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

Program Director:
Yinhai Wang, PhD
Professor and Director
E-mail: yinhai@uw.edu
Tel: 206.616.2696

Submitting Official:
Maria Sonia L. Bayya
Assistant Director
E-mail: bayyam@uw.edu
Tel: 206.685.6648

Organization Name:
University of Washington
Pacific Northwest Transportation Consortium (PacTrans)
University of Washington
Civil and Environmental Engineering Department
More Hall 112
Seattle, WA 98195

Submission Date: July 30, 2014
DUNS: 605799469 **EIN:** 91-6001537
Report #5, PPPR reporting for six months (January 1, 2014 – June 30, 2014)

Project/Grant Period: January 01, 2012-January 31, 2016
Reporting Period End Date: June 30, 2014
Report Term: Semi-Annual

Signature of Submitting Official:

1. Accomplishments

- **What are the major goals and objectives of the program?**

PacTrans focuses on using technological advances to develop data-driven, sustainable solutions for the diverse transportation needs of the Pacific Northwest. Major goals and objectives of PacTrans include serving as Region 10's research engine, applied technology showcase, workforce development base, education leader, information center, and collaboration platform.

- **What was accomplished under these goals?**

During the six month period from January 1 – June 30, 2014, we conducted several key activities to ensure our transportation expertise contributes to the advancement of the nation and region's transportation workforce development, education, research, technology transfer, and outreach, including to K-12 audiences.

- As Region 10's research engine, we have completed seven multi-institutional research projects funded for Year 1 (2012-2013) and are now undergoing final report review. Additionally, fifteen small research projects (also referred to as single institutional projects) for Year 1 (2012-2013) were also completed and are currently being posted to the PacTrans Website and distributed to the different repositories. Below is a list of the multi-institutional projects for Year 1:

    1) Education: Refinement and Dissemination of a Digital Platform for Sharing Transportation Education Materials Phase II
    2) Outreach: Educating Teenage Drivers in the Pacific Northwest Regarding the Dangers of Distracted Driving Phase II
    3) Behavior of Drilled Shafts with High-Strength Reinforcement and Casing
    4) A Platform for Proactive Risk-Based Slope Asset Management Phase II
    5) Data Collection and Spatial Interpolation of Bicycle and Pedestrian Data
    6) High Performance Bridge Systems for Lifeline Corridors in the Pacific Northwest
    7) Performance-Measure Based Asset Management Tool for Rural Freight Mobility in the Pacific Northwest

    The fifteen small research projects of Year 1 (2012-2013) are:

    1) Meeting the Demands of Modern Grade Separation and Earth Retention: Characterization of Frictional Interference in Closely-Spaced Reinforcements in MSE Walls
    2) Rendering of Dense, Point Cloud Data in a High Fidelity Driving Simulator
    3) Use of Blended Synthetic Fibers to Reduce Cracking Risk in High Performance Concrete
    4) Estimating Future Flood Frequency and Magnitude in Basins Affected by Glacier Wastage
    5) Phase II Structural Health Monitoring and Condition Assessment of Chulitna River Bridge

6) Investigation of High-Mast Light Pole Anchor Bolts
7) Production of Renewable Diesel Fuel from Biologically Based Feedstocks
8) Second Generation Accessible Pedestrian Systems
9) SSI Bridge: Evaluation of Soil-Structure Interaction Effects of PNW Bridges
10) Developing a Robust Survey Methodology for Collecting Information on the Port Truck Drayage Industry
11) Error Assessment of Traffic Data Devices
12) Bicycle Route Choice: GPS Data Collection and Travel Model Development
13) Near-Road NO2 Monitors
14) Media Filter Drain: Modified Design Evaluation
15) Recycle Concrete Aggregate for PCCP

- Our Year 2 (2013-2014) multi-institutional and small research projects are still ongoing. Solid progress has been made following the approved research plans. The seven multi-institutional projects are:
    1) Behavior of Drilled Shafts with High-Strength Reinforcement and Casing
    2) Educating Teenage Drivers in the Pacific Northwest Regarding the Dangers of Distracted Driving Phase II
    3) Performance-Measure Based Asset Management Tool for Rural Freight Mobility in the Pacific Northwest
    4) Refinement and Dissemination of a Digital Platform for Sharing Transportation Education Materials
    5) A Platform for Proactive Risk-based Slope Asset Management Phase II
    6) High Performance Bridge Systems for Lifeline Corridors in the Pacific Northwest
    7) Data Collection and Spatial Interpolation of Bicycle and Pedestrian Data

  Year 2 small research projects have also been selected and are making progress as expected. A complete list of Year 1 small research projects are as follows:
    1) Changing Retail Business Models and the Impact on CO2 Emissions from Transport: E-commerce Deliveries in Urban and Rural Areas
    2) SSI Bridge 2: Evaluation of Soil Structure Interaction Effects on PNW Bridges
    3) Evaluate H2RI Wicking Fabric for Pavement Applications
    4) Improving Performance, Knowledge, and Methods to Provide Quality Service and Products
    5) Evaluation of Existing and Alternative Information Signs in Oregon
    6) A Framework for Improved Safety and Accessibility through Pedestrian Guidance and Navigation
    7) NDE System for Determining Wood Guardrail Post Integrity
    8) Field Validation of Recycled Concrete Fines Usage
    9) The Value of Depressed Medians on Divided Highways in Alaska
    10) Development of a Durable Asphalt Mix for Eastern Washington and Mountain Passes

11) Geospatial Analysis of Bicycle Network "Level of Stress", Bicycle Crashes and the Geo-coded Pavement Conditions for Risk Factors Identification
12) Assessing the Capacity of the Pacific Northwest as an Intermodal Freight Transportation Hub
13) Investigating the Feasibility of Using QR (Quick Response) Codes for Construction Document Control in Highway Construction
14) Identifying and Analyzing the Relative Advantages and Disadvantages of Public-Private Partnerships and Traditional Delivery for Roadway Projects
15) Evaluate Presawn Transverse Thermal Cracks for Asphalt Concrete Pavement
16) Encouraging Young Civil Engineers: Support for the UAF College of Engineering and Mines Steel Bridge Team Competition Steel Bridge
17) Assessment of Lube Oil Management and Self-Cleaning Oil Filter Feasibility in WSF (WA State Ferries) Vessels
18) Improving Sustainability of Urban Streets via Rain Gardens – How Effective Are These Practices in the Pacific Northwest?
19) Modeling Passing Behavior on Two-Lane Rural Highways: Evaluating Crash Risk under Different Geometric Condition
20) Roundabout Design Training for Alaska's Engineers
21) Development of Improved Corrosion Inspection Procedures for Reinforced Concrete Bridges
22) Smartphone-Based System for Automated Detection of Walking
23) Enhancing the Resilience of Idaho's Transportation Network to Natural Hazards and Climate Change
24) Testing of Cavity Attenuation Phase Shift Technology For Siting Near-Road NO2 Monitors
25) Traffic Sensor Testing Phase II

- In addition to research projects, PacTrans also funds education, outreach, and workforce development activities at both the center level and the consortium institution level. For example, at the University of Idaho, PacTrans funds undergraduate student interns and activities for a student competition team, "Flex-Fuel Clean Snowmobile." With PacTrans' support, the Clean Snowmobile Team achieved third place in the SAE Clean Snowmobile Challenge in March 2014 while winning awards for Best Performance, Best Design, Best Ride, and Best Handling. The Clean Snowmobile team continues to create new technology for a cleaner, quieter and more fuel efficient snowmobile, with several patents as a result. This technology is needed to support the winter economy in rural areas of the inland Northwest and Alaska, and has shown that it is possible to maintain environmental excellence in pristine areas while permitting winter motorized recreation.

- The PacTrans-sponsored internship programs at the University of Idaho involve undergraduate students in research and help to both retain undergraduates and recruit the best graduate students. Accomplishments with the ongoing Development of Curriculum Material for this internship program include:

a. A detailed (12 page) outline and summary covering the goals, objectives, and learning outcomes that the curriculum materials will address. This outline and summary has been reviewed by two collaborators, Dr. Anuj Sharma and Dr. Tom Urbanik, to ensure its quality.
b. A detailed first draft (32 pages) of the chapter on traffic flow on arterials has been completed, with readings and student activities.
c. Work has started on the draft of another chapter, time space diagrams and concepts.

- Progress has also been made with the Oregon State University (OSU) led "Refinement and Dissemination of a Digital Platform for Sharing Transportation Education Materials" project that aims at developing a prototype website, www.educational-resources-pactrans.org, as the PacTrans Transportation Education Resource Center for sharing transportation resources and best practices. The objectives of this educational research include:
  a. To make further refinements to the digital platform website www.educational-resources-pactrans.org and make it suitable for widespread dissemination of educational materials.
  b. To conduct continuous strategic action-research to optimize the adoptability of the site both before and after launch to the transportation engineering community.
  c. To upload at least 300 transportation learning activities to the site prior to launch.

- As a part of the educational research effort, the University of Alaska Fairbanks (UAF) offers new modalities of instruction to faculty and evaluating their adoption. This has resulted in one short course offered to students preparing for the FE exam. The instructor received training in use of the Blackboard Collaboration tool and prepared an online lesson for students. The students took the lesson online, and then in the "flip classroom mode," did a brief session with the instructor; they then took the FE exam. Later the students took a poll on their reactions to the flip class, and their responses indicated the instructional method was successful. The instructor prepared a set of lessons-learned of his own experiences, which will be combined with similar reactions from other faculty.

- PacTrans funded a workforce development project at UAF: Roundabout Design Training for Alaska Engineers. The objective during this period of the project was to coordinate and develop lecture, workshop, and hands-on design demonstration materials in accordance with the needs of future and practicing engineers in Alaska. During this time period, planning for the seminar/workshops also began in conjunction with GHD Engineering who will administer a portion of the training. This workshop has also been approved as a special topics course to be offered through the UAF Civil Engineering Department for Fall 2014.

- PacTrans hosted a reception during the 2014 TRB Annual Meeting to facilitate collaborations among Region 10 transportation professionals. The event attracted over 300 people to attend, including scholars from Israel, Europe, Japan, and China who showed interest to collaborate with PacTrans.

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

The following training and professional development opportunities have been provided and were well attended not only by students but also transportation faculty, working professionals, and the general public:

1. "School Siting and Children's Travel" by Ruth L. Steiner, Ph.D., February 5, 2014. Dr. Ruth Steiner, a professor and director of the Center of Health and the Built Environment in the Department of Urban and Regional Planning, University of Florida Transportation Institute, presented her research at the PacTrans Seminar Series.
2. The Institute of Transportation Engineers (ITE) Washington Safety Meeting, which presented a talk on "Target Zero" by Chris Madill and Matt Neely on May 16, to help increase awareness of Washington State's goals for reducing traffic fatalities and information on the cutting-edge accident analysis techniques that will help us achieve those objectives. This was attended by an audience of researchers, transportation professionals, students and public agencies such as the City of Bellevue, Federal Way, Snohomish County, and private organizations such as Transpo Group, Traffic Data Gathering as well as other private consultants.
3. "An Introduction to the NACTO Urban Street Design-Changing the DNA of City Streets" by Peter Koonce, Ph.D., April 11, 2014. Dr. Koonce is the chair of the TRB Traffic Signal Systems Committee (AHB25). Peter Koonce, P.E., manages the traffic signals, street lighting for the City of Portland. He shared his understanding and practical experience with the graduate seminar participants at the University of Washington.
4. On May 2, Jeff Busby, Senior Manager, Project Development at TransLink in Vancouver, BC, came and talked to the University of Washington transportation graduate students at the graduate transportation seminar. He gave a very interesting talk about how areas in metro Vancouver are using transit stations to stimulate better development and the relationship between development and transportation infrastructure.
5. Demand Uncertainty and Optimism in Planning Forecasts by Stephen Boyles, Ph.D., May 16, 2014. Dr. Stephen Boyles from the University of Texas at Austin gave a talk to transportation students and faculty at a PacTrans-sponsored transportation seminar on May 16 about uncertainty in travel demand forecasts.
6. 2014 Spring PacTrans Regional Seminar wherein we invited Professor Joe Schofer who presented a talk on "Making Transportation Analysis Count: Bridging the gap between politics and planning" on May 30, 2014. Dr. Schofer is a Professor of Civil and Environmental Engineering and Associate Dean for Faculty Affairs of the Robert R. McCormick School of Engineering and Applied Science at Northwestern University. He is the 2011 recipient of TRB's Roy Crum Award for outstanding achievement in transportation research, and he presented TRB's Thomas B. Deen Distinguished Lectureship in 2014. The presentation and webinar is currently posted online at our PacTrans website (http://depts.washington.edu/pactrans/category/events/pactrans-seminar-series/).
7. Multiple undergraduate students including Benjamin Wright, Kevin Yan, Bryan Lee, etc. were offered intern opportunities at the PacTrans STAR Lab so that they can participate in research and develop their professional skills.

8. The intern program between PacTrans and WSDOT continued to offer great training opportunities for undergraduate students. More than ten students benefit from this program each year.
9. PacTrans has brought new regional industry (e.g. Transpo) and transportation agency partners (e.g. Seattle DOT) to join our intern programs. Almost every graduate student who chose to work on the non-thesis option has an intern job at the University of Washington (UW). For example, Darwin Li with Kirkland based Transpo Group, Joseph Flood with the Puget Sound Regional Council (PSRC), Luka Ukranczyk, Toll Division of the Washington Department of Transportation, and Arianna Allahyar with Parsons Brinckerhoff.
10. Our PacTrans Fellowship program continues to attract top-notch students to join our graduate program. Four new Pactrans Fellows have confirmed to come to the UW as PacTrans Fellows:
    - Ryan Hughes, St. Louis University
    - Jackson Lester, Tulane University
    - Kelly L Fearon, University of Delaware
    - Michael Corwin, North Carolina State University
11. PacTrans named and presented two outstanding students at the January 2014 TRB Conference. TRB honored Andrew Hooper, a University of Idaho graduate student, with PacTrans Student of the Year (SOY) award. Jonathan Corey from the University of Washington received the Michael Kyte Region 10 Outstanding Student Award.
12. PacTrans also helped fund Alaska Summer Research Academy (ASRA). 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.

- **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 have also participated and presented our research at the following events and were also captured and reported in our website at www.pactrans.org:

1. The University of Washington Paws-On Science Weekend held at the Pacific Science Center in Seattle, from April 4-6, 2014. PacTrans was among more than 30 research groups from the UW who shared their research at the annual Paws on Science weekend at the Pacific Science Center this year, from April 4-6, 2014. More than 30,000 people attended this event.
2. Over 30 student authors received PacTrans travel support to participate in the 2014 Transportation Research Board Annual Meeting to present their papers. Over 80 papers were presented by PacTrans researchers.
3. PacTrans researchers published 147 academic articles and made 163 invited talks or presentations to disseminate research findings. Particularly,

a. Professor Yinhai Wang delivered a talk on "Big Data, big Discoveries, and Big Decisions: Challenges and Opportunities for Transportation Professionals" at the USDOT OST-R Transportation Innovation Series on Feb. 19, 2014.
b. David Hoisington and Scott Hamel of UAF delivered a talk on "Investigation of an Anchor Nut Loosening Phenomenon in High-Mast Lighting Poles" at a research seminar conducted to outline and determine the cause of the anchor nut loosening phenomenon.
c. Mike Lowry of the University of Idaho presented his PacTrans funded research on "GIS Tools for Bicycle Network Analysis and Planning" at the Portland State University on May 30, 2014. This presentation showcased various GIS tools developed for bicycle network analysis and planning. The showcase included a tool for assessing community-wide bikeability, a tool for forecasting bicycle volumes based on street topology, and a tool for evaluating different bicycle improvement plans in terms of exposure to dangerous situations for bicyclists.

4. University of Washington Engineering Discovery Days, a two-day event held from April 25-26, 2014. Multiple transportation research products, including Kinect-based pedestrian detection system, Digital Roadway Interactive Visualization and Evaluation Network (DRIVE Net), etc. were demonstrated to visitors.
5. Undergraduate Research Symposium at the UW Mary Gates Hall, May 16, 2014. PacTrans STAR Lab intern Benjamin Wright received a Mary Gates fellowship award and was invited to present his work on travel time reliability at this prestigious research event for undergraduate students.
6. PacTrans also sponsored the Women's Transportation Seminar (WTS) Annual Conference in Portland, Oregon from May 14-16, 2014. OSU students participated in this conference and presented their research findings.

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

PacTrans will continue to follow its implementation plan to ensure that all PacTrans funded research, education, and outreach activities move forward as scheduled. Specifically, the following events have been planned for the ensuing months and endeavors mapped to meet our goals.

- External Advisory Board Meeting at the University of Washington on October 16, 2014
- Regional Professional Conference planned for October 17, 2014 to showcase research and technology
- Regional Student Conference on October 18, 2014 to facilitate student networking and collaborations across institutions in Region 10
- PacTrans will continue to host regional workshops on transportation research to identify transportation issues of regional importance

- PacTrans will continue to work with our technology transfer committee to identify research products with potential for technology transfer and intellectual property from Year 1 and Year 2 research
- PacTrans will continue to enhance the PacTrans website to include additional information about our projects and research findings, and future research opportunities.
- PacTrans Regional Transportation Seminar series and other PacTrans sponsored seminar and conference events will continue to attract top level speakers to deliver cutting edge research and practical engineering solutions to our audience.
- Our project on digital dissemination platform of transportation engineering education materials is expected to have a substantial impact on the effectiveness of transportation teaching methods by providing easy access to a diverse set of materials and that it will make the course refinement and development process much more efficient for faculty. The system will be usable by the summer of 2014.

2. Products (for the reporting period of January 1 – June 30, 2014)

	PacTrans Total	UW	WSU	UI	OSU	UAF
Publications: peer reviewed journal articles	**110**	**58**	**18**	**0**	**34**	**0**
Publications: Book chapters and other edited manuscripts	**12**	**11**	**1**	**0**	**0**	**0**
Conference papers	**37**	**26**	**10**	**1**	**0**	**0**
Conference presentations	**95**	**58**	**10**	**1**	**24**	**2**
Lectures/Seminars /Workshops/ Invited Talks	**68**	**31**	**6**	**2**	**27**	**2**
Inventions, patent applications, and/or licenses	**3**	**0**	**0**	**3**	**0**	**0**
Other products: data or databases, physical collections, audio or video products, software or NetWare, models, educational aids or curricula, instruments, or equipment	**8**	**7**	**1**	**0**	**0**	**0**

- **Examples of peer reviewed journal articles**

1) Hou, L., Lao, Y., Wang, Y., Zhang, Z., Zhang, Y., & Li, Z (2014). Exploring Time-Varying Effects of Influential Factors on Incident Clearance Time Using a Non-Proportional Hazard-based Model. *Transportation Research Part A*. In Press.
2) Ma, X. & Wang, Y. (2014). Development of A Data-driven Platform for Transit Performance Measures Using Smart Card Data and GPS Data. *Journal of Transportation Engineering*. In Press.
3) Tang, J., Wang, H., Wang, Y., Liu, X. & Liu, F. (2014). Hybrid Predicting Approach Based on Weekly Similarity for Traffic Flow at Different Temporal Scales. *Transportation Research Record*. In Press.
4) Wang, H., Quan, W., Wang, Y., & Miller, G.R. (2014). Dual Roadside Seismic Sensor for Moving Road Vehicle Detection and Characterization. *Sensors*, *14*(2), 2892-2910. http://dx.doi.org/10.3390/s140202892.
5) Lao, Y., Zhang, G., Wang, Y., & Milton, J. (2014). Generalized Nonlinear Models for Rear-End Crash Risk Analysis. *Accident Analysis and Prevention*.,*62*. http://dx.doi.org/10.1016/j.aap.2013.09.004.
6) Wang, Y., Ma, X., Lao, Y., Wang, Y., & Mao, H. (2014). A Fuzzy-based Customer Clustering Approach with Hierarchical Structure for Logistics Network Optimization. *Expert Systems with Applications*, *41*(2), 521-534,http://dx.doi.org/10.1016/j.eswa.2013.07.078.
7) Hurwitz, D., Monsere, C., Marnell, P., & Paulsen, K. (Accepted 2/1/14). Three- or Four-Section Displays for Permissive Left-Turns? Some Evidence from Simulator-Based Analysis of Driver Performance. *Transportation Research Record: Journal of the Transportation Research Board* (Paper 14-0547).
8) Wang, H., Li, Z., & Hurwitz, D. (2014). Empirical Modeling of the Heteroscedastic Traffic Speed Variance from Loop Detector Data. *Journal of Advanced Transportation*. In Press.
9) Hurwitz, D., Brown, S., Islam, M., Daratha, K., & Kyte, M. (2014). Traffic Signal System Misconceptions across Three Cohorts: Novice Students, Expert Students, and Practicing Engineers. *Transportation Research Record: Journal of the Transportation Research Board (Paper 14-2234).* In Press.
10) Hurwitz, D., Swake, J., Brown, S., Young, R., Heaslip, K., Sanford Bernhardt, K., & Turochy, R. (2014). Influence of Collaborative Curriculum Design on Educational Beliefs, Curriculum Development Networks, and Classroom Practice in Transportation Engineering Education. *American Society of Civil Engineers: Journal of Professional Issues in Engineering Education and Practice*.,*140*(3).
11) Wen, H. & Li, X. (2014). Selection of Preoverlay Repair Methods for Asphalt Overlay on Asphaltic and Composite Pavements in Wisconsin. Paper accepted for publication at *ASCE Journal of Transportations Engineering*. In Press.
12) Li, X., Wen, H., & Muhunthan, B. (2014). Modeling of the Drying properties of Soils and Cementitiously Stabilized Soils. *Transportation Research Records*. In Press.
13) Li, X. & Wen H. (2014). Effects of the Preoverlay Pavement Conditions and Preoverlay Repair Methods on the Performance of Asphaltic Concrete Overlay. *ASCE Journal of Transportation Engineering*, *140*(1), 42-49.
14) Alam, M.A., Haselbach, L., & Cofer, W. (2014). Three-Dimensional Finite Element Modeling and Analysis of Pervious Concrete Pavement: Vertical Porosity Distribution Approach, *IJERT, 2*(12).
15) Haselbach, L. & Thomas, A. (2014). Carbon Sequestration in Concrete Sidewalk Samples. *Construction and Building Materials*, *54*, 47-52.
16) Haselbach, L., Borden, R., & Gueneron, M. (2014). A Method to Estimate Carbon Dioxide Sequestration in Concrete Pavement Interiors. *ASTM ACEM 3*(1).
17) Haselbach, L., Poor, C., and Tilson, J. (2014). Dissolved Zinc and Copper Retention from Stormwater Runoff in Ordinary Portland Cement Pervious Concrete. *Construction and Building Materials,* 53C, 652-657.

18) Liu, Q.H., Qiao, P.Z., & Guo X.W. (2014). Buckling Analysis of Restrained Ortbotropic Plates under Combined In-plan Shear and Axial Loads and its Application to Web Local Buckling. *Composite Structures*, *111*(5), 540-552.
19) Chen, Q.Y., & Qiao, P.Z. (2014). Post-buckling Analysis of Composite Plates under Combined Compression and Shear Loading Using Finite Strip Method. *Finite Elements in Analysis and Design*, *8'3*(6), 33-42.
20) Zeng, L., Chen, J.J., Qiao, P.Z., & Wang, J.H., (2014). Analysis and Remedial Treatment of a Steel Pipe-jacking Accident in Complex Underground Environment. *Engineering Structures*, *58*, 210-219.

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

1) Wang, Y., Araghi, B.N., Malinovskiy, Y., Corey, J., & Cheng, T. (2014). Error Assessment for Emerging Traffic Data Collection Devices. Final Research Report. Washington State Department of Transportation and Pacific Northwest Transportation Consortium (PacTrans).
2) Wang, Y., Nisbet, J., Bremmer, D., Zou, Y., Zhu, W., Dunlap, M., Wright, B., Yan, S., & Murshed, D. Pilot Testing of SHRP 2 Reliability Data and Analytical Products. Research report for SHRP 2 L38D.

- **Examples of conference papers**

1) Islam, M., Hurwitz, D., & Brown, S. (2014*).* Identifying Traffic Signal System Misconceptions of Students and Practicing Engineers to Develop a Traffic Signal Concept Inventory. 121th ASEE Annual Conference & Exposition Conference Compendium.
2) Jannat, M., Hurwitz, D., & Brown, S. (2014). Promoting the Adoption of Innovative Teaching Practices by Transportation Engineering Faculty in a Workshop. 121th ASEE Annual Conference & Exposition Conference Compendium.
3) Dong, S., Wang, H., & Hurwitz, D. (2014). Vehicle-type Specific Headway Distribution in Freeway Work Zone: A Nonparametric Approach. Transportation Research Board Annual Meeting Compendium (Paper 14-4355).
4) Savage, D., Green, C., DenBraven, K., & Cordon, D. (2014, March). University of Idaho's Reduced Speed Isobutanol Flex Fuel Direct-Injected 797cc Two-Stroke Snowmobile. SAE Clean Snowmobile Challenge. 2nd place paper in the competition.
5) Poor, C. & Haselbach, L. (2014, February). Media Filter Drain: Modified Design Evaluation and Existing Design Longevity Evaluation. Washington State DOT and PacTRANS.
6) Thompson, M., Haselbach, L., & Poor, C. (2014, January). A Stormwater Treatment Strategy for Port Pavement Runoff Proceedings, Transportation Research Board Annual Meeting.
7) Bower N., Wen H., Wu E., & Willoughby K. (2014). Evaluation of the Performance of Warm Mix Asphalt in Washington State. Paper presented at 2014 Transportation Research Board Meeting, Washington, D.C.
8) Wen H., Zhang K., & Hobbs A. (2014, June). Simulation of Drying of Aggregates in Asphalt Plant based on Computation Fluid Dynamics and Discrete Element Method. Paper presented at the 2014 International Society of Asphalt Pavement, Raleigh, North Carolina.
9) Rose, M., Wen, H., & Sharma, S. (2014). Evaluation of Non-Nuclear Density Gauges for Measuring In-Place Density of Soils and Base Materials. Paper presented at 2014 Transportation Research Board Meeting, Washington, DC.
10) Wu, S., Zhang, K., Wen, H., DeVol, J., & Kelsey, K. (2014). Performance Evaluation of Hot Mix Asphalt Containing Recycled Asphalt Shingles in Washington State. Paper presented at 2014 Transportation Research Board Meeting, Washington, D.C,.

11) Zhou, Y., Sage, J., Casavant, K., & Eustice, J.B. (2014). Apples, Hay, and French Fries, Oh My!: Developing a Commodity Flow Framework on Washington's Highways. Paper presented at 2014 Western Economic Association International (in concert with the Transportation and Public Utilities Group), Denver, CO,.
12) Sage, J., Casavant, K, Eustice, J.B., & Zhou, Y. (2014). The search for commodity flow data: Just stop and ask them. Paper presented at 2014 Transportation Research Forum, San Jose, CA.

- **Examples of conference presentations**

1) Savage, D., Green, C., DenBraven, K., & Cordon, D. (2014, March). *University of Idaho's Reduced Speed Isobutanol Flex Fuel Direct-Injected 797cc Two-Stroke Snowmobile*. SAE Clean Snowmobile Challenge.2nd place presentation in the competition.
2) Chen, X., Henrickson, K. & Wang, Y. (2014, June). *Kinect-based Pedestrian Detection for Crowded Scenes* To be presented by **Yinhai Wang** at North America Travel Monitoring Exposition and Conference (NATMEC) 2014, Chicago, IL..
3) Xiao, S., & Wang, Y. (2014, June). *Data-Driven Geospatial-Enabled Transportation Platform for Freeway Performance Analysis.* To be presented by **Yinhai Wang** at North America Travel Monitoring Exposition and Conference (NATMEC) 2014, Chicago, IL.
4) Henrickson, K., Malinovskiy, Y., & Wang, Y. (2014, June). *Opportunistic GPS Location and MAC Address Sensing for Pedestrian Data Collection.* To be presented by **Yinhai Wang** at North America Travel Monitoring Exposition and Conference (NATMEC) 2014. Chicago, IL.
5) Xiao, S., & Wang, Y. (2014, May). *Data-Driven Geospatial-Enabled Transportation Platform for WSDOT Operational Analysis.* To be presented by **Yinhai Wang** at 2014 AASHTO Subcommittee on Information Systems Annual Conference. Bismarck, North Dakota.
6) Corey, J., Lao, Y., & Wang, Y. (2014, January). *Applicability of Conditional Left Turn Phase Reservice Strategies*. Presented by **Jonathan Corey** at the 93rd Annual Meeting of Transportation Research Board.
7) Xiao, S., Liu, X., & Wang, Y. (2014, January). *Data-Driven Geospatial-Enabled Transportation Platform for Freeway Performance Analysis*. Presented by **Sa Xiao** at the 93rd Annual Meeting of Transportation Research Board.
8) Wang, Y., Ma, X., Lao, Y., Xu, M., & Wang, Y. (2014, January). *A Fuzzy Customer Clustering Algorithm for Optimizing Hierarchical Logistics Network Structure.* Presented by **Yong Wang** at the 93rd Annual Meeting of Transportation Research Board.
9) Dunlap, M., Zhang, G., & Wang, Y. (2014, January). *Bicyclists' Sensitivity to Weather in an Arid Climate*. Presented by **Matthew Dunlap** at the 93rd Annual Meeting of Transportation Research Board.
10) Zhang, S., Wang, H., Wang, Y., & Liu, X. (2014, January). *Analysis of Weather-Lagged Effects on Freeway Free-Flow Characteristics in Jilin, China*. Presented by **Shen Zhang** at the 93rd Annual Meeting of Transportation Research Board.

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

1) Scott Hamel & David Hoisington presented a 1-hr pdh-eligible seminar on High-mast Light Poles as part of the College of Engineering's weekly professional seminar series. Approx. 70 in attendance

2) Sage, J., Casavant, K., Miller, A., Maxwell, J. (2014, March). *Freight Asset Management: Threshold and Viability Analyses of Freight Multi-Modal Facilities*. Presented at the Transportation Research Forum Annual Meetings. San Jose, California.
3) Wang, Y. (2014, February 19). *Big Data to Big Discoveries and Big Decisions: Challenges and Opportunities for Transportation Professionals*. Presented at the *RITA Transportation Innovation Series*. Washington, D.C.
4) Sage, J., Casavant, K., Zhou, Y., Eustice, J.B. (2014, March). *The Search for Commodity Flow Data: Just Stop and Ask Them*. Presented at the Transportation Research Forum Annual Meetings. San Jose, California.
5) Wang, Y. (2014, March 28). *Mining Big Data for Big Transportation Decisions and Discoveries: E-Science of Transportation Approach and Its Supporting Platform*. Hong Kong Society for Transportation Studies.
6) Wang, Y. (2014, March 26). *Traffic Accident Modeling: From Black-Box Regression to Mechanism-Based Approach*. Hong Kong University of Science and Technology.
7) Wang, Y. (2014, February 14). *Linking Big Data to Big Discoveries and Big Decisions: DRIVE Net Platform*. UC Irvine.

- **Examples of technologies or techniques**

1) Methods of modifying a direct-injection two-stroke snowmobile for flex fuel gasoline/ethanol operation using the OEM engine controller, University of Idaho.

2) Methods of modifying a direct-injection two-stroke snowmobile for flex fuel gasoline/isobutanol operation using the OEM engine controller, University of Idaho.

3) Quarter-wave resonator as a means of sound abatement in the exhaust system, University of Idaho.

4) A stress wave technique was developed that provides repeated transit time measurements using solenoid-initiated impacts. The technique minimizes variability in stress wave measurements and is a positive step towards developing a robust, reliable nondestructive technique for evaluating the condition of timber guardrail posts.

- **Scheduled known academic talks for upcoming reporting period (July 1-December 31, 2014)**

1) Wang, Y. (2014, October 24). *Measure Highway Safety Performance Using Regional Map-based Data Fusion*. Center for Advanced Transportation Education and Research (CATER).
2) Wang, Y. (2014, July 25). *From Data Poor to Data Rich: New Challenges and Opportunities for Transportation Professionals*. Keynote speech at the 10th China-Japan Joint Symposium on Transportation: Transportation in the Era of Big Data.
3) Wang, Y. (2014, July 15). *Creating a New Pedestrian and Bicyclist Data Stream through Big Data Mining*. Research Institute of Highway, China Ministry of Transportation.
4) Wang, Y. (2014, July 11). *Big Data to Big Discoveries and Big Decisions: Challenges, Opportunities, and Actions for Transportation Professionals*. Shanghai Jiaotong University.
5) Wang, Y. (2014, July 8). *Modeling Animal–Vehicle Collisions Considering Animal–Vehicle Interactions*. Tongji University Transportation Safety Workshop.

6) Wang, Y. (2014, July 6). *Advanced Methods for Pedestrian and Bicyclist Sensing*.. CICTP 2014 Plenary Session.

3. 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 University of Washington (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, Linda Ng Boyle, Ph.D., Professor with joint appointments in Industrial and Systems Engineering and 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, 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 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. Ahmed came aboard on March 2014, replacing Dr. Karen Den Braven who retired in February 2014.

- 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 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.

- From January to February 2014, Assistant Director, Ms. Meghan MacKrell, devoted 100 percent of her time to the day-to-day operations in support of the PacTrans mission. Her responsibilities include project management, grant management, social media and outreach, and managing the PacTrans operations team.

- For the month of January 2014, PacTrans full-time Fiscal Specialist, Ms. Eva Lu, devoted 100% of her time to the Center's fiscal matters and research projects. She's moved on to a new position at a department within the University of Washington.

- Graduate Student Assistant Joseph Flood devotes 50 percent of his time to assist with facilitating and coordinating seminars, workshops and events.

  From March to May 2014, Maria Bayya devoted 100 percent of her time filling in as Interim Assistant Director with responsibilities of grant management, project management and oversight of the PacTrans operations team. In June 2014 she was hired as the new Assistant Director.

- 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. For example, one important student event on the PacTrans schedule is the Region 10 Student Conference, to be held on the UW campus October 18, 2014. Leaders of the four UTCs in this region – PacTrans, the National Institution for Transportation and Communities (NITC), Center for Environmentally Sustainable Transportation in Cold Climates (CESTiCC), and Transportation for Livability by Integrating Vehicles and the Environment (TranLIVE) –all are expected to assist in the sponsorship of this conference.

- 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 state transportation agencies in Alaska, Idaho, Oregon, and Washington have all been extensively involved in PacTrans in terms of research, outreach, and technology transfer activities. Their research office directors are members of our PacTrans External Advisory Board (EAB), which provides strategic oversight to the PacTrans Board of Directors. In addition to the state DOTs, many other public transportation agencies and private companies are also actively involved in PacTrans activities. We have interactions and have partnered with City of Bellingham, City of Seattle, City of Lynnwood, City of Bellevue, City of Everett, King County, Snohomish County, Washington Traffic Safety Commission, Puget Sound Regional Council (PSRC), Washington Transportation Investment Board, and Institute of Transportation Engineers.

The PacTrans EAB provides strategic guidance to the PacTrans Board of Directors. In addition to state DOT members on the PacTrans EAB, membership includes a representative from Toyota Corporate, Port of Portland, PSRC, as well as a representative from Idaho industry, Western Trailers.

PacTrans also collaborates with Portland State University's UTC (NITC), University of Idaho's TranLIVE, and UAF's CESTiCC on various Region 10 events.

PacTrans will work with Innova for various research projects that use the four fully instrumented electric cars awarded to the UW in a recent award. Intel will also collaborate with PacTrans researchers on a smart parking initiative. Metriguard is an industrial collaborator on a PacTrans funded project about guardrail. Metriguard, located in Pullman, WA, was started by two WSU faculty over 40 years ago, and it leads the world in nondestructive testing equipment for grading lumber, veneer and field evaluation of wood materials.

4. Impact

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

The impact to our transportation program has been quite substantial and reaches across our education program, our collaboration with others in the region, and the research projects being worked on across the region, which has outcomes of national importance.

Specifically, the following impact has been observed:

– Collaborative research teams have been working on the multi-institutional research projects through solid collaborations. As transportation agencies of multiple states are involved in these research efforts and work closely with our faculty and students, each participating institution can learn from each other in enhancing its education curriculums with a clear understanding of the needs from our region.

- Our new research efforts produced interesting results that can be new course materials and lead to new research directions. Particularly, we developed a method for estimating pedestrian volume over a roadway network based on limited count data. This method may offer a new and cost-effective means for pedestrian data collection and infrastructure planning.
- PacTrans keeps supporting external instructors with great practical experience to teach both graduate and undergraduate level courses. Four extra courses were added to our transportation curriculum due to the PacTrans support in the reporting period.
- Our educational research project with all five consortium partners involved has produced educational modules and a resource sharing website to facilitate exchange of teaching materials among educational institutions.
- A workforce development program was developed at UAF to address the training needs of working professionals.
- Our outreach project on distracted driving received continuous support to extend its benefit to more high schools. A survey to teenage drivers was completed and the research team is conducting analysis on the survey data. The findings of the analysis will be greatly helpful to understand teenage driving and may offer great insights for teenage driver safety improvement.
- PacTrans research and educational activities have identified a clear need for transportation programs to enhance education on information technology and data management skills to meet market needs of future transportation engineers. The Innova Internet 2 ready cars to be delivered to the UW campus for research offer a great platform for relevant research and teaching activities.
- Our Idaho based Clean Snowmobile Team has generated remarkable impact on clean engine and snowmobile design.
- Our regional seminars and conferences offer great inputs for our curriculum reform and research initiative development. A set of research topics and training workshops have been identified for future PacTrans activities and support.

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

Faculty of multiple other disciplines worked directly or collaboratively with transportation faculty in our consortium. During this reporting period, we communicated and collaborated with professionals in environmental engineering, electrical engineering, computer science and engineering, public health, public policy, and mathematics for various PacTrans activities. Our regional transportation needs are clearly delivered to people from these relevant disciplines. They will join our effort in development of data-driven, sustainable solutions for the diverse transportation needs of the Pacific Northwest. For example, the research team that recently won the Innova University Electric Vehicles project comprises of professors from Applied Physics Lab, Civil Engineering, Computer Science and Engineering, Electrical Engineering, Mechanical Engineering, Industry Engineering, and Urban Planning. The technologies developed using the electric cars will contribute directly to transportation engineering.

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

PacTrans continues its dedication to transportation workforce development. In addition to the award-winning intern program with WSDOT and several other new intern programs recently established, PacTrans is making great efforts to merge the gap between practice and university education. One such effort is to sponsor training workshops to address practical issues on demand. Fifteen such events were sponsored by PacTrans, including the ITE Washington Transportation Safety Meeting. Our four online transportation degree granting programs continue to play an important role in workforce development, serving over 130 continuing education students during the reporting period. Furthermore, we are actively working with local partners to develop or re-establish short-term training programs. The Roundabout Design Training for Alaska Engineers is such an example.

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

PacTrans has funded seven regional projects and 15 small projects in 2012 and another seven regional projects and 25 small projects in 2013. The 2012 projects have been completed and produced many useful research findings. They will definitely add new physical, institutional, and information resources and facilitate cross sharing of existing resources among consortium partners. Research laboratories of PacTrans consortium partners working on PacTrans projects added new research equipment, software tools, and other academic resources as part of their research efforts. For example, the UW STAR Lab is sharing its traffic sensors with researchers at the University of Idaho for a multi-institutional research project focusing on pedestrian data collection in the 2013-2014 academic year. Data collected through these research projects and publications of the findings will be new resources available for public access. The resources made available through PacTrans research can also attract new research grants. The Innova University Electric Vehicle award is a great example. This award will provide four electric vehicles for university research that will be open for PacTrans researchers to use.

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

PacTrans emphasizes technology transfer and involves relevant parties early in those funded projects with a technology development component. In the 2013 PacTrans Region 10 Transportation Conference, a session was set up to show success stories of technology transfer in the PacTrans Consortium universities. Since PacTrans Year One projects have been completed, the 2014 PacTrans Region 10 Transportation Conference will serve as a technology showcase to potential users. PacTrans may provide gap funds for those technologies ready to transfer to practice.

The success of the University of Idaho Snowmobile team reflects the transfer of our own technology in a few ways. The primary method is by the hiring of our students. Often the projects they work on when they are first hired are highly related to the projects they worked on with our research platforms. Some of the ideas we implement come about from discussions with the R&D personnel from the major powersports manufacturers. Once we have demonstrated a proof of concept on our vehicle, those

manufacturers hire our graduates and have them work on implementing those lessons learned in the next generation of powersports models currently in the design phase. The second means of technology transfer is through publication of our results. We write a SAE paper each year that details the changes made and the measured results of those changes. These papers are read by industry engineers to keep tabs on the latest discoveries that are being applied to the powersports field.

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

As mentioned earlier, our outreach project directly addresses the safety needs of teenage drivers. PacTrans researchers also actively participated in discussions of important regional transportation issues. Given that transportation ties to everyone's daily life, our activities are definitely far-reaching. For example, the reason the Clean Snowmobile Challenge was created was to specifically target a societal problem. Air pollution levels in certain areas of Yellowstone National Park were in an unhealthy range. This was problematic for people who worked at the park and any visitors to the park in the winter months. Many of the technologies explored and demonstrated on our past research vehicles have been implemented in current snowmobile offerings from major companies such as Ski-Doo, Arctic Cat, and Polaris. Fuel economy has gone up, and the exhaust pollutants have dropped significantly from consumer snowmobiles. Data from testing has resulted in the creation of a "National Park Certification" for snowmobiles that use best-available-technology. Emission and fuel consumption standards are in place for any snowmobile entering Yellowstone National Park.

5. Changes/Problems

We have experienced significant personnel turnover, including the passing away of Dr. Michael Dixon, a transportation engineering professor at the University of Idaho. He was leading our effort to develop a new bicycle detection technology involving pressure-sensitive pneumatic tubes. This was one of our seven multi-institution research projects for the 2012-2013 academic year. Ahmed Abdel-Rahim has taken over the lead on this project and the change will not hinder our ability to complete the deliverables described in the original proposal and will not change the scope of work.

Karen DenBraven, associate director at the University of Idaho, retired in February 2014. Her successor was Dr. Ahmed Abdel-Rahim, associate professor of Civil Engineering at the University of Idaho.

Megan MacKrell, who was the Center's Assistant Director, left PacTrans in February 2014. Maria Bayya has taken over managing the Center operations assisting the Director, Yinhai Wang, since March 2014 and was officially appointed assistant director of PacTrans in May 2014.

6. Special Reporting Requirements

None.