



## Program Progress Performance Report for University Transportation Centers

Prepared for the USDOT Research and Innovative Technology Administration (RITA)

RITA Sponsor Award Number: **DTRT12-G-UTC10**

Project title: **Pacific Northwest Transportation Consortium (PacTrans):  
Using Technological Advances to Develop Data- driven, Sustainable Solutions for the Diverse  
Transportation Needs of the Pacific Northwest**

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**Submission Date:** September 30, 2016

**DUNS:** 605799469 **EIN:** 91-6001537

**Report #9, PPPR reporting for six months** (January 1, 2016 – June 30, 2016)

**Project/Grant Period:** January 01, 2012 – June 30, 2016

**Reporting Period End Date:** June 30, 2016

**Report Term:** Semi-Annual

## 1. 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 partner institutions. PacTrans' theme centers on "Developing Data Driven, Sustainable Solutions for the Diverse Transportation Needs of the Pacific Northwest". PacTrans will serve 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 goals. 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 five 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.

**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 this final six month period from January 1, 2016 – June 30, 2016 of our grant, PacTrans worked busily to tie off many of the administrative obligations. Although this grant funded no new research

during this reporting period, PacTrans continued to actively engage in technology transfer of many of the outcomes from previously funded research projects. The center also continued to engage heavily in education, workforce development, outreach, and collaboration.

### **Research**

During this reporting period no new research was funded under this grant, and all of the previously funded projects have already been completed and submitted through the appropriate channels.

### **Technology Transfer**

PacTrans was very active in translating research into practice during this reporting period. At the 2016 TRB Annual Meeting, PacTrans student and faculty researchers were in attendance from all five of our consortium institutions. In total, PacTrans researchers had over 100 papers accepted to, and presented at, the meeting; and those researchers participated in over 120 lecterns, poster sessions, workshops, committees, and subcommittees.

Further, in PacTrans last Program Progress Performance Report (PPPR #8), we highlighted a handful completed research projects that had been identified as success stories that reported significant results and made major findings, developments or conclusions. These projects received additional PacTrans funds to execute a predetermined technology transfer plan. PacTrans is pleased to be able to present the products that were made:

1. Multi-Institution Project Title: **Unmanned Aircraft System Assessments of Landslide Safety for Transportation Corridors**. Over the last year this team has been using drones to collect optical imagery of several unstable slopes located in Alaska, using digital cameras to characterize and model slope stability and to forecast their dynamics. This project received additional funding to create a promotional video to showcase the effectiveness of drone imaging collection. This video has been completed and can be found here: [https://www.youtube.com/watch?v=1C\\_hf6tfYqM](https://www.youtube.com/watch?v=1C_hf6tfYqM)
2. Project Title: **Greenroads: A sustainability performance metric for roadway design and construction**. Out of this research came a green roadway design and construction certification system (much like Leadership in Energy and Environmental Design (or LEED) works for building) and also the Greenroads Foundation, a 501(c)(3) that is meant to support and cultivate the mission and certification system. This project received additional funding to host a student workshop titled, "Greenroads Bootcamp." It was a full-day training event that involves: (1) a 1-hour general audience lecture about roadway sustainability and Greenroads, (2) a 2-hour in-depth training session on how to use the Greenroads Rating System to rate roadway projects, (3) a 1-hour information session with interested students, and (4) free passes for any in attendance wishing to take the Greenroads professional accreditation exam (STP Exam). The event was hosted in January on the University of Washington campus and had over 50 attendees. For more on the event visit: <http://blog.greenroads.org/2016/01/starting-off-year-right.html>

3. Small Project Title: **Improving Sustainability of Urban Streets via Rain Gardens – How Effective Are These Practices in the Pacific Northwest?** The Benton County, City of Corvallis, Oregon Water Resources Department, and Oregon-BEST, and multiple other partners constructed the OSU-Benton County Green Stormwater Infrastructure Research Facility. This facility is an instrumented, semi-controlled, and three celled testing facility for green infrastructure that captures runoff from the Benton County Public Works transportation yard. Each cell enables field-scale testing of a roadside stormwater (natural or artificial) technology, and provides opportunities for near real-time monitoring and comparison with other technologies. This project received additional funding to achieve the following tasks:

- Development of education materials, and collaborate with University of Washington to collect initial data and apply for the facility to be Technology Assessment Protocol - Ecology (TAPE) certified. The video produced for this portion can be found here: <http://research.engr.oregonstate.edu/hydroinformatics/ogsir%20home>
- Development of a web-based monitoring portal that will be made available to the community for monitoring these rain gardens in real-time and measure their performance via an embedded modeling framework. This web-based monitoring portal can be found here: <http://research.engr.oregonstate.edu/hydroinformatics/avery/monitoring-data>
- Delivery of presentations to local stormwater utilities and water managers about the facility and research conducted at the facility.

4. Small Project Title: **Alternative Information Signs: An Evaluation of Driver Comprehension and Visual Attention.** This project studied the evaluation of traffic sign understandability. By using a variety of online survey question approaches and driving simulation tasks they have been assessing the understandability of alternative Tourist Information signs in Oregon. This project received additional funding for the development and dissemination of an interactive website. The aims of the website are to:

- provide a mechanism for sharing the literature review, experimental methods, results, and findings of the project
- to provide an interactive interface that will enable users from around the world to populate a geospatial database with images and descriptions of information signs in different contexts.

This website has been completed and can be found here: <http://touristinfosign.com/>

5. Multi-Institutional Project Title: **Data Collection and Spatial Interpolation of Bicycle and Pedestrian Data.** PacTrans and the Washington State Department of Transportation jointly funded research focused on leveraging current data collection efforts to obtain more complete travel demand information, and introducing new methods that have the potential to reduce cost

and improve the quality and coverage of transportation data. This project received additional funding to develop a short film explaining the unique data collection paradigm to the non-engineering public, with the aim of addressing common complaints regarding privacy and safety. The film created in this project will be released publicly via popular video streaming services, and emphasis will be placed on clarity, simplicity, and entertainment value. This video is complete and can be found here: <https://www.youtube.com/watch?v=Fi07GCRvRMO>

## **Education**

During this reporting period PacTrans Universities continued offering research and training opportunities to students with access to data, instruments, and equipment in the transportation labs at each of the five participating consortium universities. These labs include:

### *University of Alaska at Fairbanks*

- Alaska Center for Energy and Power
- Alaska University Transportation Center

### *Oregon State University*

- Driving and Bicycling Simulator
- National Center for Accessible Transportation

### *University of Idaho*

- National Institute for Advanced Transportation Technology

### *University of Washington*

- Human Factors and Statistical Modeling Lab
- Smart Transportation Applications and Research Laboratory (STAR Lab)
- Transportation-Human Interaction and Network Knowledge Laboratory (THINK Lab)
- Urban Form Lab
- Washington State Transportation Center (UW)

### *Washington State University*

- Center for Environmentally Sustainable Transportation in Cold Climates
- Freight Policy Transportation Institute
- Washington Center for Asphalt Technology
- Washington State Transportation Center (WSU)

PacTrans had several student researchers win awards during this reporting period. Oregon State University Graduate Student, Kamilah Buker, won the Oregon Section ITC Bill Kloos Competition and Award. University of Washington Graduate Student, Anna Bovbjerg, was awarded the 2015-2016 Washington State ITE Student of the Year. University of Washington PhD candidate John Ash, and Oregon State University Masters Student Andrea Mathers, won the 2015 PacTrans Outstanding Student of the Year award and were honored and recognized at the CUTC banquet at this year's TRB annual meeting. University of Alaska, Fairbanks, PhD candidate Anthony Mullin received the 2015 Michael Kyte

Region 10 Outstanding Student of the Year Award and was recognized at the PacTrans reception at this year's TRB annual meeting.

On February 5, 2016 PacTrans hosted prospective graduate students and on April 22, 2016 PacTrans participated in the University of Washington's Engineering discovery days, an event that bring thousands of middle school age students for a large, two-day event where students and faculty from all UW engineering departments share their work with students, teachers, families and the community.

Finally, this spring PacTrans consortium university student competition teams were very successful at both the regional and national level:

- The University of Washington Hyperloop team competed in the first-ever SpaceX Hyperloop Pod Competition on January 29 through 30. The UW team was one of only 26 team who advanced to the building phase of the competition, and they won a "safety subsystem technical excellence" award. PacTrans has been sponsoring their efforts, both financially and from a mentoring perspective.
- The University of Alaska Fairbanks Steel Bridge team took 6<sup>th</sup> place at the 2016 National Student Steel Bridge Competition on May 27 and 28
- The University of Washington Concrete Canoe team took 10<sup>th</sup> place at the 2016 National Concrete Canoe Competition on June 9 through 11.
- The University of Idaho Clean Snowmobile team took 7<sup>th</sup> place at this year's SAE International Clean Snowmobile Challenge in the Internal Combustion Class this past March.

### **Workforce Development**

PacTrans hosted a number of activities geared at workforce development during this reporting period: the 2016 Northwest Transportation Conference, and six seminars/guest lecturers.

PacTrans is resolved in its mission to produce practical and applied research, and equip our students for a robust and thoughtful career in transportation engineering. For this reason, PacTrans co-sponsored and co-organized this year's Northwest Transportation Conference. This past March 15 through 17, Oregon State University and the Oregon Department of Transportation hosted the biennial conference on OSU's campus in Corvallis, Oregon. With more than 400 transportation professionals from throughout Oregon and the Pacific Northwest in attendance, this event touts being the Northwest's premiere transportation event.

ODOT Research Manager and PacTrans External Advisory Board Member, Michael Bufalino, chaired this year's event. The theme was, "Transportation Tools You Can Use on the Job." Thus the 20+ sessions, discussions, and events offered throughout the conference were all geared at equipping the professionals in the audience with practical, applicable knowledge and tools that they could take home and begin using today. Among the presenters and moderators were PacTrans associate director David Hurwitz (OSU), PacTrans PI Michael Olsen (OSU), and PacTrans PI Haizhong Wang (OSU), as well as student researchers Alireza Kashani and Kamilah Buker.

PacTrans also hosted a number of lectures and seminars during this reporting period including:

- **Dr. Yahong Rosa Zheng**, Professor Electrical and Computer Engineering, Missouri University of Science and Technology, Rolla, MO, on January 29, 2016 – Dr. Zheng discussed a system that can be used to monitor bridge scour and communicate such information to necessary authorities (e.g., bridge operation and maintenance crews) via underwater communications.
- **Charlie Howard**, Director of Planning for the Puget Sound Regional Council, on March 10, 2016 - spent the majority of his time discussing the general trends and current climate in which we find out region's transportation system. He discussed growth, issues of congestion, and Washington State's unique situation with the Growth Management Act that enables urban growth boundaries, beyond which development is discouraged.
- **Dr. Basile Chaix**, Professor and Research Director at Inserm (the French National Institute of Health and Medical Research), on March 31, 2016 - Dr. Chaix's lab seeks to take immense amounts of data, stemming from a wide array of fields, including some from the built environment, and perform analyses in an effort to make meaningful observations about the way the built environment affects the rest of our lives as humans. More specifically his group is interested in the neighborhood's effect on health and the relationship between transport and health.
- **Dr. Daniel Sperling**, Founding Director of the Institute of Transportation Studies at the University of California at Davis, on April 14, 2016 – Dr. Sperling discussed transportation revolutions – energy efficiency by using hybrids; vehicle electrification (Nissan Leaf, Tesla Model S, Chevy Volt, and Toyota Mirai); new propulsion technologies using electricity and Hydrogen. He is placing passenger transportation as the least innovative factor, and single occupant vehicles dominate the streets, but with the new mobility services (Uber and Lyft) and fast-changing digital technologies for automation of vehicles, the transportation mode will change.
- **Dr. Tarek Sayed**, Professor and distinguished Scholar at the University of British Columbia, on June 2, 2016 – Dr. Sayed discussed the importance of the proactive transportation engineering approach. Emerging trends to these ends include: use of safety conscious planning models, the explicit evaluation of safety in road design, and the video-based automated road safety analysis using computer vision techniques.

## Outreach

During this reporting period PacTrans made great use of the ample opportunities to participate in external functions that make the center more visible, show off our research, add expertise and influence, advertise to potential student, and build strong partnerships within the industry.

June 26 through June 29, 2016, PacTrans Director, Dr. Yin Hai Wang, and PacTrans Communications and Research Manager, Cole Kopca, attended the 2016 ASCE International Conference on Transportation and Development. The four-day conference, co-sponsored by PacTrans, was held in Houston, Texas, and featured dozens of great sessions ranging from rail to public transportation to innovations in pavement to system management and operations to emerging technologies. Dr. Wang had the privilege of moderating and presenting in one such session. He, along with Dr. Musharraf Zaman, professor at University of Oklahoma and director of the Southern Plains Transportation Center, hosted a session on Technology Transfer. They were joined by Waseem Fazal, of the Federal Highway Administration. Dr. Wang shared about recent successes with our Center's development of Bluetooth and WiFi mobile sensing technology. He also presented the challenges and obstacles that still stand in the way of these technologies being fully implemented to collect more robust data sets on peoples' movements in the

real world. Among these obstacle included privacy issues, as well as public perceptions due to previous experiences with people’s sensitive information.

The following are several other samples of these functions:

1. On February 8, 2016, Dr. Yinhai Wang (UW) gave the keynote address at the annual ITE/IMSA annual meeting in SeaTac, Washington
2. On February 25, 2016, Dr. Yinhai Wang (UW) gave a presentation at the Microsoft Smart Cities Workshop in Bellevue, Washington
3. On March 30, 2016, Dr. Yinhai Wang (UW) spoke at the 2<sup>nd</sup> Annual UTC Safety Summit hosted by Carnegie Mellon
4. On May 3, 2016, Billy Connor (UAF) make a presentation at the Sea Level Rise Summit in Fort Lauderdale, Florida
5. On May 30, 2016, Dr. Haizhong Wang (OSU) spoke at Tongji University in Shanghai, China.
6. On June 15, 2016, PacTrans participated in the STEM Knowledge Exchange in Washington DC

- **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 other on-campus and online courses designed for professional development in addition to the regular degree programs. The online programs, such as the online master’s program of sustainable transportation, are particularly good for working professionals because of the flexibility in schedule and location.

**Outreach:** PacTrans offers training and educational opportunities to K-12 students through its outreach activities. Examples include: UW engineering discovery days, OSU undergraduate engineering expo, and Alaska Summer Research Academy (ASRA), where high school students enrolled in the ASRA Civil Engineering Module applied basic design principles of statistics and structural analysis showing how engineering principles are used to solve problems.

**Funding assistance:** PacTrans has supported student education and research activities. Beyond our PacTrans fellows, for whom we fund tuition, we also give a significant amount of assistance to students to participate in competitions, conferences, and seminars such as the Hyperloop competition, IEEE Smart Cities Conference, the Oregon State University hosted Northwest Transportation Conference, and the Transportation Research Board Annual Meeting. This aides them with funds for presentation materials, travel expenses, and registration fees.



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

**Internships:** PacTrans internship program continues to offer students great training opportunities by partnering not only with local agencies but also private industries. We have an internship program with WSDOT, Seattle DOT, Bellevue Transportation Department, Transpo Group, FEHR & PEERS, Parsons Brinckerhoff, Puget Sound Regional Council, ODOT, etc. Additionally, PacTrans itself also offers intern opportunities for both graduate and undergraduate students to work in the PacTrans consortium university labs to gain hands on experience in transportation.

**Partnerships:** PacTrans has a partnership program with Institute of Transportation Engineers (ITE). 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.

- **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, through which PacTrans research outcomes are presented and demonstrated. Research outcomes are posted on the PacTrans website, distributed through our *quarterly newsletter* and *annual reports*, and promoted through social media such as *Facebook* and *Twitter* and the University of Washington *press media*. We also disseminate news, events and results via our website at [www.pactrans.org](http://www.pactrans.org).

The second large component of our dissemination efforts surround facilitating and attending various seminars, workshops and conferences. Many of these have been outline and discussed in previous sections: Regional Transportation Conference (October 16, 2015), Student Transportation Conference (October 17, 2015), IEEE Smart Cities Conference (October 2015), Northwest Transportation Conference (March 15 – 17, 2016), and Seminar Series guest lecturers (November 4, 2015, January 29, 2016, March 10, 2016, and March 31, 2016).

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?**

Once this performance period’s reporting is submitted, this center will be closed. Therefore, we have no plans for future work with this grant.

**2. Products (for the reporting period of January 1 – June 30, 2016)**

	<b>PacTrans Total</b>	<b>UW</b>	<b>WSU</b>	<b>UI</b>	<b>OSU</b>	<b>UAF</b>
Publications: peer reviewed journal articles	<b>114</b>	49	11	11	41	2
Publications: Book chapters and other edited manuscripts	<b>12</b>	7	0	2	1	2
Conference papers	<b>71</b>	21	8	13	26	3
Conference presentations	<b>111</b>	49	3	14	42	3
Lectures/Seminars /Workshops/ Invited Talks	<b>73</b>	29	2	8	31	3
Inventions, patent applications, and/or licenses	<b>0</b>	0	0	0	0	0
Other products: data or databases, physical collections, audio or video products, software or NetWare, models, educational aids or curricula, instruments, or equipment	<b>19</b>	0	0	2	16	1

- **Examples of peer reviewed journal articles**

- 1) Peters, A., K. Beddoes, S. Brown, and K. Chang. “Transportation Engineering Instructors’ Decision Making Processed for Course Changes.” ASCE Journal of Professional Issues in Engineering Education and Practice. Vol. 142 (3). 2016.
- 2) Hurwitz, D., E. Miller, M. Jannat, L. Boyle, S. Brown, A. Abdel-Rahim, and H. Wang. “Improving Teenage Driver Perceptions Regarding the Impact of Distracted Driving in the Pacific Northwest,” Journal of Transportation Safety & Security, Volume 8, Issue 2, 148-163. 2016. <http://www.tandfonline.com/doi/full/10.1080/19439962.2014.997329>
- 3) Neill, J., D. Hurwitz, and M. Olsen. (2016) Alternative Information Signs: An Evaluation of Driver Comprehension and Visual Attention. Journal of Transportation Engineering, ASCE, Volume 142, Issues 1. 2016. <http://ascelibrary.org/doi/abs/10.1061/%28ASCE%29TE.1943-5436.0000807>
- 4) Goodchild, A., E. Wygonik, and B. Keough. “Deliver It All.” Supply Chain Management Review, Mar/April 2016, 20-26
- 5) Langfitt, Q. and L. Haselbach. “Coupled oil analysis trending and life cycle cost analysis for vessel oil change interval decisions.” JMET Journal of Marine Engineering and Technology, Taylor and Francis Online. 2016. 10.1080/20464177.2015.1126468.”

- **Example of book chapters and other edited manuscripts**

- 1) Connor, Billy. “Laboratory Performance of Wicking Fabric H2Ri in Silty Gravel.” Sand and Organic Silt. May 2016

- 2) Olszko, E. and D.A. Bender. "Can't stress enough – scanning wood guardrail posts is a necessity." Roads & Bridges magazine (January):50-55. 2016.

- **Examples of conference papers**

- 1) Chen, P., Q. Shen, and S. Childress. "A GPS Data-based Analysis of Built Environment Influences on Bicyclist Route Preferences". Transportation Research Board 95th Annual Conference, Washington, DC, January 2016.
- 2) Jashami, H., D. Hurwitz, A. Abdel-Rahim, G. Bham, and L. Boyle. "Educating Young Drivers in the Pacific Northwest on Driver Distraction." Transportation Research Board Annual Meeting, Washington DC, January 2016.
- 3) Ganji, A., Q. Li, P. Arduino, and A. W. Stuedlein. "Performance Assessment of Laterally-Loaded Normal and High Strength Steel-Reinforced Drilled Shafts Using 1-D and 3-D Numerical Methods." 16th World Conference on Earthquake, Santiago Chile, January 9th to 13th. 2016.

- **Examples of conference presentations**

- 1) Chen, P., Q. Shen, and S. Childress. "A GPS Data-based Analysis of Built Environment Influences on Bicyclist Route Preferences". Presented in Transportation Research Board 95th Annual Conference, Washington, DC, January 2016.
- 2) Cunningham, K. "A Platform for Proactive Risk-based Slope Asset Management Phase II." Presented in Transportation Research Board 95th Annual Conference, Washington, DC, January 2016.
- 3) Cunningham, K. "A Platform for Proactive Risk-based Slope Asset Management Phase II." Presented in the American Society of Civil Engineers Conference, 2016.
- 4) Cunningham, K. "A Platform for Proactive Risk-based Slope Asset Management Phase II." Presented in the American Society of Photogrammetry and Remote Sensing Conference, 2016.

- **Example of lectures/seminars/workshops/invited talks**

- 1) Casavant, K. and J. Sage. "Transportation in the Pacific Northwest: The Good, the Bad, and the Not So Ugly." Invited Presentation at the Columbia Bank Agricultural Summit. April, 2016. Pendleton, OR.
- 2) Vargara, H. "Assessing the Capacity of the Pacific Northwest as an Intermodal Freight Transportation Hub." IE 405 Reading and Conference, Spring 2016, Oregon State University
- 3) Babbar-Sebens, M. "OSU-Benton County Green Stormwater Infrastructure Research Facility." 5th Annual Mid- Willamette Erosion Control and Stormwater Management Summit, Keizer, OR, January 26, 2016.

- **Examples of technologies or techniques**

- 1) Chen, C. "An innovative survey design to understand sustainable travel behaviors -potential of a rolling sample survey to replace traditional household travel surveys." This new survey technique, as developed in the study, has been discussed intensely within PSRC. It is likely that they will adopt it for the next survey effort.

### 3. **Participant and Collaborating Organizations: Who has been involved?**

- **What individuals have worked on the program?**

- PacTrans Director, Yin Hai Wang, Ph.D., Professor of Civil and Environmental Engineering at the University of Washington (UW), devotes 10 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, Linda Ng Boyle, Ph.D., Professor with joint appointments in Industrial and Systems Engineering and 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, professional training program development, and educational enhancements among the partner institutions.
- PacTrans Associate Director in Outreach, Mark Hallenbeck is also the Director of the Washington State Transportation Center (TRAC) office located at the UW. Mr. Hallenbeck works closely with Associate Director Anne Vernez-Moudon in organizing student seminars, internships and fellowship programs.
- PacTrans Associate Director in Oregon State University (OSU), Chris Bell, 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 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 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 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 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 on a regular basis.

- PacTrans Associate Director in Washington State University (WSU), Ken Casavant, Ph.D., Professor and Transportation Economist in the School of Economic Sciences at Washington State University (WSU) and Director of WSU's Freight Policy Transportation Institute, 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 on a regular basis.
- From January to April 2015, Assistant Director, Ms. Maria Bayya, devoted 10 percent of her time to the day-to-day operations in support of the PacTrans mission. Her responsibilities include project management, grant management, events coordination and outreach, and managing the PacTrans operations team.
- PacTrans full-time Program Coordinator, Ms. Melanie Paredes, devoted 10 percent of her time to the Center's fiscal matters, support with events coordination and outreach and day to day administrative tasks.
- Cole Kopca has been PacTrans Communications Manager since December 2015. Ten percent of his time is devoted in managing and coordinating all aspects of PacTrans publications which include newsletters, website content and annual reports.
- Weibin Zhang, Ph.D., Research Associate in the PacTrans STAR Lab at the University of Washington, devotes 30% of his time in providing research support and oversight of PacTrans consortium and center projects which include multi institution and small center projects.
- Graduate Student Assistant devotes 10 percent to assist with facilitating and coordinating seminars, workshops and events.
- The Student Leadership Council, composed of graduate students at all Consortium partner universities, is an active part of the PacTrans management structure. The Student Leadership Council facilitates student and center communications and plans their own activities.
- Additionally, PacTrans has 26 fulltime faculty at the UW engaged in transportation research. Our consortium partners (OSU, UI, WSU, UAF) have 39 fulltime faculty directly involved in PacTrans research.
  - **What other organizations have been involved as partners?**

The table below highlights the many partnerships that PacTrans has built over the duration of this grant:

Partner	Type	Fund Match		Serve on EAB	Project Collaborator	Event Collaborator
		Financial	In Kind			
Alaska State Department of Transportation	Government	X		X		
Idaho State Department of Transportation	Government			X		
Oregon State Department of Transportation	Government	X		X		
Washington State Department of Transportation	Government	X		X		
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					
Washington Traffic Safety Commission	Government Agency					
Washington State Transportation Insurance Pool	Government Agency					
University of Alaska, Anchorage	Educational Institution				X	
Washington State Department of Ecology	Government	X				
Puget Sound Regional Council	Government			X		
Washington State 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					
Port of Portland	Government			X		
BMW Group	Private Industry			X		
Western Trailers	Private Industry			X		
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				X	
Cascade Bicycle Club	Non-profit/Foundation					
Feet First	Non-profit/Foundation					
DKS Associates	Private Industry					X
Fehr and Peers	Private Industry					
Inrix Inc.	Private Industry					
Transpo Group	Private Industry					X
Intelligent Transportation Systems of Washington	Professional Association					X
Luum	Private Industry					
Kittelson and Associates	Private Industry			X		
Microsoft	Private Industry				X	
West Salem High School	Educational Institution					

**4. Impact**

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

Impacts from PacTrans-funded activities on the development of the principal disciplines to our transportation program has been observed:

1) *New data collection methods and tools*: It has been challenging and costly to collect pedestrian and bicycle volume and movement data in practice. Manual count is the main source of such data and because of the constraint of available human efforts, the availability of such data is poor. Research products from two PacTrans research projects open new ways for collecting such data.

- Project MG-2013-3 entitled “Data Collection and Spatial Interpolation of Bicycle and Pedestrian Data” produced a mobile sensing technology that makes traveler data collection easy and cost effective. This technology detects and matches Media Access Control (MAC) addresses collected through Bluetooth signals of electronic devices. It was tested on the University of Washington buses and obtained optimistic datasets potentially useful for a variety of transportation and human behavior analyses. This research product was highlighted in several news media, including King 5 TV, Seattle Times, Civil Engineering Magazine, GeekWire, etc.

- Project MG-2012-3 entitled “Performance Monitoring for Safe and Livable Communities: Fusing Data, to Improve Arterial Operations for All Users” developed video software tools for pedestrian and bicycle counting. Follow up developments of the video tools have been applied to near-miss detection and led to a collaborative research effort with Washington State Transit Insurance Pool (WSTIP) supported by a TRB Transit IDEA grant entitled “Active Safety-Collision Warning Pilot in Washington State.” Relevant stories have been reported in Mass Transit, King 5 News, etc.

2) *Advancement in the principles and practices in slope stability*: Landslides pose significant threats to the safety of motorists throughout the mountainous terrain of the Pacific Northwest. PacTrans funded a technology transfer project (PacTrans Technology Transfer Success Stories 2015 #1: Unmanned Aircraft Assesses Landslides) that uses imaging from an unmanned aircraft for landslide safety assessment in transportation corridors. This emerging survey technology is promising for faster and more efficient data collection of slopes along important roadways. One thing worth noting is that Professor Joe Wartman, co-PI of this project, was honored the E.B. Burwell, Jr. Award among the seven authors for their study of the March 2014 landslide in Oso, Washington where 43 people were killed. The Burwell Award is given each year by the Geological Society of America. It is the society’s most esteemed honor for engineering geology. This news was reported by UW Today and several association websites.

- **What is the impact on other disciplines?**

Our center theme focuses on data-driven, sustainable solutions for the diverse transportation needs of the Pacific Northwest. PacTrans activities tie naturally to sustainability and data science domains. Researchers from structure engineering, environmental engineering, electrical engineering, computer science and engineering, public health, public policy, and mathematics are attracted to collaborate with our transportation researchers for a variety of PacTrans activities. The interdisciplinary University of Washington Hyperloop student team is a great example, with approximately 70 students from engineering, computer science, economics, business, etc.

The educational platform developed through the technology transfer project, PacTrans Technology Transfer Success Story 2015 #7: A Digital Platform for Sharing Transportation Education Materials, can be applied not only in the transportation field, but also other fields for various level of educational programs.

Smart transportation technologies, such as the mobile sensing technology mentioned earlier, can be used for data collection in many other fields under the Smart Cities umbrella. Professor Yinhai Wang was invited to talk about this technology at the Gigabit City Summit hosted by Kansas City on May 17 and received very positive feedback from the audience, most of whom, were from other disciplines.

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

PacTrans continues its intern programs with transportation agencies and companies. For example, the PacTrans-WSDOT intern program involves nine undergraduate student interns to help operate ramp meter controls and other traffic management functions. These intern positions are important for



students to understand real-world problems and how the knowledge learned in the universities may be applied to solve problems.

PacTrans researchers were invited to present at several national workshop and webinars that directly contributed to workforce development. For example, Professor Haizhong Wang of OSU presented at an ITS Professional Capacity Building Program/Advancing ITS Education webinar. His presentation focused on network-wide impacts of connected vehicles on mobility: an agent-based modeling approach.

Efforts were also made to support student teams for national competitions. Funding was provided to the UW Hyperloop team, who received a “safety subsystem technical excellence” award, to attend the national competition scheduled in the fall this year. Komo News reported the story of this student team on Feb. 1, 2016. This Hyperloop team comprises of nearly 70 students from a variety of fields. Many other PacTrans-supported student team also performed well in national competitions. For example, the UW National Concrete Canoe team won the 10<sup>th</sup> place in the 2016 national competition and the UAF Steel Bridge took 6<sup>th</sup> place overall at the 2016 National Student Steel Bridge Competition.

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

To facilitate green infrastructure research, PacTrans funded a tech transfer project (PacTrans Technology Transfer Success Story 2015 #4: How Green is your Green Infrastructure? Educational Materials, Web-based Monitoring Portal, and Presentation) for the creation of a Green Storm-water Infrastructure Research Facility for the study of storm-water runoff. This new facility was reported by Oregon Best, Corvallis Gazette-Times, etc.

Another resource added during the reporting period is a digital platform for sharing transportation education materials enabled by a tech transfer project (PacTrans Technology Transfer Success Story 2015 #7: A Digital Platform for Sharing Transportation Education Materials). There are approximately two hundred Introduction to Transportation Engineering courses taught annually in the United States but little evidence to suggest that teaching materials (other than textbooks) are being shared between the instructors of these courses. This platform intends to fill up this gap by offering an easy to use system for course material sharing and experience exchange.

- **What is the impact on technology transfer?**

The Greenroads® Rating System was developed through the Region 10 UTC funds and some other sources of funds. It is an easy way to measure and manage sustainability on transportation projects. To facilitate the technology transfer effort of this technology, PacTrans funded a Greenroads Bootcamp (PacTrans Technology Transfer Success Story 2015 #2: Greenroads Bootcamp). This event attracted over 50 people. Greenroads concept and the certification process were explained to the participants. This is certainly an important step toward sustainable roadway infrastructure design and construction.

In addition, PacTrans hosted a Technology Transfer Session jointly with the Southern Plains Transportation Center at the ASCE International Conference on Transportation and Development in

June, 2016. The session highlighted UTC research and representative products and targeted new partnerships and collaborations. This conference attracted over 300 people who are mainly practitioners and is therefore a great venue for technology transfer efforts.

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

PacTrans director, Dr. Yin Hai Wang, joined John Toone, IT Project Manager at King County Metro, and Tim Streck, Director of Channel Development with INRIX, on January 27, 2016 at a Washington State House of Representatives Transportation Committee Workshop. The purpose was to help the committee understand Intelligent Transportation Systems (ITS) and transportation technologies available today to address the roadway transportation problems.

Furthermore, PacTrans funded a tech transfer project (PacTrans Technology Transfer Success Story 2015 #5: Interactive Tourist Information Sign Website) to help the public understand traffic signs. There is significant interest from organizations like the United Nations and Travel Oregon to use the research results to standardize these signs across counties to help international travelers.

**5. Changes/Problems**

NONE.

**6. Special Reporting Requirements**

NONE.

7.