Western Transportation Institute
University Transportation Center

2010 Annual Report

(For the period October 1, 2009 - September 30, 2010)

College of Engineering
Montana State University

MONTANA STATE UNIVERSITY
College of ENGINEERING

Contact Information:
Western Transportation Institute
P.O. Box 174250, Bozeman, MT 59717-4250

Phone: 406-994-6114
Fax: 406-994-1697
Web: westerntransportationinstitute.org

Note:
WTI is a department of the College of Engineering at Montana State University

Report Staff:
Carla Little
Carol Diffendaffer
Dana May

Photography:
Neil Hetherington

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MESSAGE FROM THE DIRECTOR

Integrated Approaches to Complex Problems

American history can be viewed in three transformative ages: starting from the agrarian age, moving through the industrial age, and now shifting into the information age. Transportation has largely followed suit, with the horses, wagons, and sailing ships of the 19th century being replaced by the cars, trains, and airplanes of the 20th century. As we adapt to the new realities of the information age, we must expect that our transportation system will undergo fundamental change as well.

The challenges before us are formidable, but the opportunities are exciting. A modern transportation system must focus on more than moving people and products from point A to point B – a more holistic approach is necessary to incorporate the economic, social and environmental changes that are also taking place.

University Transportation Centers provide a synergistic environment where these systematic changes can take shape and develop. At WTI, our programs are designed to nurture and accelerate this transformation:

• Research.

Our research projects increasingly take a broad view, bringing in researchers from different disciplines or stakeholders with various interests, in order to ensure that multiple ideas and points of view are considered. We also embrace the possibilities presented by new technologies to address long-standing challenges.

• Education.

Our educational programs reach out to students across a broad range of ages, backgrounds, and academic interests, in order to expand and diversify the base for the next generation of transportation professionals.

• Technology Transfer.

Our technology transfer programs embrace both extensive stakeholder outreach efforts as well as new training tools like webinars to move toward substantially more rapid and widespread implementation of transportation advancements.

In this Annual Report, you will read about some of our efforts in each of these three areas that support the concept of long-term change and adaptation of the national transportation infrastructure.

WTI appreciates the support of the Research and Innovative Technologies Administration and all of our other national, state, and local research partners who have contributed to our accomplishments in 2010. We look forward to our ongoing collaborations to reshape where we're going and how we get there.

Steve Albert, Director

MANAGEMENT STRUCTURE

The University Transportation Center management approach is designed to accomplish the following objectives:

- to provide for high quality, multi-discipline research, education, and technology transfer;
- to provide the Center's oversight members with clear, concise and accurate reports of Center activities so that they may adequately guide the long-term development of the Center;
- to utilize WTI/MSU resources (research and training facilities, human resources, physical facilities and institutional support capabilities) to maximize efficiency; and
- to establish clearly-defined roles, responsibilities, policies and procedures for all staff.

Management of the Center requires attention to the selection and conduct of research, education, and technology transfer activities, as well as careful control of expenditures. WTI has established a process for management of the Center's research, education, and technology transfer activities and utilizes the systems, policies, and procedures already in place that have been developed by WTI or that have been in place at MSU to manage funds, equipment, and personnel.

Financial administration of Center monies occurs both in-house and through the MSU Office of Sponsored Programs (OSP). The two entities perform different yet complementary aspects of financial management. The Director and Center Management rely on both sources of information to make financial decisions and oversee program development.

The Center Director manages personnel both directly and through a team approach that follows the chain of command shown in the accompanying figure. In addition to regular meetings with key staff, the Director maintains an open door policy to address conflicts or problems of a more sensitive or serious nature. Personnel are encouraged to express their concerns and provide input both in writing and verbally. WTI management staff members (Research Director, Assistant Directors, and Program Managers) are required to meet annually with the Director for a performance review. This review provides the Director with the opportunity to assess the employee's performance in the preceding year. In addition, the employee is provided the opportunity to assess their satisfaction or displeasure with their level of responsibility, challenges, workload, compensation and other issues related to WTI and Center management.

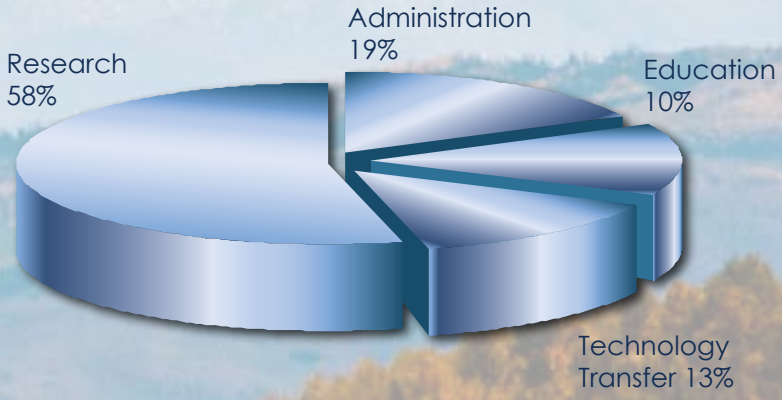
FINANCIAL STATEMENT

The following pie charts illustrate allocations and funding sources for the Western Transportation Institute's UTC programs during Year 4. Figure 1 shows the breakdown of expenditures and allocations of the federal portion ($3,243,300) of the UTC program for Year 4. Approximately $331,000 was allocated for the Education Program and $1,874,000 has been committed for research projects and laboratory/equipment funding. The remaining $1,038,000 supports the administrative and technology transfer function of WTI.

The second figure depicts the Year 4 funding sources for the WTI UTC Program. The match for the USDOT portion is by state departments of transportation and through the support of various private foundations.

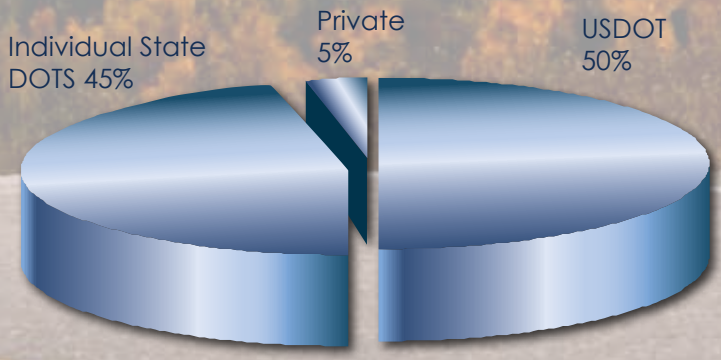
Allocations for Year 4:

October 1, 2009 - September 30, 2010



Funding Sources for Year 4:

October 1, 2009 - September 30, 2010



Research Director's Message

The challenges of creating an advanced, efficient, national transportation system require that we look beyond traditional solutions. So, how do you change the solution? One way is to change the equation.

Traditionally, a lot of transportation research has followed a standard formula: state DOT roadway problem + university-based engineer + federal funds = targeted solution. While effective, it is not the only path to new findings or practices. In fact, it can be a rather limited approach for addressing the broad range of emerging, complex transportation challenges, such as safe driving behavior, rapid freight mobility, energy efficiency, and environmental protection.

To achieve new, more comprehensive results, we have to transform the components of the research formula in a fundamental way:

• Shift the starting/vantage point.

What if you change the direction of the research by defining the problem in a different way? In WTI's road ecology program, we look at the issue of animal vehicle collisions from the perspective of the animals as well as the drivers. The result has been a range of strategies that provide animals with safe passage across the roadway and protect drivers from accidents at the same time.

• Diversify your research team.

Multi-disciplinary teams of researchers bring new ideas and broader viewpoints to the mix – and produce more holistic results. Transportation affects and is affected by economics, resource sciences, planning, and public policy, so why not add researchers from these fields?

• Embrace new research tools.

Emerging technologies can enable transportation solutions that would not have been feasible ten years ago. New tools within our research facilities themselves can also take testing, analysis, and product development in different directions.

• Expand the stakeholder base.

Collaborating with a broad range of public, private and non-profit research partners not only expands access to resources, it also helps ensure that your work will have a widespread impact.

This is not the first time that WTI has set out to redefine the transportation research environment. More than a decade ago, when advanced technologies such as Intelligent Transportation Systems were only deployed in urban areas, we spearheaded numerous projects to study the differences when you moved them to a rural setting. In this way, we helped establish rural issues as an ongoing focus area within the field of transportation research.

In 2010, we continue and expand our efforts to transform how transportation research is conducted. In this section, you will read about some of our most innovative projects, ranging from an ambulance study that begins by focusing on the safety of the emergency services personnel to a fish passage study that started as a data collection effort and ended with the construction of a research testbed.

RESEARCH

Featured Projects

Highlighted below are four notable UTC research efforts from the past year drawn from WTI's extensive portfolio of active projects. In some cases, these projects were selected for addressing issues that will have long-term fundamental impact on the U.S. transportation system. In other cases, they showcase changes to the research process itself, such as creative research team collaborations and development of new research tools or facilities.

Naturalistic Safety Evaluation of a Medic's Work Environment During Rural Emergency Response

Approximately 6,500 ambulance collisions occur every year, injuring an estimated ten people per day, and resulting in two fatalities per week. As they reach for equipment and supplies, hang IV bags, and perform CPR and other procedures in the back of a fast moving ambulance, emergency medical service (EMS) personnel are often not restrained by a safety belt. Thus EMS personnel experience an occupational fatality rate almost five times higher than the general public.

In this first of its kind project, WTI has partnered with the non-profit Critical Illness and Trauma Foundation and a major industry provider of emergency medical services, American Medical Response, to observe the conditions of emergency medical personnel while working in a moving vehicle. This observation includes the use of onboard monitoring equipment that allows for review and evaluation of movements of medics during emergency response. While studies utilizing onboard monitoring equipment have been conducted to observe driver behavior in passenger vehicles, this study is the first to be done in an ambulance as it responds to emergency situations.

The naturalistic data collected covering over 500 hours and more than 10,000 miles of travel will allow researchers to analyze the rural emergency driving environment to identify contributing factors to critical driving events, contributing factors to attending medic behavior, and severity of biomechanical forces experienced in the driver and patient compartment. Based upon research findings, the project will include development of a series of environmental, ergonomic, policy, and training recommendations, designed to mitigate circumstances that cause potentially unsafe operations in the driver's and patient's compartment of an ambulance.

US 93 Wildlife Monitoring Plan

Currently, the most extensive wildlife–crossing mitigation project in North American in terms of road length and the number of crossing structures is on a 56 mile segment of highway US 93 north of Missoula, Montana. Referred to as "The People's Way," this stretch of US 93 is regionally an important arterial that runs through a rich wildlife habitat and the Flathead Indian Reservation, homeland to the Salish, Kootenai, and Pend d' Oreille native American tribes. When it became necessary to upgrade the roadway in response to increasing traffic and associated highway safety issues, a unique agreement was forged between the Confederated Salish and Kootenai Tribes, the Federal Highway Administration, and the Montana Department of Transportation incorporating a wide array of new concepts in highway design and construction that has the potential to change the way our roads are designed in the future. Engineers and wildlife biologist developed designs that stressed motorist safety, acknowledged and respected the cultural and historical values of the Tribes, attempted to better fit the highway to the landscape, and mitigated direct road mortality and the barrier effect of roads and traffic on wildlife. Today, this stretch of US 93 is host to more than 40 wildlife crossings designed to accommodate safe crossing opportunities for a wide range of species ranging from fish and turtles to deer and grizzly bears.

While numerous wildlife mitigation strategies have been deployed and evaluated in the past, many of these projects have been located in relatively unpopulated and often protected environments (i.e, parks, public lands, etc). This project is somewhat unique in that it involves the implementation of these strategies in a mixed use environment (public land, commercial and residential property, and tribal lands). Early in the project's history, WTI was contracted to assess wildlife crossing activity prior to construction at selected locations where cross-

Featured Projects *Continued*

ing structures would be placed. From 2002-2005, WTI researchers used tracking beds to sample highway crossings, primarily of deer and bears. The results provided an excellent baseline for evaluating the effectiveness of the crossing structures which have now been built at these locations. Over the next five years, in the follow-on project jointly funded by the Montana Department of Transportation, the UTC program, the Federal Highway Administration, and the Confederated Salish and Kootenai Tribes, WTI and its partner, the Confederated Salish and Kootenai Tribes, are collecting data on animal-vehicle collisions and use of the crossing structures by different species. Where sample size allows, this data will be used to statistically analyze the effects of the mitigation measures on human safety and safe crossing opportunities for wildlife, as well as to determine their overall cost-to-benefit ratio. These analyses will determine if the objectives of the context sensitive design process were actually realized relative to improved safety and mitigating wildlife impacts, which will benefit future wildlife-vehicle collision reduction work around the country.

Automated Safety Warning Systems Controller

Building on an already solid partnership with an impressive history of delivering intelligent transportation systems to rural areas, WTI and the California Department of Transportation (Caltrans) have been developing the Automated Safety Warning Controller (Controller) device. This roadside system, designed specifically for rural applications, monitors road and weather conditions in remote areas and directly updates driver warning systems accordingly. Currently, highway and weather sensor information is analyzed by Traffic Management Center (TMC) operators, and warnings are subsequently issued through their actions. As may be obvious, this process is subject to the operating hours of the TMC, as well as the reliability of remote communication lines in severe weather conditions. These variables can lead to delays in activating traveler information signs warning of worsening road conditions. The objective of this project is to develop, test, and deploy a system that is sufficiently robust to reliably issue and update such warnings without the need for human intervention. More specifically, further research and development is being done on a rural roadside controller that can be easily configured to acquire sensor data from Roadside Weather Information Systems (RWIS), loop detectors, Microwave Vehicle Detection Systems (MVDS), and video detection systems. The roadside controller then automatically informs drivers by activating changeable message signs or flashing beacons. Successful deployment of the Controller device will aid in improving the accuracy, timeliness and reliability of warnings.

The WTI Systems Engineering Development and Integration Laboratory was conceptualized and engineered to accelerate the applied development and deployment of cutting edge technologies to solve rural transportation problems, such as automating safety warning systems. This project builds on the UTC investment in the WTI Systems Lab through a continued partnership with Caltrans to identify and solve such problems. The Automated Safety Warning System Controller will further safeguard the traveling public by providing reliable, consistent, advanced warning to hazardous conditions.

Success Story

Multiple Partners + Multiple Specialties + A Shared Facility = Endless Research Potential

Assessment of Fish Swimming Capabilities

It started with a research objective: Determine volitional swimming abilities of westslope cutthroat trout and rainbow trout native to the Northern Rockies to better understand what creates a barrier to their movement. Departing from conventional practice, the decision was made to conduct this study using an open-channel flume, which offers a more volitional or natural environment and attendant data than that generated using more traditional respirometer testing, which is conducted in swimming chambers, and thus is a more forced swimming method. The results will aid fish passage practitioners with better assessments, designs, retrofits and construction of hydraulic structures, including bridges and culverts, within our streams and rivers. The research is especially important as our society addresses the impacts of past land use activities that have created more than a million barriers in our aquatic ecosystems. However, even before the research is completed, this project has already produced much more than data.

The research partners - ecologists, biologists, and engineers hailing from WTI, Montana State University (MSU), and the Bozeman Fish Technology Center – US Fish and Wildlife Service (BFTC-USFWS) - needed a testbed for the fish to swim in. They proposed retrofitting and redesigning an existing raceway at the BFTC-USFWS to use for conducting the experiments. This interdisciplinary approach – the combination of engineers collaborating with ecologists and biologists– was a first for the BFTC-USFWS. After a year of design, construction, and testing, the new flume is completed and ready for use. The first runs of wild westslope cutthroat trout have been completed to test the flume's instrumentation. The test-bed facility can be used not only for the Assessment of Fish Swimming Capabilities study, but also to address a broader range of species (both cold- and warm-water) and research needs related to aquatic connectivity and passage issues. The testbed can be modified, including adjusting the slope of the flume or the temperature of the water, depending on the needs of the project. For example, as climate change research moves to the forefront, the testbed could be used to assess how fish adapt to changing temperatures in their native waters and the effect it might have on connectivity. The project has been supported not only by the sponsoring organizations of the research partners (WTI-MSU, BFTC-USFWS) and UTC funding, but also by contributions from diverse public and private organizations including the United States Forest Service – Gallatin National Forest, USFWS's Plains and Prairie Potholes Landscape Conservation Cooperative, the Montana Chapter of the American Fisheries Society, and Turner Enterprises, Inc. The investment in the testbed will attract and promote future interdisciplinary research and education and will help train future engineers, biologists and ecologists, making them more interdisciplinary and better able to effectively solve future problems.

The synergy of this project - the contributions of funding, expertise, and space to achieve a combined greater effect – is an example of unique partnerships transforming the way we approach conservation issues.

Awards and Recognition

WTI Director Awarded ITE 2010 Management & Operations/ITS Council Achievement Award

WTI Director Steve Albert was honored by the Institute of Transportation Engineers' (ITE) Management & Operations/ITS Council as the 2010 Individual Achievement Award winner. Albert was officially recognized at the Honorees Reception and Dinner held during the ITE 2010 Annual Meeting and Exhibit in Vancouver, British Columbia, Canada on August 10, 2010.

The Institute of Transportation Engineers is an international educational and scientific association of transportation professionals who are responsible for meeting mobility and safety needs. ITE facilitates the application of technology and scientific principles to research, planning, functional design, implementation, operation, policy development and management for any mode of ground transportation.

Albert was recognized for his devoted service and outstanding contributions to the transportation industry. The ITE awards committee noted his national leadership on intelligent transportation systems (ITS) and his on-going efforts to champion improvements to rural transportation by promoting continued research, education and the deployment of innovative safety and ITS related projects.

WTI Director Elected CUTC President

In June 2010 the Council of University Transportation Centers (CUTC) elected Western Transportation Institute Director, Steve Albert, as the organization's new president at the 2010 Summer Meeting held in College Station, Texas. Established in 1979 by the major transportation research centers and institutes in the United States, CUTC provides a forum for the Universities and Centers to interact collectively with government and industry.

Albert, who was previously serving as Vice President, has provided service and leadership to CUTC for over 13 years and has helped lead the CUTC transition from a volunteer to a professional organization. His achievements include creating the UTC Administrators annual meeting, improving strategic partnerships with AASHTO

Awards and Recognition *Continued*

RAC/SCOR and LTAP, and creating a National Laboratory repository. Well regarded in the transportation world for bringing organizations together for a common purpose, Albert, along with Michael Kyte of the National Institute for Advanced Transportation Technology, integrated the 33 member UTC Director Association with CUTC, bringing CUTC's membership to 92 centers.

Over the course of his term, Albert plans to inventory CUTC member activities and create national leveraging opportunities through CUTC and RITA, accelerate collaborative opportunities with strategic partners to demonstrate a shared and coordinated vision, and initiate proactive outreach and communications to decision makers on the value of research and education. He will also create targeted communications to promote positive UTC Program perceptions and will investigate the development of a CUTC marketing plan.

IEEE Outstanding Leadership and Professional Service Award: Bill Jameson

WTI Senior Research Scientist Dr. Bill Jameson has been honored by IEEE with the 2009 Region 6 Outstanding Leadership and Professional Service Award. The IEEE is the world's largest technical professional society and is dedicated to fostering technological innovation and excellence for the benefit of humanity. It is designed to serve professionals involved in all aspects of the electrical, electronic and computing fields and related areas of science and technology.

The Outstanding Leadership and Professional Service Award recognizes IEEE members who, through their professional and technical abilities, have made outstanding and noteworthy contributions to the Institute, their communities, fellow professionals and fellow man. Dr. Jameson's distinguished engineering career spans six decades encompassing military, private sector, public sector, education, and research and development experience. He has published peer reviewed articles and is a contributing author to a widely used communications systems text. He continues to serve as a valued researcher, educator, and professional, and contributes endless service to his community and society.

Responder System wins Best of ITS Award

Developed jointly by WTI and the California Department of Transportation (Caltrans), the Responder System received a 2010 Best of Rural ITS Award, in the category of Best New Innovative Product, Service, or Application. The Responder System is a communication tool for first responders designed to be used anytime, anywhere – particularly in remote locations. Enclosed in a rugged protective briefcase, it includes a tablet PC, camera, GPS, Wi-Fi, and cellular and satellite modems and provides an easy-to-use means to collect and share accurate incident information among emergency responders. Examples of uses includes earthquakes, plane crashes on highways, bridge failures, major slides, explosions, major traffic accidents and hazmat incidents, fires that affect traffic, and floods. The award was presented during the Opening Session of the 2010 National Rural ITS Conference, held in Huntington, West Virginia, August 2010. Key project team members include principal investigator, Doug Galarus from WTI; Caltrans project manager, Mandy Chu from the Caltrans Division of Research and Innovation; and Caltrans project champion, Ian Turnbull from Caltrans District 2. Galarus, Program Manager for the Systems Engineering, Development and Integration Program at WTI, accepted the award on behalf of the project team.

RESEARCH

Project Status 2010

Following is a list of Center research projects. New projects were selected between October 1, 2009 and September 30, 2010.

New Research Projects	Principal Investigator
Best Management Practices to Mitigate Burrowing Mammal Impacts on Montana's Highways	Angela Kociolek
Naturalistic Safety Evaluation of a Medic's Work Environment during rural Emergency Response	Laura Stanley
An Experiment in Integrating an Engineering Communications Toolkit into the Industrial Engineering Curriculum	Laura Stanley
Montana Fuel Tax Refunds	Pat McGowen
Feasibility of Reclaimed Asphalt Pavement as Aggregate in Portland Cement Concrete Pavements	Michael Berry
US 93 Post Construction Wildlife-Vehicle Collision and Wildlife Crossing Monitoring and Research	Marcel Huijser
Responder Phase 3, Deployment Assistance	Doug Galarus
Automated Safety Warning System Controller Phase 2, Deployment Preparation	Doug Galarus
Modeling Effective, Efficient, and Sustainable Emergency Medical Services Systems for Rural Areas	Shaowei Wang
Developing a Testing Methodology that Correlates Laboratory Testing and Field Performance in Measuring Performance Characteristics and the Friction Coefficient of Deicing and Anti-icing Chemicals	Laura Fay

Project Status 2010 *Continued*

Ongoing Research Projects	Principal Investigator
Effects of Defensive Vehicle Handling, Phase 3	Laura Stanley
Bozeman Pass Post Fencing Monitoring	Angela Kociolek
Banff Wildlife Crossings	Tony Clevenger
Durability of Corrosion Resistant Mineral Admixture Concrete	Xianming Shi
Rural Transportation and ITS Outreach and Assessment	Steve Albert
Ant Colony Optimization for Transportation Optimization Problems	Doug Galarus
Integration of Aviation Automated Weather Observation (AWOS) w/RWIS	Doug Galarus
Developing a Standard Test Method for Measuring Geosynthetic Soil Resilient Interface Shear	Eli Cuelho
Mobile Communications Briefcase	Doug Galarus
Inhibitor Longevity and Deicer Performance Study	Xianming Shi
Establishing Best Practices of Removing Snow and Ice from California Highways	Eli Cuelho
Snoqualmie Pass Monitoring Plan	Tony Clevenger
US 93 Wildlife Monitoring	Marcel Huijser/ Rob Ament
Developing Regional Ecosystem Framework for Terrestrial & Aquatic Resources along the I-70 Corridor, Colorado	Marcel Huijser
Roadkill Observation Collection System (ROCS), Phase III	Rob Ament
COATS Phase IV	David Veneziano
Validation of Rehabilitation Strategies to Extend the Service Life of Concrete Bridge Decks	Eli Cuelho
I-90 Snoqualmie Pass East: Pre-Construction Wildlife Monitoring of Fish Passage	Matt Blank

Ongoing Research Projects *(continued)*	Principal Investigator
Replacing Thermal Sprayed Zinc Anodes on Cathodically Protected Steel Reinforced Concrete Bridges	Xianming Shi
An Assessment of Habitat Connectivity and Fracture Zones for Carnivores Within & Between the I-90 & US 2 Corridors, Washington	Robert Long
Development of a Toolkit for Cost-Benefit Analysis of Specific Winter Maintenance Practices, Equipment and Operations	Xianming Shi
Channelized Right-Turn Lanes at Signalized Intersections: Traffic Control Empirical Investigation	Ahmed Al-Kaisy
Animal Detection System for Reliability Testing	Marcel Huijser
Highway 3 Transportation Corridor: Wildlife Movement & Mitigation Assessment	Tony Clevenger
Using Naturalistic Data to Evaluate Safety & Operational Characteristics of Highways	Pat McGowen
Evaluation of an Animal Warning System Effectiveness	Marcel Huijser
An Experimental Assessment of Swimming Capabilities of Selected Trout Species for Barrier Assessment, Barrier Design, Fishway and Culvert Design, and Retrofits	Matt Blank
Warm Mix Asphalt Paving Strategies for Use in Montana Highway Construction	Steve Perkins
Steel Pipe Pile/Concrete Pile Cap Bridge Support Systems: Confirmation of Connection Performance	Michael Berry
Interim Evaluation of Three Instrumented Bridges in Saco, Montana	Eli Cuelho
Montana Rest Area Usage: Data Acquisition and Usage Estimation	Ahmed Al-Kaisy

RESEARCH

Project Status 2010 *Continued*

Completed Research Projects	Principal Investigator
Weathershare - Phase 2	Doug Galarus
Redding Responder - Phase 2	Doug Galarus
Automated Safety Warning System Controller	Doug Galarus
Wildlife-Highway Crossing Mitigation Measures and Associated Costs/Benefits: A Toolbox for MDT	Marcel Huijser
Electrochemical Rehabilitation of Salt Contaminated Concrete – A Lab Study	Xianming Shi
Automated Cost Recovery	David Kack
Mitigation of Moisture & Deicer Effects on Asphalt Thermal Cracking.	Tongyan Pan
Impacts of Barriers on Topeka Shiner Populations	Matt Blank
Innovative Coating System for the Corrosion Prevention of Galvanized Steel	Xianming Shi
Blaine County State Highway 75 Wildlife Data Collection and Mitigation Research Project	Marcel Huijser
California Oregon Advanced Transportation System Phase 3	David Veneziano
National Wildlife Collision Study	Marcel Huijser
Effects of 4 Lane Highways on Desert Kit Fox and Swift Fox	Tony Clevenger
An Autonomous & Self Sustained Sensing System to Monitor Water Quality Near Highways	Xianming Shi
Facilitating Special Event Congestion	Suzanne Lassacher
Development of Standardized Test Procedures for Deicing Compounds-Clear Roads	Xianming Shi

Completed Research Projects	Principal Investigator
WTI System Engineering & Integration of Transportation Technology SEITTP	Doug Galarus
Lab Investigation of Deicer Impacts on Concrete Microstructure and Pavement Friction Coefficient	Xianming Shi
Rural EMS Driver Safety Research Program: Phase I, Feasibility Study	Nic Ward
Field Investigation of Geosynthetics Used for Subgrade Stabilization	Eli Cuelho
Highway 93 South Mitigation Feasibility Study in Kootenay National Park	Marcel Huijser
Portable TMC-TMS Communications Demonstration	Doug Galarus
Benefit-Cost Analysis of Maintenance Decision Support System: A Case Study for the State of Colorado	Jared Ye
Deicer Interaction with Portland Cement Concrete Pavements and Bridge Decks	Xianming Shi
Examining Paved Road Impacts on Birds	Angela Kociolek
Laboratory Testing of Mixed Liquid Deicers and Use of Multiple Performance Characteristics for Deicer Selection/Design	Xianming Shi
Northwest Passage Rural Vehicle Infrastructure Integration Demonstration Project	Gary Schoep

EDUCATION

Program Overview

The Western Transportation Institute's UTC-based Education Program strives to advance transportation education at all levels by providing students with a myriad of research and experiential learning opportunities in a multidisciplinary environment, with an emphasis on rural transportation issues. Education initiatives encompass the entire spectrum from student recruitment and retention to professional development. Pre-college outreach activities aim to excite interest in transportation careers. WTI staff provides mentorship to undergraduate and graduate students through the UTC-funded Graduate Fellowship Program and Undergraduate Research Program. The Program also supports professional development activities for students to aid with job placement. Extracurricular activities expose students from a variety of disciplines to opportunities in the transportation field.

EDUCATION

Student Research and Support

The WTI Education Program seeks to enhance student experiential learning by increasing the number of students involved in real world transportation research. The UTC Program supports two primary programs in this regard. The Undergraduate Research Experience (URE) program competitively selects four undergraduates each year to participate in a unique academic year-long research opportunity. The program provides a one-on-one mentoring relationship with a professional researcher at WTI; paid hands-on research experience; assistance in developing skills in data collection, analysis, and interpretation; and training in communicating research results to a broad audience. The goal is to foster interest in graduate school and research careers in the transportation field. The students produce a research work plan, submit a final research report, and present their research to WTI staff and students at the end of the program. Three undergraduate students from Civil Engineering and one Chemical Engineering undergraduate participated in the 2009-2010 URE program. Project topics encompassed recycled infrastructure materials, self-healing concrete, and deer-vehicle collisions.

The URE program continues to produce highly successful products. Two URE students, Brett Larabee and David Schroeder, will present their research entitled "Building Green: Development and Evaluation of an Environmentally Friendly Concrete" at the American Concrete Institute (ACI) Fall 2010 Convention in Pittsburgh, Pennsylvania. Civil Engineering undergraduate Neil DeZort's URE research paper "Development of a Crash Prediction Model for Deer-Vehicle Collisions (DVCs)," was selected for the Institute of Transportation Engineers (ITE) Intermountain Section best student paper award. The work of two former URE participants was recently featured in Discoveries and Breakthroughs Inside Science (http://www.ivanhoe.com/science/story/2010/09/760a.html). The students designed and tested a prototype cyclist sensing device using low power radios combined with GPS units to share location information between cyclists and motor vehicles. The prototype was designed by Electrical Engineering undergraduate

EDUCATION

Gordon Nelson. Penny Atkins, Industrial Engineering undergraduate, then tested the usability and acceptance of the system interface using WTI's driving simulator.

At the graduate level, the Graduate Transportation Award provides tuition support and a monthly stipend to students focusing on transportation research in their graduate program. Eight graduate students from three different academic departments were supported by Transportation Awards over the past year. Three Transportation Award recipients completed their graduate degrees during the reporting period. Tiffany Rochelle received her MS in Civil Engineering after successfully defending her thesis entitled "Establishing Best Practices of Removing Snow and Ice from California Roadways." Rochelle now works for 609 Consulting in Sheridan, Wyoming. Shaun Durkee received his MS in Industrial Engineering and accepted a position with Boeing in Pennsylvania. Durkee's thesis studied "The Effect of Simulation Attributes on Driver Perception and Behavior." Zachary Freedman completed requirements for his Masters degree in Civil Engineering this December. He defended his thesis entitled "Analyzing the Operational Effects of Passing Lanes on Two-Lane Highways," which he completed under the mentorship of Dr. Ahmed Al-Kaisy. A portion of Zachary's thesis on "Estimating the appropriateness of a new performance measure: PI," was presented at a poster session during the 2010 Transportation Research Board (TRB) annual meeting in Washington, DC. Freedman currently works as a Research Engineer for the South Dakota Department of Transportation.

In addition to the URE and Graduate Transportation Award research opportunities, WTI hires undergraduate and graduate research assistants to provide support on grant sponsored projects. Over the past year, 30 undergraduate students and 21 graduate students contributed to transportation research projects at WTI. Research assistants represented a myriad of academic disciplines and student research support added value to 28 different projects (as outlined in the table on the next page).

EDUCATION

Student Research Involvement

October 09-September 10	Undergraduate	Graduate
An Autonomous Sensing System for Water Quality Monitoring (NCHRP – IDEA)	1	
Building Green: Environmentally Friendly Concrete	2	1
Development of A Cold Region Rural Transportation Research Test Bed in Lewistown, Montana	2	
Development of a Model for Deer-Vehicle Collisions (URE)	1	
Deploying Portable Traveler Information Systems		1
Effects of Defensive Vehicle Handling Training		1
Establishing Best Practices - Snow/Ice Removal in California	1	1
Extend the Service Life of Concrete Bridge Decks	2	1
Human factors in safety research		1
I-90 Snoqualmie Pass -Pre-Construction Wildlife Monitoring Program, 2009-2010		1
Impacts of Barriers on Topeka Shiner Populations		1
Inhibitor Longevity & Deicer Performance Study – PNS	2	
Integrating an Engineering Communication Toolkit into IE Curriculum		1
Montana Fuel Tax Refunds		2
Montana Rest Area Usage: Data Acquisition & Usage Estimation	2	1

Student Research Involvement

	Undergraduate	Graduate
National Technical Assistance Center for Parks and Public Lands	1	
Reclaimed Asphalt Pavement in Portland Cement Concrete Pavements		1
Replacing Thermal Sprayed Zinc Anodes on Cathodically Protected Steel Reinforced Concrete Bridges	1	
Rural EMS Drivers Safety Research Program		1
Safe Passages Research (REU)	8	
Snow/Ice Removal Best Practices		1
Steel Pipe Pile/Concrete Pile Cap Bridge Support System	2	1
US 93 Wildlife Mitigation Measures Post Construction Evaluation		2
UTC Right-Turn Lanes at Signalized Intersections: Traffic Control		1
UTC Swimming Capabilities of Selected Trout Species for Barrier Assessment		1
UTC Systems Engineering Development & Integration Lab: Phase II	1	
Validating the Durability of Corrosion Resistant Mineral Admixture Concrete	3	1
Weather Share Phase 2	1	

The Western Transportation Institute continued its NSF-funded (and UTC supported) three-year Safe Passages Research Experience for Undergraduates (REU) Program in 2010, hosting an additional eight multidisciplinary undergraduate students from eight different colleges and universities nationwide. The students participated in a ten-week summer research program focusing on safety and environmental issues related to U.S. Highway 191 between Bozeman and West Yellowstone, MT. Participants were paired on four projects, which explored topics ranging from safety challenges on mountain roadways to fish passage through culverts. :

The students represented Civil, Biological, and Water Resources Engineering disciplines as well as Environmental Science and Policy, Human Factors, and Mathematics. The interdisciplinary student teams produced final technical reports and presentations on each of their topics. In addition to their project involvement, the students' REU experience was enriched by research seminars, training workshops, and a field trip to Yellowstone National Park.

Dr. Al-Kaisy mentored two 2009 REU participants whose work "Speed Selection at Sites with Restrictive Geometries: A Case Study," was presented at the 20th Canadian Multidisciplinary Road Safety Conference in Niagara Falls in June 2010.

EDUCATION

Extracurricular Activities

The Western Transportation Institute regularly supports activities that promote diversity in transportation professions, expose students to the wide array of multidisciplinary opportunities in transportation, and advance students' potential as future professionals. This year, WTI sponsored Janelle Booth's attendance at the WTS Advancing Women in Transportation Annual Conference, held in Washington D.C. in May. Janelle is a graduate student in Public Administration and a graduate research assistant at WTI. The conference provided networking opportunities with other students and women in the transportation field and facilitated discussion on issues shaping the future of the transportation industry. Janelle gained a better understanding of the impact of transportation policy and the wide variety of jobs and leadership positions that exist for women in this field.

WTI also sponsored the MSU Intelligent Transportation Society-Rocky Mountain Student Chapter (ITS-RM) technical field trip to Salt Lake City, Utah. Graduate and undergraduate students representing various academic disciplines traveled over their spring break to tour a number of transportation sites of interest. The trip was designed to demonstrate the diversity of transportation opportunities for students in computer science, electrical engineering, and civil engineering. The students had the opportunity to meet with professional staff members and tour transportation facilities at the Utah Department of Transportation's Traffic Operations Centerthe Department of Computer Science at the University of Utah, the light-rail and commuter rail control centers at the Utah Transit Authority, and the Fehr and Peers transportation consultancy firm.Ten student chapter members participated in the trip accompanied by faculty advisor Pat McGowen. Over the years, WTI's Education Program has provided considerable support to student chapter activities that expose students to transportation and provide professional development and networking opportunities. In particular, WTI has supported the activities of the MSU Institute of Transportation Engineers (ITE) student chapter, which continues to distinguish itself at the regional level. This year alone:

- MSU won the ITE Western District Student Chapter Award and the Student Website Award.
- MSU alumnus, Brian J. Walsh, won the Individual Achievement Award.
- MSU alumnus and past UTC outstanding student of the year, Danielle Scharf, won the Young Professional Achievement Award.
- MSU alumni served as Western District President (Michael Sanderson) and Secretary Treasurer (Alyssa Reynolds who was a UTC Outstanding Student of the Year at WTI).
- MSU student, Brian Church, won the $2000 Annual Ellis Mathes Scholarship of the Intermountain Section of ITE.

MSU transportation students' ongoing success in the professional sector is a testament to the experiences and skills they gained at the institution.

EDUCATION

UTC Outstanding Student of the Year

For the past 18 years, the U.S. Department of Transportation (USDOT) has honored an outstanding student from each University Transportation Center at a special ceremony held during the TRB Annual Meeting. Jessica Mueller was selected as the Western Transportation Institute's Student of the Year for 2009. Originally from Knoxville, Tennessee, Jessica Mueller obtained her undergraduate degree in Industrial Engineering at Tennessee Technological University and is currently pursuing a Master's degree in Industrial Engineering with the Human Factors group at Montana State University (MSU). Jessica received a Graduate Transportation Fellowship award from the MSU Western Transportation Institute to conduct research involving the effects over time of providing defensive training to novice drivers. In addition to producing technical reports to project sponsors, Jessica contributed to a published paper in the Human Factors and Ergonomic Annual Meeting Proceedings, entitled Effectiveness of a Multistage Driver Education Program for Novice Drivers. Her work on Differences in Subjective and Objective Data was also selected for presentation at the Annual Regional National Occupational Research Agenda Symposium. Jessica Mueller has consistently demonstrated a strong aptitude in both research and academic pursuits and has shared her enthusiasm for her field by mentoring an undergraduate student on an independent project from October 2008 to May 2009. As part of her award, Jessica received a $1000 stipend and the opportunity to travel and participate in the 2010 Transportation Research Board Annual Meeting.

EDUCATION

Outreach

The Western Transportation Institute hosted a Summer Transportation Institute (STI), which brought fifteen high school students to Montana State University in June for a two-week exploration of transportation. Working with faculty, the students participate in a wide variety of hands-on research activities with construction materials, software tools, driving simulators and other research equipment available on campus. They also visited field research sites and toured many types of transportation facilities.

The STI program is designed to introduce students to transportation as a possible college and career path. The participants were able to meet faculty, researchers, and university students involved in addressing a wide array of transportation related questions. They learned about public and private sector employment opportunities while touring the Montana Department of Transportation in Helena and transportation consulting firms Sanderson Stewart and HKM in Billings. STI participants additionally received guidance on college preparation and entrance and career planning.

The program is funded by the Federal Highway Administration and administered by the Montana Department of Transportation (MDT). Additional partners and contributors to the 2010 program include the Montana Chapter of the Institute of Transportation Engineers (ITE), Sanderson Stewart, HKM, MDT, and Summit Aviation.

EDUCATION

Student Success Stories

The number of awards received by students this year is evidence of the caliber and productivity of WTI's undergraduate and graduate research assistants. Tiffany Allen, a UTC Graduate Transportation Award recipient, received travel funds from the Dwight David Eisenhower Transportation Fellowship to present her work on wildlife mitigation measures along US Highway 93 during the 2010 Transportation Research Board Annual Meeting in Washington, DC.

The Institute of Industrial Engineers (IIE) Western Conference awarded MSU undergraduate Tawny Hoyt Best Technical Paper and Oral Competition Award for her independent research work on "EMS Restraint Feasibility during Emergency Transport." Tawny graduated from Montana State University in December of 2009 with a degree in industrial engineering. She received a UTC Graduate Transportation Award to begin her graduate program in Industrial Engineering under Dr. Laura Stanley starting in fall 2010.

Industrial Engineering graduate student and UTC Graduate Transportation Award recipient Jessica Mueller's paper entitled "Naturalistic Data Collection in Rural Emergency Medical Services Transportation" was selected as the second runner-up for the First Annual National Rural ITS Conference Student Paper Competition. Mueller is a graduate student in the Industrial Engineering program at MSU, a recipient of the Graduate Transportation Award, and this year's UTC Student of the Year.

Janelle Booth won the best student paper competition on the topic "The Role of School Buses in Rural Evacuations" for the 19th National Conference on Rural Public and Intercity Bus Transportation. Janelle is currently completing her Masters of Public Administration degree. She has been working with the Mobility and Public Transportation group at WTI since August 2009.

Janelle also attended and presented "Rural Transportation Infrastructure Assessment for Evacuation" at the TRB Tools of the Trade Transportation Planning in Small and Medium Sized Communities conference in Williamsburg, Virginia this September.

Ben Dorsey, a Graduate Transportation Award recipient completing his Masters in Land Resources and Environmental Sciences, received a graduate fellowship from the National Science Foundation to pursue a research project on road ecology in China over the summer. Ben will work in cooperation with researchers at the Center for Transport Environment and Safety at the Chinese Academy of Transportation Sciences (CATS) in Beijing. CATS recently established a cooperative research and education agreement with WTI. Ben's road ecology project represents the first cooperative work undertaken between these two entities.

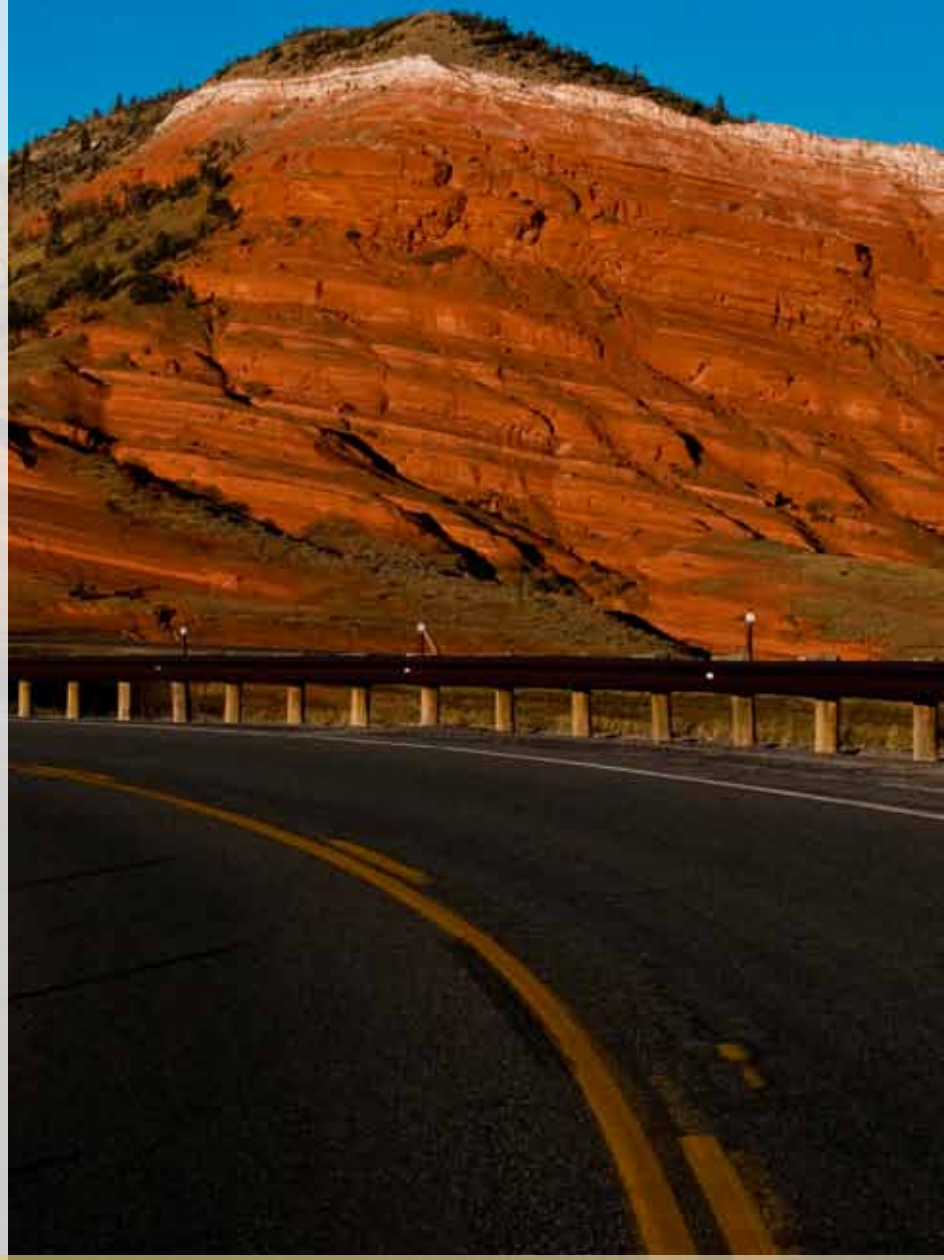
TECHNOLOGY TRANSFER

Program Overview

The goal of WTI's technology transfer program is to "increase availability of research results to potential users in a form that can be directly implemented, utilized or otherwise applied." Effective technology transfer is flexible and always evolving, taking advantage of new opportunities that complement or enhance established programs and delivery methods. WTI takes a proactive approach, and is willing to develop or sponsor specialized forums that reflect our expertise or address underserved needs of the stakeholders in the rural transportation community. As a result, our technology transfer program incorporates a variety of approaches, including:

- Conferences and Workshops – in addition to sponsoring traditional face-to-face forums, we are expanding our use of webinars as a cost-effective method of connecting experts with local practitioners.
- Publications and Presentations – WTI researchers continue to expand audiences for their publications and presentations, with a growing participation in the international research community.
- Electronic Information Resources – Research resources on the WTI website continue to develop and the WTI newsletter readership continues to increase.

The following sections describe our technology transfer initiatives in more detail, along with descriptions of a few highlighted success stories.



Conferences and Workshops

Throughout the year, WTI initiates, coordinates, and sponsors conferences and workshops in a variety of formats and sizes, in order to reach a broad range of professionals with an interest in the advancement of transportation research.

WTI Hosts Webinars

The Association of Pedestrian and Bicycle Professionals (APBP) and the Transportation Research Board (TRB) both sponsor various webinars throughout the year. These on-line courses provide an excellent opportunity for high-quality professional training on the state-of-the-practice and critical emerging issues. WTI hosted a webinar from each of these organizations over the last year. Through these forums, WTI staff and partner participants can obtain training without paying for travel costs, thus reducing per person expenditures while still offering opportunities to share knowledge and strengthen relationships within the local transportation community. In addition, Professional Engineers can use some of these courses to maintain their licenses. WTI hosted the following two webinars during the past year:

APBP Webinar: Building Political Will for Strong Bike/Walk Programs: Effective Use of the "Three-Legged Stool" model in Columbia, MO

This web briefing, hosted on November 18, 2009, described how elected officials, local government staff and independent advocates can work together to change the culture of a community. Each partner in this powerful and stable "three-legged stool" has its natural areas of strength, and these can be effectively leveraged by coordinating activities such as community outreach, media advocacy, government services, public funding, political support, legislation and others.

Webinar participants included WTI research staff, members of the City of Bozeman's Bicycle Advisory Board, and the Transportation Coordinating Committee. Using the community of Columbia, Missouri as a model, participants learned how each partner's resources and expertise contributed to their collective accomplishments, complete streets legislation, a national model Safe Routes to School program, a $22 million federal Non-motorized Transportation Pilot Program grant, and a silver level Bicycle Friendly Communities award.

TRB Webinar: Pedestrian and Bicyclist Safety and Mobility in Europe Scan: Findings and Recommendations

This webinar, hosted by WTI on May 13, 2010, presented the results of a 2009 European scan to examine innovative approaches, techniques, and policies for improving pedestrian and bicyclist safety. Presenters also described the scan team's strategy and plans for implementing key recommendations in the areas of engineering, education, enforcement, encouragement, and evaluation. WTI participants – made up of research staff, graduate students, transportation services consultants, and civil engineers – found the presentation very relevant to current alternative transportation initiatives in the U.S. and useful to their own work in this area.

Western States Rural Transportation Technology Implementers Forum

The 5th Annual Western States Rural Transportation Technology Implementers Forum (WSRTTIF) took place June 15 - 17 in Yreka, California. The Forum provides a unique opportunity for field engineers, maintenance personnel and technicians to share ideas and discuss successes and failures in implementing rural ITS projects. This year's 38 attendees hailed from six western states - Alaska, California, Montana, Nevada, Oregon, and Washington - and represented seven Caltrans districts, four Caltrans divisions, and four universities (UC Davis, UC Berkeley, the University of Washington, and Montana State University). Led by a veteran steering committee - Sean Campbell, Caltrans Division of Research and Innovation; Ian Turnbull, Caltrans District 2; Doug Galarus, Program Manager, WTI Systems Engineering Development and Integration group; and Leann Koon, WTI Systems group Research Associate – this year's Forum included six highly interactive technical presentations with in-depth equipment demonstrations.

In addition to the presentations, equipment displays, and technical demonstrations, participants had numerous networking opportunities. The speaker and topic diversity, the small and focused participant group, and the honest discussions of successes and failures that are fostered throughout the Forum, continue to make this a valuable and instructive event for all involved.

Program Overview

National Summit for Rural Traffic Safety Culture

The second annual National Summit for Rural Traffic Safety Culture was held July 11-13, 2010 in Big Sky, Montana. The Summit was hosted by the AAA Foundation for Traffic Safety and the Western Transportation Institute and sponsored in part by American Traffic Safety Service Association, Centers for Disease Control and Prevention, Federal Highway Administration, and the National Highway Traffic Safety Administration. Similar to the first Summit, the purpose of this year's gathering is to increase understanding amongst traffic safety researchers, practitioners, and policy makers about the role of traffic safety culture on (1) behavioral factors that increase rural (and national) traffic crash risk; (2) attitudinal barriers to public and political acceptance of traffic safety interventions; and (3) organizational resistance to safety program change or implementation. The 1 ½ day Summit was comprised of presentations, small group discussions and larger question/answer sessions which generated substantial and lively debate.

Thanks to the positive response from the first summit, this year's event had 67 Summit participants from 22 states plus Canada and the United Kingdom. The attendees developed a list of critical research needs/policy recommendations/action items…. Or, Due to the growing interest in traffic safety issues, attendees have expressed interest in continuing this forum as an annual event.

National Rural ITS Conference

The 2010 National Rural Intelligent Transportation Systems (NRITS) Conference was hosted by the Nick J. Rahall Appalachian Transportation Institute August 1-4, 2010 in Huntington, West Virginia. This year's conference, The Bridge to Success: Engineering the Future of Rural ITS, was attended by over 250 participants and 50 guests from 38 states and Canada who had the opportunity to visit over 34 vendor displays and participate in a wide variety of sessions, professional tours, and activities.

Keynotes for the Opening Session included Congressman Nick J Rahall II, US House of Representatives; a video message from US Senator Jay Rockefeller; and Peter Appel, Administrator, Research and Innovative Technology Administration, USDOT. One of the highlights of this year's forum was the introduction of the first annual NRITS student paper competition hosted by the US DOT ITS Joint Program Office. This competition expands professional development opportunities for both undergraduate and graduate students interested in transportation careers.

WTI served as one of the sponsors of this year's conference, along with Bayliss & Ramey, Inc., Federal Highway Administration, ITS America, ITS Canada, ITS Joint Program Office, Research and Innovative Technology Administration (RITA), Marshall University, M.H. Corbin, Inc., Open Roads Consulting, Inc. , RGA, Inc., Rahall Transportation Institute, Vaisala, and West Virginia Division of Highways

Peer-reviewed Publications

Ahmed Al-Kaisy

• Al-Kaisy, A. and Karjala, S. (2010) "Car-Following Interaction and the Definition of Free-Moving Vehicles on Two-Lane Rural Highways." Journal of Transportation Engineering, ASCE Publications, Vol.136, Issue 10, pp. 925-931.

• Ismeik, M. and Al-Kaisy, A. (2010) "Characterization of Cell Phone Use While Driving: the Jordan Experience," Transport, Vol. 25, Issue 3, pp. 252-261.

Tony Clevenger

• Ford, A.T., K. Rettie, A.P. Clevenger. 2009. Fostering ecosystem function through an international public-private partnership: a case study of wildlife mitigation measures along the Trans Canada Highway in Banff National Park, Alberta, Canada. International Journal of Biodiversity Science, Ecosystems Services & Management 5:181-189

• Clevenger, AP, M Sawaya. 2010. A non-invasive genetic sampling method for measuring population-level benefits of wildlife crossings for bears in Banff National Park, Alberta, Canada. Ecology and Society 15(1): 7.

• Clevenger, AP, M.P. Huijser. 2009. Handbook for Design and Evaluation of Wildlife Crossing Structures in North America. Department of Transportation, Federal Highway Administration, Washington D.C., USA.

• Van der Ree, R., Jaeger, J.A.G., Van der Grift, E., Clevenger, A.P. (guest editors) (2009-2010): Effects of Roads and Traffic on Wildlife Populations and Landscape Function. Special issue of Ecology and Society, vol. 14-15.

Marcel Huijser

• Huijser, M., Duffield, J., Clevenger, A., Ament, R., and McGowen, P. Cost Benefit Analysis of Mitigation Measures Aimed at Reducing Collisions with Large Ungulates in North America; A Decision Support Tool. Journal of Ecology and Society. 14(2):15

Suzanne Lassacher

• Suzanne Lassacher, David Veneziano, Steve Albert, Zhirui Ye, "Traffic Management of Special Events in Small Communities," TRB Transportation Research Record, Journal of the Transportation Research Board, NO. 2099, 2009

Xianming Shi

• Shi, X. On the Use of Nanotechnology to Manage Steel Corrosion. Recent Patents on Engineering 2010, Volume 4, Number 1, January 2010; pp. 44-50(7).

• Shi, X., Fay, L., Peterson, M.M., and Yang, Z. Freeze-thaw Damage and Chemical Change of a Portland Cement Concrete In the Presence of Diluted Deicers, Materials and Structures Volume 43, Number 7, 933-946, DOI: 10.1617/s11527-009-9557-0, October 2009.

• Liu, Y., and Shi, X.. Cathodic Protection Technologies for Reinforced Concrete: Introduction and Recent Developments. Materials and Structures DOI 10.1617/s11527-009-9557-0 October 2009

Yu, H., Shi, X., Hartt, W. H., Lu, B. Laboratory Investigation of Reinforcement Corrosion Initiation and Chloride Threshold Concentration for Self-compacting Concrete, Cement and Concrete Research 2010, 40(10), 1507-1516

• Yang, Z., Hollar, J. and Shi, X., Surface-sulfonated Polystyrene Microspheres Improve Crack Resistance of Carbon Microfiber-reinforced Portland Cement Mortar, Journal of Materials Science 2010, 45(13), 3497-3505

• Shi, X., Liu, Y., Mooney, M., Berry, M., Hubbard, B., Nguyen, T.A. Laboratory Investigation and Neural Networks Modeling of Deicer Ingress into Portland Cement Concrete and Its Corrosion Implications, Corrosion Reviews 2010, 28(3-4), 105-153

Shi, X. Winter Road Maintenance: Best Practices, Emerging Challenges, and Research Needs, Journal of Public Works & Infrastructure 2010, 2(4), 318-326

Peer-reviewed Publications *Continued*

Laura Stanley

• Antin, J., Stanley, L., and Cicaro, K. Conventional vs. Moving-Map Navigation Methods: Efficiency and Safety Evaluation. Transportation Research Record, No 2138, 34-41, 2009

Christopher Strong

• Strong, C., and Z. Ye, Spillover Effects of Yield-to-Pedestrian Channelizing Devices, Safety Science, Volume 48, Issue 3, March 2010, pages 342-347

David Veneziano

• Veneziano, David, Shaowei Wang and Xianming Shi. "Precipitation Variation and the Identification of High-risk Wet Accident Locations in the State of California". Transportation Research Record, Journal of the Transportation Research Board, No 2107, pp. 123-133, 2009

Nic Ward

• Creaser, J., Rakauskas, M.E., Manser, M., & Ward, N.W. (2009). Evaluating Design Options for a Dynamic Traffic Sign. Proceedings of the 5th International Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design

• Rakauskas, M.E., Ward, N.W. (2009). Retrieving 511 Traveler Information on a Mobile Phone: Implications for Driving Performance and Interactive Voice Response Menu Design. Transportation Research Board Annual Meeting 2009, Paper #09-1400

Jared Ye

• Ye, Z., and D. Lord. 2009. Estimating the Variance in Before-After Studies, Journal of Safety Research, 40(4): 257-263

• Ye, Z., J. Chaudhari, J. Booth, and B. Posadas, Evaluation of the Use of Rural Transportation Infrastructure in Evacuation Operations, Journal of Transportation Safety & Security, 2(2), 2010, pp.88-101

• Ye, Z., and Y. Zhang. 2010. Speed Estimation from Single Loop Data Using an Unscented Particle Filter, Computer-Aided Civil and Infrastructure Engineering, 25(7): 494-503

Ye, Z., and D. Lord, Estimating the Variance in Before-After Studies, Journal of Safety Research, Vol. 40, No. 4, 2009, pp. 257-263

Strong, C.K., Ye, Z., and Shi, X. Safety Effects of Winter Weather: The State of Knowledge and Remaining Challenge, Transport Reviews 2010, 1-23

TECHNOLOGY TRANSFER

Books

• Beckmann, J., A. P. Clevenger, M. Huijser, J. Hilty, eds. 2010. Safe passages: Highways, wildlife and habitat connectivity. Washington, D.C.: Island Press.

• Clevenger, A. P., A. T. Ford. 2010. Wildlife Crossing Structures, Fencing and Other Highway Design Considerations. In Beckman, et. Al. 2010, 17-50.

• Huijser, M. P., P. T. McGowen. 2010. Reducing Wildlife-Vehicle Collisions. In Beckmann, et al. 2010, 51-74.

• Blank, M. D.. 2010. Safe Passages for Fish and Other Aquatic Species. In Beckmann, et al. 2010, 75-96.

• Ford, A.T., A.P. Clevenger, K. Rettie. 2010. Banff Wildlife Crossings, Trans-Canada Highway, Alberta—An international public–private partnership. In Beckmann, et al. 2010, 123–134.

• Huijser, M. P., D. E. Galarus, A. V. Kociolek. 2010. Current and Developing Technologies in Highway-Wildlife Mitigation. In Beckmann, et al. 2010, 309-322.

• Hilty, J. A., J. P. Beckman, A. P. Clevenger, M. P. Huijser. 2010. The Way Forward: Twenty-first Century Roads and Wildlife Connectivity. In Beckmann, et al. 2010, 323-334.

Presentations

Michelle Akin
• Clear Roads Face-to-Face Technical Advisory Committee Meeting, August 2010, Grand Rapids, MI, "Developing a Test Methodology That Correlates Laboratory Testing and Field Performance in Measuring Performance Characteristics and the Friction"

Steve Albert
• CUTC Summer meeting, June 2010, College Station, TX, "Development of Sustainable Partnership and Lessons Learned"
• Special Screening of "Division Street" film, October 2009, Washington, DC, "Division Street: the Background Behind the Film"

Ahmed Al-Kaisy
• 2010 National Rural ITS Conference, August 2010, Huntington, WV, "Explore ITS Technologies for Work Zones and Work Zone Impact Areas"

Tiffany Allen
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Effectiveness of Wildlife Guards Along US Hwy 93"

Janelle Booth
• National Evacuation Conference, February 2010, New Orleans, LA, "Evacuation Preparedness of Public Transportation and School Buses in Rural Coastal Communities of the Northern Gulf of Mexico Region" (With Jaydeep Chaudhari)
• National Evacuation Conference, February 2010, New Orleans, LA, "Evaluation of the Use of Rural Transportation Infrastructure in Evacuation Operations" (With Jaydeep Chaudhari)
• TRB Tools of the Trade Transportation Planning in Small and Medium Sized Communities, September 2010, Williamsburg, VA, "Rural Transportation Infrastructure assessment for Evacuation"

Jaydeep Chaudhari
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Use of Geographical Information System as Sketch Planning Tool to Replace Traditional Transit Route Planning Practice for College and University Communities"
• International Transport Forum, May 2010, Liepzig, Germany, "Use of Geographical Information System as Sketch Planning tool to Replace Traditional Transit Route Planning"

Doug Cross
• AASHTO 2009, October 2009, Palm Desert, CA, Poster Session "100% Fly Ash Concrete"

Eli Cuelho
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Caltrans Snow-Ice Project Update and Findings"
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Caltrans Bridge Deck Project Brief"
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "TRANSCEND Update"
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Geosynthetic Subgrade Stabilization"

Laura Fay
Clear Roads Annual Meeting, August 2010, Grand Rapids, MI, "Developing a Test Methodology that Correlates Laboratory Testing and Field Performance in Measuring Performance Characteristics and the Friction"

Zachary Freedman
2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Estimating the Appropriateness of New Performance Measures for Two Lane Highways"

Presentations *Continued*

Douglas Galarus
• AASHTO 2009, October 2009, Palm Desert, CA, "Demonstrations of Responder and Weather Share"
• NRITS 2010 Conference, August 2010, Huntington, WV, "Development of a One Stop Shop for Rural Traveler Information"
• Western States Forum, June 2010, Yreka, CA, "Automated Safety Warning Controller Phase 1-Proof on Concept"
• NRITS 2010 Conferences, August 2010, Huntington, WV, "Automated Safety Warning Controller Phase 1-Proof of Concept"

Tawny Hoyt
• IIE Western Regional Conference, February 2010, Seattle, WA, "Seat Belt Usage Feasibility in Rural Emergency Response Vehicles"

Marcel Huijser
• NRITS 2010 Conference, August 2010, Huntington, WV, "The Reliability of Animal Detection Systems and Reliability Norms"

Xianming,Shi
• 1st International Conf in NA on Nanotechnology in Cement/Concrete, May 2010, Irvine, CA, "Laboratory Assessment of a Self Healing Cementitous Composite"
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "An Autonomous and Self-Sustained Sensing System to Monitor Water Quality Near Highways"
• 1st International Conf in NA on Nanotechnology in Cement/Concrete, May 2010, Irvine, CA, "A Moleculary Dynamics Study of Interactions between Corrosion Inhibitors, Nanoparticles and other Minerals in Hydrated Cement"
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Cost-Benefits of Winter Maintenance Tools: A Renewed Perspective Based on Recent Research"

Laura Stanley
• Human Factors and Ergonomics Annual Meeting (HFES), October 2009, San Antonio, TX, "Effectiveness of a Multistage Young Driver Education Program"
• National Conference for Undergraduate Research, March 2010, Missoula, MT, Tawny Hoyt's "Restraint Feasibility of EMS Personnel During Rural Emergency Transport"
• American Driver Traffic Safety Education Association, July 2010, St Louis, MO, "Multi Stage Approach to Novice Driver Safety"

David Veneziano
• Clear Roads Face-to-Face Technical Advisory Comm.mtg,8/9/2010 0:00:00, Grand Rapids, MI, "Cost Benefit Toolkit Project Findings"
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Safety Evaluation of Gateway Monuments" (With Jared Ye)
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Cost Benefits of Winter Road Maintenance Tools" (With Jared Ye)

Nic Ward
• Toward Zero Deaths: A National Strategy for Highway Safety Stakeholder Workshop, August 2010, Washington, DC, "Overview of Traffic Safety Culture"

Zhirui Ye
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Improving Shuttle Ridership Using ITS Technologies" (with Steve Albert and Jaime Eidswick)
• 2010 Transportation Research Board Annual Meeting, January 2010, Washington, DC, "Use of GIS as Sketch Planning Tool to Replace Traditional Transit Route Planning Practice for College and University Communities"
• CURIS Expo, May 2010, Picayune, MS, "Evaluation of Use of Rural Transportation Infrastructure in Evacuation Operations"
• National Evacuation Conference, February 2010, New Orleans, LA, "Evaluation of Rural Infrastructure in Evacuation Operations"

TECHNOLOGY TRANSFER

Websites and Electronic/Internet Resources

Electronic information sharing resources are cost-effective tools for making research findings readily accessible to a wide audience. The WTI website has long been a cornerstone of our technology transfer program. This section will summarize our progress on our website, rural transportation clearinghouse, and rural transportation blog as well as lessons learned, and remaining challenges to full optimization.

Websites

WTI currently utilizes two websites: a research focused website at www.westerntransportationinstitute.org to provide current research information and a complementary education focused website located at www.wti.montana.edu,. The research site is designed to best serve the needs of research professionals and features research results and laboratory resources. The education focused site uses the same template as the Montana State University and College of Engineering websites and centers on our partnership with the MSU campus. As such, it is geared towards students, promoting the student fellowship program and employment opportunities.

The research website is designed to be more prominent and accessible for users outside of the MSU campus, with the goal of disseminating our research results to the broadest possible audience. The website has also provided an opportunity to expand the amount of information available about our rural mission, each or our focus areas, and our expanded laboratory facilities. In addition, an unforeseen benefit of splitting the web content into two sites is that WTI is able to generate content targeted to the needs of each audience.

Rural Transportation Clearinghouse

Creating online forums for research professionals to collaborate and share research results has been a long-term goal of the technology transfer program at WTI. The rural clearinghouse is envisioned to be a one-stop-shop for aggregating documents, conference presentations and other content not currently posted online by RIP or TRIS. Research professionals will be able to post and download relevant documents and even rate the documents on their usefulness. When fully implemented, the rural transportation blog will be a more informal forum for research professionals to share research results, lessons learned and provide ad-hoc assistance to each other through bi-directional communication.

On the surface creating these online forums appeared to be a straightforward. However, we have learned that developing and managing a quality resource that is accurate and up-to-date on an ongoing basis is a much more complex process than originally anticipated. The software developer has installed the software on the WTI server and made the application live. The TRB Transportation Thesaurus key words are being used to classify the documents and the search function is relatively accurate. The current challenge for the upcoming year is populating the clearinghouse with quality documents with no copyright restrictions.

Rural Transportation Blog

In parallel to the clearinghouse project, WTI began developing the rural transportation blog by purchasing and installing a software package that manages online communities. As soon as the blog was launched, a large roadblock appeared--researchers are already very busy conducting their actual research, so they did not have enough time to also write meaningful blog content. The blog was up and running, but with no useful content.

As an initial step, an administrative staff member began to post conference presentations and other related content on the blog. The blog has been divided into eight key areas to help browsers find relevant content. However, the blog is currently limited to one-way communication, due to the tight security restrictions, which are necessary to keep out the spammers who want to fill up the site with advertisements and adult content. A challenge for the upcoming year is to evaluate the benefits of two-way communication, balanced with the associated administrative burden of screening postings to the blog.

Websites and Electronic/Internet Resources *Continued*

E-newsletter

WTI's quarterly e-newsletter was launched in 2008. In the past year, the newsletter has elevated its readership, as well as its prominence at the national level. With recipients now at 2945, reader feedback and requests for additional information on featured research has also grown. TR News, a publication of Transportation Research Board selected a newsletter story on public transportation in a rural area to be developed into a larger story for their monthly Research Pays Off feature.

The October 2009 WTI E-Newsletter included these articles:

- Challenges of Research Integration: Whose project is it?
- WTI Attracts New Partners to Road Ecology Initiatives
- Get on the Bus - WTI Helps Connect Small Communities on the Hi Line
- Montana Local Technical Assistance Program is Now Part of WTI
- Alaska Workshop Promotes Public-Private Partnerships
- Senator Max Baucus Tips Hat to WTI
- 2009 National Rural ITS Conference, Advancing Rural ITS to the Next Level
- 2009 Safe Passages Research Experience for Undergraduates (REU)

The January 2010 WTI E-Newsletter included the following articles:

- Winter Maintenance and Effects - Balancing Safety with Sustainability
- Infrastructure Maintenance and Materials: Fly Ash, Warm Mix Asphalt
- Road Ecology: FWHA Handbook, US 93 Phase 2 Post Construction Agreement, ARC
- 2010 National Summit for Rural Traffic Safety Culture
- Chinese Delegation Visits MSU to Explore Collaboration with WTI
- National Scan of Best Practices for Chemical Treatments on Unpaved Roads
- Division Street: movie Premiere at the Nation's Capitol
- Outstanding Student of the Year – Jessica Mueller
- WTI Student Success Stories: Zachary Freedman and Tiffany Holland present at 2010 TRB
- IEE Outstanding Leadership and Professional Service Award: Bill Jameson

The April 2010 WTI E-newsletter included the following articles:

- Teamwork brings ITS to Rural Areas
- Taking it to the Next Level: Systems Integration Program Accelerates Deployment by Building on Success
- Annual Forum Nurtures Rural ITS Deployment in Western States
- Sign of the Times: Dynamic Message Signs are a Cost-effective Speed Management Tool
- Bozeman Area Students Learn About Wildlife and Highways
- Traffic Safety Culture 2010
- 2010National Rural ITS Conference
- LTAP Initiates Stakeholder Discussions on Transportation Workforce Development for Montana
- WTI Staff Assist Lego Robotics Team to Explore Transportation Solutions
- Tawny Hoyt Wins IIE Western Conference Best Technical Paper and Oral Competition Award

The July 2010 WTI E-newsletter included the following articles:

- Transportation and Federal Lands: Balancing Visitor Access with Resource Preservation
- At Your Service: Technical Assistance Center Reaches Out to Public Land Mangers
- Promoting Bicycling on Federal Lands
- Variable Message Signs in Grand Canyon National Park
- Yellowstone Park and WTI Address Traffic Problems on U.S. 89
- WTI Director Elected CUTC President
- ARC Competition Officially Launched Design Teams: Submit your entries!
- High School Students Explore Transportation Modes and Careers
- Huntsville, We Have A Problem… WTI Sponsors Students at Space Camp
- First Annual National Rural ITS Conference Student Paper Competition: WTI Grad Student Selected
- WTI Director Awarded 2010 Management and Operations/ITS Council Achievement Award

TECHNOLOGY TRANSFER

Success Story

China Exchange Program Leads to Research and Education Opportunities

Recent exchange activities between WTI and the Chinese Academy of Transportation Sciences (CATS) are enabling an ongoing partnership to share information and expertise.

In October 2009, a four-person delegation from the Chinese Academy of Transportation Sciences (CATS) visited WTI to learn about and discuss road ecology challenges and solutions. After this trip, representatives from both organizations signed a Memorandum of Understanding (MOU), which establishes collaborative research, education, and professional opportunities as they relate to road ecology and related transportation issues with an impact on the environment. Subsequently, in September of 2010, a five-person delegation from WTI spent a week in Beijing with their Chinese counterparts, visiting project sites and exchanging ideas.

These delegation visits have immediate impact, by allowing experts in the two countries to directly share information and provide technical assistance on current projects and issues. Furthermore, they established a foundation for ongoing activities with longer-term benefits:

- The two partners are now developing proposals for joint areas of collaboration including road ecology research projects, PDA/GPS data collection, winter maintenance, and staff training, allowing them to combine resources toward common research goals.
- A WTI graduate student studying road ecology worked as intern at the China Academy of Transportation Sciences (CATS) during the summer of 2010 summer, opening the door for expanded international educational programs for students.
- The exchange program establishes a formal mechanism for sharing technology, data, and expertise across national boundaries, which supports USDOT goals to improve both the domestic and the international transportation system and strengthen US participation in the global economy.