban, X. (2020) “Charging infrastructure location for battery electric buses: A mixed integer linear programming approach.” 100th Annual Meeting of Transportation Research Board.

Chang, K. and Hodgson, C. (2021) “Using Drone Technology to Collect School Transportation Data.” Transportation Research Board Annual Meeting.

Liao, F. (2021) “Tracking human mobility amid the COVID19 pandemic in the Pacific Northwest region of the United States.” Annual Meeting of American Geographers, April 9, 2021, Seattle, USA.

Chang, K., McCormack, E., Goodchild, A., Ranjbari, A., Diehl, C., Hu, Y., and Mulligan, E. (2020) “Managing Increasing Demand for Curbspace in the City of the Future.” PacTrans Regional Transportation Conference; virtual.

Wang, Y., Sun, W., Brown, S., Chang, K., Connor, B., and Jessup, E. (2020) “Development of the PacTrans Workforce Development Institute.” PacTrans Regional Transportation Conference; virtual.

Hasan, M., Khanal, M. (2020) "Crash Prediction Model for I-84 in Boise, Idaho." 2020 ATMAE and IAJC Joint Virtual Conference, November 4-6.

Wang, Y., Moudon, A.V., Shen, Q. (2021) How Does Ride-Hailing Influence Individual Mode Choice? An Examination Using Longitudinal Trip Data from the Seattle Region. TRB conference January 2021.

Cui, Z., Zhu, M., Wang, S., Wang, P., Zhou, Y., Cao, Q., Kopca, C., and Wang, Y. (2021) "Traffic Performance Score for Measuring the Impact of COVID-19 on Urban Mobility." Presented by Zhiyong Cui at the 100th Annual Meeting of Transportation Research Board, Jan. 2021.

Ke, R., Cui, Z., Chen, Y., Zhu, M., and Wang, Y. (2021) "IoT System for Real-Time Near-Crash Detection for Automated Vehicle Testing." Presented by Ruimin Ke at the 100th Annual Meeting of Transportation Research Board, Jan. 2021.

Zhuang, Y., Pu, Z., Yang, H., and Wang, Y. (2021) "Quantized Convolutional Neural Network for Edge-based Parking Surveillance." Presented by Yifan Zhuang at the 100th Annual Meeting of Transportation Research Board, Jan. 2021.

Wartman, J. (2020) "The RAI system." Presented at meeting of the FHWA pooled fund project on rock-slope stability and runout. Virtual.

Example of lectures/seminars/workshops/invited talks

Richards, E. (2021) "An Evaluation of GPR techniques for analyzing the safety of interior Alaskan ice roads under varying river ice and environmental conditions." Thesis defense held on January 29, 2021, open to the public and attended by 22 participants.

Richards, E. (2021) "GPR measurements for Ice Road safety." Public seminar hosted by American Water Resources Association Alaska section. March 17, 2021.

Jessup, E. (2020) "Freight System Impacts Resulting from COVID-19." Freight Session provided at the PacTrans Conference 2020. Organizer, facilitator, and moderator.

Moudon A.V. (2020) "University of Washington COVID-19 Mobility Survey Preliminary Results." Keynote presentation, PacTrans Conference 16 October 2020.

Wang, Y. (2021) "Overview of the University Transportation Center Program." Transportation Research Board. Mar. 16, 2021.

Wang, Y. (2021) "Edge AI and Computer Vision for Real-Time Near-Crash Detection for Automated Vehicle Testing." Transportation Research Board Annual Meeting's Workshop on Applications of Machine Learning to Transportation. Jan. 22, 2021.

Wang, Y. (2020) "Edge Computing for Safer and Smarter Transportation Applications." Connected Cities with Smart Transportation (C2Smart) Webinar. Nov. 24, 2020.

Wartman, J. (2020) "Advances in Field Reconnaissance." Keynote talk, practice of post Geo-disaster reconnaissance in India, Dec. 2020.

Examples of Website(s) or other Internet site(s)

http://research.engr.oregonstate.edu/concreteff/ffactor.html
https://github.com/olawlor/AK_ATV
PacTrans Pacific Northwest (PNW) Covid19 Dashboard:
https://uidaho.maps.arcgis.com/apps/opsdashboard/index.html#/012bb13099e44aadbb59f9e16af587c5
https://www.psrc.org/whats-happening/blog/report-covid-19-mobility-survey-now-available
https://www.psrc.org/sites/default/files/covid-19-survey-report-oct2020.pdf
https://www.psrc.org/whats-happening/blog/take-fall-2020-covid-19-mobility-survey

Examples of New Methodologies, Technologies or Techniques

Heckendorn, R. Incorporated BSM messaging into the VISSIM simulator for easy simulation and control of messaging and signal response to BSM.

Krings, A. Two Algorithms were developed that allow for bicycle safety application safety in the presence of right-hook conflicts. This was done under consideration of malicious act attempting to jam the communication between the participants.

Lawlor, O. Development of an approach to reduce operator nausea in VR vehicles by match-moving a lightweight simulator chair to the simulated visual world.

Olsen, M. ROARS GIS Toolkit- ArcGIS python scripts to perform the rockfall rate system analysis to predict increases in rockfall activity due to seismic activity.

Wengrove, M. Development of a new technology to estimate significant wave height of ocean waves using GNSS-R. This is a low-cost method to estimate significant wave height in regions where roadways are vulnerable and next to the coast line.

Simpson, B. New methodology for using physics-based machine learning algorithms to compute loading on bridges.

Liu, C., Yang, H., Chen, H-Y., and Wang, Y. "Bi-level Optimization Algorithm for Dynamic Reversible Lane Control based on Short-term Traffic Flow Prediction." Presented by Chenxi Liu at the 100th Annual Meeting of Transportation Research Board, Jan. 2021.

Wang, S., Pu, Z., Cao, Q., Li, Q., and Wang, Y. "Lightweight Convolutional Neural Networks for Crowd Density Estimation." Presented by Shuo Wang at the 100th Annual Meeting of Transportation Research Board, Jan. 2021.

Yang, H., Zhu, M., Ke, R., Liu, C., and Wang, Y. "Novel Network-Scale Traffic Sensing Approach Using Multi-camera Object Tracking and Re-Identification." Presented by Hao Yang at the 100th Annual Meeting of Transportation Research Board, Jan. 2021.

Examples of Data/Database/Video/Software/Educational Aids/Curricula/Equipment

Stuefer, S., Richards, E. The GPR and manual river ice measurements and support documentation were submitted via email to the PacTrans data management personnel. DOI has not been created for this dataset. The project data were also published as part of the MS thesis. The thesis defense was also recorded; it is available upon request.

Heckendorn, R. Software for simulating BSM messages for simulated traffic in VISSIM. This is useful for building code that runs signals based on connected vehicle telemetry.

Brown, S. Developed a guidebook for the development of professional development courses.

Olsen, M. UAS Structure from Motion (SfM) and UAS lidar course material used in CE461/561.

Olsen, M. Laboratory Exercise on Change Analysis - Data collected from our study sites in Alaska were utilized by students in CE566 in a new change analysis laboratory exercise introduced in Fall 2020. Those data were again used in a second offering of CE566 in Winter quarter 2021. Additionally, in Winter Quarter 2021, 3 students utilized those scans as part of their final project. In this, they explored the rockfall activity index, clustering analysis, and more tools developed in PacTrans Research. They also explored other lidar analysis tools. In Fall 2020, two students utilized these data for their final project in the course to extract various rock slope metrics. They were also introduced to the goals of the PacTrans project.

Wang, Y. City of Bellevue curbside parking events video data; Highway rest area truck parking events video data; PacTrans Workforce Development Institute training course slide deck, training video.

Wartmen, J. PRJ-2291 | RAPID: Quantifying Temporal Changes in Rockfall Magnitude-Frequencies for Well-Characterized Rockslopes Shaken by the 2018 Alaska Earthquake, DOI, 10.17603/ds2-jmfv-9171

Outcomes

OUTCOMES: Technology Transfer Plan Outcomes Metrics	Annual Targets	Numbers for Reporting Period
Number of early adopters of our research outputs	10	3
Changes made to the transportation system, or its regulatory, legislative, practice manuals, design standards, or policy frameworks	2	0

PacTrans previously funded a project titled, "3D Virtual Sight Distance Analysis Using Mobile Lidar Data," from Michael Olsen of Oregon State University. Based on that research Dr. Olsen also successfully received PacTrans Success Story funding to create a Sight Object Distance Analysis Tool (SODA). During this reporting period, they introduced this tool to a company called Continental Mapping. Subsequent collaboration with Continental Mapping has resulted in a "Quick Call" Proposal for MNDOT focused on performing site visibility analysis with lidar.

A second great example of new outcomes during this reporting period regards new developments with the UW, OSU, UAF, multi-institutional team that has been work for the past several years on critical rock slope stability methods. PacTrans has funded several of their projects over the years, we have written about them extensively in previous Semi Annual Project Reports, and they have been featured in the UTC spotlight newsletter. During this reporting period, the rockfall activity index system has been fully adopted by the state of Oregon and is currently part of a large pool fun FHWA project lead by the Washington Department of Transportation, which includes partners from six other states.

Impact

IMPACTS: Technology Transfer Plan Impacts Metrics	Annual Targets	Numbers for Reporting Period
Number of research outputs that positively contribute to the reduced roadway vehicle to vehicle or vehicle to ped/bike crash rates	3	1
Number of research outputs that positively contribute to improving roadway travel reliability, efficiency, accessibility	7	4

What is the impact on the effectiveness of the transportation system?

PacTrans recently funded a project titled, “Connected-Vehicle Traffic Signal System Modeling Platform,” to University of Idaho’s Robert Heckendorn. The goals of this work were, first, to develop a driver simulator with connected vehicle testing capabilities in which Signal Phasing and Timing (SPaT) messages

are communicated from the simulator to the driver through a communication interface, and second, a connected-vehicle hardware-in-the-loop microscopic simulation model for Road Side Unit (RSU) through a Basic Safety Message (BSM) interface. This work with BSM messages and cars has led to work on traffic simulations directly targeted at adaptive signaling algorithms. This is leading to improved signal efficiency and has the potential to unlock signaling for other attributes like fuel efficiency.

What is the impact on the adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company?

Last year, PacTrans funded a technology transfer success story titled, "Curb Monitoring and Management using Mobile Unit for Sensing Traffic (MUST) Sensors." The UW STAR Lab has developed this MUST sensor over the past several years and utilized this success story funding to deploy several sensors in downtown Bellevue, in locations where freight delivery vehicles, TNC rideshare companies, public transit, and general public parking needs are all in strict competition for valuable curbspace. The installation has allowed the research team to continue making improvements to the hardware, and continue development of techniques for sensing curbspace usage. The efficient and accurate collection of real time curbspace use data is necessary for better understand the needs and to develop more effective management systems.

What is the impact on the body of scientific knowledge?

As mentioned in past, recent Semi Annual Progress Reports, PacTrans recently funded several "quick call" projects, specifically aimed at gathering and analyzing perishable data concerning the COVID-19 pandemic. UW's Anne Vernez Moudon, UW's Don MacKenzie, and UI's Haifeng Liao, have each separately collected multiple rounds of longitudinal survey data about various aspects of peoples' changes in mobility patterns, and OSU's Sal Hernandez has collected survey data on freight operators' fatigue due to changes caused by the pandemic. This data collection and analysis was deemed by our Board of Directors and External Advisory Board to be vital to ongoing research needs concerning COVID-19, and the forthcoming products resulting for these four quick projects are also helping our agency partners to better understand the current state of our collective transportation network and the people that use it.

What is the impact on transportation workforce development?

During the course of the FAST Act grant, PacTrans has been funding an ongoing multi-institutional education project to create the PacTrans WDI. This endeavor reached a major milestone during this reporting period. In February 2021, the WDI was officially launched with training course on the Manual for Uniform Traffic Control Devices in partnership with the Washington State Department of Transportation. This first course titled, *Understanding and Applying the MUTCD*, had 24 WSDOT employees as participants. The WDI is subsequently working to develop courses on subjects such as developing the human factors, data analysis and tools, project management, pedestrian safety, and GIS for transportation. The goal of the WDI is to address the workforce development and continuing educational needs of our agency and industry partners in the Pacific Northwest and beyond.

Changes/Problems

None.

Special Reporting Requirements

Research Project Requirements

Per our research update above, PacTrans recently selected and began new projects for the 2021 – 2022 research performance period. Those projects began in March 2021. Records of these projects will be uploaded to RiP and put on our website in the coming weeks. Further, PacTrans has begun include the requirement for an ORCID number from each PI before their project funds are released.

Submission of Final Research Reports

As final versions of technical project reports are completed and checked for ADA compliance, they are then uploaded to our repository and linked on the research project profiles on the PacTrans website. Then they are submitted to TRID and Research HUB as well. PacTrans staff is currently finishing the publication of Year 2 technical reports and preparing to begin receiving draft technical reports for Year 3 funded projects.