



Semi Annual Progress Report for University Transportation Centers

Prepared for the USDOT Office of the Assistant Secretary for Research and
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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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Reporting Period End Date: September 30, 2023

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 April 1, 2021 – September 30, 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.

As mentioned in previous Semi Annual Progress Reports, PacTrans has shifted our last two research performance periods forward on the calendar in an attempt to maximize the amount of time researchers have to conduct their work while still ensuring that all projects will be completed on time and technical reports will be submitted to the necessary repositories before the grant ends. During this performance period PacTrans facilitated a Request for Proposals for our sixth and final year of FAST Act funded research. While the selection of funded projects is still in progress, we aim to have all projects started by the beginning of the next calendar year.

During this reporting period, we finalized and submitted the last remaining outstanding Year 2 (2018 – 2020) projects. Further, we began the collection, peer reviewing, and finalization of draft technical reports from Year 3 (2019 – 2021) projects, as well as the three specially funded COVID-19 projects. Lastly, we monitored the progress of Year 4 (2020 – 2022) and Year 5 (2021 – 2022) projects via Research Project Progress Reports.

Finally, one major highlight from this reporting period on the subject of research pertains to the career advancement of several of our junior researchers. PacTrans aims to utilize our small projects funding to primarily support junior faculty as they explore new areas of research and establish their areas of expertise. During this reporting period, three PacTrans junior faculty received prestigious early-career investigator awards: Erica Fischer (OSU) and Idil Akin (WSU) were recipients of the Faculty Early Career Development, or CAREER, awards from the NSF, and Meagan Wengrove (OSU) was the recipient of a Young Investigator Program award from the Office of Naval Research. Each of these awards was based, in part, on research funded by PacTrans small projects.

Technology Transfer

During this past reporting period PacTrans released our third round RFP for success story funding. This funding is meant to encourage investigators with meaningful research results to generate outputs that are geared toward practitioners and implementation. Proposals will be reviewed and ranked by both PacTrans Board of Directors as well as the Technology Transfer Advisory Board (T2AB). Selections will take place in mid to late November and projects are anticipated to commence in January of 2022. Simultaneously, the recipients of the second year of Success Story funding are currently wrapping up their projects which began in January of 2021.

PacTrans hosted three technology transfer webinars during this reporting period that highlighted

PacTrans funded research:

1. April 27, Xianming Shi and Ziyuan Pu, Exploring Weather Related Connected Vehicle Applications for Improved Winter Travel
2. June 16, Don MacKenzie and Chintan Pathak, Training in ChargeVal: UW's Simulation Tool for Electric Vehicle Travel and Charging
3. June 18, Chris Parrish, UAS Applications in Transportation

In April, Nathan Belz, PacTrans PI and Associate Professor of Civil, Geological and Environmental Engineering at the University of Alaska Fairbanks, was invited to testify to the Alaska House Transportation Committee about four-wheeler and snow machine use on public roads in the State. Belz was invited by the chair of the House Transportation Committee, Rep. Grier Hopkins, due to his profound knowledge on the subject, acquired through research funded jointly by PacTrans and the Alaska Department of Transportation & Public Facilities back in 2017. This research evaluated safety issues related to off-highway vehicle and snow machine use on and near roads in Alaska.

Also in April, PacTrans Director, Yin Hai Wang, had the opportunity to weigh in on the role of AI in Transportation Asset Management, during a National Academies interview for an article titled, *The Era of Smart Infrastructure Demands Strong Data, Technology Management*. As the incoming chair of the Transportation Research Board's Standing Technical Committee on Artificial Intelligence and Advanced Computing Applications, professor Wang exchanged his views on how Artificial Intelligence (AI) could be employed in transportation asset management as a way to address safety and system reliability.

Finally, PacTrans Assistant Director, Cole Kopca, made a high-level presentation on PacTrans while participating the 2021 University Transportation Centers Mobility Summit hosted by Carnegie Mellon.

Education

During this past six-month performance period, PacTrans activities revolving around students and education have been incredibly successful.

In our previous Semi Annual Progress Report, PacTrans reported that we had successfully launched a student organized PacTrans Doctoral Webinar Series (<https://www.linkedin.com/company/pactrans-doctoral-webinar-series/>). During this reporting period, that effort hosted three more outstanding installments of this series. The organizing committee also built out a new website to host information on upcoming webinars as well as recordings of previous ones.

PacTrans educational partner, Gonzaga University's School of Engineering & Applied Sciences, hosted a series of Civil Engineering Social Justice Events. These activities were supported by PacTrans funding, were moderated by Abigail Marquez (student), and were led by Dr. Rhonda Young, P.E., Professor of Civil Engineering at Gonzaga University.

This summer Oregon State University with support from PacTrans, and in partnership with the Oregon Department of Transportation and the Federal Highway Administration, hosted in first ever Summer Transportation Institute where ten students had the opportunity to learning about surveying, drone flight, bicycle safety and infrastructure, and play in a virtual sandbox.

PacTrans consortium partner institution Institute of Transportation Engineers (ITE) Student Chapters also had an outstanding year. So, for example, the OSU ITE Student Chapter won the ITE International Outstanding Student Chapter, took first place at the Collegiate Traffic Bowl, received the ITE Western District Outstanding Student Chapter, received the ITE Western District Outstanding Graduate Student Award (Amy Wyman), took first place at the ITE Western District Traffic Bowl, and from the university their team received the Campus Impact Award, and the Faculty Advisor Award.

Several other student related highlights from this reporting period included:

- Zhiyong Cui (UW) received the 2021 best dissertation (first prize) award from the IEEE ITS Society
- Four UW students, who have all been supported by PacTrans (Gabriela Giron, Cole Kopca, Iman Haji, and Peter Yu) received ITE Washington Student Scholarship Awards
- WSU Student Team won 1st Place at Construction Management Competition
- Meixin Zhu (UW) took 4th place in Smart Transportation-Collision Recognition Based on Big Data of Internet of Vehicles
- Two WSU Students, Ayumi Manawada and Chelsea Pardini, were awarded the Karen P. DePauw Leadership Award and the Harriette B. Rigas Award, respectively, by the Association for Faculty Women (AFW).
- David Hurwitz (OSU) received 2021 Wilbur S. Smith Distinguished Transportation Educator Award
- Anne Goodchild (UW) received the ITE International Innovation Award

PacTrans welcomed four new PacTrans Fellows at the beginning of this school year; three from the University of Washington and one from Oregon State University. At UW, these are high achieving master's students who receive tuition funding from PacTrans in partnership with our respective departments. While in school, these students must maintain a high-grade point average and will all participate in internships to better prepare then for careers after they graduate. At OSU, this is a student research position given to just one student each year.

Workforce Development

During this reporting period, the PacTrans center has made significant progress in workforce development.

In the previous reporting period, PacTrans has successfully launched the workforce development institute (WDI). PacTrans WDI has delivered several online training courses. For example, WDI developed "Understanding and Applying the Manual on Uniform Traffic Control Devices (MUTCD)" and delivered to WSDOT employees in February 2021. Great feedback was received following the first delivery. During the past 6 months, the WDI has been working on revising the course and delivering it again to a broader audience. In addition, the PacTrans WDI has developed and successfully delivered another new training course: "Incorporating Human Factors into Roadway Design and Crash Diagnostics" in June 2021.

Besides developing and delivering training courses, the PacTrans WDI has been making efforts to make the institute sustainable. Specifically, the WDI has been developing its outreach and marketing approach to better reach the targeted working professionals.

In April, PacTrans hosted a webinar titled, *Workforce Management in Transportation*. The presentation featured Amanda Holland, the Interim Commissioner at the Alaska Department of Transportation and Public Facilities. She presented the findings of a recent NCHRP Domestic Scan program project. The presentation featured an 8-step strategic workforce management process that the scan team recommended.

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

Many of the specific details of these opportunities have been discussed above. More generally, PacTrans provides training and professional development opportunities through multiple channels:

Research: Through the lifespan of this grant, PacTrans annually selected research projects that offered 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 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 also supports a wide variety of student activities geared toward enhancing their educations. Several examples include: supporting ITE student chapter activities, travel support for students to present accepted work at conferences, sponsorship of student competition teams, and so much more.

Outreach: PacTrans offers training and educational opportunities to K-12 students through its outreach activities. Two quick examples include: (1) UW is currently working with UW Summer Youth program to develop two transportation theme courses for middle- and high-school aged students, and (2) this past summer with PacTrans support, OSU hosted 17 students for their annual National Summer Transportation Institute.

Funding assistance: PacTrans financially supports students through their participation in research activities, as well as fellowships. During this past reporting period, PacTrans welcomed four new graduate fellows (three from UW and one from OSU), and funded two undergraduate research fellows. The Undergraduate Research Fellowship offers undergraduate students the opportunity to participate in research while receiving a stipend for things like conference travel, or research supplies.

Seminars, workshops, and conferences: As outlined above, PacTrans offers many opportunities for training and professional development through its webinar series and various workshops, such as the seven webinars we hosted during this reporting period. PacTrans also emphasizes our Region 10 Transportation Conference and Region 10 Student Conference as important opportunities for training and professional development.

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 or our students. With the WSDOT for example, we have set up internship opportunities both with their traffic management center and their tolling operations group.

Partnerships: PacTrans leverages partnerships in a variety of ways that support training and professional development. For example, beyond collaborating on research, we regularly work with industry partners to provide opportunities for students to learn more about what they do. During this reporting period, PacTrans worked with Kittelson and Associates to promote a series of webinars that explores careers in transportation, internship opportunities, and expose students to real world projects.

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

PacTrans utilizes a full suite of avenues for effectively promoting our research and technology transfer efforts to local and state transportation agencies and private partners in the region. 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*, *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. During this reporting period, for example, PacTrans was heavily involved in both the Third Annual National Mobility Summit of US DOT University Transportation Centers as well as the 2021 International Conference on Transportation and Development.

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, PacTrans recently began leveraging our own webinar series to highlight many of our PacTrans funded projects. As reported above, during this reporting period, PacTrans hosted three such webinar that each featured one of our multi-institutional research projects. These webinars are then recorded and published on our PacTrans YouTube channel for future viewing.

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 continue processing and disseminating all remaining year 3 (2019 – 2021) projects. We will also continue to monitor all year 4 (2020 – 2022) and year 5 (2021 – 2022) projects. PacTrans will also complete the selection process for year 6 (2022 – 2023) projects, and initiate the new subawards by January 2022.

Technology Transfer

During this next reporting period PacTrans will complete the selection process for the success story funds that were mentioned in the previous section. These projects are slated to begin before the end of the year and PIs will have six months to finish the proposed activities.

Also, during this next reporting period, PacTrans has several great opportunities for technology transfer. Two such examples are the PacTrans Region 10 Transportation Conference and the TRB Annual Meeting.

The PacTrans Region 10 Transportation Conference: this year it will be held virtually with a main event on the third Friday of October and a webinar each day the following week. This event attracts hundreds transportation professionals from public agencies, private industry, and academia each year. During the event, several researchers will have the opportunity to present their work during moderated technical sessions and others will create videos for our virtual poster sessions.

The Transportation Research Board (TRB) Annual Meeting: this has always been one of the most influential opportunities for our researchers to disseminate their work. Each year we send roughly one hundred PIs and students to the TRB annual meeting where we participate in over 120 committee meetings, poster presentations, workshops, and lectures.

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. We support professional organization student chapters, such as the Institute of Transportation Engineers, and student competition teams, such as UI's clean snowmobile team, and UW's Hyperloop team. Most of these teams have regional and national competitions during the spring.
2. 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.

We will also host the 2021 Region 10 Student Conference in October where students will have the opportunity to learn from practitioners, ask questions of a recent graduate panel, compete in a poster competition, and network with their student colleagues.

PacTrans will also continue to host our Doctoral Webinar Series. This series provides an opportunity once per month for a graduate student to present their research to an audience of their peers.

Workforce Development

PacTrans has a few important focuses for workforce development over this next reporting period:

The PacTrans WDI will be developing a marketing approach to promote its training courses and offer more training services to the working professionals in the Pacific Northwest. Specifically, the WDI will conduct outreach activities to transportation agencies and companies to promote the training courses. In addition, PacTrans WDI will reach out to the targeted audiences through conferences, professional organizations, social media, etc.

The PacTrans WDI will work on the delivery of the following training course:

- Transportation Data Analytics and Tools
- Understanding and Applying the MUTCD
- Geospatial Analysis for Transportation Planners & Practitioners
- An Introduction to School Zone Safety

PacTrans will also host our monthly seminar/webinar series. Speakers committed to deliver talks at our seminar/webinar include Professor Elise Miller-Hooks, Bill & Eleanor Hazel Chair in Infrastructure Engineering at George Mason University and Professor Fred Mannering, Associate Dean for Research at the University of South Florida. More speakers are being confirmed.

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
Oregon Department of Transportation	Government
Puget Sound Regional Council	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
Innova EV	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	82	29	31	7	14	0	0	1
Publications: Book chapters and other edited manuscripts	7	1	1	0	1	3	0	0
Conference papers	58	13	14	7	20	2	1	1
Conference presentations	65	11	27	8	16	1	1	1
Lectures/Seminars /Workshops/ Invited Talks	86	26	27	1	24	5	1	2
Policy Papers	3	1	1	0	1	0	0	0
Websites or Other Internet Sites	5	2	0	1	0	1	1	0
New Methodologies, Technologies or Techniques	13	6	1	0	3	3	0	0
Inventions, patent applications, and/or licenses	2	0	0	0	2	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	26	10	1	8	5	2	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	291
Number of software tools and technologies made available to practitioners	10	13

Examples of peer reviewed journal articles

- Massey et al. (2021) "Rockfall activity rates before, during and after the 2010/11 Canterbury Earthquake Sequence," Journal of Geophysical Research - Earth Surface, in re-review.
- Liao, F.H.F., and Lowry, M. 2021. "Motor vehicle collisions due to speeding in Seattle and New York City during the 2020 COVID-19 Pandemic". Findings. In revision
- Richards, E., Stuefer S.L., Rangel R.C., Maio, C., Belz, N., Daanen R., 2021, "An evaluation of GPR monitoring methods on varying river ice conditions: a case study in Alaska", Geophysics, back from the journal with minor revision.
- Belz, N.P., Sayre, T. (in preparation). "Safety Analysis of Off-Highway Vehicles Use Within Public Rights-Of-Way in Alaska", Journal of Accident Analysis and Prevention
- Belz, N.P., Fulton, G., Meyer, F. (in preparation). "Establishing Methods for Detecting Anti-Icing and Deicing Chemicals Using Spectral Data". Journal of Remote Sensing.

- Geyin, M., Maurer, B.W., and Christofferson, K. (In Review). "An AI Driven, Mechanistically-Grounded Geospatial Liquefaction Model for Rapid Response and Scenario Planning." *Soil Dynamics and Earthquake Engineering*, Elsevier Publishing.
- Akin, I.D., Garnica, S.S., Robichaud, P.R., and Brown, R.E. "Surficial stabilization of wildfire-burnt hillslopes using xanthan gum and polyacrylamide," *Geotechnical and Geological Engineering*, (2021) <https://doi.org/10.1007/s10706-021-01951-4>
- Wang, Y., Moudon, A.V. and Shen, Q. "How Does Ride-Hailing Influence Individual Mode Choice? An Examination Using Longitudinal Trip Data from Seattle Region". Paper accepted for publication in *Transportation Research Record*.
- Diehl, C., Ranjbari, A., and Goodchild, A., "Curbside Management Challenges and Opportunities: Insights from the Public and Private Sectors in 14 US Cities" *Transportation Research Record*
- Zhu, M., Zhu, W., Lutin, J., Cui, Z., and Wang, Y. "Developing a Practical Method to Compute State-Level Bus Occupancy Rate." *Journal of Transportation Engineering, Part A: Systems* 147, no. 6 (2021): 05021001. (Published)
- Wang, P., Chen, X., Zheng, Y., Cheng, L., Wang, Y. and Lei, D. "Providing real-time bus crowding information for passengers: A novel policy to promote high-frequency transit performance." *Transportation Research Part A: Policy and Practice* 148 (2021): 316-329. (Published)
- Zhou, Y., Yuan, Q., Yang, C. and Wang, Y. "Who you are determines how you travel: Clustering human activity patterns with a Markov-chain-based mixture model." *Travel Behaviour and Society* 24 (2021): 102-112. (Published)

Examples of Book Chapters and Other Edited Manuscripts

- Neumann, C. "Fluid Structure Interaction for Cascading Seismic and Tsunami Events using Real-Time Hybrid Simulation", M.S. Thesis, Oregon State University, Corvallis, OR. (2021)
- Wei, H., Wang, Y. and Ma, J. "Disruptive Emerging Transportation Technologies Primer: State-of-the-Art Development and Implications for the Future of Transportation". ASCE Publication. May 2021. (Published)
- Richards, E. "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. (2021)
- Stuefer S. and Richards, E. "River ice measurements for transportation safety in rural communities, PacTrans final project report", University of Alaska Fairbanks.

Examples of conference papers and presentations

- Wartman, J. (2021) "Capturing Geotechnical Extreme Event Performance with the Nheri Rapid, Geoextreme", ASCE Conference.
- Sharif, A., Gopal, P., Saugstad, M., Bhatt, S., Fok, R., Weld, G., Dey, K., Froehlich, J. E. (2021). "Experimental Crowd +AI Approaches to Track Accessibility Features in Sidewalk Intersections Over Time". *Proceedings of ASSETS 2021*. 6 pages. To Appear.
- "Talking about Diversity, Equity and Inclusion (DEI) with Civil and Environmental Engineering Students" Center for Infrastructure Transportation and Education (CIT-E) workshop, August 10-11, 2021.
- Kim, S., Park, J., Wengrove, M. and Dickey, J. (2021). "Feasibility Study of GNSS Interferometric Reflectometry (GNSS-IR) for retrieving significant wave height". *2021 IEEE GNSS+R Conference Proceedings*.
- Kasi, Z., Simpson, B., Scott, M. "Nonlinear analysis of structures using physics-informed deep learning", *Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering, & Technology (IACM Conference)*: San Diego, CA: 09-2021.
- Neumann, C., Simpson, B., Lomonaco, P., Schellenberg, A. Keynote Talk "Fluid Structure Interaction for Cascading Seismic and Tsunami Events using Real-Time Hybrid Simulation", *Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering, & Technology (IACM Conference)*: San Diego, CA: 09-2021.
- Mohammad B., and Krings, A. "Reliability of VANET Bicycle Safety Applications in Malicious Environments", in *Proc. 27th Telecommunications forum, TELFOR 2019, Serbia, Belgrade, November 26-27, 2019*.
- Mohammad B., and Krings, A., "On the Reliability of VANET Safety Applications for Bicycles", in *Proc. IEEE International Conference on Connected Vehicle and Expo, (ICCVE), Graz, Austria, 2019*.
- Shi, X., Pu. Z. Exploring Weather Related Connected Vehicle Applications for Improved Winter Travel. A presentation for the Region 10 University Transportation Center PacTrans, April 27, 2021, online.
- AlQahtani, O., and Sheldon, F.T., "VANET Cluster Merging Weight Factors Study," *IEEE Proc. Int'l Conf. on Computer, Information and Telecommunication Systems (CITS), Istanbul, Turkey, Nov. 11-13, 2021*.

- AlQahtani, O., and Sheldon, F.T., "Enhancing Vehicle Ad Hoc Network (VANET) Protocols," Proc. European WIRELESS (EW2021), Verona, Italy, Nov. 10-11, 2021
- Olsen, MJ. "Shake, rock, and roll: Analyzing and forecasting post-earthquake rockfall activity from point clouds", GAGE\SAGE Community Science Workshop, (August 2021)
- Olsen, MJ. "Foreseeable trends in surface survey techniques including InSAR, LiDAR differencing, laser scanning, engineering value from the monitoring of slopes -current practice and the future", New Zealand Geotechnical Society 2021 Conference, Queenstown New Zealand.
- C. Higgins and Parrish, C., 2021. "Blue Skies – Bring in the Drones". NASCC: The Virtual Steel Conference, World Steel Bridge Symposium, 16 April.
- Richards, E., Stuefer S.L., 2021. "An analysis of GPR methods for identifying varying ice cover types based on dielectric properties: A case study in Interior Alaska". CGU HS Committee on River Ice Processes and the Environment 21st Workshop on the Hydraulics of Ice Covered Rivers, Saskatoon, Saskatchewan, Canada, August 29 - September 01, 2021.
- Geyin, M. and Maurer, B.W. (2022). "An AI-Driven, Mechanistically Grounded Framework for Geospatial Modelling of Soil Liquefaction." ASCE Geo-Congress, March, Charlotte, USA. American Society of Civil Engineers.
- Woodside, J., Young, R., Chang, K., & Hurwitz, D. (2021) "Systemic Evaluation of Bicycle Stop Laws". ITE 2021 Annual Meeting & Exhibition, Portland, OR, July 18-21.
- Ricord, S., Littlebull, H., Wang, Y., and Sun, W. (September 27 – October 1, 2021)." Low-Cost Technology Implementations for Data Collection and Visualization in Tribal Areas". 2021 National Transportation in Indian Country Conference. https://9d4c1830-23f2-4f35-b70b-83fc44816860.filesusr.com/ugd/cea1b2_ba6f0699277640838d2b767994a1344b.pdf

Example of lectures/seminars/workshops/invited talks

- Wartman, J. (2021) "Landslide Field Reconnaissance: Approaches, Tools, and Outcomes", New Zealand geotechnical symposium 2021.
- Gave talks to Intra-American Development Bank, City of Amsterdam, World Enabled Group
- "Transportation, Social Justice, and Inclusion Webinar" March 25, 2021. Archived at <https://gonzaga.edu/school-of-engineering-applied-science/degrees-and-programs/civil-engineering/civil-social-justice> R Young
- Invited panel, "Mitigating Computational Bottlenecks," Special Session on Super advanced exploration, simulation, and monitoring, WCEE20 World Conference on Earthquake Engineering: Sendai, Japan 2020, 09-2021
- Ashour, L., and Shen, Q. 2021." Incorporating Ride-Sourcing Service into ADA Paratransit: Opportunities and Challenges for King County Metro". Presentation of the project results and recommendations to staff members of King County Metro.
- Olsen, MJ. Mobile lidar surveying, ASCE 2021 student competition (June 2021).
- Olsen, MJ. Rockfall analysis with point clouds, ODOT Geotechnical/Geoenviromental meeting (July2021)
- 2 webinars for Alaska DOT&PF providing an overview of the Synthesis of Practice for Roads and Airports Constructed on Permafrost
- Belz, N.P. (April 2021). Safety Evaluation of Off-Highway Vehicle Use on Public Roadways, Invited Testimony to State of Alaska House Transportation Committee, Virtual.
- UC Boulder, 4/23/21, Will it Stay or Will it Go? Use of LiDAR to Assess Slope Instability Ben L
- UC Irvine, 5/21/21, Will it Stay or Will it Go? Use of LiDAR to Assess Slope Instability
- ASCE GI Portland Chapter, 10/6/21, Will it Stay or Will it Go? Use of LiDAR to Assess Slope Instability
- Wang, Y., Sun, W., Ricord, S., and Littlebull, H., 2021 Jun 30. Rural Data Collection, Management and Visualization Solutions. Tribal Traffic Safety Committee Meeting.

Example of Policy Papers

- Ashour, Lamis and Shen, Qing. 2021. Incorporating Ride-Sourcing Service into ADA Paratransit: Opportunities and Challenges for King County Metro. Reported submitted to King County Metro.

Examples of New Methodologies, Technologies or Techniques

Wartman, J. The Rockfall Activity Index (RAI), updated version 2

Wengrove, M. Using GNSS-R for estimating significant wave heights in the coastal ocean

McCormack, E. Developing tools for DOT avalanche monitoring staff to use Structure from Motion on unmanned aircraft to assess avalanche risk.

Simpson, B. Development of real-time hybrid simulation to study wave loading on bridges.

Simpson, B. Development of machine learning models to estimate the response of structural bridges.

Hu, C. A cost-efficient estimator strategy for estimating the tire road friction coefficient and sideslip angle is designed, and the structure and theoretical deduction of the design of data-driven motion control with prescribed performance is conducted.

Geyin, M., Maurer, B.W., and Christofferson, K. (In Review). "An AI Driven, Mechanistically-Grounded Geospatial Liquefaction Model for Rapid Response and Scenario Planning." Soil Dynamics and Earthquake Engineering, Elsevier Publishing.

Wang, Y. IoT solution to enhance safety and accessibility for pedestrians at signalized intersections under the Signal Phasing and Timing (SPaT) Challenge; Edge computing and IoT device for real-time curbside parking monitoring.

Examples of Websites

Rockfall Impacts on Mobility (RIM) Database [supporting dataset], <https://trid.trb.org/view/1867269>,
<https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/5J7JTL>
<http://projectsidewalk.org/>
<https://lawlorcode.com/atv>
 "Civil Social Justice Initiatives" www.gonzaga.edu/CivilSocialJustice

Examples of Inventions, Patent Applications, and/or Licenses

Olsen, M. We have submitted invention disclosures to OSU for different components of our rockfall analysis code developed with partial support from several PacTrans projects. We are in the process of developing licensing agreements.

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

Wartman, J. Rockfall Impacts on Mobility (RIM) Database [supporting dataset], <https://trid.trb.org/view/1867269>,
<https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/5J7JTL>

Froehlich, J. Video: https://youtu.be/5wrpe1_jtmU

Froehlich, J. Also starting to develop an urban accessibility design curriculum, you can see it here:
<https://docs.google.com/document/d/13ICLFjoLVgguMujl38VOZxTe35U-ZtiB4AocrYGzKbA/edit>

Simpson, B. Data from the hybrid simulation experiments is available upon requests.

Darrow, M. I incorporated the results from the site characterizations of the Parks and Glenn Highway study sites into the class GE F440 Slope Stability.

Ban, J. The dataset for the network, data, and transit related schedule etc. of South King County transit network

Lawlor, O. Our vehicle simulator technology is capable of VR or WebGL output, and handles offroad vehicles (with tire suspension and arbitrary terrain). It is open source, available here: https://github.com/olawlor/AK_ATV

Olsen, M. 2021 laser scan survey data for Alaska

Olsen, M. Curb Ramp laser scan database

MacKenzie, Don; Jabbari, Parastoo; Ranjbari, Andisheh, 2021, "COVID-19 Disruption on Travel Patterns data",
<https://doi.org/10.7910/DVN/FN8RZK>, Harvard Dataverse, V2, UNF:6:fgUAVTCUVHefvfcxb+zxHQ== [fileUNF]

Olsen, M., Wartman, J., Leshchinsky, B., Shaefer, K., & Cunningham, K. (2021). Rockfall Impacts on Mobility (RIM) Database [supporting dataset].

Geyin, Mertcan; Maurer, Brett (2021) "RapidLiq: Software for Near-Real-Time Prediction of Soil Liquefaction." DesignSafe-CL.
<https://doi.org/10.17603/ds2-4bka-y039>.

Chu, E. The GUI of a point cloud segmentation program, namely Vo-Norvana, was developed with the PacTrans tech transfer project. E Chu

Video for workforce development training;

Video for cost-effective IoT device for comprehensive sensing and V2X applications;

Data for rural roadway safety analysis;
Data for vehicle and pedestrian detection.

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	1

The following are several great examples of the outcomes seen due to PacTrans funded research:

The STAR Lab developed an Internet of Things technology for integrated traffic sensing and Connected Vehicle applications called Mobile Unit for Sensing Traffic (MUST). The City of Lynnwood and the City of Bellevue have decided to install the MUST sensors on their problematic corridors to test the performance of the sensors. This technology can detect dangerous driving conditions using edge AI technologies and inform traffic control centers and roadway users using V2X communications when needed. The State Transportation Innovation Council is currently sponsoring this test.

In April, Nathan Belz, PacTrans PI and Associate Professor of Civil Engineering at the University of Alaska Fairbanks, was invited to testify to the Alaska House Transportation Committee about four-wheeler and snow machine use on public roads in the State. Belz was invited by the chair of the House Transportation Committee, Rep. Grier Hopkins, due to his profound knowledge on the subject, acquired through research funded jointly by PacTrans and the Alaska Department of Transportation & Public Facilities back in 2017. This research evaluated safety issues related to off-highway vehicle and snow machine use on and near roads in Alaska.

Recently, the multi-institutional research team that has been development a suite of new methods, technologies, and applications to better analyze critical rock slopes along transportation infrastructure, has updated their rock fall activity index (RAI), which was originally developed through a PacTrans funded project several years ago. During this reporting period, this updated RAI was adopted by the Oregon Department of Transportation.

Researchers at the University of Alaska, Fairbanks have been developing cutting edge methods and equipment for better testing dust palliatives, which cut down on the significant amount of dust particle caused by unpaved roads. During this reporting period a new procedure was developed as part of this work and it was adopted by the Alaska Department of Transportation and Public Facilities as part of Alaska Test Method 318.

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	2
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?

E-Commerce increased by 43.7% in 2020 and this has made the saturated use of curbside space further demanded. Many cities are looking for a curbside space management solution. One technology transfer project PacTrans and the City of Bellevue jointly funded was to test a STAR Lab curbside space management solution in the City of Bellevue through the City’s Curbside Management Pilot Program. After three rounds of testing and competition with seven commercial company products, this STAR Lab solution ends up being the best performer. Such a solution is expected to help improve efficiency of urban curbside space management, reduce delay and emissions, and improve safety.

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?

Over the years we have reported a great deal on the multi-institutional PacTrans research team that has been developing new methods, technologies, and applications to better analyze critical rock slopes along transportation infrastructure. Their work has been implemented in several state DOTs in the region as well as several other locales internationally. During this reporting period, the team worked with Oregon State University to create a start-up company called EZDataMD. The purpose is to further develop the software that supports their methods and techniques, as well as to commercialize the product to ensure the state DOTs and others who have been using their products, have access to the most up-to-date software.

What is the impact on the body of scientific knowledge?

The Pacific Northwest’s costal transportation infrastructure has a unique vulnerability to risks involving seismic and tsunami loading. PacTrans has several PIs from Oregon State University that are building sophisticated models using machine learning and other cutting-edge algorithms to study fluid-structure interactions. PacTrans has funded a number of those studies, and during this reporting period, OSU Professor Michael Scott presented some of this work in a PacTrans Webinar Series webinar. Recently this work by Professor Scott as well as colleagues such as Assistant Professor Barbara Simpson has yielded bounties of new data that is being made publicly available that was previously impossible due to computational and experimental constraints. These datasets promise to revolutionize the way we

understand fluid-structure interactions and ultimately inform the next generation of bridge design and construction in locations where seismic and tsunami hazards are high.

What is the impact on transportation workforce development?

In June 2021, the WDI delivered the online training course on human factors in partnership with the Washington State Department of Transportation. The course titled, Incorporating Human Factors into Roadway Design and Crash Diagnostics, had 18 WSDOT employees as participants. In the meantime, the WDI has been promoting and scheduling the delivery of several training courses titled, Transportation Data Analytics and Tools, Understanding and Applying the MUTCD, Geospatial Analysis for Transportation Planners & Practitioners, and An Introduction to School Zone Safety, respectively.

Changes/Problems

NONE.

Special Reporting Requirements

Research Project Requirements

Per our research update above, PacTrans is in the process of selecting new projects for the 2022 – 2023 research performance period. Those projects are scheduled to begin in January, but records of these projects will be uploaded to RiP and put on our website within one month of final selection. 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 have completed submission of our Year 1 and Year 2 final technical reports, and are about halfway through year 3 final technical reports.