Semi Annual Progress Report for University Transportation Centers

Prepared for the USDOT Office of the Assistant Secretary for Research and Technology (OST-R)

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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's (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 the dissemination of results to policymakers, 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 partners and new opportunities with current partners to collaborate on transportation-related endeavors.

What was accomplished under these goals?

During the period from October 1, 2023 – March 31, 2024, 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 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. Thus, all projects that will have been funded during this grant were initiated before the end of the most recent performance period. PacTrans research staff have been wrapping up the last of the Year 5 (2021 – 2022) and Year 6 (2022 – 2023) projects. This has entailed peer review, technical editing, ADA compliance checks, gathering of project data, and finalizing UTC research project information sheets. This information is all made available on the project profile pages of our website and the reports and data have been submitted to TRiD, NTL, etc.

Technology Transfer

During this past reporting period, PacTrans PIs and staff have worked diligently to finalize the last of our Success Story Technology Transfer projects. These projects include:

- "Vo-Norvana: A Practical Software Tool for Quick Point Cloud Processing" by PI Michael Olsen (OSU)
- "Enhanced Intersection Signal Control System with Pedestrian and Cyclist Crossing Time Assurance" by PI Yinhai Wang (UW)
- "Predict Near-term Traffic Performance like Weather Forecast" by PI Yinhai Wang (UW)
- "Avalanche Monitoring System in Mountainous Area based on IoT Sensor Network" by PI Yinhai Wang (UW)
- "Roadway Traffic and Environmental Conditions Monitoring and Safety Alert System" by PI Yinhai Wang (UW)
- "Software for Real-time Prediction of Earthquake-induced Ground Failure" by PI Brett Maurer (UW)
- "Technology Transfer of the Findings of "Cost Comparison of Washington Safety Rest Area Operations with Other States" by PI Kishor Shrestha (WSU)

PacTrans and its PIs engaged in several 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) and the UW Mobility Innovation Center (MIC). This year we also added a new contributing partner to the conference, the UW College of Built Environments Technology Community of Practice. It was held on Friday, October 13, 2023, on the University of Washington campus. The theme of this year's conference was Bridging People and Technology for Improved Mobility and Safety. With over two hundred in attendance, it was a very successful conference that included a keynote presentation, a plenary session, and two sessions of three breakout technical panels. Panels were on topics such as transformative solutions, workforce development, artificial intelligence, connected and automated vehicles, rural safety, and supply chain disruptions. PacTrans also presented five annual awards and hosted a poster session that showcased over twenty ongoing/recently completed PacTrans research projects. Accolades from this conference included:

- Mark Hallenbeck (Washington State Transportation Center) won the 2023 Lifetime Achievement Award
- Haizhang Wang (Oregon State University) won the 2023 Outstanding Research Award
- Anne Vernez Moudon (University of Washington) won the 2023 Outstanding Educator Award
- Billy Connor (University of Alaska Fairbanks) won the 2023 PacTrans Excellence in Technology Transfer Award
- Alaska Department of Transportation and Public Facilities won the 2023 PacTrans Partner of the Year Award

In November, several PacTrans researchers participated in and presented work at the ITS Washington Annual Meeting in SeaTac, Washington. Of note, Chenxi Liu (UW) participated in the session, Demystifying Artificial Intelligence and Its Application for Smart Cities, with their topic of Revolutionizing Road Transportation with Artificial Intelligence Empowered Technologies

In January, PacTrans participated heavily in the 2024 103rd Transportation Research Board (TRB) Annual Meeting. In total, our faculty and student researchers participated in over one hundred workshops, lecterns, and poster presentations. This annual meeting continues to be a very productive way for PacTrans to present research findings to a national and international audience. In concert with the TRB Annual Meeting, the CUTC Awards Banquet was hosted; at this event, PacTrans was honored with the 2024 Technology Transfer Leadership Award, shining a light on our commitment to knowledge dissemination and practical applications.

Education & Workforce Development

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.

This past January, PacTrans supported over thirty-five students from consortium universities to participate in the 103rd Transportation Research Board (TRB) Annual Meeting. Several other accolades from this conference included:

- Chenxi Lu (UW) won the Michael Kyte Outstanding Student of the Year Award.

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- Frank Yang's dissertation received Best Dissertation Award (second place) from the TRB AED50 AI and Advanced Computing Applications Committee.
- PacTrans undergraduate research fellow (UW) Peter Yu Peter Yu is selected as one of the 2024 Husky 100: https://www.washington.edu/husky100/blog/announcing-the-2024-husky-100/.
- Logan Scott-Deeter (OSU) won the PacTrans USDOT UTC Outstanding Student of the Year Award
- Zhipeng Li's (WSU) dissertation titled "Fly Ash Based Geopolymer for Concrete Infrastructure: Development, Characterization, Application and Life Cycle Assessment" received the Best Doctoral Dissertation Award from the 2024 Milton Pikarsky Memorial Winners in Science and Technology.

PacTrans also hosted our 10th Annual Region 10 Student Conference. This event was organized by a committee of students that represent each of our consortium partner universities. This event was hosted on the UW campus the day after our annual conference and featured activities that included three speaker presentations, a career development panel, and the annual student poster competition.

Several other student- and faculty-related highlights from this reporting period included:

- The UW ITE Student Chapter attended the 2024 ITE Western District Student Leadership Summit at Cal Poly SLO
- The UW ITE Student Chapter's Peter Yu, Garett Davis, and Jonah Lorica won the Western District Traffic Bowl and are headed to internationals
- PacTrans board member, Xianming Shi (WSU), was honored as a senior member of the National Academy of Inventors
- Two WSU students, Amir Ali Shahmansouri and Ali Mahmoodigahrouei, were awarded the 2024 Eastern Washington Masonry Promotion Group Graduate Fellowship
- WSU's Ali Mahmoodigahrouei was also awarded the 2024 Graduate Research Assistant Award, by the WSU Graduate School, the 2024 University Transportation Center (UTC) Student of the Year, awarded by the U.S. Department of Transportation, and the Spring 2024 Dissertation Grant by Graduate & Professional Student Association (GPSA)
- WSU's Chuan Chen was awarded the 2024 Richard Perteet Graduate Fellowship in Civil Engineering
- WSU's Taiwo Olawale Akinleye received the 2024 GeoEngineers Incorporated Scholarship
- A WSU research team recieved a grant called 2023 STEM Talent Challenge by the U.S. Department of Commerce's Economic Development Administration (EDA) for a project named "Washington's High-Demand Advanced Civil Engineering Workforce Development"

Also, during this reporting period, PacTrans offered four wonderful webinars/seminars to our students and our broader community:

1. In November, we hosted Kelvin Wang (Montana State University) for a talk titled, Intelligent Evaluation of Transportation Infrastructure: Pavement and Bridges
2. In January, we hosted Prateek Bansal (National University of Singapore) for a talk titled, Marrying Cognitive Psychology and Behavior Modelling: New Advancements and Results.
3. In February, we hosted Zhanping You (Michigan Technological University) for a talk titled,

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Recycling Waste Materials for Pavement Construction
4. In March, we hosted Roger Millar (WSDOT Secretary of Transportation) and Dennis Truax, (ASCE President) for a talk titled, Preparing Future Transportation Leaders for a Sustainable Tomorrow

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 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. Online programs, such as the online master's program in 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 the UW Teen and Youth Program to develop a course titled *Introduction to Autonomous Cars* that will be offered to sixth through eighth graders, 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 five new graduate fellows (four 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 thirteen 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.

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 the American Society of Civil Engineers in supporting student activities and organizing the upcoming International Conference on Transportation and Development.

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 LinkedIn and Facebook 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 including 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?

The closing date of the grant coincides with the last day of this reporting period. Therefore, the main item that PacTrans will be working on is getting all of the closing documentation finalized and submitted by June 30, 2024.

Research

PacTrans will work to ensure that all funded research projects are fully completed, technical reports and data are uploaded and made available via the project pages on the PacTrans website, and that they are all sent to TRiD, NTL, etc.

Technology Transfer

PacTrans will work to ensure that all funded technology transfer projects are fully completed, and outputs from those projects are broadly disseminated via the PacTrans website and other digital media.

PacTrans will also use the forthcoming PacTrans Region 10 Transportation Conference as a great venue to push out research products to potential users.

Education & Workforce Development

PacTrans will continue developing short-term training courses to help address the workforce challenges in Region 10.

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 30 percent of his time to 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 the Student Leadership Council. He is the regional and national leader 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 5 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 5 percent of her time leading the Education and Workforce Development Committee. She is involved in curriculum changes, training program development, and educational enhancements among partner institutions.

- PacTrans Associate Director at Oregon State University (OSU), **David Hurwitz**, Ph.D., Professor of Civil and Construction Engineering at OSU, devotes 5 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 regularly.

- PacTrans Associate Director at the University of Alaska Fairbanks (UAF), **Billy Connor**, Director of the Alaska University Transportation Center (AUTC), devotes 5 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 regularly.

- PacTrans Associate Director at the University of Idaho (UI), **Ahmed Abdel-Rahim**, Ph.D., Associate Professor of Civil Engineering at UI, devotes 5 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 regularly.

- PacTrans Associate Director at 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 5 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 regularly.
- Assistant Director, **Cole Kopca**, devoted 50 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.
- Assistant Director of the Workforce Development Institute, **Melissa Amrhein**, devoted 80 percent of her time to the Center's workforce development programs.
- PacTrans full-time Finance, Grants, and Research Manager, **Christina Yarbrough**, devoted 80 percent of her time to the Center's budget, expenditure, and research management.
- PacTrans full-time Communications and Marketing Specialist, **Kristine Pham**, devoted 95 percent of her time to the Center's communications and marketing work.
- PacTrans part-time Program Coordinator, **Melanie Paredes**, devoted 30 percent of her time to the Center's fiscal matters, support with events coordination and outreach, and day-to-day administration.
- PacTrans has 28 full-time faculty at the UW engaged in transportation research. Our consortium partners (OSU, UI, WSU, UAF, GU, BSU) have 41 full-time 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
Oregon Department of Transportation	Government
City of Moscow	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	**67**	24	12	8	21	1	1	0
Publications: Book chapters and other edited manuscripts	**14**	2	1	11	0	0	0	0
Conference papers	**54**	20	5	6	19	3	1	0
Conference presentations	**83**	27	19	9	24	3	1	0
Lectures/Seminars/Workshops/ Invited	**45**	21	6	2	15	1	0	0
Policy Papers	**5**	3	1	1	0	0	0	0
Websites or Other Internet Sites	**7**	4	0	0	1	2	0	0
New Methodologies, Technologies, or Techniques	**13**	6	0	1	5	1	0	0
Inventions, patent applications, and/or licenses	**3**	0	2	0	1	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	**10**	4	0	2	3	1	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	253
Number of software tools and technologies made available to practitioners	10	13

Examples of peer-reviewed journal articles

Mohamed T. Elshazli, Dina Hussein, Ganapati Bhat, Ahmed Abdel-Rahim, Ahmed Ibrahim (2024). Advancing infrastructure resilience: machine learning-based prediction of bridges' rating factors under autonomous truck platoons. Accepted for publication by the Journal of Infrastructure Preservation and Resilience, Springer Nature.

Young, Rhonda, Kevin Chang, David Hurwitz, Antonio Roman Campos, Jasmin Woodside (2024). "Characterizations of Expert and Public Perception of Bicycle Rolling Stop Laws" Transportation Research Record. In Press.

Elshazli, Mohamed T., Dina Hussein, Ganapati Bhat, Ahmed Abdel-Rahim, and Ahmed Ibrahim (2024). "Advancing infrastructure resilience: machine learning-based prediction of bridges' rating factors under autonomous truck platoons." Journal of Infrastructure Preservation and Resilience 5, no. 1: 1-26

McCabe, D.1, Ban, X. and Kulcsár, B. (2024). Minimum-delay opportunity charging scheduling for electric buses. Submitted to Transportation Research Part E. http://arxiv.org/abs/2403.17527

Markus, S.J.; Wartman, J.; Olsen, M.; Darrow, M.M. (2023). Lidar-Derived Rockfall Inventory—An Analysis of the Geomorphic Evolution of Rock Slopes and Modifying the Rockfall Activity Index (RAI). Remote Sens. 2023, 15, 4223. https://doi.org/10.3390/rs15174223

Xu, Ang and Yan, Chiwei and Goh, Chong Yang and Jaillet, Patrick, A Locational Demand Model for Bike-Sharing (2023). Available at SSRN: https://ssrn.com/abstract=3311371 or http://dx.doi.org/10.2139/ssrn.3311371, under major revision at Manufacturing & Service Operations Management.

H. Jashami, D. Cobb, I. Sinkus, Y. Liu, E. McCormack, A. Goodchild, D. Hurwitz (2023) "Evaluation of Bicyclist Physiological Response and Visual Attention in Commercial Vehicle Loading Zones" Journal of Safety Research https://doi.org/10.1016/j.jsr.2023.11.018.

Lowry, M. (2024). "Multimodal experience as a predictor and catalyst of travel behavior." Travel Behaviour and Society, Volume 34.

Jung, J. Che, E., Olsen, MJ., Parrish C., Turkan Y, Yoo, S. (2024). Instance-based clustering of road markings with wear and occlusion from mobile lidar data, Journal of Computing in Civil Engineering. In Press.

Chen, Xianda, Meixin Zhu, Kehua Chen, Pengqin Wang, Hongliang Lu, Hui Zhong, Xu Han, Xuesong Wang, and Yinhai Wang (2023). "FollowNet: A Comprehensive Benchmark for Car-Following Behavior Modeling." Scientific Data. Vol. 10, Iss. 1, 828.

Examples of Book Chapters and Manuscripts

A V Moudon. Health in the City. In Women Reclaiming the City: International Research on Urbanism, Architecture, and Planning. Tigran Haas, Ed. London: Rowman & Littlefield, 2023

Examples of conference papers and presentations

Neeta "Fast Machine Learning (AI) Based High Fidelity Mesoscopic Modeling Tool for Traffic Simulation", ASCE International Conference on Transportation and Development (ICTD 2024), June 2024

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Tariq A. Lamei Mohamed, Ahmed Abdel-RAhim, and Ahmed Ibrahim "Data Needs Analysis for Resilient Multimodal Rural Freight Corridors", ASCE International Conference on Transportation and Development (ICTD 2024), June 2024

Ahmed Ibrahim, Mohamed Elsahzly, and Ahmed Abdel-Rahim, "Leveraging AI and Machine Learning for Bridge Structural Assessment and Connected Trucks Advancement", ASCE International Conference on Transportation and Development (ICTD 2024), June 2024

McCabe, D., Ban, X., 2024. ZEBRA: A Web App for Electric Bus Planning. Transit Data Challenge, organized by TRB Committee AP010. Poster Presentation at the 103th Annual Meeting of Transportation Research Board, Washington DC.

Kasi, Z., Simpson, B.G., and Scott, M.H. "Estimating the Dynamic Response of Structures Using Recurrent Neural Networks", World Conference on Earthquake Engineering (WCEE2024), Milan, Italy, June 2024.

Young, R., Chang, K., and Hurwitz, D. (2024). "Characterizations of Expert and Public Perception of Bicycle Rolling Stop Laws: Public Hazard or Practical Convenience?" Transportation Research Board, Washington, DC.

Liao, F. H.F. et al., 2023 Spatial Inequality in Access to Emergency Food Resources: The Case of Seattle, WA. 2023 Region 10 Transportation Conference. October 13, 2023.

Herrman, D. and Darrow, M. (2023). "A systematic analysis of the Schmidt hammer for field assessment of rock strength." AEG 66th Annual Meeting, September 20-22, 2023

D. Ji, Y. Turkan, P.M. Calvi "Deep Learning-based Surface Defect Detection: Three-class Segmentation", ASCE International Conference on Computing in Civil Engineering, July 28-31, 2024, Carnegie Mellon University Pittsburgh, Pennsylvania, USA.

Young, Rhonda, Kevin Chang, David Hurwitz, Antonio Roman Campos, Jasmin Woodside. "Characterizations of Expert and Public Perception of Bicycle Rolling Stop Laws: Public Hazard or Practical Convenience?" Presented at the 2024 Annual Meeting of the Transportation Research Board, Washington, D.C., January 2024.

Example of lectures/seminars/workshops/invited talks

Yinhai Wang. ASCE Francis C. Turner Lecture. "Revolutionizing Road Transportation with Artificial Intelligence Empowered Technologies." Nov. 15, 2023.

Yinhai Wang. Norwegian Public Roads Administration. "University of Washington Transportation Research Resources and Example Projects at the PacTrans STAR Lab." Oct. 30, 2023.

Chenxi Liu. Norwegian University of Technology (NTNU). "Developing AI-Empowered Transportation Technologies for Improved Mobility and Safety." Oct. 29, 2023.

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

Zero-Emission Bus Range & Recharging Assessment (ZEBRA): https://bit.ly/zebra-app.
Traffic Performance Score Website: http://tps.uwstarlab.org/.

Examples of New Methodologies, Technologies or Techniques

An algorithm to estimate demand for free-floating micro-mobility systems.
https://github.com/angxu1/bike_sharing

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

Shucheng Zhang, Chenxi Liu, and Yinhai Wang (2024). Machine-learning based system for traffic sign recognitions using live video feed.

Shuyi Yin, Mehrdad Nasri, and Yinhai Wang (2024). Street light location data collection tool using Google street views.

Outcomes

OUTCOMES: Technology Transfer Plan Outcomes Metrics	Annual Targets	Numbers for Reporting Period
Number of early adopters of our research outputs	10	7
Changes made to the transportation system, or its regulatory, legislative, practice manuals, design standards, or policy frameworks	2	2

The lack of truck parking facility and real-time truck parking availability information has been a major problem faced by transportation professionals and commercial vehicle operators. The project jointly funded by PacTrans and WSDOT, entitled "Real-Time Truck Parking Information Integration, Visualization and Prediction," resulted a machine-learning-empowered system for short-term truck parking availability prediction. The system has been implemented on two WSDOT truck parking facilities and the prediction results are satisfactory. This project was honored as one of the AASHTO High Value Research Project Sweet Sixteen award in 2022. WSDOT and the PacTrans research team are working together to further implement the system to more parking facilities with a new grant from Federal Motor Vehicle Carrier Safety Administration.

Another excellent outcome example from our research portfolio comes from a small research project entitled "Extending the SR-522 SPaT Challenge to Active Transportation Users." This project resulted in a comprehensive intersection sensing and control technology for traffic safety improvement. The concept paper based on this research products received the USDOT Intersection Safety Challenge Award for Phase 1A.

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?

Most research products from PacTrans research generate positive impacts to the effectiveness of the transportation system. The Traffic Performance Score website is such an example. The University of Washington STAR Lab started to work on a Traffic Performance Score Website in 2019 with funding

support from PacTrans, Seattle DOT, and WSDOT. This system can predict traffic performance like predicting weather conditions for the central Puget Sound area. It presented a new way for quantifying traffic performance and can take a variety of impacting factors, such as special events, incidents, etc., into account. Recently, a sequence-to-sequence online learning algorithm has been implemented to automatically learn from observations to improve predication accuracy. Such a system can help answer questions like how a particular event scheduled in the area may affect traffic performance on a particular corridor or a network. Data collected by this system has been shared with transportation professionals through the TRB AI and Advanced Computing Application Committee's website and served as benchmarks for new algorithm and system developments.

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?

An earlier research product from PacTrans, Mobil Unit for Sensing Traffic (MUST), has been carried to practice by a PacTrans spinoff company called AIWaysion, Inc. since November 2022. MUST received the Innovative Project Award from the FHWA Build a Better Mousetrap program. It offers a new way for data collection, traffic monitoring, and communications with roadway users. Now the technology has been used in five states. The spinoff company also received two USDOT Small Business Innovation Research awards to date.

Another example is the avalanche monitoring technology developed by the UW STAR Lab. A prototype avalanche sensing system was developed through a PacTrans Success Story project. The system has been demonstrated at several avalanche-prone locations and received very positive feedback. Recently, the research team received further funding support from both WSDOT and the NCHRP IDEA program to further develop and test the technology. Once successful, this new technology will make avalanche monitoring and prevention much easier and cost-effective.

What is the impact on the body of scientific knowledge?

PacTrans extensive research portfolio contributes greatly to the scientific body of knowledge in the transportation field. For example, several researchers of PacTrans summarized their machine learning research findings and experiences into a textbook, Machine Learning for Transportation Research and Applications, published by Elsevier in 2023. Also, PacTrans works hard to facilitate knowledge sharing through workshops, symposiums, and conferences. In addition to its own PacTrans Region 10 Transportation Conference, it also co-organizes the AI in Motion: Shaping the Future of Mobility and Safety Symposium, scheduled May 15-17, 2024, in Austin, Texas with Texas DOT and the Region 8 UTC (Southern Plains Transportation Center) and the Data Driven Solutions and AI Technologies for Safer and Smarter Mobility workshop scheduled May 28-39, in Oslo, Norway with Norwegian Public Roads Administration and WSDOT.

What is the impact on transportation workforce development?

PacTrans' multi-institution educational research project led to the creation of the PacTrans Workforce Development Institute (WDI) in 2021. Since then WDI has delivered courses to both working professionals and K-12 students and gradually built up its partnership network and influence. During this reporting period, PacTrans hired Melissa Amrhein as assistant director of WDI to expedite the training program development. Through working with Washington State Transportation Center (TRAC), Northwestern Tribal Technical Assistance Program (NW TTAP) Center, and the Washington State Senate Transportation Committee, $1 million state funds are allocated to support our workforce development efforts.

PacTrans has also partnered with Washington State Local Technical Assistance Program (LTAP) and NW TTAP Center to develop Washington State's Roads Scholars and Safety Championship certificate programs. These programs will make training more accessible to local communities and help address the workforce challenges significantly.

Changes/Problems

None.

Special Reporting Requirements

Research Project Requirements

Per our research update above, PacTrans is working diligently to wrap up all remaining ongoing research projects. Records of these projects have all been uploaded to RiP and put on our website. 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 Year 6 technical reports.