



2009 Annual Report

University Transportation Centers Program:
Region X



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Message from the Director

As Director of the Transportation Northwest (TransNow) regional University Transportation Center (UTC), it is my pleasure to present this annual report summarizing TransNow's 21st year of operation. This report covers TransNow's fiscal year from July 1, 2008 through June 30, 2009 including its research, education, outreach, and technology transfer activities.



RESEARCH

Over the last fiscal year TransNow funded 14 new research projects and seven continuing research projects. Two of these projects involved collaborative research efforts between principal investigators at the University of Washington (UW) and Washington State University (WSU).

Applied Research. The overwhelming majority of TransNow-sponsored research projects received cash matching funds from public/private transportation organizations. The Washington State Department of Transportation (WSDOT) was the matching co-sponsor for 13 of this year's 21 TransNow-sponsored research projects. Most of the remaining eight projects received matching funds from other state and/or local transportation agencies. Since this has been the pattern of TransNow research partnerships over the years, it is not surprising that the majority of TransNow-funded research is focused on solving the current and projected transportation problems that face state and local transportation agencies. Consequently, the vast majority of TransNow research has been applied research that can be used quickly to solve real-world problems.

Basic Research. TransNow also encourages higher-risk research that has little chance of short-term results, but has the potential for huge long-term benefits. University faculty who are interested in basic research are usually unable to obtain funds from the usual transportation research funding sources. To help foster basic transportation research, TransNow provides initial seed money plus the required matching amounts for highly innovative transportation research project proposals. This year, TransNow selected a proposed

project entitled "Power Roads" for funding as a basic research project. This project is investigating the use of photovoltaic coatings of roadway infrastructure to generate electricity.

EDUCATION

Student Support. During its 2008-09 fiscal year, 20 Masters and four Ph.D. degrees were received by students in the core graduate transportation program of TransNow's Advanced Institute (AI), which is located in the Department of Civil and Environmental Engineering (CEE) at the UW Seattle campus.

- **Financial Aid.** During that same period, TransNow awarded eight scholarships and 19 fellowships to undergraduate and graduate students at the UW and WSU who were performing transportation research and/or taking transportation courses in the AI program. These student stipends were matched on a 10 to 6 basis by public/private transportation organizations. All of the corresponding matching funds went directly to TransNow students in the form of cash stipends or salaries. Additionally, TransNow provided 31 teaching and research assistantships to students in the Center's program.
- **Regional Student Conference.** Last year TransNow hosted the annual Region X Transportation Student Conference. Nearly 60 students attended this regional conference at the UW campus to discuss their research projects and other activities that may affect their current educational goals and future careers as transportation professionals.

- *Other Student Support.* As in previous years, TransNow continued to provide student support in a variety of established forms such as prizes, student events, travel expenses to professional meetings and conferences, equipment and facility use, and so forth.

Collaborative Education R&D Projects. TransNow sponsored and/or participated in three significant education projects during the last fiscal year. One involved collaboration between WSU and UW faculty, and the other two involved collaboration of faculty and students from the university consortia at all four Region X UTCs.

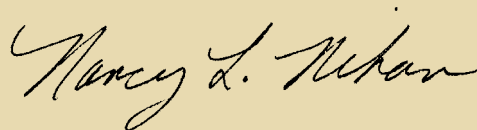
- *TransNow-Sponsored UW/WSU Online "Green" Course Development Project.* One of this year's new research projects involved pedantic research focused on developing an online course on sustainable roadway design and construction. No courses currently exist that cover this important and timely topic. Once developed, the course will be available to all Region X consortium universities.
- *Region X Education Conference.* This June, faculty and students from Region X UTC programs met in Portland, Oregon for a transportation education conference sponsored by the four Region X UTCs (AUTC, NIATT, OTREC, and TransNow), the Institute of Transportation Engineers (ITE), and the Council of University Transportation Centers (CUTC). The conference included panel discussions and workshops addressing potential educational improvements and curriculum sharing among the Region X university transportation programs. TransNow provided travel expenses for Professor Yinhai Wang and Ph.D. students Kelly Pitera and Kari Watkins to attend the conference. TransNow PI, Professor Joe Mahoney, also attended.
- *Region X FHWA/UTC-Sponsored Project.* The four Region X UTCs collaborated on a research proposal responding to an RFP from the Federal Highway Administration (FHWA). FHWA funding for the proposed four-year project was awarded last year and the first year of project work officially started on January 1, 2008. NIATT has the lead role in this collaborative effort, which will produce new transportation course modules and "develop, deploy, and assess a new educational paradigm for transportation professionals and university students". For further information about this collaborative project that commits matching funds and faculty/student participation from each of the four Region X UTCs, go to www.webs1.uidaho.edu/TEDPP-RegionX/management_team01.htm

TECHNOLOGY TRANSFER AND OUTREACH

TransNow researchers continue to generate professional journal publications and conference presentations to disseminate their research results. Last fiscal year, TransNow faculty and students produced 10 final research reports, approximately 20 Transportation Research Board (TRB) publications, and numerous presentations at transportation conferences and professional meetings. TransNow staff produced three newsletters, the annual report and other publications, and made major modifications to the website. In addition to the usual tech transfer and outreach activities, a few additional activities bear special mention:

- *New Communications Facility.* Autumn 2008 marked the official opening of the TransNow Communication Center, a new facility developed with TransNow and UW funds that provides video conferencing, webinar, course development, and other telecommunication services to TransNow faculty, students, and local partners. A picture of this new facility is shown on page 37.
- *Traffic Hero (Modeled After the Guitar Hero Videogame).* This June, one of TransNow's Ph.D. students began developing a new video game that is sure to be a popular draw at next year's UW College of Engineering Open House, which attracts thousands of high school and elementary school students and their families to the Seattle campus each year to learn about careers in engineering. Read about this new video game at www.transnow.org/documents/OpenHouseInteractiveDemo.pdf.
- *Advisory Committee Meeting.* The June meeting of the TransNow Advisory Committee focused on examining current collaborative efforts with our public/private partners and discussing new opportunities for increased collaboration for our mutual benefit. The meeting led to several new ideas and potential new partnerships that will be pursued in the coming year.

This concludes my summary of the highlights of TransNow's 21st year of operation. We look forward to another year of new opportunities and successful programs.



TransNow Center

TransNow at the UW is a Regional University Transportation Center (UTC) administered by the United States Department of Transportation through its Research and Innovative Technology Administration (RITA).

TransNow is a showcase for transportation research and education in the Pacific Northwest (Federal Region X) which includes Alaska, Idaho, Oregon, and Washington. The TransNow Center, in its role as regional conference planner, research coordinator, and educational liaison, has made a significant contribution to the leadership of the transportation community in Region X which serves as a microcosm of transportation for the entire country, with a diversity of modes, infrastructure systems, and area types that make it a prime testing ground for studies in transportation operations and planning.

The Center also provides support for research, education, and technology transfer through our consortium university, WSU. Students and faculty at WSU play a key role in their respective local area and have developed strong relationships with state transportation departments and other regional organizations.

MISSION

TransNow is committed to the development and maintenance of a center of excellence in transportation research and education. It will serve as a primary source of and resource for competent transportation professionals for the 21st century.

CENTER THEME

The Center theme is Transportation Operations and Infrastructure. Research projects funded by TransNow fall within one of the three major theme areas:

- 1) Traffic Operations with an emphasis on ITS
- 2) Freight Operations and Logistics with an emphasis on freight mobility
- 3) Infrastructure Construction with an emphasis on smart infrastructure

MANAGEMENT STRUCTURE

The management structure of TransNow consists of the Director and staff, Board of Directors, and an Advisory Committee. The Center Director coordinates research and educational activities with the Board of Directors (BOD), which exercises oversight authority over TransNow.

The TransNow BOD includes the TransNow Center Director and Associate Center Directors, senior faculty from the UW and WSU programs, Washington State Transportation Center (TRAC) Directors, and non-voting representatives of both the WSDOT and the Federal Highway Administration (FHWA). The BOD meets each year to discuss and vote on TransNow research, education, and technology transfer activities.

TransNow's Advisory Committee consists of 36 members representing universities, local and state agencies, and industries of the Region X area. The members review proposals, contribute to TransNow workshops and conferences, and are involved in other TransNow activities.



TransNow Center Personnel

Nancy L. Nihan, *Director; Professor, Transportation and Construction Division, UW CEE Department*

Peter M. Briglia, *Associate Director, Communications; Associate Director, New Initiatives in Freight & ITS*

G. Scott Rutherford, *Associate Director, Professional Development and Internships*

John Stanton, *Associate Director, New Initiatives in Transportation Infrastructure; Professor, UW CEE Department*

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Anthony Curreri, *Information Technology Specialist*

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TransNow Board of Directors (clockwise from top left row): John Stanton, Mark Hallenbeck, Pete Briglia, Dave McLean, Jerry Lenzi, Nancy Nihan, and Megan Hall. Also pictured: Jennifer Sheldon (Program Manager). Not pictured: G. Scott Rutherford and Ken Casavant.

TRANSNOW AT A GLIMPSE

A snapshot of TransNow's key metrics during the 2008-2009 year

Research:

- 19 new research proposals received
- 80 proposal peer reviews received
- 14 new research projects funded
- 7 continuing research projects funded
- 2 UW and WSU collaborative research projects
- 13 projects had matching funds from WSDOT
- 10 final reports published

Education:

- 8 scholarships awarded
- 19 fellowships awarded
- 27 degrees received
- 9 theses and dissertations published
- 31 teaching and research assistantships provided

Advisory Committee

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Research Projects

TransNow sponsored research primarily responds to the needs of the WSDOT and other transportation agencies in the state. It naturally follows that it is focused on solving current and anticipated transportation problems. Whether the research involves new techniques to seismically retrofit transportation structures or the development of a new tolling rate algorithm, the emphasis is on research that can be implemented and quickly provide benefits to users of the transportation system.

TransNow also sponsors higher-risk, conceptual research that is not ready for immediate implementation. This research can lead to breakthroughs that provide a high rate of return on the initial investment. A project that explores the use of computer networking congestion control mechanisms in freeway ramp metering algorithms or a project that investigates the use of photovoltaic coatings on roadway infrastructure to transform the roadside into an electricity generating utility are two examples of basic research supported by TransNow.

The research falls into TransNow's three theme areas: infrastructure, traffic operations/Intelligent Transportation Systems (ITS), and freight. These research projects are primarily conducted by Civil Engineering professors though some projects involve professors in other disciplines such as Electrical Engineering, Urban Design & Planning, and Economics. Research is conducted at both the UW and WSU and a few of the projects involve the collaboration of professors from both universities.

Research proposals are subject to a peer review process that is overseen by the TransNow Director and Board of Directors. The proposals are evaluated to determine the:

- Technical Merit
- Alignment with regional and national priorities
- Capabilities and resources of the research team
- Project scope

Upon completion of the research a draft technical report is submitted and subject to a peer review prior to publication of the final report.

TransNow funded a total of 21 research projects in 2008-2009. Seven projects were continued from the previous fiscal year. Fourteen were new research projects; five of which were two-year projects that will continue to receive funding in 2009-2010.

This section provides more detail on these research projects listed under the following headings:

- Research Projects – New
- Research Projects – Continuing

Sustainable Roadway Design and Construction: An Online Course (new)

OVERVIEW:

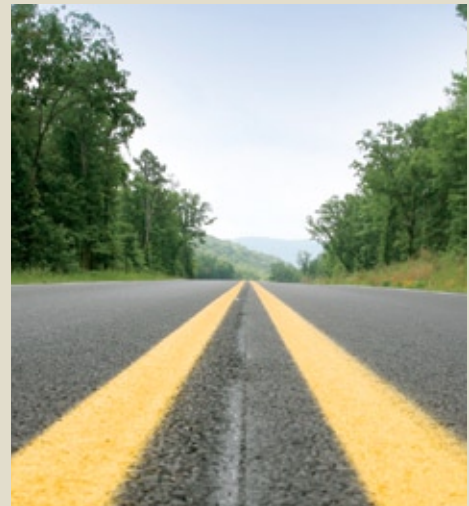
This project will create and deliver an online course in sustainable transportation infrastructure. The course will define the concept of sustainability as applied to transportation infrastructure and will investigate:

- systems for evaluating sustainability,
- specific materials, methods and practices that are more sustainable than current methods, and
- life cycle cost assessment and life cycle cost analysis for transportation infrastructure with an emphasis on roads and pavement.

No courses on this subject are currently available. The course would reside online at either the UW or WSU and would be available for use by any Region X consortium university. The course would be suitable for undergraduate and graduate students in addition to state and local agency engineers and decision makers.

UPDATE:

This project is under a six month extension and will be complete in January 2010. Researchers are currently finalizing the development of the course. Upon its completion, a final report will be available at www.transnow.org/publication/final-reports/.



Project number: 544831 & 61-7118

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New Models for Port Development: Changing Logistics Practices in a Continental Transportation System (new)

OVERVIEW:

The Port of Prince Rupert, located in Northern British Columbia, is the second largest deep-sea port on the west coast of Canada. It opened for container business in 2007 and expects to develop into a significant marine container terminal handling two million TEUs by 2012. This port will be the closest major port to Southeast Alaska and is co-located with the ferry terminal, which is the only Canadian port of the Alaska Marine Highway System. This port also offers up to 58 hours shorter transit time between North America and key ports in Asia compared to other West Coast ports.

The Port of Prince Rupert also presents a completely new and untested model for port development. All other major North American ports are located in major urban centers with extensive inland transportation infrastructure. This is not the case for Prince Rupert. The port's rural location may be viewed as both an asset and vulnerability. The asset concerns the lack of congestion and fewer conflicts with the smaller local population. The vulnerabilities arise due to possible disruptions in transporting goods on the single-track rail line which is prone to landslides and flooding and the lack of any landside infrastructure such as warehouses or transshipment facilities.

This project will gather goods movement data on trade between Alaska, Washington, and British Columbia to develop a regional flow map. Telephone interviews with shipping lines and major transportation providers at regional ports



Project number: 61-7121

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will be conducted to obtain qualitative information. Key North American importer profiles will be examined to identify the logistical characteristics of the goods most likely to utilize the new port and high level consequences will be estimated for North American trade flows.

UPDATE:

This project is under a six month extension and will be complete in January 2010. Project tasks included data collection, operational cost and benefit analysis, qualitative interview, and synthesis of analytical and qualitative results. Researchers also wrote a paper on their findings entitled "The Port of Prince Rupert as a Successful National Gateway Strategy" and submitted it to the TRB for presentation at the 2010 Annual Meeting. Upon the project's completion, a final report will be available at www.transnow.org/publication/final-reports/.



Project number: 544785

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Design Choice of Aggregate Gradation for Hot Mix Asphalt Mixtures (new)

OVERVIEW:

The current Superpave hot mix asphalt (HMA) mixture design procedure is based on a trial and error process and does not provide specific guidance on the development of the appropriate aggregate gradation. This procedure is time consuming, costly, and may not always lead to satisfactory performance. The effect of aggregates on mixture performance is still unclear. A thorough understanding of the effects of aggregate properties on HMA performance as well as a gradation design method based on theoretical analysis and mixture performance will be of significant benefit to local practitioners.

The objective of this project is to perform an extensive study on aggregate materials used in HMA so that an aggregate gradation can be designed to achieve the highest HMA performance. The study will evaluate aggregate packing and gradation properties for HMA mixture design and propose a new gradation design method using laboratory testing and discrete element modeling (DEM) based on the concept of the Bailey Method. (The Bailey Method is a method designed to provide guidance on choosing aggregates with good aggregate interlocking (if desired) and aggregate packing. The DEM approach is considered an excellent approach for modeling aggregate behavior due to the aggregates' discontinuous nature.) The influence of aggregate properties, including angularity, shape, and surface texture, may be considered. Measures that can best describe an aggregate gradation and can be associated with HMA mixture performance will be developed. The laboratory performance of the mixtures designed by the new gradation method will be compared with those designed by the traditional Superpave mix design method. It is expected that the proposed gradation design method will provide guidance on how to achieve the volumetric criteria and ensure high aggregate interlocking and adequate resistance to permanent deformation and other pavement premature distress.

UPDATE:

This project will continue into 2009-2010. During the first year of research, tasks included a literature review, DEM simulation, and experimental gradation design. The second year's tasks will include performance evaluation and the development of a gradation guideline. Thus far, researchers have prepared a paper entitled "Determination of HMA Voids in Mineral Aggregate Based on the Analysis of Aggregate Gradation and Packing" and will submit it for presentation at the 2010 Annual TRB Meeting.

Fatigue Testing of a Critical WSDOT Luminaire and Traffic Pole Details (new)

OVERVIEW:

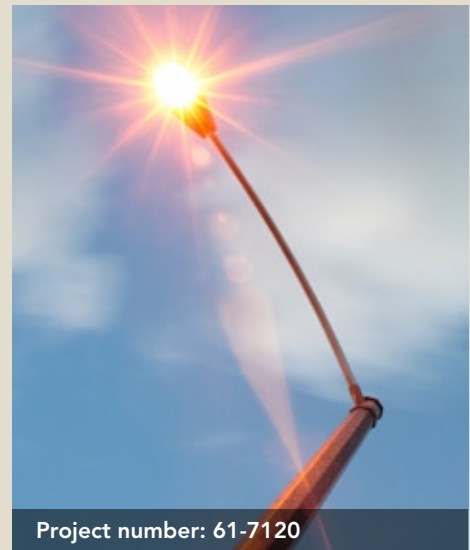
WSDOT has installed thousands of luminaires and over 1,000 traffic signals, each with several poles, around the state. Those steel poles were projected to have a 25-year design life and over half of them are approaching that milestone. WSDOT recently funded a research project to review and summarize the literature on pole life span, compare critical pole fatigue details to those for which test data is available, conduct a preliminary study on methods to calculate the remaining fatigue life of critical pole details and make recommendations on the need for a testing program to determine the remaining life span of older luminaires, traffic signal and sign poles.

Given the age of some of the most critical luminaire structures in the state (some luminaires on I-5 have not been replaced since they were installed as part of the construction of I-5 in the 1960s) and the wide variety of critical fatigue details used in these structures, it is highly likely that the review will result in the identification of several details for which fatigue data are not available. A lack of data will severely impair the ability of the researchers to reliably assess the fatigue life of these structures.

This project will develop a laboratory fatigue test program to investigate the most critical details identified from the initial WSDOT research. The proposed testing program will result in: (1) fatigue life curves for those critical details, (2) concepts for improved details, (3) recommendations for additional field testing to more accurately estimate the spectrum of fatigue loading, and (4) recommendations for additional laboratory testing of improved details, possible retrofit measures, and means of self-sensing fatigue damage.

UPDATE:

This project will continue into 2009-2010. During the project's first year, WSDOT research tasks included literature review and database development, estimation of stresses on representative luminaire poles, and identification and ranking of critical pole configurations and details. In the second year, TransNow will characterize the remaining fatigue life of in-service traffic signal and luminaire poles, complete conceptual development and experimental performance of retrofit measures, and develop recommendations for WSDOT. At this time, there is no implementation activity, however, researchers will submit their findings in a paper to TRB and in presentations to WSDOT.



Project number: 61-7120

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pole life span
field testing
retrofit measures



Project number: 61-7122 & 544841

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Requirements For Washington Statewide Freight Simulation Model (new)

OVERVIEW:

Research conducted by a joint UW and WSU team is exploring dynamics of the freight transportation system and developing tools and case studies to understand the impact of infrastructure failures on supply chains within Washington State. This research will develop a Geographic Information Systems (GIS) based transportation network which can be used to map supply chains and understand the impact of infrastructure changes on freight flows. This project lays the groundwork for building a more resilient transportation system.

This phase of the work will develop requirements for a statewide freight model that could be used to estimate the impacts of changes in the transportation system on freight flows generated by different economic industry sectors within the State of Washington. The following issues will be addressed:

- Estimated cost to build the model
- Data requirements
- Long term maintenance of the model
- Geographic scope of the model
- Model methodology

The results of this research will enable WSDOT to determine the utility and feasibility of developing statewide modeling tools to investigate freight system resiliency and include it in transportation planning and engineering decisions.

UPDATE:

This project is under a six month extension and will be complete in January 2010. Research tasks this year included discussions with key stakeholders to identify research priorities and model applications, reviewing existing models and data sources, identifying methodology and scope, and developing long-term management plans. Researchers also conducted presentations on their research at the 2009 Safety and Security Education and Research conference in Seattle and the 2009 TRB Freight Data and Air Quality conference in Irvine, California. In addition, researchers submitted papers on their research to TRB including, "A Comparison of Infrastructure Utilization by Freight Industries: Case Studies of Potatoes and Diesel in Washington State" and "Building Freight Transportation System Resilience: Actions for State DOTs". Upon the project's completion, a final report will be available at www.transnow.org/publication/final-reports/.

Low-Cost, Distributed-Sensor-Based Weigh-In-Motion Systems (new)

OVERVIEW:

Monitoring truck weights is essential for traffic operations, roadway design, traffic safety, and regulations. Traditional roadside static truck weighing stations have many operational shortcomings, so there have been ongoing efforts to develop and implement Weigh-In-Motion (WIM) systems to make vehicle weight monitoring and enforcement more automatic, unobtrusive, and cost-effective. Current WIM systems typically rely on a transverse, instrumented beam installed in the roadway itself which can act as a transducer system whose response can be related to vehicle weights via calibration and basic principles. These systems work reasonably well but they are still relatively costly to install and maintain since they require modification of the roadway, therefore placing limits on where and when they can be installed.

The proposed work aims to investigate an approach to WIM systems that can greatly reduce costs and increase flexibility and reliability by using the fact that the unmodified roadway pavement/foundation subsystem itself can be viewed as a transducer system amenable to direct characterization and calibration. Rather than using a relatively expensive, obtrusive single sensor system, the proposed approach would use a large number of inexpensive, self-powered, unobtrusive wireless sensor devices that would work together at a given location to achieve reasonably accurate vehicle weight measurement without modifying the roadway itself. The fundamental technologies and theoretical building blocks underlying the proposed approach all exist, but research is needed to answer a number of technical and practical questions to enable the development of a deployable system. The project will develop both virtual and physical prototype systems that will be used to investigate the feasibility, suitability, accuracy, and generality of the proposed technology as a future heavy vehicle weight monitoring system.

UPDATE:

This project is under a six month extension and will be complete in January 2010. Tasks completed thus far include sensing system implementation, sensing system algorithm development, test data gathering, numerical model development, numerical model calibration, and large scale simulations. Two papers have been written and will be submitted for presentation at the 2010 Annual TRB Meeting including, "Low-Cost, Roadside Sensors for Weigh-in-Motion Applications," and "Low-Cost Vehicle Detection Based on Simple Light Sensing". Upon the project's completion, a final report will be available at www.transnow.org/publication/final-reports/.



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unobtrusive
wireless sensor
devices



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Power Roads (new)

OVERVIEW:

"Power Roads" will explore the feasibility of using new, flexible photovoltaic coatings applied to the extensive surface area of roadway infrastructure to generate electricity. Initial efforts will focus on the feasibility of installing the coatings on retaining walls or bridges but later efforts will investigate whether the coatings can be installed on pavement surfaces.

The project will investigate the technology, explore the feasibility, and conduct a proof of concept demonstration at a test site in the Seattle area. If feasible, this effort will enhance the sustainability of highway infrastructure by making highways and related infrastructure energy producers and not just energy consumers.

UPDATE:

This project is under a six month extension and will be complete in January 2010. This year, researchers experimented with solar electrical generating components in low light conditions and direct sunlight conditions. In the near future, researchers will attempt installation in local pavement. Researchers also garnered support from potential project partners in order to collaborate on developing a renewable energy course at the UW. Upon the project's completion, a final report will be available at www.transnow.org/publication/final-reports/.



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Transportation Impacts of Structural and Geographic Shifts in the Pacific Northwest Warehousing Industry (new)

OVERVIEW:

Employment data indicate that the warehousing industry has experienced rapid growth and restructuring since 1998. This restructuring has resulted in geographic shifts at the national, regional, and local levels. Uneven growth in the development of warehouses in the Pacific Northwest has had a significant impact on the regional transportation system, but the extent of this impact is unknown.

Recent and ongoing research indicates that growth in the warehousing industry is profound. County Business Patterns data published by the US Census Bureau indicate that at the national level, the number of warehouses grew by just over 100 percent from 1998 to 2005; from 6,712 in 1998 to 13,483 in 2005.

Exploring the counties in Washington State, King County experienced the strongest absolute growth, adding 59 warehouses to the 61 reported in 1998. In relative terms, however, Pierce County added warehouses at a faster rate (159 percent) than any other county.

At the national and state levels, preliminary data indicate that there has been strong growth in warehousing establishments, but that the growth has been uneven. This work examines the growth of warehousing in the Puget Sound area and the impact of truck trips in one part of that area, the Green River Valley.

UPDATE:

This project's tasks included the download of county level establishment-by-size County Business Patterns Data for analysis, calculation of the net change in number of establishments by size for all 3,140 counties in the US, creation of a geodatabase of the data, mapping of ports, major road and rail transportation networks and nearest population and manufacturing centers, and the creation

of a multiple regression model with growth in the number of establishments as the DV and distance to each of the variables measured and land rents as IVs. Researchers published their findings for a presentation "On the Rise of Mega DCs: Recent Trends and Implications for the Future" at the INFORMS Annual Meeting in Washington, DC. In addition, they submitted a paper for publishing entitled "The Rise of Mega DCs: A Permanent or Ephemeral Feature on the Logistics Landscape?" View the final report online at www.transnow.org/publication/final-reports/documents/TNW2009-04_Goodchild_WA_Warehousing.pdf.

Dynamically Calibrated Arterial Cameras (new)

OVERVIEW:

This proposed project will extend the work of previous projects that have developed algorithms and software to measure traffic speed under adverse conditions using un-calibrated closed circuit TV (CCTV) cameras. The present implementation uses the WSDOT CCTV cameras mounted along the freeways and has an interface for automated camera calibration that allows the cameras to be used for freeway traffic speed and speed variance measuring and recording in addition to providing video images. The algorithm uses features found on the freeway, such as fog lines and lane markers, to calibrate the camera. Arterials have different features, such as turn arrows and stop bars that can be used for calibration. This effort will develop algorithms that calibrate the cameras based on common features found on arterials and will implement the algorithm to measure speeds on arterials.

The result will be a portable system that can function on both freeways and arterials with only limited infrastructure investment. The utility of this project is that it will leverage existing infrastructure and software to collect traffic data on arterials where there are no loops or other types of detectors.

UPDATE:

This project is under a six month extension and will be complete in January 2010. Project tasks this year included identification of arterial camera locations of value, collection of camera images, identification, development and implementation of features useful for calibration, and support to WSDOT in using the calibration application. Tasks yet to be completed are testing of the application at a variety of locations and publishing research findings. Upon the project's completion, a final report will be available at www.transnow.org/publication/final-reports/.



Project number: 61-7169

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speed variance
measuring and
recording



Project number: 61-7170

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Developing A Truck Trip Generation Tool (new)

OVERVIEW:

The majority of this nation's freight moves on trucks. In spite of the importance of trucks to our economy, there is relatively little information available on how different land uses generate truck trips. Although the ability to accurately calculate truck trip generation is an important step in the process of forecasting truck traffic and freight movements in general, truck trip generation tools are relatively uncommon. Such information is required as input into travel forecasting models and is needed to plan freight-oriented infrastructure projects. This project is working to address this gap by: (1) collecting ITE-style truck trip data for selected major categories of trip generators and land uses in the Puget Sound region, (2) exploring existing employment, parcel, business, and transportation databases and determining whether they have content that could be used to develop truck trip generation estimates suitable for intra-regional planning, and (3) exploring if the linkages between regional commodity flow data and the local-level truck data from the steps above can be used to develop truck trip generation rates.

UPDATE:

This project will continue into 2009-2010. During the first year of research, tasks included a literature review, collecting facility level generation data, and a review of available databases for data storing. The second year's tasks will include analyzing the commodity of flow data and documenting the results. Thus far the research yielded two survey instruments used for interviewing operators of individual grocery stores and grocery distribution warehouses.



Project number: 61-7211

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A Microscopic Approach for Quantifying Recurrent and Non-Recurrent Delays on Freeways (new)

OVERVIEW:

Travel delays associated with freeway bottlenecks and/or incidents are important data for estimating freeway travel costs. Quantifying recurrent (daily congestion) and non-recurrent (accidents or weather) delays, however, has been a challenge and enormous efforts have been made to quantify freeway travel delays. Most existing procedures are based on either a deterministic queuing diagram or shock wave analyses. However, a recent study that verified several existing procedures using ground-truth data concluded that both types of procedures underestimated delay in congested conditions. One of the causes of underestimation may arise from the fact that traffic flow theory is not applicable to heavily congested conditions.

Additionally, both types of methods assume that the beginning of the queue is at the downstream sensor station, an assumption which can be violated in many cases. Since traffic data are collected from discrete point sensors, this assumption results in errors depending on the distance between the downstream sensor station and the congestion starting point. Therefore, existing delay estimation methods are defective at least in certain conditions and a new approach for quantifying recurrent and non-recurrent delays needs to be developed.

This project proposes to develop a new algorithm to improve delay estimation accuracy. This algorithm is microscopic in nature because propagation of shock waves, lane-changing behavior, and phase transition between free-flow and

congested flow are considered in delay estimation. Empirical studies using recorded video and high-resolution loop data will be conducted to support the development of this new algorithm. For verification purposes, recurrent and non-recurrent delay data will be manually extracted from video recorded at the upstream and downstream locations of a congestion spot. The proposed algorithm is expected to produce improved delay estimates for freeways.

UPDATE:

This project will continue into 2009-2010. During the first year of research, tasks included test site collection and literature review, ground-truth delay data collection, and identification of error sources in DQT-based IID estimates. Second year project tasks include developing a new incident-induced delay calculation algorithm and implementing the application online. Researchers presented a paper entitled "Video-Based Vehicle Detection and Tracking Using Spatio-Temporal Maps" at the 2009 Annual TRB Meeting; it will be published in the *Transportation Research Record*. Researchers are currently working on a new research paper entitled "Using Precise Time Offset to Improve Freeway Vehicle Delay Estimates." This paper will be submitted for publication in the *Journal of Computing in Civil Engineering*.

Real-Time Travel Time Prediction on Urban Traffic Network (new)

OVERVIEW:

Most transportation agencies would like to provide travel time information as part of their Advanced Traveler Information Systems (ATIS). Travel time prediction on urban traffic networks, however, is a very challenging issue because of interrupted traffic flows and random vehicle arrivals. Therefore, most ATIS provide no information on urban street travel times despite the needs of travelers. Most existing travel time prediction algorithms were designed specifically for freeway applications. With the increasing deployment of traffic detectors and the growing availability of traffic signal control data on urban traffic networks, predicting urban arterial travel times becomes feasible.

In this research, an arterial travel time prediction algorithm will be developed and implemented in an interactive online platform based on Google Maps. The proposed algorithm uses both historical and real-time traffic and signal control data as inputs. Traffic data are common loop detector outputs, such as lane occupancies and volumes. Signal control data include signal cycle lengths and timing plans for each roadway link.

A VISSIM traffic simulation model will be built to help calibrate and test the proposed travel time prediction algorithm. The calibrated algorithm will be implemented on a Google-Map-based ATIS that can be used to predict arterial travel time and identify the shortest travel route for any user specified origin-destination pair.

UPDATE:

This project will continue into 2009-2010. During the first year of research, tasks included data collection, literature review, and development of an algorithm for urban travel time prediction. Ongoing tasks include algorithm verification and assessment, and system implementation and evaluation. In addition, two research papers entitled "Impacts of Freeway Traffic Congestion on En-route Traveler's Diversion" and "Volume Correction for Wired-Together Loops at Signalized Intersections" are under development and scheduled to be submitted for presentation at the 2010 Annual TRB Meeting.



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Project number: 61-7318

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The Effect of Light Rail Transit on Travel Mode Choice and Physical Activity: A Natural Experiment (new)

OVERVIEW:

Current transit investments yield benefits that go beyond traffic congestion relief and include improved environmental quality and potential gains in human health due to increased physical activity. Past research on the effects of such infrastructure investments on mode choice and physical activity has been limited by the ability to draw causal inference.

A five-year study was proposed to the National Institutes of Health that takes advantage of the introduction of light rail transit (LRT) in Seattle. Using a case-controlled longitudinal panel design, the study assesses the behavior of 1,000 adults living either close to (within one mile; case) or far from (control) an LRT station at three points in time: prior to (baseline), soon after, and more than 2 years after the introduction of LRT service. It is hypothesized that residents living close to LRT will have an increase in transportation-related walking and total physical activity relative to residents living farther away.

Individuals' walking will be assessed using a portable GPS and a seven-day travel diary, and physical activity assessed via accelerometry. The neighborhood built environment will be evaluated using parcel-level land use data. Changes in non-LRT infrastructure and availability (e.g., bus routes) will also be considered.

UPDATE:

Tasks for this project included the creation of a sampling procedure to generate addresses for potential respondents, recruitment of 1,000 respondents, and the purchase of accelerometers and GPS devices. The findings of the research may be viewed online at www.transnow.org/publication/final-reports/documents/TNW2009-05_VernezMoudon_EffectofLight%20Rail_61-7318.pdf.



Project number: 61-7320

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School Based Travel, A Mobility Assessment (new)

OVERVIEW:

The number of children being driven to schools by their caretakers has increased dramatically over the past decade, and now the majority of school-based trips are made by private automobiles. This has contributed to worsening traffic congestion. It has also been linked with increases in children's chronic diseases such as respiratory diseases related to poor air quality. Increases in the percentages of children that are overweight or obese can be related to the decline in activity due to this life style change.

Nationwide, Safe Routes to School programs (SRTS) have grown to support efforts to increase the number of children using active modes of travel to school and to insure their safety. With one of the longest running Safe Routes to Schools program (SRS) in the country, WSDOT is now the lead agency in a newly created Safe Routes to School Pooled Fund Research Project. Partner states in this Transportation Pooled Fund (TPF) project are Texas, Alaska, and Florida. Called Statewide Mobility Assessment Study, this TPF research has two phases. The first phase will review data on travel modes used by children traveling to school and identify methods to monitor travel to school. The second phase will develop

methods to establish and measure realistic targets for the mode split of travel to schools, based on the age of the child population, school size and location, travel options, and other factors.

This project will (1) improve the quality and extent of the data needed to understand the current mode split in school-based travel, and (2) examine associations between mode split and school size and location, characteristics of the student population, and transportation facilities available around schools.

This TPF project presents a unique opportunity to develop standards and metrics for assessing the impact of school-based traffic on multiple aspects of mobility, including traffic congestion, environmental quality, and the health of children. The project also fills the important need of providing effective measures to allocate safety enhancement projects around schools. Finally, the multi-state, collaborative scope of the project promises to yield results which will be influential at the national level.

UPDATE:

This project will continue into 2009-2010. During the first year of research, project tasks included a review of transportation and public health literature that addresses the proposed issue, consolidation and development of baseline data of all school districts and individual schools in the four participating states, SRTS grantees since 2002, and data available on the number of children walking or biking to school, and preparation of a statewide pilot survey to tally children walking or biking to school.

Rapid Construction Of Earthquake-Resistant Bridges (continuing)

OVERVIEW:

Earthquakes cause damage to bridges. In many cases that damage is repairable, but the bridge is permanently deformed and may be unusable while it is brought back into plumb and the repairs are made. For example, the Alaskan Way Viaduct in Seattle had to be closed after the 2001 Nisqually earthquake because of a large offset at the joint between two parts of the structure.

This project will adapt a technology to bridges that would ensure minimal residual seismic deformations of the bridge, thereby permitting its use in the critical hours after the earthquake strikes. The technology also leads to seismic damage levels that are much lower than those that typically occur in conventional construction. When used in combination with precasting techniques, it also allows a significant reduction in on-site construction time. This feature provides benefits to DOTs by minimizing both traffic congestion and exposure of workers to hazardous conditions. The system thus provides three benefits at once (rapid construction, immediate post-earthquake use and low earthquake damage and repair costs).

The concept was first developed at the UW in the 1990s for beams in building frames. It uses conventional materials, combined in an innovative way, to give the structure "self-righting" or "self-healing" properties. Many buildings, including the tallest concrete building in San Francisco, have now been constructed using it. Building codes are now being changed to allow its use without special testing and permitting. This research adapts it for use in bridge columns.

UPDATE:

This project was a continuation of work performed during 2007-2008. The project is complete and its final report is available for download at www.transnow.org/publication/final-reports/documents/Final_EarthquakeResistentBridges_61-5915.pdf.



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Greenroads: An Environmental Rating System for Roadway Design and Construction *(continuing)*

OVERVIEW:

While the idea of sustainable infrastructure has caught on in the building world (US Green Building Council, LEED standards, Built Green, etc.) it remains in its infancy in the transportation infrastructure world. Recent research at the UW developed an environmental ratings system for roadway design and construction, called "Greenroads". This work led to the discovery of gaps in information necessary for proper sustainability evaluation and the current research will address several of those gaps. The ultimate goal is to fully develop the concept and have it adopted as the first environmental ratings system for roadway design and construction in the U.S.

UPDATE:

This research is a continuation of work from 2007-2008. Project tasks during the second year included finalizing a rating system of "credits", calibrating credits to reflect sustainability impact, completing a dynamic online system to upload, evaluate, and track project information, developing an online life cycle analysis tool for roads, completing case studies to test the rating system, presenting a preliminary working system to agency and industry groups for revision, and creating or negotiating for a governing body to manage Greenroads. The Greenroads website (www.greenroads.us) went live in January 2009. In addition, pilot projects have begun with Bothell, WA (SR 522), Parsons Brinckerhoff and the City and County of Denver, CO (14th Street), WSDOT, and Granite Construction and Caltrans (I-80). Case studies have also been made in Seattle with the 2nd Avenue paving and the Denny-Western-Elliott-15th paving, as well as the I-90 ramps paving.

Several presentations of the research have been made at local and national conferences, including the American Planning Association National Planning Conference, American Public Works Association Washington Chapter Spring Conference, Road Builder's Clinic, Rocky Mountain Asphalt Conference and Equipment Show, Roads to Green 2009 Conference, Western Federal Lands Highway Division Winter Conference, and the TRB Annual Meeting. In addition, two papers have been submitted for publishing to the *Transportation Research Part D: Transport and Environment*, including "Greenroads: A Sustainability Performance Metric for Roadways," and "Weighting a Sustainability Performance Metric for Roadways".

This project is under a six month extension and will be complete in January, at which time a final report will be available at www.transnow.org/publication/final-reports/. The entire study and current rating system is posted at www.greenroads.us.

environmental ratings system evaluation

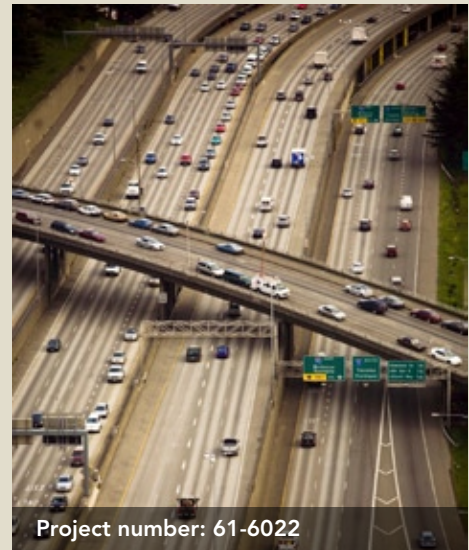
Development Of A Statewide Traffic Data System (continuing)

OVERVIEW:

This research targets improvements to data, data collection systems, and data management systems that will make WSDOT traffic data across the state better and more consistent. The project involves a series of data analysis, data management, data query, and data transmission tasks. The basic problem being examined is how to obtain data from multiple sources and databases currently supported by WSDOT, identify those data which are invalid, remove those data from further analysis, and provide a common interface that can be used by WSDOT staff to obtain roadway performance measures. Currently, none of these tasks is done in a standardized way within WSDOT. This research will need to develop and apply consistent data quality tests, develop meta-data standards for WSDOT, and develop (or recommend the purchase of) software tools that can function across unlike data structures.

UPDATE:

This project is a continuation of work from 2007-2008 and will be complete in spring 2010. Research tasks completed thus far include data collection, investigation of loop detector errors, development of the loop error correction algorithms, implementation and evaluation of the algorithms, and design and implementation of the central database and central web server. Current tasks include a system test and modifications and research dissemination. In addition, one paper has been accepted for publication by the *Transportation Research Record*. The research team is working on two more papers entitled "A Dynamic Threshold Approach for Identifying and Correcting Loop Detector Errors" to be submitted to the *Journal of Transportation Engineering* and "Single Loop Error Identification and Correction" to be submitted to the *Journal of Intelligent Transportation Systems*. Additionally, the research team made three presentations at the Second International Symposium for Freeway and Tollway Operations in June 2009 and the 2009 Annual TRB Meeting.



Project number: 61-6022

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Ultrasonic Detection of Cross-Section Loss in Tieback Rods Due to Corrosion (continuing)

OVERVIEW:

Corrosion of tieback rods in sheet piling systems can compromise the reliability of associated transportation structures due to loss of the cross-section of the tieback rods and their resulting reduced strength. Common inspection techniques currently involve excavating to the location of a few tieback rods for visual appraisal. This process is expensive and labor-intensive. Furthermore, the actual condition of the vast majority of tieback rods in a sheet piling system remains unknown, since only a few tieback rods are typically inspected.

Ultrasonic inspection of tieback rods will provide a more comprehensive technique for detecting loss of cross-section associated with corrosion. Ultrasonic inspection is already used to successfully detect fracture of anchor bolts in transportation sign structures by coupling ultrasonic transducers to one end of an anchor bolt and propagating a bulk wave along the bolt length. Cracks and fractures are detected by reflected signals that arrive prior to reflections from the back wall (far end) of the anchor bolt. The proposed research regarding tieback rods will involve similar propagation of bulk ultrasonic waves at the exposed end of a tieback rod. However, instead of looking for "early echoes" in the signal



Project number: 430820

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associated with cracks or fracture, the portion of the ultrasonic signal following the back wall echo will be investigated for evidence of loss of cross-section due to corrosion.

The development of an effective ultrasonic technique for inspecting tieback rods in sheet piling systems has the potential to save money by avoiding the costs of periodic excavation. Furthermore, an efficient ultrasonic inspection technique will improve safety and structural reliability by facilitating condition assessment of every tieback rod in a sheet piling system.

UPDATE:

This research is a continuation of work from 2007-2008. The second year's project tasks included completing the ultrasonic signal analysis and ultrasonic inspection procedure. Researchers also submitted an article to be published in the *Materials Evaluation* journal of the American Society for Nondestructive Testing (ASNT). Read the final report at www.transnow.org/publication/final-reports/documents/TNW2009-07.pdf



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A Self-Adaptive Toll Rate Algorithm for High Occupancy Toll (Hot) Lane Operations

(continuing)

OVERVIEW:

Research on the usage of HOV lanes indicates that HOV facilities are frequently underutilized even when general purpose (GP) lanes of the same roadway segment are congested. HOV lanes can play a bigger role in addressing urban traffic congestion. Over the past decade, a new concept called High Occupancy Toll (HOT) lanes has been developed to allow better utilization of these HOV facilities. A HOT lane allows single occupancy vehicles (SOVs) to use the lane provided that they pay a toll. By adjusting the toll rate, demand for a HOT lane can be effectively controlled and congestion can be avoided.

Setting the toll rate properly is crucial for HOT lane operations. On the one hand, if the toll rate is set too high, the HOT lane capacity may not be fully utilized. On the other hand, if it is too low, the HOT lane may become congested, traffic flow will break down and the total throughput of the road will be reduced. Therefore, the toll rate strategy should be carefully determined.

During this two-year project, researchers will develop a new toll rate algorithm using state-space-based optimization theory. Direct traffic measurements from on-road sensors, such as speed, volume, and lane occupancy, and variables calculated from them, such as travel time and vehicle delay, will be used to establish a discrete control state space. This toll rate algorithm is expected to generate a system-optimal toll rate dynamically based on real-time traffic detector measurements and predicted traffic information.

Thus far, researchers have completed:

- research into studies of related control theories,
- HOT lane system modeling,
- digital tolling controller design, and
- implementation of the self-adaptive toll rate algorithm (SATRA).

UPDATE:

This project is under a six month extension and will be complete in January 2010. Thus far, researchers completed studies of related control theories, HOT lane system modeling, digital tolling controller design, self-adaptive toll rate algorithm implementation, and simulation model development and calibration. Current tasks include system evaluation and research documentation. In addition, researchers published "A Feedback-Based Dynamic Tolling Algorithm for High Occupancy Toll (HOT) Lane Operations" in the *Transportation Research Record* and "Simulation-based Investigation on High Occupancy Toll (HOT) Lane Operations for Washington State Route 167" in the *Journal of Transportation Engineering*. Researchers are working on three additional papers to be submitted for presentation at the 2010 Annual TRB Meeting, including "Impacts of HOT Lane Operations on HOV Travelers," "Quantifying the Attractiveness of High Occupancy Toll (HOT) Lane Under Various Traffic Conditions Using Traffic Sensor Data," and "Analyzing System Performance for Washington State Route 167 High Occupancy Toll (HOT) Operations". The research team also made a presentation about the self-adaptive toll rate algorithm approach at the Second International Symposium for Freeway and Toll Lane Operations in June 2009. Upon the project's completion, a final report will be available at www.transnow.org/publication/final-reports/.

Freight Performance Measures (continuing)

OVERVIEW:

The State of Washington began to test truck performance measures in 2004, and this project will build upon lessons learned from that effort. The WSDOT and the Freight Mobility Strategic Investment Board funded the earlier study at the UW to develop a data collection system to cost effectively measure truck movements along specific roadway corridors and evaluate them against preset benchmarks. The study assumed that the proposed benchmarks could be used both to improve the truck improvement project selection process and to evaluate the effectiveness of the completed improvement projects. The findings from that report recommended that, with a much higher density of truck data and clear goals set by freight customers, on-board GPS devices may allow the public sector to track performance against goals.

With the growth in transponder, satellite, and cellular phone technology since 2004, it may now be feasible to track trucks at a lower cost. Tracking truck trips from origin to destination will help locate, measure, and analyze causes of delay and other performance attributes to determine where problems exist and whether highway improvements are closing performance gaps for freight customers. Combining data from these new technologies with more traditional sources of truck data, such as roadside counters and surveys, may increase the feasibility of developing useful performance measures.

UPDATE:

This project has been extended to conclude in June 2010. The first two years of research included documentation of truck-oriented freight performance measures and programs that are planned or in use in North America. A database of data from GPS vendor companies Qualcomm, Trimble/@-Road, and Sprint/Nextell/Turnpike Global and from the American Transportation Research Institute was built. The research team is developing tools to manipulate and analyze this data, which is stored in a high capacity server at the TransNow center. They will expand the database to include statewide data and improve the design and implementation of a truck data collection system. Other tasks included scanning nationwide truck performance measurement methodologies, determining customers' performance



Project number: 61-6327

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requirements, gathering and evaluation existing sources of truck data in Washington State, and designing and implementing a truck data collection system. Researchers have presented their findings to the Western Governors Associations and the TRB's Air Quality and Infrastructure Conference. Upon the project's completion, a final report will be available at www.transnow.org/publication/final-reports/.



Project number: 463258

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Structural Health Monitoring of Reinforced Concrete Columns Confined with FRP

(continuing)

OVERVIEW:

In the last few decades, extensive research has been carried out to develop strengthening techniques for reinforced concrete (RC) infrastructure using fiber reinforced polymer (FRP). When a RC structure is strengthened using FRP sheets, the bond between FRP and concrete plays a crucial role in the performance of the strengthened structure. The failure of RC columns strengthened using FRP starts when debonding of the most highly stressed FRP strip occurs. Early detection of debonding using structural health monitoring (SHM) of the strengthened member is the key to avoid such brittle failure. SHM can provide information concerning the development of debonding, which can be used to implement timely action for maintenance/repair to ensure the safety of structures. This research project will investigate the use of SHM of RC structures strengthened with FRP using Lamb waves.

UPDATE:

This project is a continuation of work from 2007-2008. Second year tasks included testing the design and construction of column specimens and analyzing and interpreting test results. The final report is available online at www.transnow.org/publication/final-reports/documents/TNW2009-08.pdf.

strengthening
using fiber
reinforced polymer

Long-term Development and Success Stories

A significant number of TransNow success stories that emerge each year are the fruition of several years of investment. Successful research projects, for example, lead to demands for further research and new funding for follow-up projects. Investments in young transportation professionals who are developing their research areas can lead to new sources of funding for their support. This year, TransNow can proudly give three examples of success stories that are the product of long-term and continuing development efforts: Developing an Area-Wide System for Coordinated Ramp Metering Control, Improved Freight Modeling of Containerized Cargo Shipments between Ocean Port, Handling Facility, and Final Market for Regional Policy Planning, and Precast Concrete Bridge Bent Designed to Re-Center after an Earthquake. Additionally, our faculty and executive staff continue to achieve recognition for their long-term work and are highlighted under Honors and Awards.

Research

DEVELOPING AN AREA-WIDE SYSTEM FOR COORDINATED RAMP METERING CONTROL – TRANSNOW REPORT: TNW2008-11

Contact:

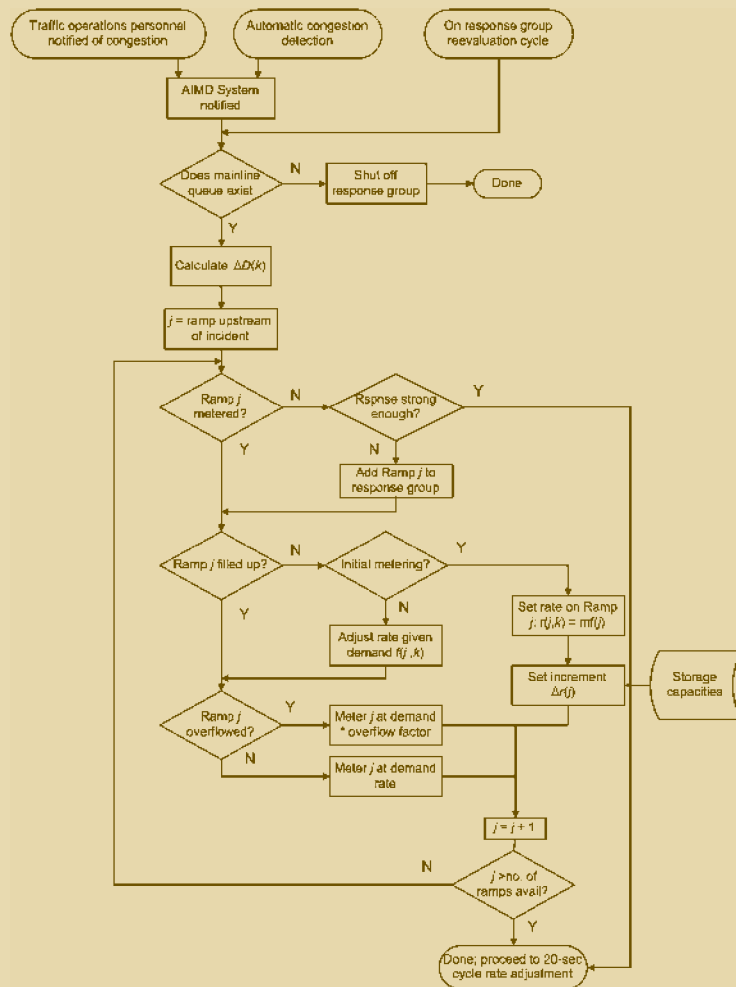
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Ramp metering is used to control freeway demand and break up long strings of vehicles merging onto a freeway. The result of implementing ramp metering is a reduction in secondary queuing within the merging area and a reduction in freeway congestion downstream from the ramp. Since the simplest ramp metering systems use pre-timed signals they are particularly useful for reducing recurring congestion that occurs at the same time and in the same place every day due to a lack of capacity. Since a major part of congestion is nonrecurring, which is congestion due to incidents or collisions, dynamic ramp meter control algorithms have the potential to provide larger benefits.

This project reviewed existing ramp metering algorithms and observed that some of them need a long start-up time for metering rates to get low enough to be effective, most do not proactively reduce the chance of vehicle spillover onto city streets and do not use ramp storage capacities to reduce mainline congestion.

A new algorithm was then developed to address these issues. It is inspired by the Additive Increase Multiplicative Decrease (AIMD) congestion control mechanism used in the field of computer networking. AIMD probes for usable bandwidth by additively increasing the transmission rate until loss occurs and then multiplicatively decreasing it until congestion is removed. The result is a saw-tooth type of algorithm behavior.

The objective of this AIMD algorithm is to curb the growth of traffic congestion and discharge vehicle queues as quickly as possible. This requires the establishment of a demand reduction target when the ramp meters start to work. Then ramp meters must be grouped to act together to address congestion simultaneously. The algorithm decreases the metering rate multiplicatively until the demand at the bottleneck is less than the reduced capacity. Then the algorithm additively increases the metering rate until the on-ramp demand is reached if no congestion is detected. If congestion is detected, the algorithm switches to the multiplicative decrease mode, again. This progress repeats during the control period. The AIMD algorithm also has a mechanism to prevent on-ramp spillover onto the adjacent local roadway. When the queue of cars completely uses all of the storage on a ramp, the metering rate is set at the arrival rate so the on-ramp storage space remains full; however, it does not spillover and affect the local street. (See a schematic of the algorithm's operation on the following page.)



AIMD algorithm response group flowchart

This algorithm was tested, using the VISSIM microscopic traffic simulation model, at two locations; both on Seattle freeways. One was northbound I-5 in northern Seattle and the other was westbound I-90 in Bellevue and Issaquah. The existing WSDOT ramp metering algorithm was also modeled to provide a benchmark for comparison. The simulation scenarios consisted of lane-blocking incidents during both peak- and non-peak-traffic conditions during two mid-week days in August 2006.

The AIMD algorithm outperformed the current ramp metering algorithm in most cases, reducing the average system wide vehicle delay and improving mainline travel. In particular, AIMD significantly reduced the average system wide delay by up to 28 percent. In one scenario, AIMD reduced ramp spillover onto surface streets, compared to the current WSDOT ramp metering algorithm, and still reduced system wide delay by a little over five percent.

The report recommends improvements to the AIMD algorithm that need to be modeled and additional experimental scenarios that need to be tested for further development of the algorithm before a field demonstration can be conducted.

IMPROVED FREIGHT MODELING OF CONTAINERIZED CARGO SHIPMENTS BETWEEN OCEAN PORT, HANDLING FACILITY, AND FINAL MARKET FOR REGIONAL POLICY PLANNING

– TRANSNOW REPORT: TNW2008-08

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The goal of this project was to create a regional freight model that considers the movement of containerized cargo through regional handling facilities. This model was designed to evaluate the affect of regional handling facilities on mode choice and to consider the affect of regional changes (land values or infrastructure development) on the logistics strategies of importers. The methodology considers the economic choices that shippers make which drive the decision to use such facilities. For example, transloading (transferring goods from 40 foot maritime containers to 53 foot domestic

containers to take advantage of reduced transportation costs) over direct shipping due to reductions in total logistics costs. The model is capable of providing insight into the relative sensitivity of regional changes on national import behavior and vice-versa. Examples of model applications include providing insight into the following questions:

- How would a truck-only lane affect the ratio of shippers that choose to transload containers originating at the Port of Seattle?
- How does the location of handling facilities in the Puget Sound area affect the logistics cost and mode choice?

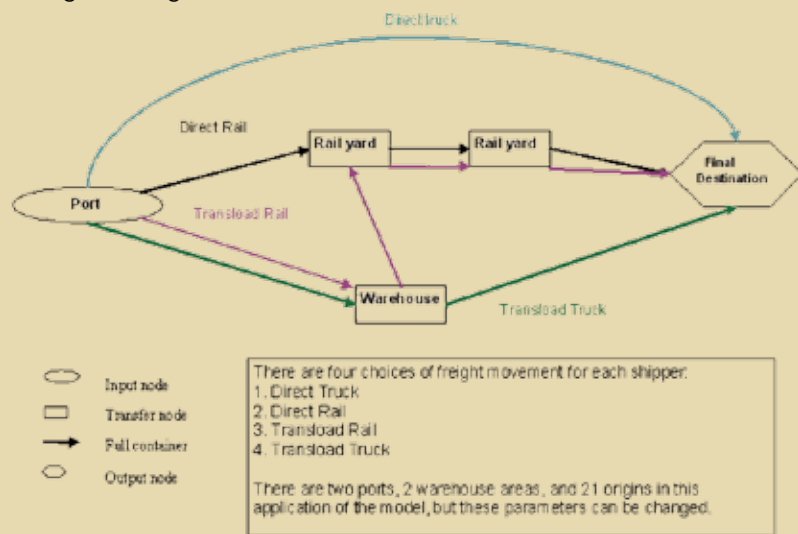
This research project developed a model that predicted mode choice and the decision to transload, based on characteristics of the shipper and their goods (the total volume of imports and the average value of the goods, for example). The model consists of two origin nodes (the Ports of Seattle and Tacoma) and four mode choices (see the figure at top right, facing page):

- direct shipping by truck,
- direct shipping by rail,
- shipping by truck and using a handling facility, and
- shipping by rail and using a handling facility.

There are 21 regions in the US that serve as final destinations. The allocation of commodity flows is made based on population and average income for each region. There are two components of cost in the model: transportation cost and inventory cost. A combination of these costs determines the route choice and mode choice for shippers. The model selects the least cost strategy by comparing the sum of transportation and inventory costs for each of the four strategies.

The value of the model was demonstrated through three case studies. The first looked at the installation of a truck only lane on SR 167. The second looked at how a significant consolidation of shippers would affect logistics strategies and the third considered the impact of a loss of cargo for specific destinations.

The model is an effective planning tool for considering the impact of system changes on logistics patterns and vice versa. The first case study demonstrated the relationship between regional infrastructure and national logistics strategies. A truck only lane would increase the benefit of transloading and therefore increase the demand on the truck only lane. The second case study demonstrated that consolidation of shippers saves logistics costs at the aggregate level and increases transloading activity. The third case study demonstrated that the model could be used to evaluate the impact of changes in national demand patterns on regional cargo flows.



Import Model Description and Flow Schematic

PRECAST CONCRETE BRIDGE BENT DESIGNED TO RE-CENTER AFTER AN EARTHQUAKE

– TRANSNOW REPORT: TNW2008-09

Contact:

John Stanton, Marc Eberhard, Laila Cohagen,
and Jason B.K. Pang
University of Washington
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206-543-6057

During an earthquake, conventional columns in a reinforced concrete bridge are likely to crack and yield, which leads to permanent displacements. These displacements can force bridge owners to close the bridge to traffic, even emergency vehicles, until it is either jacked back into position – which is unlikely – or demolished and rebuilt. The technology investigated in this project makes the bridge behave as though connected by rubber bands. If it does move during an earthquake, it suffers little damage due to the elastic connections and then it snaps back into place so the different parts remain aligned and traffic can use it as soon as it has been inspected.

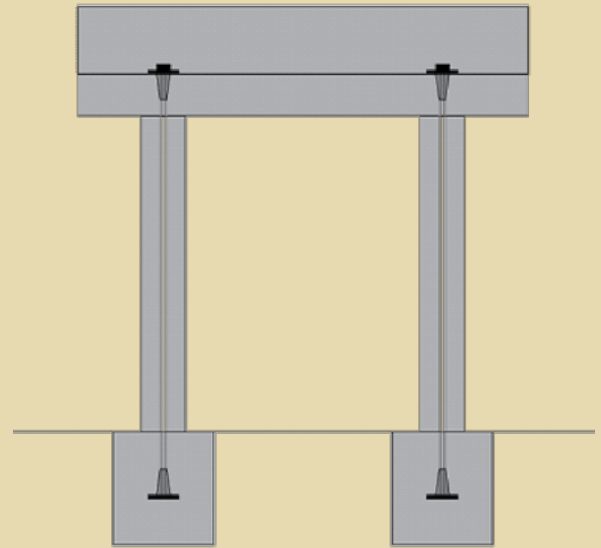
According to Professor John Stanton, one of the investigators on this project, this technology was first developed at the UW for use in buildings. “The tallest concrete building in San Francisco, which is 40 stories tall, uses it.” The UW research team is trying to adapt the technology for use in bridge columns. “It is actually pretty exciting stuff,” says Professor Stanton.

This study is part of a series of research projects conducted at the UW that have investigated the use of precast concrete components to accelerate the construction of bridges. The use of precast components can shorten construction time; thereby reducing traffic disruptions, improve work zone safety, and reduce life cycle costs. In precast structures, however, the connections between components are susceptible to earthquake damage. Most applications of precast bridge structures have been in regions of low seismic activity where connection damage is of little concern. In regions with significant seismic activity, concerns about connection damage have limited the use of precast bridge components.

In this study, the post-earthquake residual displacements (essentially the ability to re-center) of reinforced bridge bents that used precast cap-beam-to-column connections were investigated. (See the figure at right.) The bridge bent system had both mild steel reinforcing bars that were intended to dissipate energy thereby limiting the maximum displacements and an unbonded (free to move relative to the concrete) post tensioned tendon that was supposed to remain elastic and re-center the column. The columns tested had different mild steel to prestress ratios that affected their re-centering ability.

Three scale columns were tested: two designed to re-center and a control column tested in a previous study with nominal re-centering capability. The data from these tests were used to evaluate the relationship between re-centering capability, as predicted by a previously developed equation, and that achieved in practice.

The two test columns showed better re-centering capabilities than the control column. Recommendations for future designs to improve re-centering ability were made based on the results of these tests.



Re-centering bridge bent with prestressing strands

HONORS & AWARDS

Shane Brown (WSU) was awarded the American Society for Engineering Education (ASEE) Zone 4 Outstanding Paper Award for “In-Class Peer Tutoring: A Model for Engineering Education” at the ASEE Annual Conference in 2009.

Ken Casavant (WSU) was awarded the Sahlin University award for Leadership in February, 2009. The award was given to recognize Ken for demonstrating leadership and service to the university and the community that is above and beyond assigned academic duties.

Anne Goodchild (UW) was awarded the 2nd place prize for an outstanding paper on “Material Handling and Logistics” paper by the College-Industry Council on Material Handling Education in 2008.

Joe Mahoney (UW) was honored by the UW’s CEE Department to address the topic of transportation infrastructure and the road ahead to colleagues and peers at the endowed Henry Roy Berg Lecture in May, 2009. He was also selected by the TRB to give a lecture, “Dialog with Leaders in Design and Construction of Transportation Facilities” at the Annual TRB Meeting in January 2010.

Jennifer Sheldon (UW) was appointed to a three-year term on the TRB’s Technology Transfer Committee. The committee focuses on information exchange and research on the processes and methods for technology transfer and assists the TRB and other committees in their technology transfer endeavors.

Shihui Shen (WSU) was named Outstanding Faculty Advisor within the WSU CEE Department for the 2008-2009 year. In addition, she and three other faculty members were chosen by WSU’s Excellence in Science and Engineering Center to participate in the External Mentoring Program in order to develop career opportunities by expanding connections with industry leaders.

John Stanton and Dawn Lehman (UW), along with research assistant Meredith Anderson, were awarded the Engineering Structures Munroe Prize for their paper, “A Cyclic Shear Stress-Strain Model for Joints in Non-ductile Reinforced Concrete Frames”. Their work was awarded for the best paper published in the Engineering Structures journal in 2008.

Education

As part of our mission to bring talented professionals into the transportation field, TransNow provides funding to students seeking transportation-related degrees at the UW and WSU. This is achieved through TransNow's Advanced Institute program, established in 1991. Students and faculty at the UW and WSU are directly involved in transportation research and education, and have developed strong relationships with state transportation departments and other regional organizations through internship and fellowship programs and teaching and research assistantships.

In addition, TransNow provides match dollars for student awards from other transportation organizations such as the Women's Transportation Seminar (WTS) and the Institute of Transportation Engineers (ITE). TransNow sponsors students' attendance to various field-related conferences and meetings in the country. In 2008-2009, Advanced Institute provided funding for over 50 students at the UW and WSU.

We invite interested students to visit us at www.transnow.org or contact the center at transnow@u.washington.edu for more information.

Student Events

QUARTERLY STUDENT WELCOME EVENTS

TransNow sponsors welcome events for transportation students, faculty, and staff during fall, winter, and spring quarters. These events acquaint newcomers with returning members of the CEE community at the UW. The receptions also allow students to become familiar with academic resources provided by TransNow. This year, fall quarter commenced with a pizza and Pictionary, winter quarter included pizza and bowling, and spring quarter closed with pizza and billiards.

ANNUAL TRB MEETING

Each year TransNow provides travel funds for students to attend the TRB annual meeting in Washington, DC. Students are able to participate in presentations on the research projects for which they provided assistance as well as view other presentations on transportation research projects sponsored by other organizations from around the country. This year, participating students included: Chilan Ta, Yegor Malinovskiy, Junfeng Jiao, Runze Yu, Yao-Jan Wu, Ken Perrine, and Kari Watkins.



Runze Yu



Jon Corey



Left to Right: Chilan Ta, Runze Yu, Yegor Malinovskiy, Anna Lee, Li Leung, Ken Perrine, Guohui Zhang

I think attending TRB is stimulating. You get exposure to so many areas of research. It is invigorating giving you a lot of encouragement to come back and work on your own research. And undoubtedly, attending the TRB can lead to making connections within your field.”

Kelly Pitera, PhD Student

The TRB is such a rewarding experience in that you have the unique opportunity to network with other transportation professionals and academics. Having one place where nearly the entire transportation research community comes together to present and discuss their work makes the annual meeting an event that cannot be missed. I think that it cannot be emphasized enough that presenting at TRB and becoming involved with the committees is one of the first steps in becoming known in the field of transportation research.”

Kari Watkins, PhD Student

A STUDENT'S PERSPECTIVE

THE ANNUAL TRB MEETING: A REWARDING EXPERIENCE TO PURSUE

By Minh Huynh, WSDOT Intern and TransNow Fellow

Every year, a few selected students from the UW CEE and Urban Design and Planning Departments are granted with the opportunity to attend the Annual TRB Meeting in Washington, D.C. These students gather with thousands of transportation professionals and students from around the world in the nation's capital to share research with each other. Research covers all transportation modes with participation from individuals in the private sector, public sector, and academia.

To many, the TRB Meeting is an opportunity to present their work; a forum to network with peers in their field. Many students are performing research to write Masters theses or PhD dissertations. As part of this goal, students aim to have their research published and implemented in the real world. The TRB Meeting provides an excellent foreground for highlighting students' work.

To have the opportunity to present research at the TRB meeting, a student must complete quality research. Upon completing the research, a student and his or her faculty adviser submit to a TRB selection committee a paper or poster for presentation. The committee determines whether the research is appropriate for paper presentation or poster session. Research that is presented with a paper will also be published in the TRB's Transportation Research Record.

Presenting at the TRB meeting is a testament to the merit of student research. Students who are selected to attend the meeting move on to careers in transportation within academia, private industry, and the public sector. TransNow helps students achieve their pursuits by funding their attendance to the meeting.



Keynote speaker, Dr. Stephen Van Beek of the Eno Foundation, addresses students about future transportation policy

REGION X TRANSPORTATION STUDENT CONFERENCE

The Sixth Annual Region X Student Conference, open to transportation students in Federal Region X, was hosted by the UW in November 2008. Nearly 60 students gathered at the UW for the conference to share and discuss their work. In addition to student presentations and posters, the conference featured a panel discussion of transportation professionals on the push for sustainability and its affect on transportation careers. Eno Foundation president, Dr. Stephen Van Beek, provided the keynote address on *A New Era for Transportation Policy: 2009 and Beyond*. Sustainability and the future of transportation were key themes of the conference — an appropriate focus in current times and relevant to the concerns and hopes of the student population.

This year's conference was organized by a student committee from the UW. TransNow thanks Yao-Jan Wu, Kelly Pitera, Yegor Malinovskiy, Oran Viriyincy, Kari Watkins, Adam Parast, Ken Perrine, and Jon Corey for their tremendous efforts in hosting the conference. Additional thanks goes to Parsons Brinckerhoff, The Transpo Group, and UW's Star Lab for financial contributions.

The 2009 Region X Student Conference will be hosted by the University of Oregon in Eugene, Oregon. Stay posted for schedule updates and instructions about submitting projects for presentation.



Students from UW, WSU, UO, PSU, UI, and UAF attend the conference



UW Students Ken Perrine and Todd Merkens



Yao-Jan Wu, General Chair of the conference planning committee, and Rolando Melgoza and Chengyu Dai from PSU

2008 REGION X TRANSPORTATION STUDENT CONFERENCE: PRESENTATION AND POSTER WINNERS

BEST PRESENTATION

First Place: Meead Saberi Kalae (PSU) – Evaluating the Data Accuracy of Loop Detectors in Adaptive Signal Control Systems

Second Place (Tie): Kari Watkins (UW) – Reliability Measures: Which Statistics Will Actually Help Manage Our Roadways?

Ken Perrine (UW) – An Area-Wide System for Coordinated Ramp Meter Control

BEST POSTER

First Place: Nathan McNeil (PSU) – Bike Box Evaluation

Second Place: Li Leung (UW) – An Investigation of Commercial Vehicle Crossing Times at the Pacific Highway Port-of-Entry

Third Place: Huan Li (PSU) – Assessment of an Optimal Bus Stop Spacing Model Using High Resolution Archived Stop-Level Data

“What impressed me most about the conference was the diversity of research underway at our region’s universities and colleges. Each presenter and poster highlighted a different piece of the challenge facing transportation. The diversity at the conference well reflected how the transportation industry increasingly facilitates information technology and other new approaches to support multiple modes of travel and maximize the most of our transportation infrastructure.”

Todd Merkens, UW Masters Student and Tolling Engineer with WSDOT

Student Support Services

ADVANCED INSTITUTE: INTERNSHIPS AND FELLOWSHIPS

The TransNow AI program supports students through tuition assistance by partnering with various internship and fellowship programs offered by government agencies and private industries. Graduates and undergraduates were paid stipends by their employers while TransNow funded their tuition expenses. The following organizations partnered with TransNow to provide this support for the 2008-2009 year:

- Washington State Department of Transportation
- The Transpo Group
- DKS Associates
- WHPacific, Inc.
- Parsons Brinckerhoff
- Port of Seattle
- Seattle Department of Transportation



After a recruitment reception in winter 2008, students Yu Tang, Chuong Pham, and Luan Nguyen applied for TransNow funding. Yu and Luan are interns with TransNow fellowships, while Chuong is an RA.



Yu Tang, Intern for the SDOT

WSDOT'S TRAFFIC MANAGEMENT CENTER INTERNSHIP PROGRAM

By Luan Nguyen, 2008-2009 TMC Intern

Stuck in traffic on the freeway today? With growing populations and the same amount of roads, freeway congestion is increasingly becoming a common problem. While building more roads may help solve freeway traffic, it is highly costly. One solution is to manage the freeways and use their capacities as efficiently as possible. This role is assigned to the freeway flow operators at WSDOT.

During my internship as a Flow Operator at the WSDOT Traffic Management Center (TMC), I assisted in regulating the freeway flow in the Seattle area. As a flow operator, there are three primary tasks that must be maintained. The first task involves finding incidents that are blocking the freeway and communicating that to the public. Using closed circuit television cameras, flow operators are able to visually verify incidents on the freeways. Communication with the public is done by posting messages through WSDOT's website, variable message signs, and highway advisory radio transmitters. The second task is to maintain

safety by reporting locations of accidents to radio dispatch. The timely reporting of incident locations will aid emergency services in arriving at the scene in a timely fashion. WSDOT's incident response teams are also dispatched through the radio to clear blocking incidents and restore capacity to the freeways. The third primary task is to regulate the flow of traffic as congestion builds up. This is done by utilizing the onramp meters in heavy traffic areas. The meters will assist in releasing vehicles onto the freeway as fast as possible while preserving the flow on the mainline. These essential tasks help keep the freeways flowing and relieve the magnitude of traffic jams.

The WSDOT maintains TMCs across the state, including Shoreline, Tacoma, Bellingham, Vancouver, Yakima, Spokane, and Wenatchee with a winter operations center on Snoqualmie Pass. The TMCs are in operation 24 hours a day, seven days a week to help clear roads and keep traffic moving safely.

ADVANCED INSTITUTE: RESEARCH AND TEACHING ASSISTANTSHIPS

The AI program also provides financial support for student teaching and research assistantships, which allows students to advance their education through valuable field experience and training in the classroom and the laboratory. Work performed under the guidance of professors is often highlighted at events such as the Region X Student Conference, the Annual TRB Meeting, and other field specific conferences.



Ken Perrine, Research Assistant for Yinhai Wang



Chuong Pham, Research Assistant for Mark Hallenbeck



TRANSNOW LIBRARY

TransNow serves students and faculty at the UW CEE Department by offering a library facility equipped with copies of frequently requested journals, research reports, theses, transportation-related agency materials, newsletters, and textbooks.

EQUIPMENT FOR TRANSPORTATION STUDENT CHECKOUT

TransNow equipment available to students includes one Canon PowerShot SD1100 IS digital camera, four Kustom Signal radar guns, two Cannon L2A 8mm video cameras, one Sony Mini-DV camcorder, and one Dell laptop projector. A rental library of 10 Dell Inspiron 630m laptops is also available for transportation research and class work. Installed software includes: Microsoft Office, Microsoft Visual Studio, HCM 2000, and HCS+.

STUDENT AWARDS

The center matches student awards given by transportation organizations to further extend student opportunities. This year's participating organizations include:

- Women's Transportation Seminar
- Coral Sales Company
- John Conrad Transportation Scholarship
- Pertteet Engineering Graduate Fellowship

KARI WATKINS NAMED 2008 TRANSNOW STUDENT OF THE YEAR

Kari Watkins, UW PhD student, was awarded the 2008 TransNow Student of the Year for Federal Region X. She was nominated for her excellence in academic achievement and dedication to the local transportation community. TransNow awarded Kari \$1,000 and sponsored attendance to the Annual TRB Meeting in January 2009. She was also recognized by CUTC at the annual awards banquet held in conjunction with the TRB meeting.

At 15 years old, Kari left her hometown of Detroit to live in Germany, where her dreams formed for working in transportation. She was fascinated by a transportation system where everyone could easily get around without a car, enabling both the young and old to travel without relying on others. She returned to the US to obtain a Civil Engineering degree from Georgia Tech and went to work in consulting with Wilbur Smith Associates. Over the next decade, she worked on projects ranging from bus rapid transit studies to regional transportation visions. While obtaining her Master's degree at the University of Connecticut, she was asked to teach a few courses and she first developed her passion for educating engineers. After convincing her husband and two young daughters that her dream was worth

(continued on next page)



Kari accepts her award at the CUTC Awards Banquet

the risk, they sold a house, packed many bags and moved across the country to Seattle, where she began a PhD program at the UW. While at the UW, Kari has demonstrated excellence in academic achievement and commitment to the development of sustainable transportation and transportation choices. Her most recent projects include investigating travel time reliability and transit traveler information.

WOMEN'S TRANSPORTATION SEMINAR SCHOLARSHIPS

UW graduate students **Chilan Ta** and **Basma Makari** were awarded WTS scholarships for excellent academic achievement. Chilan, Masters student in transportation engineering and RA for Anne Goodchild, received the \$4,000 Shawna Mulhall Memorial Scholarship. **Basma Makari**, Masters student in transportation engineering and WSDOT fellow, received the \$4,000 Helene M. Overly Memorial Scholarship. TransNow provided additional funds for a total award of \$6,400 for each student.



Chilan Ta



Basma Makari

CORAL SALES COMPANY SCHOLARSHIPS

WSU undergraduates **Andrew Fegan** and **Stephanie Schlatter** and UW undergraduates **Celeste Hoffman** and **Ryan Mak** received \$1,000 scholarships from Coral Sales Company to honor their academic achievement. TransNow provided additional funds for a total award of \$1,600 for each student.



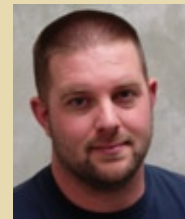
Andrew Fegan



Stephanie Schlatter

JOHN CONRAD TRANSPORTATION SCHOLARSHIP

WSU undergraduate student **Zack Stuteville** was awarded \$1,000 with the John Conrad Transportation Scholarship offered through the university's CEE Department. TransNow provided additional funds for a total award of \$1,600.



Zack Stuteville



Josh Van Wie

PERTEET ENGINEERING GRADUATE FELLOWSHIP

WSU Masters student **Josh Van Wie** was awarded the \$1000 Perteet Engineering Graduate Fellowship. TransNow provided additional funds for a total award of \$1600.



Joel Franklin



Ken Perrine

Where Are They Now?

The 320 graduates of the TransNow AI program continue to excel in various transportation-related fields. Below are highlights from a few graduates.

Joel Franklin (PhD 2006) is an Assistant Professor at the Royal Institute of Technology in Stockholm, Sweden. He teaches courses on Transport Policy and Evaluation as well as Geographic Information Systems in Transport Analysis. Currently, he is researching a few projects which include: *Intrapersonal Variations in Value of Travel Time Savings, With Implications for the Equity Effects of Congestion Pricing; Modeling Travel Time Reliability and Lateness for Drivers on Stockholm Highways; and Non-parametric Methods for Evaluating the Equity Effects of Transport Policies.*

Ken Perrine (MS 2008) began an internship with the Seattle Department of Transportation upon graduating in December 2008. His responsibilities include traffic operations and signal timing. Ken has been accepted to the University of Texas at Austin and is considering further education in computer engineering.



Xiaoping Zhang

Xiaoping Zhang (PhD 2004) is a Senior Engineer at DKS Associates in Seattle. As a transportation engineer, she has worked on corridor studies, traffic analysis, and simulation modeling. She presented some of her work at the Annual ITE Meeting in San Antonio, Texas in August 2009.

Student Spotlight

Yegor Malinovskiy—Yegor's interest in the transportation field was inspired by his two undergraduate majors: Civil Engineering and Computer Engineering. Taking advantage of this background, Yegor completed PedTrack, a pedestrian tracking program, during his senior undergraduate year and was named a Mary Gates Research Scholar in recognition for this effort. Continuing as a Master's student under the guidance of Professor Yinhai Wang, Yegor improved the initial algorithm to include bicycles and published his work in the Transportation Research Record (TRR), while becoming a member of the TRB's Bicycle Committee (ANF20). Although bicycle and pedestrian transportation issues continue to be a primary area of interest, Yegor also designed and implemented tools for vehicle detection while working as a Research Assistant for the UW Smart Transportation Applications and Research (STAR) lab.

More recently, Yegor's work involved developing a new occlusion-robust and environment insensitive algorithm for freeway vehicle detection. Details regarding this algorithm can be found in TransNow Report TNW2008-12 or TRR. Presently, Yegor is busy developing a Bluetooth travel-time measurement device that can inexpensively collect travel times along a particular corridor. This type of information is most valuable for



travelers and will eventually become a part of a large information system being created in STAR Lab.

To contrast arduous months in the lab, Yegor spends his summers traveling, making sure to observe the transportation infrastructure wherever he goes. His most recent adventures include Denmark, Chile, and Montenegro. In Denmark, Yegor spent several weeks learning about the Scandinavian approach to sustainable transportation and infrastructure through a UW program sponsored by the ScanDesign foundation.

Yegor plans to continue his studies as a PhD student under Prof. Yinhai Wang, and to use his technical skills and world experience to further advance the field, particularly in the areas of sustainable and responsible transportation.

“Yegor’s multi-disciplinary background makes him an ideal researcher in ITS. Yegor has been involved in the STAR Lab research since his junior year and has demonstrated great capability and creativity in his research. He is a very productive researcher and has published three journal articles, which is remarkable for a student of his age.”

Yinhai Wang, Associate Professor, UW



Outreach

TransNow implements outreach programs each year to foster a spirit of learning within the community. Some outreach activities include volunteering for transportation-related or education-based events. Others highlight regional partnerships as TransNow and other Region X UTC partners celebrate each others' achievements.



Region X Students of the Year (SOY) were honored at the Region X Reception held in conjunction with the TRB meeting. Pictured from left to right are: AUTC Director Billy Connor, TransNow SOY Kari Watkins, NIATT Director of the Center for Clean Vehicle Technology Karen Den Braven, TransNow Director Nancy Nihan, NIATT SOY Nicholas Harker, OTREC Director Robert L. Bertini, and OTREC SOY Christo Brehm.

REGION X TRANSPORTATION CONSORTIUM HOSTS ANNUAL RECEPTION

The Region X Transportation Consortium (RXTC) hosted a reception at the 88th Annual Meeting of the TRB in Washington, DC. The annual RXTC reception provides an opportunity for transportation professionals, educators and students to visit with colleagues from the four state region of Alaska, Idaho, Oregon and Washington. For the first time, the UTC Students of the Year (SOY) were introduced (see picture).

The RXTC was officially formed in January 2008 through a memorandum of understanding and includes the four state DOTs and the four UTCs from Oregon, Washington, Idaho and Alaska. The RXTC is currently sponsoring a pooled fund project led by OTREC to examine the impacts of climate change on surface transportation in the Northwest. This project will involve faculty from OTREC and the University of Alaska, Fairbanks.

For more information on the RXTC visit www.transnow.org/regionx/.

STUDENT VOLUNTEERING

Every year, TransNow students volunteer for an event or project within the transportation community. As part of the requirement for funding, students give back by helping to build a stronger community through education. In the past many of our students volunteered at the UW College of Engineering Open House, but as that event has been postponed until spring 2010 students branched out to other avenues of volunteering including guest writing for our publications, taking photos at TransNow-sponsored events, improving or creating new Open House exhibits, and more. We are grateful for the hard work of our many dedicated students. Below are a few highlights from this year's volunteer projects:



5th grader Justin Ting stands beside his presentation, Solar Speed Racer.



UW Student Anna Lee and 5th grader, Joshua Romano.

UW STUDENTS VOLUNTEER AT LAURELHURST ELEMENTARY SCHOOL SCIENCE FAIR

By Anna Lee and LisaRene Schramm, with input from Peter Liu

In March, Laurelhurst Elementary School held a Science Fair for its kindergarten through 5th grade students. The theme this year was "Sustainable You and Inventions," and students were encouraged to do presentations or experiments regarding environmental and/or innovative topics. In order to help the children define and focus on project ideas, UW students worked with 5th graders during school visits.

Laurelhurst students met with the UW students to brainstorm ideas for a project. The ideas ranged from the more mechanic: "During what time of day do solar powered cars work the best?" to the organic: "Can my chinchilla power a light bulb faster than I can?" Some more innovative projects included mouse trap cars, "human batteries" and rocket powered steamboats. As brainstorming continued, UW students helped the children determine hypotheses, establish experiments, create step by step plans to accomplish their experiments, and learn how to present their findings.

On the day of the science fair, UW students Anna Lee, LisaRene Schramm, and Peter Liu donned white lab coats as they judged projects and listened to the student presentations. Laurelhurst students were asked about their understanding of the scientific process and about the significance of

their findings. The children were judged on their scientific knowledge, creativity, technical skills, and presentation and display skills.

According to Liz and Mark Hoffman, parents of two science fair participants, the children "left the night feeling proud of their work and encouraged by the judges." One of the Science Fair Committee members, Arlene Murray, mentioned in a post-wrap-up email that "it was obvious from the presentations that the science fair participants were enthusiastic about their inventions and experiments and that they learned much about experiment design and the scientific process." Peter said of his experience that "when I was the same age I did not know most of the stuff they know right now... The two projects that I liked the most were the *Carbon Footprint* and the *Volcano Eruption*." The science fair was a great opportunity for UW students to use their science and math backgrounds to help inspire young kids to learn and have fun.

Anna and LisaRene completed the Master's program in transportation in spring 2009. While at the UW, Anna was a WSDOT and TransNow fellow. LisaRene was a DKS intern and TransNow fellow. Peter Liu received his undergraduate degree and was a WSDOT Traffic Management Center intern and TransNow tuition scholarship recipient.

STUDENT'S QUESTION MOLDS CEE WEBSITE PROJECT

By Jie Sheng

What exactly do transportation engineers do? That's a question I had when I first entered the CEE Department, and a question common among prospective engineering students. With this question in mind, I started a project to help create a resource on the CEE website in order to inform and excite students about transportation engineering. The goal of this project is to find websites, articles, videos, pictures, and blogs that will give insights about the field of transportation engineering in Washington and in countries around the world. The project demonstrates the variety of challenges and opportunities transportation engineers come across, as well as a lot of cool stuff they get to do. My accomplishments so far have been focused on transportation work in Washington State. I've found videos simulating each replacement option for the Alaskan Way Viaduct, and articles discussing the

planning process of transportation engineers for this project. I've included photos of the Wilburton Tunnel demolition process, and various traffic conditions transportation engineers must deal with (multi-car pileup accidents, severe weather conditions, horrific traffic etc). In addition, there are many website links that provide information on all the remarkable things transportation engineers get to do. My hope for this project in the future is to find amazing transportation projects around the world, to provide prospective students with a look at the many different endeavors transportation engineers get to participate in, and to get students excited about unique field of transportation engineering.

Jie finished her undergraduate education at the UW. During her junior and senior years, she was a WSDOT Traffic Management Center Intern and recipient of the TransNow tuition scholarship.

Technology Transfer

Technology Transfer is an important part of the Center's program. At the proposal stage of research, PIs submit an implementation plan describing their intentions for disseminating the results of their research. At each semi-annual period during research, PIs update their implementation plan to report technology transfer activities accomplished during the period. To ensure that research results are readily available to potential users in a form that can be directly implemented or utilized, TransNow staff also performs technology transfer activities. These technology transfer activities include publishing final reports, newsletters and annual reports, all of which are posted on the TransNow website. Newsletters and annual reports are also distributed to the organization's contact list and can be sent via email. In an effort to reduce the impact on the environment, TransNow is increasing its email distribution of publications. To take advantage of receiving publications via email, contact transnow@u.washington.edu.



PhD student Dean Chahim speaks about Engineers without Borders outreach efforts in Bolivia

TRANSNOW ADVISORY COMMITTEE MEETING

The TransNow Advisory Committee met on June 11, 2009 at the University Club on the UW campus. The meeting focused on partnerships that TransNow has formed with local agencies and industry to conduct transportation research.

One of these was the collaboration between the Freight Mobility Strategic Investment Board (FMSIB), WSDOT, Washington Trucking Associations and TransNow to investigate truck performance measures. Professor Ed McCormack gave a briefing on the project and Karen Schmidt, FMSIB Executive Director, discussed the importance of this work to the trucking industry.

Professor Mark Haselkorn discussed another partnership led by the UW Department of Human Centered Design and Engineering (formerly Technical Communications) that included TransNow researchers and staff from agencies and organizations concerned with security at our borders with Canada and Mexico.

Examples of partnerships with other Region X UTCs, state departments of transportation in the region, local transportation agencies and port districts were discussed. Ideas for other partnerships were requested from those in attendance.

TRANSNOW COMMUNICATION CENTER

The TransNow Communication Center (TCC) was designed for parties affiliated with the UW to easily meet with remote parties via audio and/or video conference. Holding meetings in the room is a financially viable option, as the TCC possesses the capability of sharing video and PowerPoint content with meeting participants. The room is designed to fit 10 active participants, 10 observers, and one presenter. It is suitable for meetings and lectures, and boasts the capability of recording presentations onto DVD or creating a computer file for sharing on the internet. For more information about the TCC, visit www.transnow.org/about/tcc/.



TCC Room

WEBSITE: WWW.TRANSNOW.ORG

The TransNow website was re-designed this year in an effort to provide more information about our education and research arms and decrease our carbon footprint. One feature we added was a page providing links to our students' Masters Theses and PhD Dissertations that are available for online download or purchase through the UW Engineering Library. We also improved our RFP process so that proposals can be made and reviewed online. TransNow's website received 9,054 visits in 2008-2009. 1,823 visits came from 104 countries outside the US. 7,231 visits came from people within the US, with 3,312 of those being from Washington State. 67 percent of visitors had never visited our site before. The website consists of the following sections:

Home

- Contains up-to-date news information about the Center and Region X

About Us

- Provides information about TransNow's mission, staff, directory, location, and the TransNow Communication Center

Research

- Contains information about current and past research projects, reporting requirements and deadline information for principal investigators

Education

- Provides information on the TransNow Advanced Institute program, including alumni's Masters Theses and PhD Dissertations, additional funding opportunities, equipment checkout availability, Research Library catalog, helpful software and web applications for courses and research, and UW and WSU transportation engineering course requirements

RFP

- Provides a web-based process for submitting research proposals for new and continuing research, Advanced Institute funding, and conducting proposal reviews

Publications

- Contains TransNow's annual reports, newsletters, research project descriptions, and final reports

Links

- Lists links and contact information for many agencies and transportation related resources

Region X Consortium

- Provides an overview of the Region X Transportation Consortium, a regional directory, and information on the Region X Student Conference

NEWSLETTERS

The TransNow Newsletter contains highlights of research, student achievements, events, and news pertaining to the TransNow center and the Region X Transportation Consortium. The newsletter is published three times per year and posted to the TransNow website as well as distributed to approximately 2750 people via email and postal mail.

Paper Presentations at the 2009 Annual Meeting of the Transportation Research Board

The following papers are products of collaboration between TransNow and other transportation-related entities.

PRESENTER/AUTHOR	CO-PRESENTERS/AUTHORS	TITLE OF SESSION	TITLE OF PAPER/PROJECT
Sanjeev Adhikari (MICHIGAN TECHNOLOGICAL UNIVERSITY)	Shihui Shen (WASHINGTON STATE UNIVERSITY), Zhangping You (MICHIGAN TECHNOLOGICAL UNIVERSITY)	<i>Evaluation and Characterization of Asphalt Mixtures in the Laboratory and Field</i>	<i>Evaluation of Fatigue Models Based on Laboratory Testing of HMA</i>
Selmin Creamer (WASHINGTON STATE UNIVERSITY)	Eric Jessup, Ken Casavant (WASHINGTON STATE UNIVERSITY)	<i>Innovations in Statewide Planning</i>	<i>Econometric Modeling and Forecasting of Annual Vehicle Miles of Travel for Washington State Highways</i>
Anne Goodchild (UNIVERSITY OF WASHINGTON)		<i>Data on Goods Movement Impacts on Air Quality Issues</i>	<i>Looking Forward: Next Steps for Improving Goods Movement Data</i>
Anne Goodchild (UNIVERSITY OF WASHINGTON)		<i>Assessing and Addressing the Impacts of Border Inspections on International Trade in an Evolving Global Environment</i>	<i>FAST Program and Its Impact on Cross-Border Trade in Cascade Gateway Trade Corridor</i>
Steven Greenwood (WASHINGTON STATE UNIVERSITY)	Mohamed ElGawady, William Cofer, David McLean (WASHINGTON STATE UNIVERSITY)	<i>New Solutions for Concrete Materials</i>	<i>Performance of Hollow-core Prestressed Concrete Piles Under Lateral Loading</i>
Hai Huang (UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN)	Shihui Shen (Washington State University), Erol Tutumluer (UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN)	<i>Railroad Track Structure System Design Committee</i>	<i>"Sandwich" Model to Evaluate Railroad Asphalt Trackbed Performance Under Moving Loads</i>
Yunteng Lao (UNIVERSITY OF WASHINGTON)	Yao-Jan Wu and Yinhai Wang (UNIVERSITY OF WASHINGTON), Xiaoguang Yang (TONGJI UNIVERSITY, CHINA)	<i>Planning for Pedestrians</i>	<i>Applicability of Signalized Single and Double Phase Midblock Crossings in Highly Populated Areas</i>
Lin Lin (UNIVERSITY OF WASHINGTON)		<i>Dwight David Eisenhower Transportation Fellowship Program Research Showcase, Part 3</i>	<i>Predicting Pedestrian Collision Frequency on State Routes in King County, Washington</i>
Yegor Malinovskiy (UNIVERSITY OF WASHINGTON)		<i>Research in Bicycle Transportation</i>	<i>Computer-Vision Algorithm for Automated Data Collection on Shared Pathways</i>
Yegor Malinovskiy (UNIVERSITY OF WASHINGTON)	Yao-Jan Wu and Yinhai Wang (UNIVERSITY OF WASHINGTON)	<i>Detecting Traffic</i>	<i>Video-Based Vehicle Detection and Tracking Using Spatiotemporal Maps</i>
Steve Muench (UNIVERSITY OF WASHINGTON)		<i>Sustainable Construction</i>	<i>Rating Your Project for Sustainability: The Greenroads Rating System and How Construction Contributes</i>

PRESENTER/AUTHOR	CO-PRESENTERS/AUTHORS	TITLE OF SESSION	TITLE OF PAPER/PROJECT
Steve Muench (UNIVERSITY OF WASHINGTON)	Jeraloe Anderson (UNIVERSITY OF WASHINGTON), Martina Soderlund (STANTEC, INC.)	<i>Sustainability Issues in Pavement and Asset Management</i>	<i>Greenroads: Development of a Sustainability Rating System for Roadways</i>
Kenneth Perrine (UNIVERSITY OF WASHINGTON)	Yunteng Lao and Yinhai Wang (UNIVERSITY OF WASHINGTON)	<i>Freeway Operations</i>	<i>Areawide System for Coordinated Ramp Meter Control</i>
Shihui Shen (WASHINGTON STATE UNIVERSITY)	Ho-Ming Chiu (WASHINGTON STATE UNIVERSITY), Hai Huang (UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN)	<i>Fatigue and Healing in Asphalt Binders</i>	<i>Fatigue and Healing in Asphalt Binders</i>
Chilan Ta (UNIVERSITY OF WASHINGTON)	Anne Goodchild and Kelly Pitera (UNIVERSITY OF WASHINGTON)	<i>Freight Systems Research</i>	<i>Structuring a Definition of Resilience for the Freight Transportation System</i>
Anne Vernez Moudon (UNIVERSITY OF WASHINGTON)	Lin Lin, Junfeng Jiao, Phil Hurvitz (UNIVERSITY OF WASHINGTON), Paula Reeves (WASHINGTON STATE DEPARTMENT OF TRANSPORTATION)	<i>Pedestrian Safety</i>	<i>Risk of Pedestrian Injury and Fatality in Collisions with Motor Vehicles: An Ecological Study of State Routes and City Streets in King County, Washington</i>
Yao-Jan Wu (UNIVERSITY OF WASHINGTON)	Mark Hallenbeck and Yinhai Wang (UNIVERSITY OF WASHINGTON)	<i>Innovations in Transportation Planning Applications</i>	<i>Interaction Between Arterial and Freeway Performance: Case Study</i>
Hee-Jung Hwang (PUSAN NATIONAL UNIVERSITY, KOREA)	Un-Kun Lee (BUSAN KYUNGSANG COLLEGE, KOREA), Kwang-Ryul Baek (PUSAN NATIONAL UNIVERSITY), Yao-Jan Wu and Yinhai Wang (UNIVERSITY OF WASHINGTON)	<i>Applications of Intelligent Transportation Systems: Monitoring and Managing Traffic</i>	<i>Stereo Image Processing Algorithm for Preceding Vehicle Detection Using Lane-Related Information</i>
Runze Yu (UNIVERSITY OF WASHINGTON)	Yinhai Wang (UNIVERSITY OF WASHINGTON) and Guohui Zhang (THE UNIVERSITY OF TEXAS AT AUSTIN)	<i>Freeway Operations</i>	<i>Loop Detector Segmentation Error and its Impacts on Traffic Speed Estimation</i>
Jianyeng Zhang (MARYLAND STATE HIGHWAY ADMINISTRATION)	Xiaolei Ma and Yinhai Wang (UNIVERSITY OF WASHINGTON), Ping Yi (UNIVERSITY OF AKRON)	<i>Fundamentals of Traffic Detection for Signal Timing</i>	<i>Measuring Signalized Intersection Performance in Real Time with Traffic Sensors</i>



Funding and Expenditures

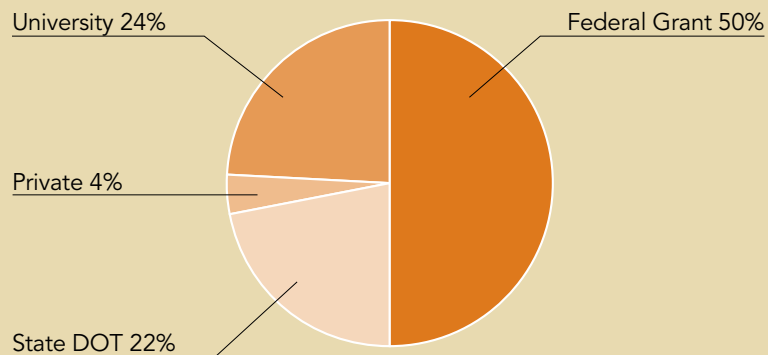
FINANCIAL PARTNERSHIPS

Strong financial partnerships and solid financial commitments from local, state, and regional organizations throughout Federal Region X have evolved through the UTC 100 percent match requirement. In addition to cash and in-kind match for research projects, all scholarships, fellowships, and internships provided by TransNow require a non-federal cash match.

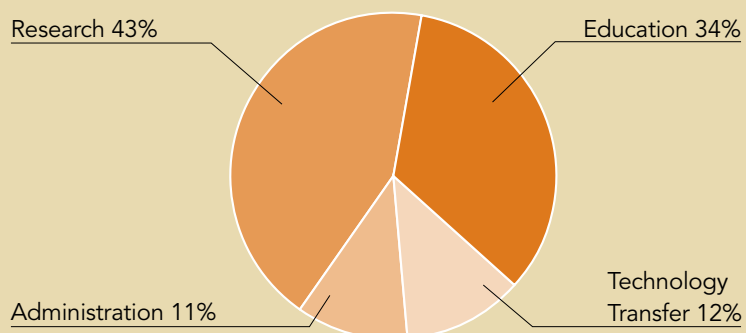
The following companies, public agencies, professional societies, and scholarship programs teamed up with TransNow during the 2008-2009 year to provide matching dollars for TransNow funded research and scholarships and internships to TransNow's students.

- Microsoft Gift Fund
- Private Software Funds
- Ford Gift Funds
- Los Angeles Alliance for a New Economy
- Washington State Department of Transportation
- Washington State University
- University of Washington
- ENO Transportation Foundation
- Washington State Section Institute of Transportation Engineers
- Women's Transportation Seminar
- Valle Scholarship and Scandinavian Exchange Program
- Coral Sales
- WHPacific, Inc.
- KPFF Consulting Engineers
- DKS Associates

FUNDING SOURCES



EXPENDITURES





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