Western Transportation Institute

UTC Annual Report 2003

Western Transportation Institute

Montana State University-Bozeman

Western Transportation Institute
University Transportation Center
2003 Annual Report

(For the period October 1, 2002-September 30, 2003)

College of Engineering

Montana State University-Bozeman

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Graphics: P. 19 & 31 *Neil Hetherington*

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Mission Statement

To lead the nation in "making rural travel and transportation across all surface transportation modes safer, more efficient and more convenient."

Message from the Director

I am pleased to present the Western Transportation Institute's UTC Annual Report for 2003. It has been an important year of growth and accomplishment for WTI, with the successful implementation of exciting technology deployments, expansion of our partnerships to the international level, and the addition of new educational opportunities for students.

This year is also significant because it marks the fifth year of our designation as a University Transportation Center. At this time, it seems appropriate to also provide a "big picture" perspective of what UTC support has helped us to accomplish. This year's report will begin with an overview of our major accomplishments over the course of this entire period.

In looking back over the past five years, it is gratifying to note that WTI and its programs have expanded in scope, depth and reach:

Research Staff and Resources: we have built up a professional staff with recognized expertise in all of our research focus areas, and we are constantly cultivating additional affiliations with faculty members who are conducting exciting, relevant research.

Partnerships: despite "Western" in our title, we have actually established partnerships, deployed technologies, and conducted evaluations in every region of the country, and have current collaborations with several other countries.

Academic Programs: our academic program has grown from a few student research assistants, to a coordinated, comprehensive program of outreach activities and support for students from elementary school through graduate school.

Technology Transfer: thanks to Internet technology, we have been able to build our own website, and link our information to many others, making our research findings easily accessible to transportation professionals and research practitioners anywhere in the world.

Through the years, we have noted a growing connection between our research and education programs, and we are excited by the implications this has for the development of the future transportation workforce. Research conducted in a university environment yields many important benefits. The most obvious is that research advances the state of the art in technology advancements, leading the way for the next generation of infrastructure improvements. Secondly, by allowing students to participate in the research, we are simultaneously training the future transportation professionals in the technologies that they will be developing, installing and maintaining. For these reasons, we believe that the UTC program is a good investment for students, for the advancement of technology, and for the economic vitality of our country.

In both the current year, and our five years as a UTC, WTI has demonstrated our ability to produce top-level research with broad appeal. The fact that universities, departments of transportation, and other agencies from around the country seek us out as research partners and expert sources shows our established reputation for successful collaboration. It also indicates that while our research may begin with a rural focus, the findings are significant to many others on a regional, national and even international level.

I believe this Annual Report provides a valuable perspective not only on what WTI has accomplished so far, but also on what we are capable of achieving in the future.

Sincerely,

Stephen Albert
Director

Five Year Overview of the Center

Introduction

The Western Transportation Institute was founded in 1994 by the Montana and California Departments of Transportation, in cooperation with Montana State University – Bozeman. WTI's initial focus was to conduct research and demonstration projects that addressed the unique transportation challenges of rural areas. In 1999, the Research and Special Programs Administration of the United States Department of Transportation designated WTI as a University Transportation Center.

With the recognition and financial support afforded by the UTC program, WTI has been able to expand the scope, depth and reach of its activities. Since 2003 marks the end of five years in the UTC program, this year's Annual Report has been expanded to include a review of cumulative accomplishments. In this way, the Report can showcase the long-term impact of UTC support, in addition to providing the customary annual update.

This five-year review is presented in terms of "success stories:" major accomplishments in the areas of WTI Administration, Financial Status, Research, Education, and Technology Transfer. They are achievements that have occurred over multiple years, and are notable for demonstrating the substantial growth, development, or change that has occurred since the beginning of the period.

Administration

Success Story: WTI improves internal staffing structure to maximize research quality, expand educational opportunities, and broaden technology transfer.

Since its creation in 1994, WTI has grown from an initial staff of two, to its current size of 35 professional staff, plus affiliated faculty and 50 students from 13 MSU departments. In the same period, the value of WTI's research portfolio has increased from $75,000 to $7 million. This growth has allowed WTI to significantly increase the scope and depth of its research activities.

To ensure that the organization's resources and growth are successfully managed, WTI has progressively adopted a more formalized internal structure. Over the last five years, WTI has added the following professional staff positions to ensure high quality research products, to enrich educational opportunities and to promote broad technology transfer:

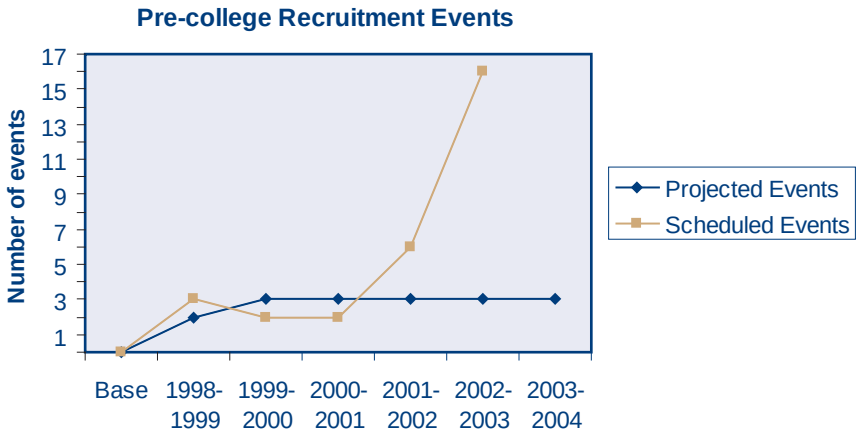
Technical Writer – The Technical Writer provides quality control of WTI's products by reviewing all reports and other documents released by WTI, and also produces original outreach materials, tailored to a variety of audiences, to disseminate the findings of WTI research. The presence of a full-time Technical Writer has improved WTI's ability to produce consistently high quality research documents. Technology transfer efforts have also been expanded and improved, now that WTI has an increased capacity to create educational materials in a variety of accessible and easily comprehensible formats.

Research Director – The Research Director provides direction for the overall WTI research portfolio, as well as guidance and mentoring of all research staff members. The Research Director has ensured that research project selection corresponds to the emerging issues and priority needs of the transportation community. The Director has also ensured that WTI research meets stringent academic and scientific standards, and that staff receive the assistance and support they need to continually develop their research skills.

Deputy Director – The Deputy Director provides the day-to-day leadership and management of staff and students. The Deputy Director is responsible for all internal operations of WTI and interacts with other MSU Departments to facilitate collaboration with the University. In addition, the Deputy Director has guided WTI's strategic planning process, which has resulted in the development of more than two dozen Strategic Objectives to improve our

capacity to forge effective collaborations, promote staff development, and meet the increasing needs of sponsors.

Educational Program Coordinator – The Educational Program Coordinator provides day-to-day supervision of the students who work at WTI and builds the educational program by developing student enrichment and outreach opportunities. Having a staff person dedicated to education on a full-time basis has had at least three major benefits. First, student learning experiences are improved because the educational programs are more structured, well-managed, and regularly developed and expanded. Secondly, the funding available to educational programs has further



increased, because the Coordinator has successfully pursued grants from additional agencies. In the last year alone, WTI has received a major grant from the National Science Foundation for a Research Experience for Undergraduates program, and funding from the Engineering Information Foundation for the Bridges and Dams outreach program for elementary school students. Finally, having a full-time Educational Program Coordinator has had a profound effect on the number of students that WTI can reach through pre-college recruitment activities, as evidenced in the graph. These events are very important for attracting more students to careers in the transportation field.

Why is this important? Having a formalized organizational structure ensures that WTI will effectively and responsibly manage our growing financial resources. In addition, having full-time staff dedicated to administration, research, education, and communications functions allows for continuity of operations and research, ongoing development of educational opportunities, and effective technology transfer.

Financial Status

Success Story: WTI annual education spending budget grows tenfold, from $50,000 to $500,000.

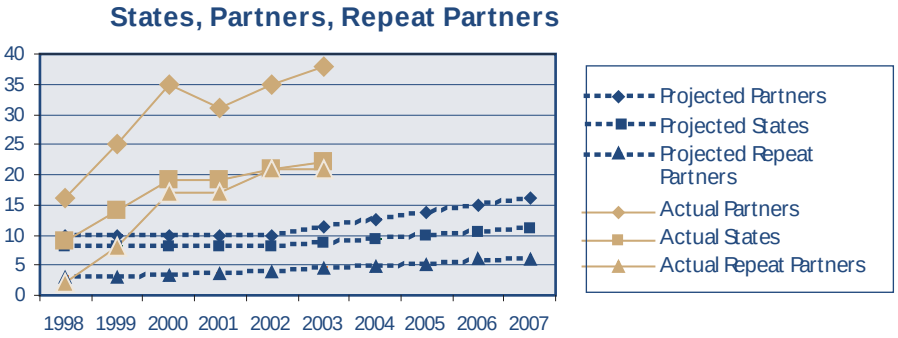
Prior to its designation as a UTC, WTI dedicated approximately $50,000 of its annual budget to educational programs. This support was largely limited to salaries for graduate and undergraduate student research assistants who worked on research projects. Annual UTC funding adds an average of $400,000 to the annual expenditures on educational programs, which is used for various student outreach, development and support efforts. UTC funding for research projects further increases the resources available to hire students to serve as research assistants, adding an additional, estimated $50,000. As a result, WTI's effective annual expenditures related to education and student support has grown from $50,000 to approximately $500,000 over the last five years of UTC funding, a tenfold increase. Educational spending now represents 20% of our total UTC funding.

Why is it important? UTC support has allowed WTI to create a strong, consistent source of funding for education. As a result, WTI can carry out its commitment to providing a broad range of programs that attract students to transportation and train them for professional careers.

Research

Success Story: Partnerships allow WTI to expand research and leverage UTC funding into a multi-million research portfolio

Through the years, WTI has effectively used partnerships to achieve many research goals, including: increasing the resources available to a project; expanding access to technical experts; expanding deployments to a wider region; adding depth to or broadening the scope of research.



UTC designation and support has provided credibility and seed money to further our ability to attract research partners. WTI's success is evident from the growth we have achieved in both number of partnerships and size of our research portfolio.

WTI has forged successful research collaborations with academic institutions, public entities and private organizations throughout the nation and even overseas. In our relatively short history, we have worked with 22 different states, giving us first-hand deployment experience in every part of the country. We are most proud of our ability to attract repeat partners, because this shows that our partners believe that we can provide a high level of expertise and resources, and that we are conducting research on issues of regional and national importance. We have attracted as many as 21 former partners to new projects in a single year. As shown in the figure below, our ability to attract new and repeat partners has exceeded even our own projections.

One of the most tangible benefits of research collaborations is the ability to pool financial resources. When funding is contributed by partners, WTI can expand the scope of research projects, and often build on initial successes. For example, since 1998, WTI has invested $216,000 in a series of seven projects related to improving transportation in National Parks. By pooling funding with states and other partners, the combined value of the research is more than $1.9 million. In a similar fashion, WTI has conducted five research projects related to transportation and wildlife interactions, for which $205,000 in UTC funding has helped attract more than $2 million in other funds. Looking at the combined impact in these two research areas, WTI has leveraged a nearly 10:1 return on our UTC investment.

Leveraged Funding: National Park Research Projects 1998-2003

Project	UTC Funds	Other Funds	Total Funds
National Parks Alter. Trans. Workshop	$35,000	$30,000	$65,000
ITS Applications in GGNRA	$42,000		$42,000
ITS Applications in CA National Parks		$420,000	$420,000
Transportation Toolkit for Fed Land Mgrs	$64,000	$60,000	$124,000
CANAMEX Corridor	$14,000	$400,000	$414,000
Alternative Trans in Yellowstone NP	$61,000	$138,000	$199,000
US 89 Traveler/Weather Information		$650,000	$650,000
TOTAL FUNDING VALUES	**$216,000**	**$1,698,000**	**$1,914,000**

Leveraged Funding: Transportation and Wildlife Projects 1998-2003

Project	UTC Funds	Other Funds	Total Funds
Animal Vehicle Crash Mitigation	$90,000	$915,000	$1,005,000
Artemis Clearinghouse	$31,000		$31,000
Roadside Animal Detection Testbed		$463,000	$463,000
US 93 Wildlife Crossings		$562,500	$562,500
Mitigating Wildlife Mortality	$84,500	100,000	$184,500
TOTAL FUNDING VALUES	**$205,500**	**$2,040,500**	**$2,246,000**

Why is it important? Research partnerships allow WTI To generate large results from a relatively small investment of UTC funds. In addition, WTI builds a reputation for successful collaboration, based on knowledge and experience gained by conducting research throughout the region and the country. This reputation in turn facilitates forging of future partnerships. Collaborations also facilitate broad and rapid technology transfer.

Education

Success Story: WTI develops a broad range of educational programs that serve growing numbers of students of all ages, interests and backgrounds.

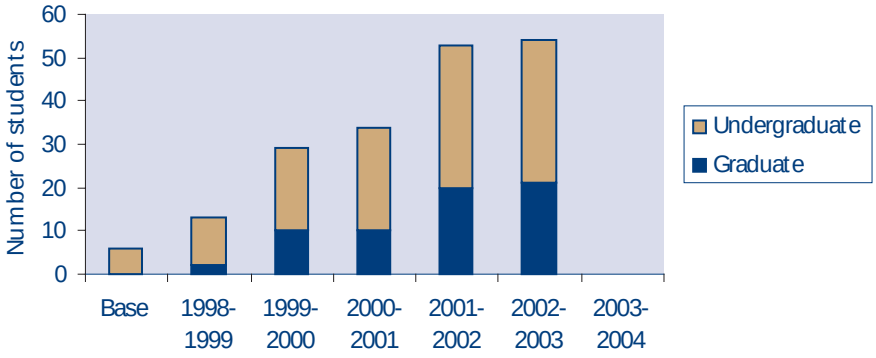
Before receiving UTC designation, WTI's principal involvement in education was the hiring of students as research assistants. While this is a critical and fundamental component of training future transportation professionals, it tends to limit WTI's "target" audience to university level students.

UTC funding has allowed WTI to expand our educational programs to include broader outreach to students of all ages. Programs like "Bridges and Dams" and "Gear Up" use fun, hands-on activities to introduce basic engineering principles to children in elementary and middle school. Other programs like "Expanding Your Horizons" and "Building Bridges" are specifically targeted at student populations (such as women and ethnic minorities) that are traditionally under-represented in professional transportation careers. High school programs are designed to showcase opportunities in transportation, and to build awareness of the necessary coursework to succeed in these fields. Over the course of five years, WTI has developed a full range of educational outreach programs that meet the needs of students of all ages, interests, and backgrounds.

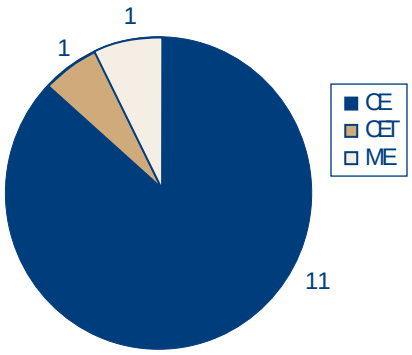
Direct support to university students remains a core element of our education program. Research positions at WTI give under-graduate and graduate students valuable training and work experience that prepares them for advanced study and professional careers in transportation. UTC funding for the Education Program has allowed WTI to create scholarship and fellowship programs that have substantially increased the number of students working at WTI. Student employment is further increased when UTC research project funding is used to hire student assistants. The figure below showcases the substantial increase in student employment since 1998.

Another long-term achievement in education is the successful recruitment of students from diverse academic backgrounds. WTI has proactively raised our visibility on campus, so that students are aware of the valuable educational and work experience opportunities we offer. As a result, we have expanded the reach of our programs well past the Civil Engineering Department, the traditional course of study for students interested in transportation.

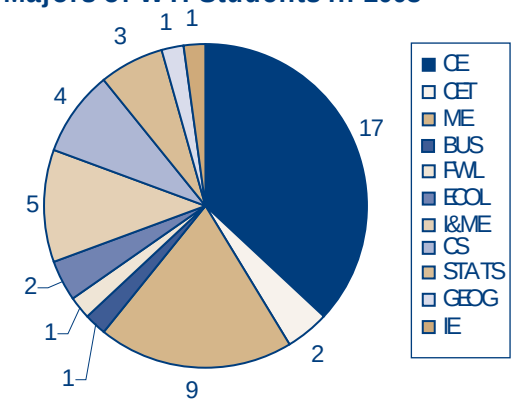
Students working at WTI



Majors of WTI Students in 1998



Majors of WTI Students in 2003

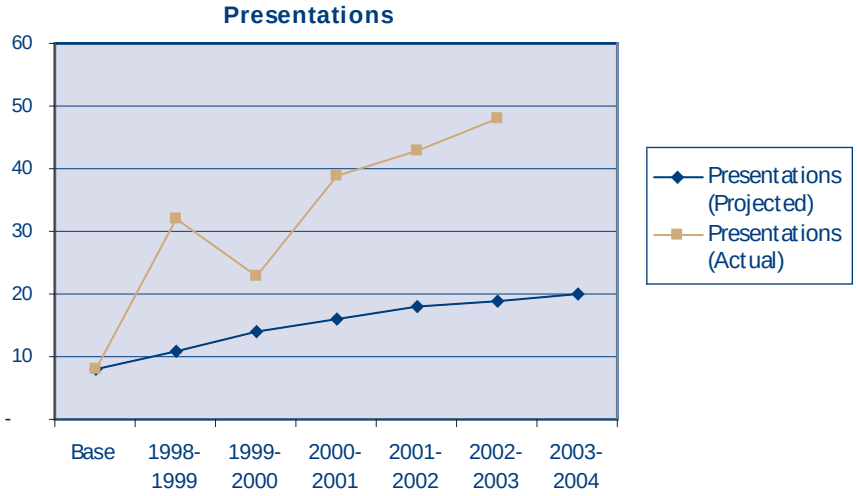


Why is this important? Workforce development is a key issue in field of transportation. By offering an increasing number of work opportunities at WTI, we are helping to train enough students to replace the retiring generation of engineers. In addition, by recruiting students of diverse backgrounds and interests, we are training future transportation professionals with broad perspectives, who can develop comprehensive, innovative solutions to future transportation challenges.

Technology Transfer

Success Story: WTI researchers expedite dissemination of research results through growing number of presentations.

WTI is constantly working to increase awareness of rural transportation challenges and the corresponding advanced technology solutions. A very effective method is to give presentations at transportation gatherings of all sizes and varieties. The researchers at WTI continually seek out new audiences with whom to share their knowledge via outreach workshops and presentations. Over the past five years, WTI has had tremendous success in expanding access to our research results through these outreach activities.



Our partnerships with transportation and other organizations have increased the opportunities to present our research findings at regional, national, and international forums. The number of presentations made by WTI researchers increases each year, and has far exceeded our own projections in every one of the last five years.

These presentations have an added benefit to our education program, because WTI encourages and pays for students to attend and make presentations at these forums. In this way, presentations serve as professional development opportunities for our staff, as well as our students.

Why is it important? These conferences and workshop opportunities are an excellent technology transfer tool because they allow for a faster dissemination of knowledge and information. In this way, the results can be useful months and even years before they would be published via the peer review process. Another benefit is that information and lessons learned from smaller projects are shared even though they often do not make the final cut in a peer reviewed publication.

At these technology transfer events information may be presented as soon as the research portion of the project is completed. At this point, data is finalized but the final report may still be in progress. Researchers not only have the chance to share their findings but also to receive input from peers, who may assist in analyzing the data and refining conclusions. The result is a more collaborative process, higher quality research, and a quicker method to advance the current state of the practice in rural transportation solutions.

By allowing students to attend and participate in these events, we expand the real-world training opportunities available through our education program and further contribute to the development of the future transportation workforce.

Conclusion

WTI has established successful, ongoing programs in research, education and technology transfer that produce tangible results. They contribute not only to the state-of-the-art, state of the practice in transportation advancements, but also to the training of the next generation of transportation professionals.

In the last five years, WTI has developed a formalized organizational structure, a nationally recognized level of technical expertise, leading edge facilities and equipment, and an established base of research partners throughout the region and the country. Our large number of repeat partnerships demonstrates our reputation for excellence among other renowned universities and research centers. Our ability to leverage funds has allowed us to grow our research portfolio from $75,000 to $5 million in only ten years. These accomplishments ensure WTI's ongoing capacity for forging effective collaborations, maximizing value and use of resources, and producing top quality research.

Administration

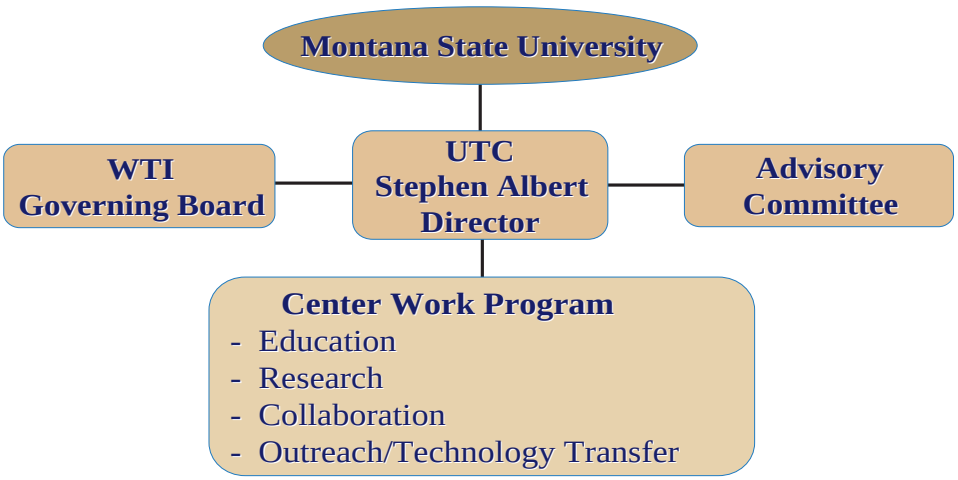
The following section provides an overview of the administrative functions, structure, achievements and initiatives of the Western Transportation Institute.

Management Structure

As the Montana State University-Bozeman (MSU-Bozeman) focal point for transportation research and technology transfer, the Western Transportation Institute's (WTI) University Transportation Center (UTC) mission is to lead the nation in "making rural travel and transportation across all surface transportation modes safer; more efficient and more convenient." Established in 1994 by the Montana and California Departments of Transportation, in cooperation with MSU, WTI has focused on rural transportation challenges and currently has research and demonstration projects in 30 states. Physically located in the College of Engineering, WTI has a 72 person multi-disciplinary research staff of students, professionals and associated faculty from engineering (mechanical/industrial/civil), computer science, psychology, fish and wildlife, business, biology and economics. WTI concentrates on meeting the growing demands for additional transportation professionals by providing students with "hands-on" experience, and conducting research that will make a difference in the everyday lives of the people of Montana and rural America.

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

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



The administrative staff manages the Center's research, education, and technology transfer activities and utilizes the systems, policies, and procedures already in place at MSU to manage funds, equipment and personnel.

Administrative Staff

Jeralyn Brodowy
Business Manager

Catherine Heidkamp
Communications and Information Systems Manager
Technology Transfer Coordinator

Susan Gallagher
Program Coordinator
Education Coordinator

Paris Hodgson
Accounting Technician

Roberta Colvin
Accounting Technician

Carla Little
Technical Editor

Neil Hetherington
Graphics Technician

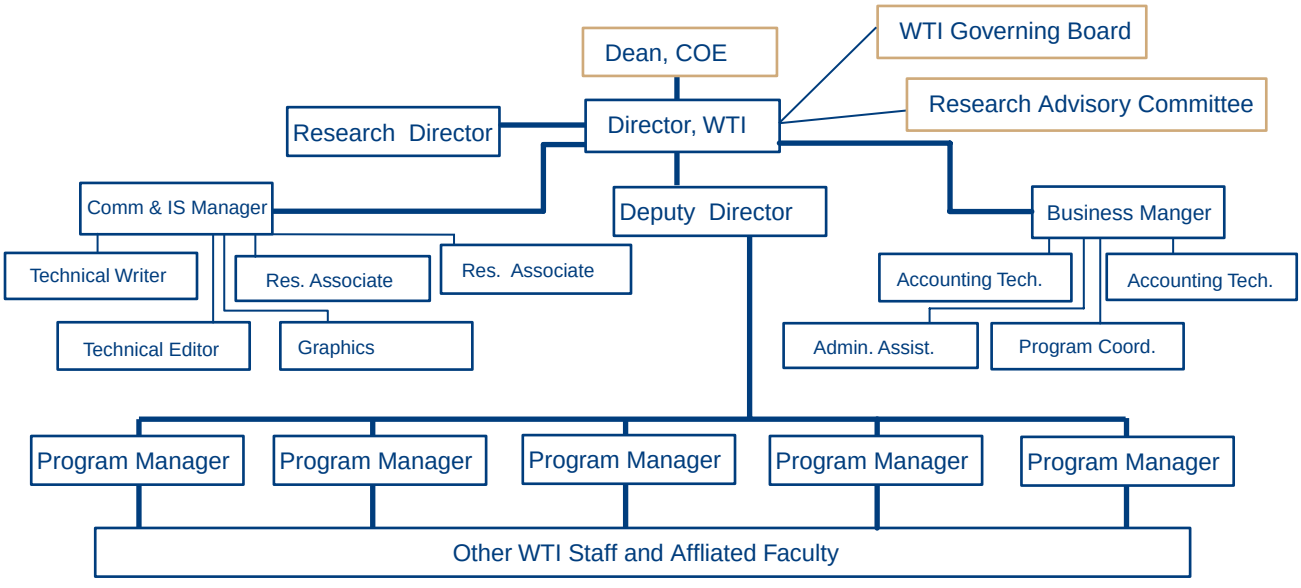
Administration Success Story

WTI Appoints Deputy Director and Research Director

Following WTI's extensive strategic planning process last year, the positions of Deputy Director and Research Director were created to facilitate the day-to-day administration of WTI and to ensure the ongoing high quality of research products. The WTI Director will continue to focus on the outreach and partnership-building efforts that form the foundation of WTI's research approach.

The Deputy Director will provide the day-to-day leadership and management of staff and students. The Deputy Director will be responsible for all internal operations of WTI; he will interact with other MSU-Bozeman Departments with which WTI collaborates. In addition, the Deputy Director will mentor less experienced staff and ensure that the WTI education and technology transfer programs are based on sound strategic and tactical principles and practices.

The Research Director will provide leadership and management of University Transportation Center research and the overall WTI portfolio; he will guide the strategic and tactical direction of all research, and facilitate discussion among a growing number of staff and faculty throughout MSU-Bozeman. He will also be responsible for the development of a public and private sector Research Advisory Committee. The Research Director will be responsible for quality control and timeliness of deliverables to meet sponsor objectives. By interacting with other MSU-Bozeman Departments and outside research partners, he will build positive relationships that promote collaboration, ensure sustainability, and maintain WTI's reputation for excellence.



Administration Initiatives for 2004

Strategic Planning Implementation

Strategic Planning has always driven WTI's efforts to achieve excellence in its internal and external relationships, as well as staff development. Last year saw major revisions to the Plan. Strategic Goals and Objectives were significantly modified and updated to reflect WTI's elevated position within the University (departmental status in the College of Engineering) and the needs of a rapidly expanding sponsor base. Fiscal year 2004 marks the "year of implementation" of the Strategic Plan. Over two dozen Strategic Objectives have been assigned to staff members for implementation over the next year. When fully implemented, the Strategic Plan will be monitored annually to determine if adjustments are needed.

New Proposal Procedures

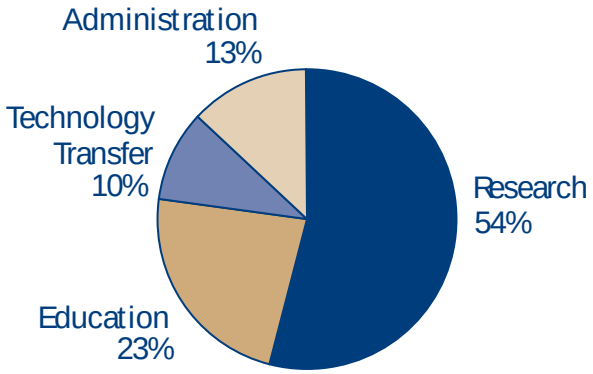
The strategic planning process identified a high priority need to "develop and implement a plan for review, evaluation, and selection of new WTI projects" based on a set of defined project selection criteria. The purpose was to ensure that new research development efforts were consistent with the strategic plan and that the costs and potential benefits of pursuing the opportunities were reasonable. A committee of WTI research and administrative staff developed a set of "bid consideration procedures" to formalize these evaluations. The new procedures, to be implemented in fiscal year 2004, will improve control, oversight, and tracking of WTI's budgets, research direction, and the quality of program development efforts.

When staff members become aware of an opportunity, they may use a detailed checklist of questions to determine the likelihood that a request for proposal application will be approved. They will then complete a "Bid Consideration Form" detailing the expected benefits, costs, risks, and probability of success of the effort. A bid consideration committee, chaired by the Research Director, evaluates these factors and decides whether WTI will pursue the opportunity and, if so, at what level of research development funding. After the proposal is submitted, the new procedures support tracking of the proposal through the sponsor's funding decision process.

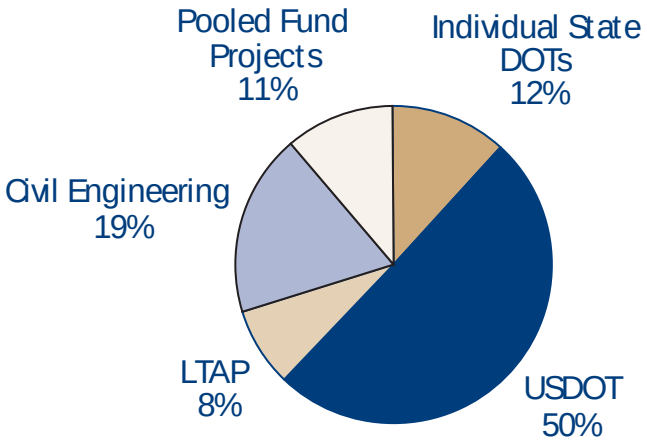
Financial Statement

The following pie charts illustrate expenditures and funding sources for the Western Transportation Institute's UTC program during the past year. The first figure illustrates the breakdown of expenditures and allocations of the Federal portion ($1,832,600) of the WTI UTC program for Year 5. Approximately $420,000 was allocated for the Education Program, and $986,600 has been committed for research funding. The remaining $426,000 supports the administrative and technology transfer functions of WTI. The seond figure depicts the Year 5 funding sources for the WTI UTC program. The match for the USDOT portion is provided by the Montana Local Technical Assistance Program, the MSU-Bozeman Civil Engineering Department, pooled fund research and demonstration projects, as well as individual state Departments of Transportation.

Expenditures for Year 5:
October 1, 2002 - September 30, 2003



Funding Sources for Year 5:
October 1, 2002-September 30, 2003



Research Staff

Ed Adams
Associate Professor,
Civil Engineering

Stephen Albert
Director

Lisa Ballard
Research Engineer

Joel Cahoon
Assistant Professor,
Civil Engineering

Jodi Carson
Assistant Professor,
Civil Engineering

Eli Cuelho
Research Engineer

Greg Cross
Senior Research Associate

Mike Edens
Post-Doc
Research Associate

Doug Galarus
Senior Research Associate

Amanda Hardy
Research Associate Ecologist

Jaime Helmuth
Research Associate

Marcel Huiser
Research Ecologist

David Kack
Research Associate

Ali Kamyab
Research Associate

Mike Kelly
Senior Research Scientist

Manjunathan Kumar
Research Associate

Robb Larson
Adj. Asst. Professor,
Mechanical Engineering

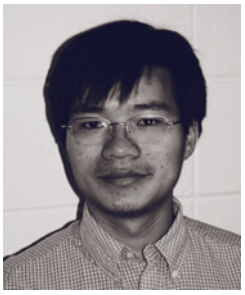
Suzy Lassacher
Research Associate/
Information Systems

Patrick McGowen
Research Engineer

Ladean McKittrick
Senior Research Engineer,
Civil Engineering

Ed Mooney,
Associate Professor,
Industrial Engineering

Steve Perkins
Associate Professor,
Civil Engineering



Xianming Shi
Research Associate

Jerry Stephens
Associate Professor,
Civil Engineering

Chris Strong
Research Engineer

John Taylor
Senior Research Engineer

Pat Wright
Senior Research Associate

Kate Hunter-Zaworski
Senior Research Engineer

Research

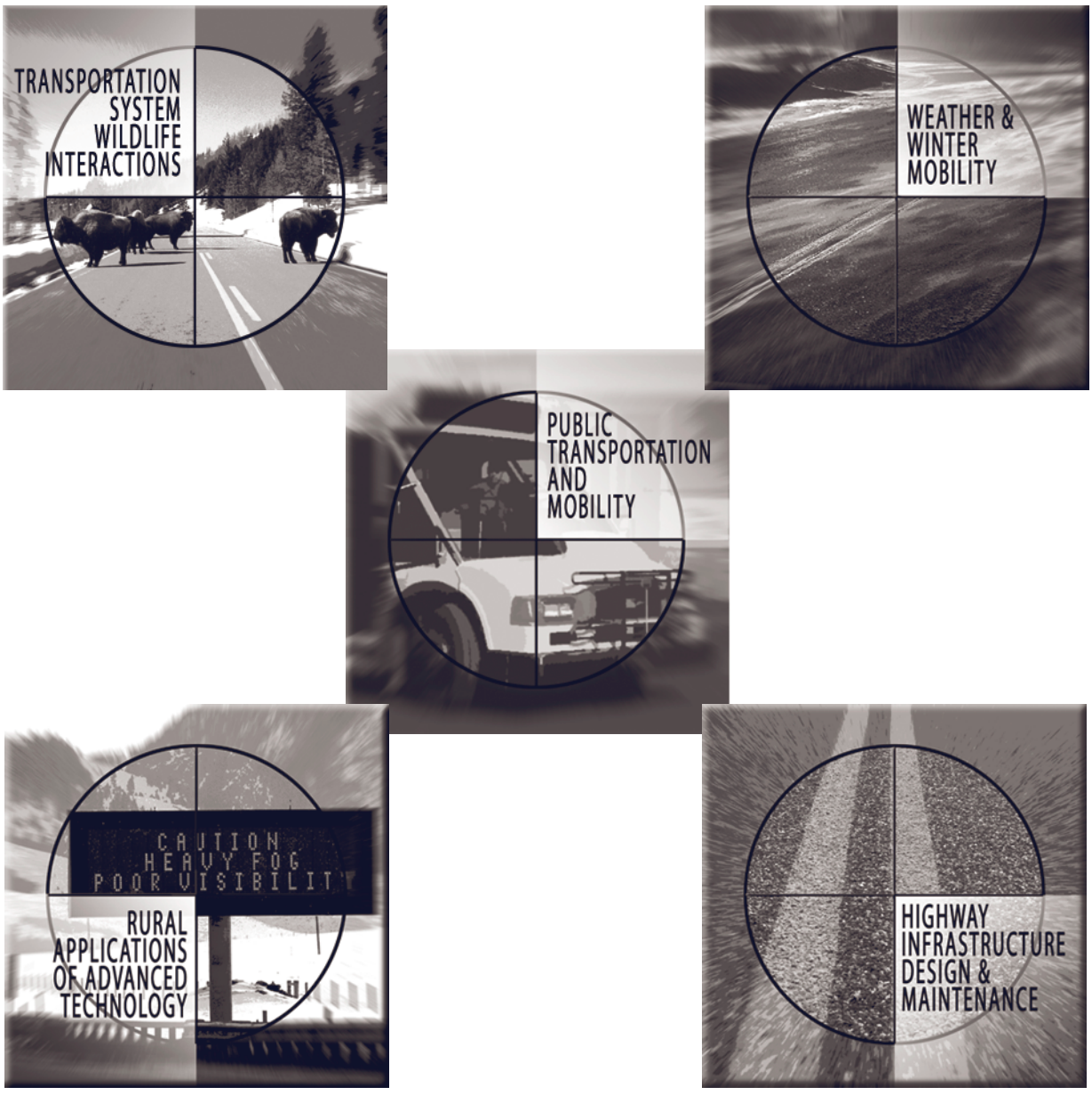
"To create an ongoing program of basic and applied research, the products of which are judged by peers or other experts in the field to advance the body of knowledge in transportation."

Research Program

Since research is WTI's core activity, project selection and prioritization is an important part of our work. WTI continually reviews the process for choosing research projects that will match staff strengths, respond to emerging issues, and produce significant results.

In recent years, WTI developed focus areas to help select priorities internally and to define the organization's research specialties to the outside world. This year, a new focus area was created, entitled "Public Transportation and Mobility." As populations grow in rural and small urban areas, there is an increasing demand for transit systems or other options that meet the mobility needs of the residents. Over the last two years, WTI has worked on several projects to increase the availability of transportation in rural areas and small towns through long-term planning, coordination, and the introduction of new technologies. Since state and federal programs also show a growing recognition for rural transportation needs, opportunities for WTI to apply its expertise in this new focus area are expected to increase.

The following section provides details on all of WTI's new, ongoing and recently completed UTC research projects, and highlights this year's successful efforts to effectively deploy new technologies.



New Research Projects

Project#	Project Title	Principal Investigator
425074	Statewide Demand-Responsive Software	David Kack
425157	ODOT ITS Performance and Benefit Plan	Christopher Strong
426700	Compressibility and Heave Characteristics of Subgrade Soils Exposed to Freeze/Thaw Conditions	Robert Mokwa
426847	Mitigating Wildlife Mortality and Habitat Fragmentation	Tony Clevenger
426886	Bozeman Transportation Research, Applications, and Instrumentation Laboratory (TRAIL)	Suzanne Lassacher
426940	Paratransit Operations Review	David Kack

Statewide Demand-Responsive Software

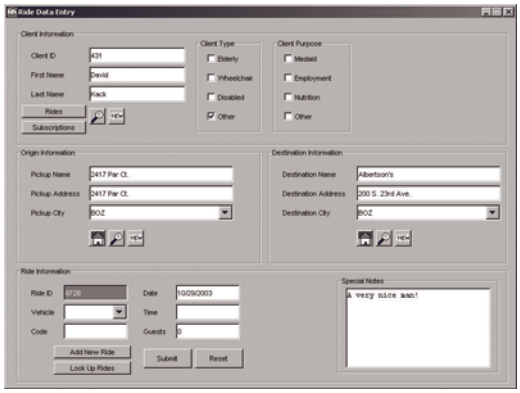
David Kack
406-994-7526
dkack@coe.montana.edu

WTI recently completed a five-year service improvement plan for GALAVAN, a paratransit provider in Bozeman, Montana. One of the outcomes of that project was the development of a tailored client management software package for GALAVAN.

The software has the potential to assist other demand-responsive transit providers in Montana that have inadequate resources for efficiently tracking their clients and operations. Many of these providers are currently performing these data collection and reporting tasks by hand. The purpose of this project is to provide a one-year test of the GALAVAN client management software.

Tracking software will help small transit providers to measure the effectiveness of their operations, identify opportunities for improvement, and facilitate coordination of services.

In addition to GALAVAN, three other demand-responsive transportation providers in Montana will be selected to participate in the test. At each site, WTI will install the software and provide technical training and assistance. WTI will also evaluate the performance of the software and perform revisions based on input from users at the test site.



Oregon ITS Performance and Benefit Plan

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The Oregon Department of Transportation (ODOT) has implemented many intelligent transportation system (ITS) projects and services throughout the state, including an Advanced Transportation Management System (ATMS), Advanced Travel Information Systems (TripCheck), Highway Travel Condition Reporting System (HTCRS), Road and Weather Information Systems (RWIS), Variable Message Signs (VMS), and others.

By documenting and showcasing the benefits of current ITS systems, ODOT can begin to build public and institutional support for future ITS expansion.

In order to ensure support for ongoing ITS investment, ODOT is working to evaluate the performance of ITS, document the benefits, and educate the public about how ITS enhances transportation safety, mobility and efficiency. Through this project, WTI is conducting a series of individual research tasks that will assist ODOT with this effort.

One of this year's accomplishments has been the development of a web page that documents some of the primary benefits of ODOT's ITS deployments. The web page contains a comprehensive list of projects in Oregon, grouped by purpose of the project, such as Traveler Information, Safety, and Public Transportation. The introductory page also has links to detailed information on specific systems, including documented benefits with supporting numbers and performance data.

The intent of the web page is to make information on the benefits of Oregon ITS systems readily available to the public. The page has been incorporated into the ODOT website at www.odot.state.or.us/its.

WTI also evaluated an infrared camera that could be used for detecting ice on roadways. The evaluation used MSU's cold weather chamber to generate a variety of weather conditions, in order to examine how quickly and accurately the camera detected phase change. The results of this evaluation will help ODOT to more accurately detect when roadways require winter maintenance.

Compressibility and Heave Characteristics of Subgrade Soils Exposed to Freeze/Thaw Conditions

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Frost action below road pavements and structures supported on shallow foundations results in significant long-term maintenance problems in most temperate zones in which seasonal soil freezing occurs. The problem is widespread, and is becoming increasingly important as wheel loadings, traffic frequency, and costs of pavement structures increase. A practical approach is needed for evaluating the frost susceptibility of soils and for predicting the magnitude of strength reduction, heave, and settlement of soils exposed to repeated freeze-thaw cycles.

This project could lead to highway construction methods that decrease the number of long-term maintenance problems resulting from severe winter weather.

This project addresses the problem of quantifying effects of frost action including heave that occurs during the freezing process, and settlement that occurs during thaw. Geotechnical and engineering mechanics principles will be used to develop practical methods for investigating and analyzing the long-term behavior of soils subjected to repeated cycles of freezing and thawing, with an emphasis on frost heave aspects related to construction and performance of pavement structures. Compressibility and settlement characteristics of thawing soils will also be addressed, with an emphasis in developing practical methods and correlations using in situ devices and laboratory tests.

Experimental and analytical research is proposed to develop systematic and practical methods that can be applied to the analysis and design of highway pavement sections and shallow foundations constructed in cold climates. The research will focus on regional soil conditions and seasonal variations that are common to the state of Montana and the inter-mountain region of the United States. The project will make extensive use of unique and specialized geotechnical and snow mechanics equipment currently available in the Civil Engineering Department at Montana State University (MSU), including a customized cone penetrometer and a Cold Region Laboratory Weather Chamber.

Mitigating Wildlife Mortality and Habitat Fragmentation

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The purpose of this collaborative project is to continue landmark wildlife mitigation research in Banff National Park begun by Dr. Anthony Clevenger. In 1996, Dr. Clevenger initiated an intensive five-year research program in Banff. The study focused on wildlife crossing structures and fencing on the Trans-Canada Highway, in order to address permeability for wildlife, animal-vehicle mortalities, wildlife movements, and habitat connectivity in the Bow River Valley. The research team evaluated means of mitigating road effects on wildlife and made recommendations for future transportation planning efforts in the mountain parks.

The Banff-Bow Valley provides an unrivalled environment for research on the efficacy of wildlife crossing structures and reducing wildlife-vehicle collisions. There is a variety of wildlife crossing structure designs built during two time periods as well as numerous park-supported wildlife research studies. Banff mitigation research has the world's longest, year-round monitoring program and largest dataset on passage use by wildlife.

The findings from the Banff research are helping to guide the design of mitigation measures for wildlife on future highway construction and reconstruction projects in the United States.

The new partnership with WTI will enable Dr. Clevenger to continue his research in Banff beyond the original five-year program and to secure additional long-term funding. Additional goals of this project are the integration of Banff research with the US 93 reconstruction project in Montana, the development of partnerships with Canadian and US agencies, and the establishment of a long-term collaborative research project in Banff.

Transportation Research, Applications, and Instrumentation Laboratory (TRAIL)

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The Transportation Research, Applications, and Instrumentation Laboratory (TRAIL) will demonstrate and evaluate various data acquisition, control systems, information delivery, and management systems in small urban and rural environments. The laboratory would provide a test bed for the various types of research currently being conducted by WTI, including weather and winter mobility, highway infrastructure design and maintenance, wildlife and ecology, commercial vehicle operations, emergency medical services and public transportation.

TRAIL will be developed and deployed in multiple phases, with the initial phases being deployed locally at Montana State University – Bozeman. The first phase of this project will be to develop the requirements and determine the potential partnerships for a local component of the transportation laboratory, including instrumentation, communication, and a data processing and management center. The goal of the second phase is to establish a "smart travel corridor" for 19th Street in Bozeman, Montana, a primary traffic corridor in the city that is experiencing a high rate of development and a rapid increase in traffic volumes and congestion. Deployment of traffic, weather, and road condition sensors will allow WTI to obtain real-time and summary data on travel conditions, which can be communicated to the TRAIL data management center for processing and archiving.

The TRAIL laboratory will serve as a test bed for a variety of new human factors, weather, pavement, animal detection and traffic technologies.

Future phases will seek to implement new systems and technologies, in collaboration with national and international research partners. The long-term goal of the project is to open a facility where a wide range of new technologies research can be conducted, where students have hands-on learning opportunities, and where technology transfer can be expedited through facilitated data collection and sharing.

Paratransit Operations Review (MET Transit)

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The purpose of this project is to identify technologies and other service improvements that could improve the effectiveness and efficiency of the MET Transit paratransit system in Billings, Montana. In particular, MET transit is interested in assessing the potential value of technologies such as new computer-aided scheduling and dispatching software, Automatic Vehicle Location (AVL) and Mobile Data Communications (MDC)..

Initially, WTI will conduct a review of MET Transit's operations and work flow, with particular emphasis on how rides are requested and assigned to vehicles. Researchers will identify technologies that may enhance the efficiency of MET's operations, and survey other providers to document the benefits gained by and lessons learned from using those technologies.

The technology plan developed through this project will likely serve as a model to many other paratransit providers in small urban or rural areas.

The final report will include recommended strategies for the selection and purchase of technologies, as well as a basic architecture of a possible system for Billings.

On-Going Projects

Project #	Project Title	Principal Investigator
426121	Winter Surface Condition Forecasting	Ed Adams
426131	ITS Applications in Golden Gate National Recreation Area, Phase I, Muir Woods	Christopher Strong
426142	Geosynthetic Pullout Behavior under Small Displacements	Eli Cuelho
426218	Evaluating the Accuracy of RWIS Sensors	Ali Kamyab
426243	Impacts of Weather on Rural Highway Operations	Manju Kumar
426324	Communications and Power Improvements for Rural ITS Field Devices	Ali Kamyab
426349	Case Studies of Maintaining ITS Devices in Rural Areas	Manju Kumar
426360	Tribal Automated Accident Reporting System	Gary Harkin
426366	Canamex Smart Tourist Corridor	John Taylor
426443	Saco Bridge Field Evaluation	Eli Cuelho
428466	Transportation Toolkit for Federal Lands Managers	Christopher Strong
426553	National Park Service Sustainable Transportation	Mike Kelly
426705	Comparative Evaluation of Wind Warning Systems	Manju Kumar
426711	Roadway Weather Severity Index	Christopher Strong
426719	Video Surveillance Trailer Equipment	Christopher Strong
427304	Artemis Clearinghouse	Pat McGowen
427514	Mobile Laboratory	Robb Larson
427869	California – Oregon Advanced Transportation System (COATS) Program Showcase	Christopher Strong
427951	Demonstration and Evaluation of ITS on the Rural Highway Environment (Frontier)	Patrick Wright
428464	Development of Test Protocols for Characterization of Soil/Geosynthetic Interaction and Intrinsic Geosynthetic Material Properties	Eli Cuelho
428467	Animal – Vehicle Crash Mitigation	Pat McGowen

Winter Surface Condition Forecasting

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The Western Transportation Institute and Civil Engineering faculty at MSU, in consort with external partners, is in an ongoing development of a pavement temperature model for highways. This thermal model is a first step in what, it is hoped, will be the continuing development of a winter highway safety emphasis and the complimentary expansion of WTI/CE technical expertise. The goal of the University Transportation Center's (UTC) winter surface condition program is to extend the knowledge that has been gained in the winter highway forecasting of pavement temperatures modeling and draw upon the well established snow and ice competency which has historically been a strength at MSU-Bozeman.

The practical highway safety concern with regard to the thermal modeling effort is not temperature per se, but the associated icing conditions that may result. This feature, along with other refinements and improvements, is being incorporated into the model under several projects including this UTC program. The highway thermal model is a state of the art development that is (to our knowledge) leading the field in this type of analysis. The project began "operational" testing with the Montana Department of Transportation on Bozeman Pass in the winter

of 2001- 2002. It is currently running in a forecast mode that utilizes a National Weather Service forecast that is, subsequently, spatially refined to yield a weather forecast at the 1 km^2 scale. The actual terrain/road surface forecast is finally accomplished at a 30 m resolution; a scale based on standard U.S. Geologic Survey digital elevation maps. The strength of the model is the ability to deal with the effect of topography, including influences such as shadowing and wind. This is a computationally expensive analysis and, although a number of optimizations are being investigated, it will remain such. New equipment directly related to this effort, funded in part under the UTC program, includes the purchase of an 8-processor computer with a RAM upgrade to the existing computer. This has reduced the pressure on the College of Engineering computers and provides faster calculations. Funding for the computational equipment was pooled between a National Science Foundation grant, the Civil Engineering Department and the Western Transportation Institute (UTC) funds.

This project will develop testing procedures, equipment and models that can improve our ability to identify and analyze the factors that affect road surface conditions during winter weather.

In order to continue to progress and lead in any scientific/engineering endeavor it becomes necessary to probe ever deeper into our understanding of basic principles and to comprehend how the specific is tied to the whole. This is no less true of highway maintenance, if we are to progress in the practical operations. It is with this goal in mind that the UTC program has been initiated. Specifically, the UTC plan is to provide some of the more fundamental work required to continue to work toward an ever more robust thermodynamic analysis of winter conditions along roads and highways. This effort will help to develop a more through understanding of physical processes germane to conditions on and along the highway and position the group on an overall stronger foundation for subsequent work.

A specially designed low temperature environmental chamber has been developed. The purpose of the chamber is to provide a means to examine the influence of environmental and meteorological parameters that influence winter road and adjoining terrain conditions. The chamber provides a test area on the order of 1 m^2 on which experiments may be conducted. The unit provides fully programmable temperature and solar radiation input to allow for simulation of, for example, an ice-covered or wet road subjected to diurnal cycling. Albedo, which is a measure of the amount of radiation absorbed or reflected from a surface, is a necessary parameter when computing the thermal calculation for a material. Realistic values of the highly variable and dynamic properties of snow or ice covered pavements is paramount to modeled accuracy. Contaminants such as sand or chemicals used in maintenance operations may be considered in regard to albedo and how and where melting or potential disbanding of ice may take place on a road. Little work in this area has been carried out with an eye toward winter highway safety. The test apparatus will be of great potential benefit in these areas. Changing surface conditions on snow surrounding a roadway is also significant, since the albedo of a snowcover directly influences reflected energy available to the road. Investigation is planned for this influence as well. These textural changes will also influence the potential for avalanches and flooding due to snowmelt. The cold chamber will be of long term utility potentially for such studies as thermal shock on pavement, springtime break-up and deterioration due to freeze thaw and solar radiation.

ITS Applications in Golden Gate National Recreation Area Phase I: Muir Woods

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As visitation to national parks increases, the transportation system in the parks and surrounding communities may suffer from congestion, lack of parking, deteriorating infrastructure, poor traveler information, and other factors that may affect the public's enjoyment of these unique resources. However, the impact from reducing visitation would not only affect the National Park Service's (NPS) success in attracting visitors, but would also have a significant economic impact on the surrounding communities. The challenge for NPS is to find a way to execute its dual mission of preserving the historic, cultural and national resources under its control while promoting the enjoyment of these resources by the American public.

This project will test whether advanced technologies can help manage the impacts of increased visitation at our National Parks.

This project seeks to overcome this problem at one particular location, the Golden Gate National Recreation Area (GGNRA). GGNRA attracts more visitors than any other land administered by NPS west of the Mississippi River, with over 14 million annual visitors. GGNRA attracts tourists from local communities as well as other states and countries to enjoy the many unique cultural, historic, and natural features in the area near San Francisco Bay. The resulting traffic challenges the National Park Service in providing adequate pre-trip traveler information, relieving traffic congestion, having sufficient parking, and promoting alternative access modes. This park represents a unique location where intelligent transportation systems (ITS) applications have the potential to help the NPS address their challenges, and produce findings that may be useful and applicable to many other parks and recreational lands across the country.

The goal of this project is to develop an "early-winner" project focusing on access to Muir Woods, an old-growth redwood area in Marin County, California. Projects will reflect challenges based on the potential for benefits, cost, institutional issues, and other factors. Research will be conducted in partnership with the California Department of Transportation, NPS, and other stakeholders as required.

Geosynthetic Pullout Behavior Under Small Displacements

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As road agencies move toward a mechanistic-empirical design method for flexible pavements, it becomes necessary to define the mechanistic behavior of the materials or pavement systems. Much of the work in updating the American Association of State Highway and Transportation Officials (AASHTO) 2002 Pavement Design Guide has been related to defining numerical response models related to each component of the pavement system.

In terms of producing a pavement design utilizing geosynthetics as reinforcement, mechanisms of reinforcement must be fully understood. One way of studying these mechanisms is by conducting laboratory experiments like the pullout test. The pullout test looks at the interaction between the soil and geosynthetic through the extrusion of the geosynthetic from the soil mass. Traditionally, pullout tests are performed by applying a constant rate of pull to the geosynthetic while simultaneously measuring displacements along the embedded length. This type of test correlates well with applications like geosynthetic-reinforced embankments or walls but does not fully describe the kind of interaction experienced within the pavement system. Pavement structures undergo rapid cyclic loading from wheel loads applied at the road surface. Therefore, it is necessary to test geosynthetic/soil interaction under this type of loading (i.e., cyclic).

By studying the interaction between geosynthetic materials and the surrounding soil using cyclic loads, this project will provide valuable data that can be applied to future pavement design standards.

Currently, the resilient modulus test may be used as a means of determining stress strain characteristics of unbound granular base/subbase materials and subgrade soils. This test applies a cyclic stress to a column of soil at various levels of confinement while simultaneously measuring strain. When sufficient cycles have occurred such that the plastic strain in the sample is essentially zero, a modulus value may be determined using the cyclic stress and the resilient strain – which is almost completely elastic. To understand cyclic behavior of geosynthetics embedded in soils, an experiment that utilizes cyclic loading better emulates the behavior of dynamically loaded reinforced soils.

Therefore, an initial cyclic pullout test method has been developed to replicate the resilient modulus test using an existing pullout test facility. Resembling the resilient modulus test, the pullout experiment applies a cyclic load to the geosynthetic under varying confinements. Applied loads and displacement of the embedded end of the geosynthetic are measured. Unlike traditional pullout tests, a very short length of geosynthetic is embedded in the soil to minimize strain along its length, so that the entire sample of geosynthetic is engaged at once. Also being investigated are specific interaction relationships of the different geosynthetic material components to further understand how reinforcement is being developed.

Results collected so far have been very promising, providing good correlations between load-displacement responses and modulus-confinement relationships. Test procedures have been modified slightly to improve data collection and sample preparation. If after further analysis this experiment continues to provide the information necessary for describing soil-geosynthetic interaction under cyclic loading, a test protocol will be developed to eventually create a standard test procedure.

COATS SHOWCASE: Evaluating the Accuracy of RWIS Sensors

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Many transportation agencies use Road Weather Information Systems (RWIS) to make critical decisions regarding road maintenance and use, especially during severe weather conditions. For these systems to provide quality and accurate data, RWIS technologies such as pavement sensors must function properly and consistently.

The techniques for testing and calibrating sensors have traditionally been the responsibility of vendors contracted for RWIS maintenance. Various weather detection technologies have been deployed in the California/Oregon Advanced Technology Transportation Systems (COATS) study area, offering the opportunity for researchers to examine the effectiveness of these sensors. For this evaluation, WTI will evaluate the accuracy of RWIS sensors at selected sites throughout California and Oregon.

This project will provide transportation agencies with independent research results regarding the accuracy of RWIS sensors.

RWIS sensors will be evaluated for accuracy at selected sites during the wintertime (December 2003 through February 2004) in California and Oregon. An infrared (IR) camera, acquired by the Oregon Department of Transportation (ODOT) to detect ice formation on the pavement, was tested in the new weather chamber addition to the cold regions laboratory at Montana State University in May 2003. The results indicate that the IR camera would accurately predict surface conditions and temperature phase changes. Based on the findings, an experimental design has been developed for collecting and analyzing data and assessing the sensors' accuracy. Accordingly, the camera will be installed on top of a 30-foot mast on roadway shoulders of two selected study sites (one in each state) to record the phase change of ice/snow on the pavement. The camera's recorded data will be compared to the actual temperature readings of the selected in-place pavement sensors and visual recordings, conducting by an observer. Data will be recorded under different traffic and weather conditions. Appropriate statistical data analyses to determine whether there are significant differences between the recorded camera and sensors data will be conducted. The outcome will determine the accuracy of the selected field sensors.

COATS SHOWCASE: Impacts of Weather on Rural Highway Operations

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Weather poses a significant challenge to rural highway operations. In many cases, the operation of the transportation system under severe weather can be improved through the strategic use of advanced operational strategies, including the use of intelligent transportation systems (ITS). To estimate the benefit of ITS or other solutions requires accurate estimates of the pre-deployment, baseline conditions for roadway operations. However, very little baseline data exists for highway capacity and speeds in rural environments during weather events, such as snow, heavy rain, and fog.

This project will provide foundational data that will help evaluate the effectiveness of future road safety technologies and improvements.

The objective of this project is to develop a method for estimating the road capacity reduction effects of weather on rural highway capacity, through the correlation of data collected from various detection technologies combined with information about weather conditions and road grades. This project will provide valuable information that may be used to assess the benefits of a variety of transportation system improvement projects, including intelligent transportation systems (ITS).

Several data collection sites will be selected within the COATS study area. These sites will have both road weather information systems (RWIS) and detection systems to measure vehicle volume and speed under various environmental conditions. The entire set of locations will include sites subject to a variety of weather conditions, and sites with a variety of grades and geometric characteristics. Traffic and weather data will be collected over the course of six to nine months, in order to capture a variety of weather events. Statistical comparisons between periods of free flow traffic and periods of adverse weather conditions will be conducted to isolate the effects of various weather events on roadway capacity and speed. A series of models will then be developed to help assess the baseline capacity and speed conditions under various weather conditions.

COATS SHOWCASE: Communications and Power Improvements for Field Devices

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Intelligent Transportation Systems use advanced computer, electronics and communications technologies to improve the operation of the surface transportation system. However, many rural areas lack an integrated communications or power infrastructure that can support the deployment of ITS, so agencies are typically forced to improvise a solution.

The purpose of this project is to document case studies of innovative solutions for addressing the communications and power needs of ITS field devices deployed in a rural environment. By documenting and building upon the lessons learned from past deployments, the reliability and effectiveness of future ITS deployments may be significantly improved.

This project will provide an important informational resource to rural areas trying to address transportation challenges with a limited communications or power infrastructure.

A web-based survey was conducted among the 50 state Departments of Transportation to inquire about their experiences in the deployment of video and non-video applications and alternative power sources in rural areas. Upon receiving and reviewing the responses, the promising alternative power sources were identified. No case studies were selected among the communication technologies as none were found to be new applications. A second survey was distributed via email among the states that indicated employing alternative power sources to obtain additional information on the functionality, application, cost, and lessons learned of their systems.

COATS SHOWCASE: Case Studies of Maintaining ITS Devices in Rural Areas

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Proper maintenance of intelligent transportation systems (ITS) elements is crucial because it can extend the useful life of the ITS infrastructure, help increase reliability, reduce long-term costs, and build public confidence in ITS development. ITS maintenance in rural environments has unique challenges compared to urban areas, due to the reduced availability or greater expense of contract maintenance, long distances separating field devices from trained maintenance staff, specialized training needs for ITS maintenance, and limited system redundancy.

As more ITS technologies are employed in the COATS study area, a rich repository of information on actual maintenance becomes available, offering the opportunity to collect pertinent cost data and develop best practices. The objective of this project, therefore, is to document case studies of ITS maintenance to guide future ITS deployments in the COATS study area, improve maintainability of field devices in the design and procurement stages, and generate more accurate information on maintenance costs.

A literature review will be conducted to help assess the maintenance needs of ITS elements. Based on input from local stakeholders, several ITS technologies and deployment locations will be identified for case studies. Locations will be selected based on the availability of adequate experience and record keeping, in order to document maintenance history and develop lessons learned. Data will be collected from maintenance staff for each device to gain an overall understanding of the systems/devices, their perceived usage and maintenance history. A detailed review of maintenance records will be used to identify primary maintenance concerns from technical and institutional perspectives. The results of this effort will be compiled, summarizing major findings and providing recommendations for improved maintenance procedures.

Tribal Automated Accident Reporting System

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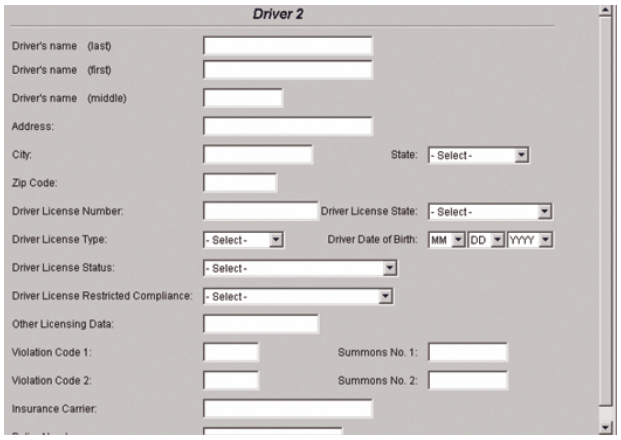
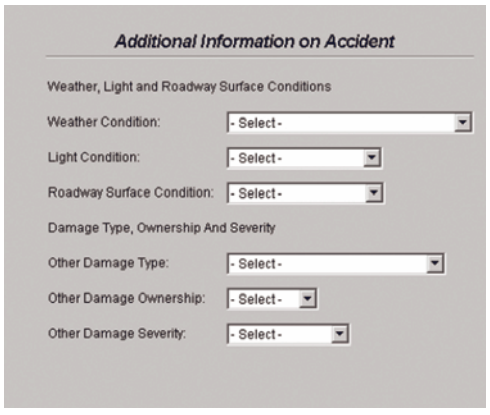
Accident data is a useful tool for transportation and emergency response planning. In Montana, the availability of quality data is limited due to several factors related to the current reporting system: the inaccuracy of data, the incompleteness of the data and the potential errors associated with transcribing and communicating the data.

The purpose of this project is to improve accident reporting in the State of Montana through the application of advanced technologies. The basis of the improvement is the use of mobile computing systems to collect the data at the accident scene and the use of Global Position System (GPS) units to identify the accident locations with greater precision.

Researchers developed a prototype system with two major components: the mobile data collection portion and the fixed data upload and database interface portion. The initial platform for the mobile product was Pocket PC's coupled with GPS units. The mobile platform software provided a user interface that mimics the current State of Montana paper reporting system to maximize user acceptance and minimize errors. The fixed data/interface product was intended to operate on current computing systems, to interoperate with current database mechanisms supported by local and State of Montana agencies for accident reporting, and to provide the user with an opportunity to perform validity checking on the report data. The prototype demonstrates the potential for creating an accident reporting system with a corresponding database; however further research is needed to address compatibility issues between the GPS systems and PC systems as well as limitations of the Pocket PC.

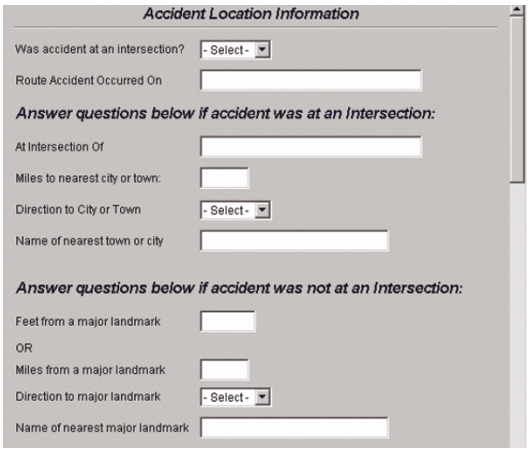
Collecting accurate crash data is a fundamental component of research to develop and test transportation safety advancements.





The Pocket PC offers limited screen space for data entry, making it difficult to implement complex forms. Tablet PCs offer greater flexibility for creating forms that mirror their paper counterparts. As a result, WTI is investigating the viability of a Tablet PC implementation.

An added outreach component of this project has been a targeted effort to meet with Native American leaders in Montana, to identify the reasons for low accident reporting on reservations and investigate whether advanced technologies such as these can facilitate increased reporting. The outreach effort has identified important obstacles to increased data collection and reporting, such as a lack of clearly established policy on the traffic accident reporting process. In addition, there is not yet agreement among the tribes about which data should be reported to the state. Ongoing efforts to create new technology solutions will have to be flexible enough to be adapted to the needs of individual tribes.



CANAMEX Smart Tourist Corridor

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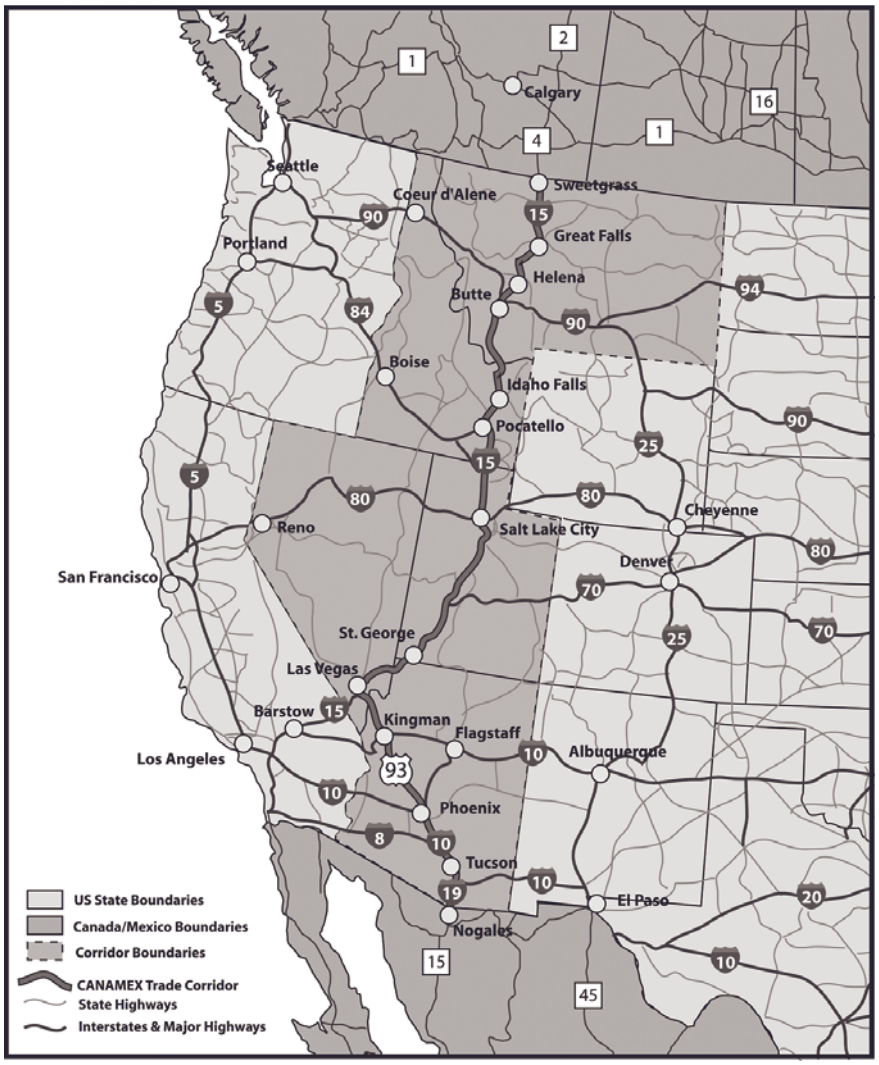
As part of the North American Free Trade Agreement (NAFTA), Congress designated a number of trade corridors to stimulate economic development among Mexico, the United States and Canada. Ultimately the CANAMEX corridor will extend from Edmonton, Alberta to Mexico City. Within the U.S., the Corridor generally follows the Interstate System from the Canadian border at Sweetgrass, Montana, through Idaho, Utah, Nevada and ends at Nogales, Arizona – a distance of 1500 miles. The Governors of the five states created the CANAMEX Corridor Coalition (CCC), a policy level body, made up of a senior transportation official and a highly regarded entrepreneur from each state. The CCC commissioned the CANAMEX Corridor Plan with the goal of stimulating economic development, particularly in rural areas along the Corridor. The Plan, published in April 2001, identified a number of important initiatives that, if carried out, would achieve the overall goal.

By improving services to all travelers along a major trade corridor, this project will enhance transportation safety and improve economic activity at the local, state and international level.

The CCC selected the initiative "Smart Tourist Corridor" to launch implementation of the Plan. This initiative will utilize Intelligent Transportation Systems (ITS) to significantly enhance information available to tourists and other Corridor travelers, as well as improve their safety. The CCC selected WTI to develop the Smart Tourist Corridor Action Plan.

To date, two Technical Memoranda of the Action Plan have been completed. First, an array of services that must be available to tourists and other travelers has been defined, and preliminary concepts have been developed for innovative ways to make the information readily available (TM 1). Secondly, a Corridor Operations Plan has been prepared; this element of the Action Plan inventories what ITS devices and systems are currently available; analyzes existing operations on the Corridor; and makes recommendations for improving incident management strategies, information exchange, telecommunications, and telematics (TM 2).

The final component will identify the technological communications infrastructure necessary to assure that the elements of the Smart Tourist Corridor Action Plan provide the above services conveniently, efficiently and effectively. It will also present a prioritized list of recommended ITS deployments (TM 3 and Final Report).



Saco Bridge Field Evaluation

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Near Saco, Montana, there are three bridges on Route 243, located very close together, that are scheduled for replacement. Since the three new bridges will experience the same vehicular loads and environmental conditions, and have a common size and quality of construction, the Montana Department of Transportation (MDT) recognized a unique opportunity to evaluate the relative performance of bridge decks having different designs. The new bridges will be constructed with three different types of concrete bridge decks:

This project will allow MDT to conduct a nearly "side-by-side" field comparison of three different types of bridge construction.

a conventionally reinforced deck made with standard concrete,

a deck with reduced reinforcement made with standard concrete, and

a conventionally reinforced deck made with high performance concrete (HPC).

The purpose of this project is to evaluate the relative performance of the three different types of concrete bridge decks, in order to assess resistance to cracking and service life for each design method. The project is jointly funded by MDT and RSPA. UTC's support will allow WTI to obtain the specialized monitoring equipment for this unique evaluation.

More than 60 strain sensors were embedded in each bridge deck during the construction of the bridges. Since then, the long-term monitoring was initiated and the live load tests were conducted. Live loads were applied to the bridges using overloaded, 10-wheeled maintenance trucks driving at slow and fast speeds. During these tests, responses from the embedded sensors were monitored and stored. This data will be evaluated to determine differences in the way load is transferred through the bridge deck and into the structure.

Transportation Toolkit for Federal Land Managers

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One important group of stakeholders in understanding the needs of America's rural transportation system is Federal lands, including National Parks. The Federal government manages significant portions of rural land, much of which serves as destinations for tourism and recreation. Unlike many tourist destinations, Federal lands are mandated to preserve and protect unique natural, cultural and historical resources. Maintaining the balance between the demand for increased visitation and the need to preserve resources can be challenging.

This project will help federal land managers match their transportation challenges with appropriate and innovative solutions.

One area in which this balancing act has important consequences is the transportation system. Within a Federal land, there may be significant constraints on the transportation infrastructure, including gate capacity, air and noise pollution, right-of-way limits, lack of ability to expand parking and similar issues. Unless these problems are addressed, they may result in potential resource damage and a degraded visitor experience. The nature of these problems typically does not match the skill set of Federal land managers, whose expertise is directed toward preserving the resources (biological, cultural, archeological, historical) and providing for the public enjoyment of the resources within their boundaries. The lack of background in transportation may hinder Federal land managers from appreciating and implementing various transportation solutions – both "traditional" traffic engineering measures as well as advanced technology or intelligent transportation systems (ITS) system improvements – that may allow for both increased visitation and resource preservation.

The purpose of this project is to provide Federal land managers with greater awareness of the tools available to solve transportation challenges in their jurisdiction, and to understand the next steps needed to pursue implementation of these solutions. The project seeks to develop a system that will help managers identify possible transportation system improvements based on user input related to characteristics of their specific land. WTI is leading this effort to prioritize the key types of transportation challenges facing Federal lands, identifying and classifying appropriate solutions, and programming the software system. It is anticipated that a prototype will be developed by the summer of 2004.

Information Technology to Support National Parks Alternative Transportation

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The National Parks are becoming increasingly crowded and congested, and the National Park Service is exploring ways to motivate visitors to use alternate forms of transportation (e.g., busses and trams). A recent surveys of park visitors by WTI found that a significant percentage of visitor would be willing to ride on a more flexible system of transit busses in Yellowstone Park if it allowed riders to set their own itineraries and schedules.

Advances in computer and display technology may also provide a path to this goal. Portable computing and display devices are becoming increasingly common for travel and tourism applications such as location, route selection, and identifying nearby destinations and attractions, and can be expanded to provide interactive information concerning the flora, fauna, geography, geology, ecology, history, and culture of a tourism site.

This project is a preliminary step in designing an alternative transportation system that will be embraced and fully utilized by National Park visitors.

An earlier WTI project is exploring the features of an alternative transportation system, especially the information system component, for Yellowstone National Park. This project is an extension of that preliminary effort.

During the initial effort, WTI developed a low-level prototype of a candidate Yellowstone Park portable information system based on the results of the completed front-end analysis. This project continues that effort through at least one additional design-evaluate cycle to produce a higher quality and fidelity prototype based on Internet technology. It is expected that additional functionalities will be added to the Internet-based prototype as a result of further analysis and of the planned evaluations. In addition, the functionalities may be updated according to decisions made by the NPS on the operational philosophy of the alternative transportation systems.

As part of the initial project, WTI became involved with the NPS alternative transportation process, and participated in a national design symposium that developed requirements for the new vehicles. During this project, WTI will maintain contact with NPS headquarters staff to remain abreast of design decisions that would affect the functional requirements for the portable information system, and to provide design inputs, based on the surveys and focus groups completed this summer.

COATS SHOWCASE: Comparative Evaluation of Wind Warning Systems

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High crosswinds can cause high-profile vehicles, such as commercial vehicles and recreational vehicles, to overturn and lower-profile vehicles to leave their lanes. These conditions pose a serious threat to traveler safety. The Oregon and California Departments of Transportation have used ITS installations to continually measure wind speed and direction and automatically warn motorists when hazardous windy conditions are present. Three such systems have been deployed: US Route 101 between Port Orford and Gold Beach, OR; Yaquina Bay Bridge (US Route 101) in Newport, OR; and Interstate 5 between Yreka and Weed, CA.

This project provides a unique opportunity to compare the relative effectiveness of three different types of wind warning systems.

The objective of this evaluation is to assess the safety benefits, motorist satisfaction and operational benefits associated with automated wind warning systems installed in the COATS region, and contrast the relative merits of each system type. This evaluation will assess whether these different systems have resulted in a reduction in the frequency and severity of crashes involving high profile vehicles, and will also identify other benefits.

The evaluation will include a nationwide survey to identify comparable systems; an analysis of crash data; developing and testing hypotheses for the types of crashes which could most likely be avoided through use of these systems; a motorist survey to determine public perception of these systems; an assessment of the operational benefits related to these systems; and an assessment of their technological performance. Because these systems have unique aspects – including project justification and the "best" measures of effectiveness, method of motorist information, and integration with other types of traveler information – this project will assess the relative merits of different types of system concepts, and make recommendations that may guide future design and implementation of these systems.

COATS SHOWCASE: Roadway Weather Severity Index

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Weather can have a significant impact on rural highway operations, as it may increase crash frequencies on roadways. It is difficult to correct for the effects of weather when identifying the advantages and disadvantages of operational and safety improvements. A weather index for roadways could help in such situations. Severe weather indices have been developed for other fields, such as wildlife management, household utilities and inland maritime icebreaking operations. These indices tend to have higher values with more extreme weather. For surface transportation however, extreme conditions may not be the best measure of weather severity.

A weather severity index will help transportation officials to isolate the effects of weather on roadway safety and winter maintenance costs

The purpose of this study is to research and develop a weather severity index appropriate for surface transportation, ideally providing correlations with winter maintenance costs and roadway crash frequency. The project will begin with a review of weather indices that have been developed in other fields, and a review of available data, including weather data, winter maintenance cost data, and crash data. Various statistical analyses will be used to identify those factors that seem to be most influential in safety and maintenance costs.

WTI will use the preliminary findings to determine the number and nature of indices to be developed. These indices will be validated against historical data, and perhaps tested using weather forecast data to determine their accuracy, effectiveness, and usefulness. The final report will document all information collected and will also present a refined version of the indices, with detailed descriptions of data sources, interpretation guidelines, and results of calibration and validation.

COATS SHOWCASE: Video Surveillance Trailer Equipment

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WTI conducts transportation research throughout the western United States. The variety of project locations and relative distance to WTI's base in Montana can make data collection difficult. For this reason, WTI purchased three custom-designed video surveillance trailers to use in COATS Showcase evaluation activities. These trailers were custom-built for long-term surveillance activities with a minimum of maintenance. The equipment includes the following characteristics:

These trailers will expand WTI's technical resources and capabilities, by facilitating long-term evaluations of its research projects, regardless of where they are located.

- autonomous power, through an integrated solar panel and battery system, to allow for up to 30 days of continuous operation;
- trailer-mounted, to allow for ease of mobility and adjustment;
- microwave sensor input, to activate video recording only when vehicles are approaching the camera location;
- a mast-mounted closed-circuit television camera, which can record real-time black-and-white from up to 25 feet above ground; and
- a time-lapse video recorder, which can record at variable speeds up to real-time (30 frames per second).

WTI developed initial requirements for these trailers and has used them in several research projects. Through this COATS Showcase project, WTI has sought to expand the capabilities and usefulness of these trailers. This year, the mast system was extended on each of the trailers to permit a greater height from which to view traffic. On one trailer, WTI doubled the size of the solar panel to increase the recharge rate of the trailer. A weather system was also purchased to provide additional data regarding current field conditions. WTI is continuing to pursue ways to enhance the trailers to make them suitable for a broader range of research applications.

The trailers were first used for the evaluation of an icy curve warning system in northern California. They were deployed to measure vehicle speeds in a non-intrusive way during a variety of weather and lighting conditions. A paper presented at the 2003 Transportation Research Board annual meeting, based in part on that evaluation, showed that the trailers proved to be effective in accurately and precisely measuring vehicle speed.

ARTEMIS Clearinghouse

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More than 120 fatalities and several thousand injuries per year can be attributed to animal-vehicle collisions in the U.S. The interrelation between transportation systems, wildlife, and effective mitigation strategies are important in providing safe roadways for the traveling public. Traditional countermeasures such as signing, fencing and animal crossings can vary greatly in effectiveness based on the methods being tested. Other innovative countermeasures are being applied and evaluated by state departments of transportation and other organizations. Unfortunately, many agencies attempting to deal with animal-vehicle collisions do not have readily available information regarding mitigation options, their effectiveness and "lessons learned" from other deployments.

The ARTEMIS Clearinghouse and partner efforts will greatly expand the information resources available to transportation agencies trying to research and evaluate wildlife mitigation options.

The purpose of the Artemis Clearinghouse project is to provide an on-line searchable database of information about animal-vehicle collisions and mitigation options. The audience Artemis intends to serve includes other universities, transportation professionals and resource managers that may be considering techniques to mitigate animal-vehicle collisions.

While WTI was developing the Artemis Clearinghouse, other institutions were simultaneously developing similar on-line searchable databases. Recognizing the opportunity to maximize resources, build synergy, and create a more comprehensive and useful product, WTI, the USDA Forest Service, and Utah State University partnered to modify Artemis from a centralized clearinghouse into a collaborative and nationally coordinated effort. These coordination efforts also build a foundation for ongoing research and information exchange in the field of wildlife mitigation.

As of July 2002, the Artemis Clearinghouse database contained 62 records referencing 90 literature sources. Throughout 2003, WTI worked with these partners to merge the developing Artemis database case studies into The Wildlife Crossing Structures Toolkit (http://www.wildlifecrossings.info). The Artemis Clearinghouse remains on the Internet; however it will not be updated or maintained in order to focus efforts on the Wildlife Crossing Structures Toolkit. The Artemis Clearinghouse database is located at http://wtigis.coe.montana.edu/projects/animal/index.php. Users can find information on wildlife mitigation deployments, including the location of the project, general description, benefits, costs, issues, and contacts.

Mobile Laboratory

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WTI has created a mobile laboratory to support transportation-related research projects, in compliance with WTI's mission to make rural transportation and travel safer, more efficient, and more convenient. The Mobile Laboratory supports research, evaluation and development of new products and technologies for transportation, evaluation of prototype devices and systems, and testing of commercially available systems.

Two primary usage modes are supported:

Fixed Site mode: Usage includes measurement and recording of site-specific data such as traffic counts & classification, weather conditions, and animal-vehicle interactions. The lab features dual mast-mounted traffic cameras with video recording and data logging equipment. The deployable pneumatic mast can alternatively be topped with a weather station for climate condition data acquisition or to support calibration, maintenance & repair of RWIS (Road and Weather Information Systems) stations. The vehicle can serve as a portable environmental shelter and field laboratory with most of the tools and facilities found in a conventional laboratory.

The Mobile Laboratory is not only a valuable research facility; it also provides unique learning opportunities to many students at the university.

Roving Mode: Location-dependent roadway data can also be gathered real-time using a variety of on-board sensors. Sub-meter accurate GPS coordinate and time stamping of acquired data is supported. Examples of this operational mode include thermal mapping of road surface temperatures, road surface roughness or reflectivity studies and logging of highway surface or roadside features.

Mixed-mode studies such as inter-vehicle fleet communication and roadside-to-vehicle communications research, development and testing projects are possible. The platform also serves as a technology demonstration unit for educational outreach throughout the region, and supports Montana State University undergraduate and graduate research. The flexible nature of the facility will ensure that a wide variety of transportation research projects can be accommodated.

The 1-ton, four-wheel-drive "cube van" lab houses a large selection of equipment, including two laptop computers with docking stations, a high-speed multi-channel data acquisition system with dedicated computer, and 120-volt A/C power supplied by a deep-cycle storage battery bank feeding a 3000 watt DC-to-AC power inverter, and a 4 KW RV-style generator. An air conditioner and heater for the "cube" box along with an insulated, finished interior and several windows and vents, and a desk-type workstation ensure operator comfort. Web-enabled cell phone service and a 2-way radio provide communication support. Two removable, auxiliary captain's chairs can be installed for extra riders. Portable, re-configurable equipment rack modules with quick-release mounts enable rapid installation, removal, retrofit and storage of experimental equipment. Ample storage is present, and a variety of portable power tools, hand tools, safety and repair items are on hand.

The mobile laboratory became operational in the summer of 2002. Several orientation sessions were held, and the lab is now available to MSU faculty and student researchers from many disciplines across campus. Projects underway include testing of an MSU-developed retro-reflectivity mapping module for highway striping assessment and final calibration of a thermal mapping module that includes GIS mapping support. Recent Master's in Mechanical Engineering graduate Tylar Bunger, under project researcher Ed Adams and Mobile Lab PI Robb Larson, utilized the vehicle extensively for acquisition of weather data to help predict roadway surface temperatures as part of his master's thesis. Other users include Dr. Paul Stoodley from the MSU Center for Biofilm Engineering, who has configured the lab with mobile test equipment for in-situ streamwater sampling.

The lab should continue to support these and similar projects throughout its predicted operational life of 10 years.

California/Oregon Advanced Transportation Systems (COATS) Showcase

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The California/Oregon Advanced Transportation Systems (COATS) project began in 1998 as a bi-state partnership to improve rural transportation through the demonstration and evaluation of intelligent transportation systems (ITS). The first phase resulted in the successful completion of an ITS Strategic Deployment Plan in 2001. The California Department of Transportation (Caltrans) and the Oregon Department of Transportation (ODOT) decided to continue their partnership, enabling the project to continue in the form of COATS Showcase.

By providing more credible and detailed information about ITS benefits, Showcase can help to create broader awareness and acceptance of the potential of ITS.

Showcase is comprised of a set of evaluations that seek to clarify the benefits associated with ITS investment, and to identify lessons learned from demonstration projects that may help to improve future deployment. Evaluations are developed to cover the broad geographic area of the COATS study region – an 80,000 square mile area encompassing the southern half of Oregon and the northern third of California – and the comprehensive, multimodal nature of the COATS project's goals and objectives. Once designed and selected, the evaluations become independent projects. Evaluations added in the last year are included and described in the "On-going Research Projects" section beginning on page 24.

Frontier

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The 1991 Intermodal Surface Transportation Efficiency Act promoted research, demonstration and implementation of Intelligent Transportation Systems technology. To date, projects have primarily focused on applications of this technology in metropolitan environments to address problems such as congestion, mobility and incident management. Even efforts designated as "rural" were instituted on multilane, high-volume, Interstate highways connecting major urban areas. The nation's "real" rural highway system (two-lane highways) — which comprises over 80 percent of road mileage in the U.S. and accounts for approximately 40 percent of all vehicle miles traveled each year – has largely been ignored with respect to ITS. This is true despite the fact that 61 percent of all fatal accidents occur on rural roads. An unproven assumption has been made that urban ITS applications are directly transferable to the rural highway environment to meet rural traveler needs. Unfortunately, little work has been conducted in rural areas to adequately confirm or dispute this assumption.

Frontier deployments will help fill a major gap in ITS research by generating valuable data regarding the cost-effectiveness of using advanced technologies to address rural transportation issues.

The primary objective of this research effort is to prove that advanced technologies can be successfully transferred to rural environments. The obvious approach in this proof is to deploy, on a small scale, appropriate ITS technologies in rural areas and document the resulting benefits. This information, when shared with other rural areas, can help to encourage rural travelers to embrace ITS solutions. Secondary objectives of this project are to encourage multi-state communication, cooperation and coordination, improve efficiency by reducing the tendency to "re-invent the wheel" from state-to-state, and advance the state-of-the-practice in rural ITS with regional deployment.

Phase I research has been completed and Phase II demonstration is currently in progress. Project selection has been completed. The eight participating DOT's that comprise the Technical Advisory Committee selected two demonstration projects from 16 proposals, as follows:

Rural Travel Time Estimation Project (Oregon), using Automatic License Plate Readers

High Water Level Sensor Project (Texas), to notify maintenance personnel of impending flooding

Each of the projects has been deployed, and Phase III evaluation is under way. The evaluation will focus on the effectiveness of each concept, including traveler benefits, maintenance issues, and feasibility in rural environments.

Development of Test Protocols for Determining Intrinsic Geosynthetic Material Properties

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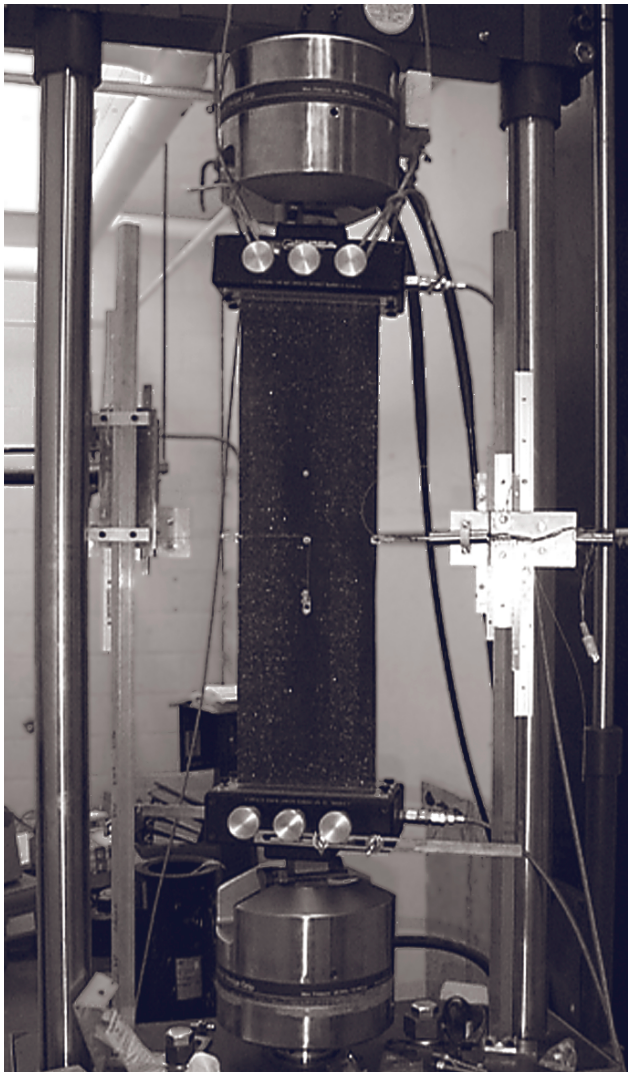
This project focuses on the development of test protocols for geosynthetic materials. It is necessary to determine test protocols to measure material responses under various loading conditions. Specifically, sample geometry, load rates and temperature are being varied to investigate differences in material responses. Tests have been conducted on all eight geosynthetics. Additionally, a literature review was conducted to identify other issues regarding specific test protocols.

Generally, constitutive material properties are defined by testing a sample of material such that boundary effects caused by sample geometry or the loading mechanism are negated. The difficulty in doing this for geosynthetics is that they behave more like a structure than a pure material. Because of this, it is necessary to first determine a specimen geometry that reduces these boundary effects. Initially, two types of testing have been incorporated: uniaxial and wide-width testing having a width-to-length ratio of 1:3 and 2:1, respectively. More recently, a suite of test samples of various sizes has been tested. Material properties derived from these tests are being compared to one another to determine a potential relationship between sample geometry and elastic properties.

These test protocols will allow researchers to more accurately characterize geosynthetic materials used as reinforcement in flexible pavements.



Additionally, material properties are being determined from tension testing using three different load rates. The first load rate being used matches the national standard for wide-width testing of geosynthetics, established by the American Society for Testing and Materials (ASTM), of 10% per minute. The second rate simulates strain rates experienced by geosynthetics in a laboratory experiment that applies cyclic loads to the top of a geosynthetic reinforced pavement test section. These load rates correspond to an in-air tension testing rate of approximately 50% per minute. The third load rate simulates a truck traveling at 65 mile per hour over a geosynthetic reinforced flexible pavement. This load rate corresponds to approximately 1000% per minute.

A new instrument called a 'clip gage,' used to measure strain directly on the sample, was developed and used during material testing. Eight materials were rigorously tested and the results from the clip gage proved to be accurate and consistent. Data from these tests is being written up into a final report which includes an extensive literature review of other parameters that may affect test protocols.

Animal-vehicle Crash Mitigation Using Advanced Technologies Pooled Fund Study

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The number of deer-vehicle collisions is estimated to total more than one million. These collisions cause approximately 211 human fatalities, 29,000 human injuries and over one billion dollars in property damage a year. Reducing the risk of human death, injury and reducing property damage benefits the traveling public. Three methods have typically been used to reduce animal-vehicle collisions;

- warn the driver of the hazard through warning signs or public education;
- improve the driver's ability to react through reduced speed zones, vegetation clearances or improved lighting; or
- limit animal presence on the roadway using fences, sometimes in combination with over- and underpasses, reflectors, scent and sound-based repellents, or reduced herd size.

This project evaluates whether new technologies are indeed a valuable addition to the existing spectrum of mitigation measures.

Some of the measures mentioned above have had limited effectiveness, have had mixed results or have been too costly to implement on a widespread basis.

With the advent of Intelligent Transportation Systems and an increased focus on technological solutions, many feel that alternative solutions to animal-vehicle crashes should be examined. In an effort to address these challenges the "Animal-vehicle Crash Mitigation Using Advanced Technologies Pooled Fund Study" was initiated to investigate the most promising roadway animal detection/driver warning systems to mitigate animal-vehicle crashes. This study is funded by the Departments of Transportation of 15 states and the Federal Highway Administration. The Oregon Department of Transportation (ODOT), in cooperation with WTI, is the lead state for this research and demonstration project.

This research and demonstration project will result in the installation of prototype animal detection and driver warning systems and an evaluation of their effectiveness in reducing animal-vehicle crashes. Progress in the past year has consisted of the following activities. The installation of an animal detection system in Yellowstone National Park / Montana (site 1). The finalization of the engineering plans for another animal detection system in Pennsylvania (site 2). Ongoing preparations for a study that aims to compare several technologies for detecting animals under similar circumstances (Phase II). Preparation of an overview document, which identifies all known animal detection systems throughout Europe and North America and experiences with operation and maintenance.

The sites selected for demonstration and evaluation include:

Site #1 Montana, US 191, about 50 miles south of Bozeman/Belgrade, MT where the predominate challenge is elk-vehicle collisions in the winter months. The system at this site was designed by Sensor Technology Systems.

Site #2, Pennsylvania, US 22, about 35 miles northwest of Harrisburg, at a location with a known concentration of deer-vehicle collisions. The system that will be installed at this site was designed by Oh Deer, Inc.

Important lessons have been learned already regarding the design of animal detection systems, the partnership with vendors of experimental technologies, and the installation of these systems. Furthermore, a broad overview of experiences with operation and maintenance and other issues has been obtained from other sites throughout Europe and North America.

Completed Projects

Project #	Project Title	Principal Investigator
426354	Galavan Service Improvement Plan	Lisa Ballard
426390	Personal Digital Assistants for Emergency Medical Services Providers	Steve Albert
426554	Paratransit Systems Operation Model	Ed Mooney
426579	Montana Department of Transportation Maintenance Process Improvements	Steve Albert
426589	Public Safety & Communications State of the Practice	Greg Cross
428055	Safe Passage: Development and Demonstration of a Rural Weather Prediction Model and Motorist Communication System for Safe and Efficient Traffic Management/Infrastructure Maintenance	John Mounce
428465	Field Study to Evaluate Intrusion Detection Technology: Intersection Crash Avoidance	Kate Hunter-Zaworski
428468	Development of a Surface Transportation and Weather Decision Support Tool and Strategic Plan for Improved Highway Operations in Montana	Lisa Ballard

Galavan Service Improvement Plan

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Transportation services for the elderly and persons with disabilities are in growing demand in many regions of the country. For example, the Greater Bozeman Area (Montana) Transit Development Plan has identified a need to serve the elderly population in the Gallatin Valley as a primary goal over the next 20 years. This goal of this project was to produce a five-year service improvement plan for GALAVAN, the principal paratransit provider in the region.

Researchers collected data through a wide variety of methods including riding in GALAVAN vehicles with clients, reviewing GALAVAN records, analyzing census data, and an interview with the Director. WTI also surveyed the Advisory Board, GALAVAN staff, and a targeted group of individuals.

The GALAVAN Service Improvement Plan may serve as a model to other regions looking to improve or expand paratransit services through operational efficiencies.

The resulting plan includes recommendations for system improvements related to technology, hours of service and the operational area, vehicle and staff levels, marketing and budget, and coordination with other providers. These recommendations were further categorized to identify near-term recommendations that could be implemented within the next year, medium term recommendations to implement within the next three years, and long-term recommendations that have a three to five year time frame. The plan also analyzes and accounts for the impact of the possible development of a transit system in the Bozeman area.

One of the immediate benefits of this project was the development of software specifically for GALAVAN. After identifying a need for an electronic trip record system, WTI created a software package to help GALAVAN manage and schedule riders as well as provide utilization reports. This software, which was installed and deployed in March 2003, may serve as a useful tool for other small paratransit providers.

Personal Digital Assistants For Emergency Medical Services Providers

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Emergency Medical Service (EMS) agencies and providers are a critical component of transportation systems, as they provide life-saving services when roadway accidents occur. Many EMS agencies are testing new information technologies, such as Personal Digital Assistants (PDA), to transmit critical patient information from the crash scene to physicians at the receiving hospital. However, to date there have been few controlled trials concerning the efficiency and effectiveness of these devices versus traditional methods.

The Montana EMS Section is currently in the final design phases of a scannable paper patient information form and companion desktop software system, to replace their 25-year-old current system. The deployment of the new system provides an excellent opportunity for a side-by-side comparison of paper-based and PDA collection. This project compared the effectiveness of the scannable paper-based/desktop patient information system against a PDA-based/desktop system.

If Personal Digital Assistants prove to be an accurate and cost-effective tool for EMS providers, applications could be expanded to include GIS/GPS functions, access to reference databases, or the electronic transmission of patient vital signs and photos.

Two Montana communities with similar EMS response areas were selected to participate in the study; one was assigned to the PDA group and the other to the scan sheet group. A four-member panel of medical and emergency response professionals conducted a review of prehospital patient records for the six month period prior to the pilot deployment, and a second review of records from the one-year deployment period. Data gathered by the panel was entered into a database and analyzed. Researchers examined issues of timeliness, accuracy, completeness and legibility of data, along with the cost of system deployment, training, and maintenance.

Paratransit Systems Operations Models

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As elderly populations grow, paratransit services for elderly, disabled and other users in rural or small urban environments will become increasingly important. Local transportation planners need tools to help with paratransit system design and operational management.

Tools for evaluating operational efficiencies become increasingly important as localities try to meet the growing demand for paratransit services with limited resources.

The purpose of this project was to develop and test prototype models of paratransit systems that can be used to evaluate routing, scheduling and dispatch alternatives. The models are demand-driven, constructed to represent the decisions, objectives and constraints involved in paratransit use. Historical data available from Galavan, a paratransit provider in Gallatin County, Montana, were used to develop and test the models and software. The end products of this project are expected to be useful to many small urban and rural areas developing paratransit systems. Project partners include Galavan and the Gallatin County GIS Center.

Montana Department of Transportation Maintenance Process Improvements

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Advanced technologies have many potential applications in the transportation field, including improving maintenance operations through the coordination and integration of resources. These technologies offer the potential to conduct more highway work with less human resources, open work zones to traffic in a more expedient manner, provide better service without increasing costs, and increase work zone safety for workers and travelers. In order to pursue these potential benefits, WTI has evaluated technologies that may be beneficial to the maintenance division of the Montana Department of Transportation (MDT).

This project will not only serve MDT, but also provide valuable state of the practice information to all Departments of Transportation exploring the potential of advanced technology to address maintenance needs.

The purpose of this project was to develop new R&D initiatives for advanced technology applications, while improving MDT's maintenance operations. To facilitate this objective, an extensive literature review was conducted to assess the use of advanced technologies in the maintenance field. WTI created an applications matrix that compares MDT's current maintenance activities with the revised state of the practice from the literature review. The applications matrix was then used as a tool to guide discussions with MDT maintenance personnel and determine target areas for candidate projects and demonstrations.

The following target areas have been established as points of focus from the preliminary evaluation of the applications matrix and meetings with MDT maintenance personnel: Information Gathering and Dissemination Technology, Decision Support Systems, and Inventory Tracking and Control Systems. This analysis will facilitate the development of a proposal for design, implementation, and evaluation of a candidate project.

COATS SHOWCASE: Public Safety and Communications State of the Practice

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Emergency service providers are examining technology and communication improvements that can expand their ability to provide a coordinated response to emergencies that involve multiple agencies or jurisdictions. However, emergency medical services are generally funded by independent local jurisdictions that often lack the funding, technical staff, institutional relationships and resources necessary to develop a coordinated and integrated emergency service system at the local or regional level.

This project will provide a key informational resource to states and localities looking for effective technologies that meet their emergency response coordination needs.

The purpose of this project is to document innovative transportation-related emergency medical service technology and communications applications, activities or projects employed by state emergency medical service agencies. The findings have been compiled into a state-of-the practice document that will serve as an important foundational step for future initiatives.

WTI used several methods to identify applicable technologies and approaches. A broad literature search was conducted of transportation, emergency service and emergency medical service databases, publications and websites. Current and near-term potential technology or communications enhancements were identified through interviews with individuals and organizations, a Web-based search, and a survey.

Field Study to Evaluate Intrusion Detection Technology: Intersection Crash Avoidance

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This project evaluated the state of the art and effectiveness of intrusion detection technology at low volume railroad grade crossings through a demonstration project. The project was a cooperative effort between WTI, Oregon Department of Transportation, and Willamette and Pacific Railroad with support from the Federal Highway Administration and the Federal Railroad Administration. The project activities have included an assessment of current intrusion technologies. Two different technologies were selected for field studies. These were video detection and microwave detection. The technologies are very different but can work in concert to provide all weather, day and night coverage. It is anticipated that both technologies will be used to provide fail-safe detection and monitoring at railroad grade crossings. The two systems were evaluated in a controlled laboratory environment prior to full field deployment, to ensure that the selected technologies satisfied the sensitivity parameters.

This project may provide effective new tools for preventing life threatening collisions at railroad crossings.

Field tests of the intrusion detection technology were undertaken on the Willamette and Pacific Railroad right-of-way. Data was collected on the failure rate of the locked gate, status of the intrusion detection equipment and the overall effectiveness of this technology at low volume railroad crossings. The initial field tests did not produce the anticipated results. A new study has been proposed to evaluate the discrepancies between the laboratory and field test results.

SAFE-PASSAGE: Development and Demonstration of a Rural Weather Prediction Model and Motorist Communication System for Safe and Efficient Traffic Management and Infrastructure Maintenance

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SAFE-PASSAGE is a research and demonstration project that focuses on the utilization of Intelligent Transportation Systems technology and operating procedures to optimize motorist safety and incident management within a 30-mile rural section of Interstate 90 between Livingston and Bozeman, Montana. The operational problems in this project section are primarily weather-related. Severe snow storms, icy road conditions, and high winds all cause road closures within the project corridor. Commercial vehicles are particularly affected by the road and weather conditions in this area due to a loss of friction resulting in chain requirements and high winds that necessitate slow-speed detours.

SAFE PASSAGE provided a testing opportunity for advanced technologies and incident management procedures that may prove to be effective on many other mountain passes.

The primary components and objectives of the SAFE-PASSAGE project are to: 1) validate and implement a computer model to micro-forecast pavement temperature and roadway conditions; 2) provide real-time motorist information through the implementation and effective operation of an on-roadway communication system incorporating VMS/HAR/cellular phone mediums; and 3) establish a rural traffic management center for reception, coordination, and dissemination of all relevant data between responsible agencies.

Five years of evaluation have been completed, along with final analysis and reporting. Major accomplishments of the project include:

The Pavement Temperature Prediction Model was developed (and expanded past its original intent) and is capable of running in a true forecast mode to predict pavement temperatures throughout the SAFE-PASSAGE corridor with the interfacing occurring between the model and its users via a web page. WTI and MDT are able to access the web page and view predicted weather and pavement conditions throughout the corridor. This information can then be used to mobilize maintenance equipment and warn drivers of the conditions ahead through the motorist communication system. Following initial testing and use, software improvements and updates were installed to expand the model's forecasting capabilities.

The Motorist Communication System of SAFE-PASSAGE became operational in March 2001 when the variable message signs were turned on. The VMS were used extensively in the winter of 2001-2002 to warn of dangerous wind, snow and ice conditions. Two motorist surveys have been conducted and confirm that travelers in the corridor are aware of the utility of real-time communication. A vast majority of the survey respondents stated that they believed VMS to be highly effective in communicating timely warning information.

Researchers have created tools to facilitate the establishment of a Rural Traffic Management Center (RTMC). Project staff created an operations manual for the RTMC and a VMS/HAR message library that will assist MDT with any future development of an RTMC for the SAFE-PASSAGE corridor.

Crash analyses for the initial deployment of the project indicated a slight reduction in the number of accidents. The final report includes recommendations to MDT for expanding the use and improving the effectiveness of the components of the Safe Passage project.

Development of a Surface Transportation and Weather Support Tool and Strategic Plan for Improved Highway Operations in Montana

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For the purpose of winter road maintenance, Montana Department of Transportation (MDT) has deployed a road-weather information system (RWIS), including 59 environmental sensor stations throughout the state. RWIS data is available to maintenance staff via the Scan Cast web-based program developed by Surface Systems, Incorporated (SSI). Maintenance staff also has access to a variety of other sources of information that can be used to help in winter maintenance. Decision makers access weather information from public sources including the National Weather Service, the Weather Channel, and Weather Underground. MDT also has contracts with weather service providers to provide localized services via television, radio, and Internet surface forecasts at RWIS sites. MDT is also trying the SSI Scan Sentry system, which actively alerts users under alarm conditions.

The improvements and tools developed by this project will make it easier for MDT staff to access RWIS and use the data to make road maintenance decisions.

Through anecdotal information, MDT headquarters staff has perceived that the different sources of information, especially the MDT-collected information, are not being provided in a format that is fully useful to the maintenance staff. The computer-based information is not available through a single interface, and users feel they have time to check only one source of information. Users perceive that information from the RWIS stations and forecasts is not always accurate and current. Furthermore, data is often shown in tabular form for an individual site instead of graphical or geographical form and is difficult for the user to process. Finally, the users like the function of the Scan Sentry active alarm system, but would like to see some refinement and be able to have more control over the alarm parameters.

To address these issues, WTI and Meyer Mohaddes and Associates (MMA) are working with MDT to evaluate the state's needs for improved road weather information. At the outset of the project, the key participants agreed on the following project outcomes: recommend improvements in use of current equipment; identify training requirements; and develop a concept for a new decision support tool.

To accomplish the desired project outcomes, the participants have completed three major tasks to date:

Surveyed MDT maintenance chiefs, superintendents, and field supervisors in their use of existing resources. From the survey results, it was not possible to identify why the MDT data is underutilized, but there are hints. Training issues and planning issues are two possible reasons, but ease of use, perceived inaccuracy, and perceived issues with the age of data are also implicated. Only 37 percent of responders felt it is always easy to obtain current RWIS information; 43 percent encounter computer hardware or software problems more than one per month while trying to obtain RWIS data; 61 percent encounter weather station data that is not current more than once per month; 50 percent encounter inaccurate data from weather station sites more than once per month.

Identified and validated high-level requirements for improved use of current equipment and a winter maintenance decision support system. Five areas identified through the survey results and a review of the national Surface Transportation Weather Decision Support Requirements (STWDSR) efforts are: (1) Training in RWIS topics should be provided to winter maintenance decision-makers, (2) RWIS stations should improve winter maintenance decisions, (3) Delivery of RWIS information should utilize current communications technologies in addition to current methods, (4) The display of RWIS data should facilitate winter maintenance decisions, and (5) Anti-icing is a new maintenance treatment, and should be improved as a treatment option.

Developed a prototype of a weather decision support tool. Two goals for the development of a prototype were to identify what is technically possible and to have a product that shows possible functionality to the maintenance users in soliciting requirements. Comments from MDT staff and the survey results indicated that a geographic information system (GIS) solution may be appropriate for this application, and thus a prototype was developed with a desktop GIS. Initial reception of the prototype has been positive.

Research Success Stories

Innovative Technologies Deployed in 2003

The application of new technologies to transportation challenges in the rural environment has been a hallmark of WTI's research approach. Intelligent transportation systems and other advancements have made it possible to find new options for longstanding transportation problems on rural roads or in small towns. In 2003, several innovative technologies were installed and deployed as part of WTI research projects:

Saco Bridge – The purpose of the Saco Bridge project is to evaluate the relative performance of three different types of concrete bridge decks, in order to assess resistance to cracking and service life for each design method. Three similar bridges located close together near Saco, Montana were reconstructed with three different types of concrete bridge decks. This year, more than 60 advanced strain gages were embedded in each bridge deck. This equipment allowed for the beginning of long-term monitoring to measure bridge deck response, global movements of the bridge deck including settlement, and crack propagation data.

Animal Vehicle Mitigation – WTI is currently conducting the Animal-Vehicle Crash Mitigation Using Advanced Technologies Pooled Fund Study, which involves 15 states in an effort to investigate the most promising roadway animal detection/driver warning systems to reduce the number of animal-vehicle collisions. The project has achieved an important milestone this year through the installation and deployment of a prototype system in Yellowstone National Park. The system will be evaluated for its effectiveness in reducing elk-vehicle collisions, particularly in the winter months.

GALAVAN Software – WTI developed a five-year service improvement plan for GALAVAN, the principal paratransit provider in the Bozeman, Montana area. In addition to identifying system improvement recommendations, the plan resulted in the development of software that helps to manage and schedule riders and produces utilization reports. The software was installed and put into use at GALAVAN this summer. In a follow-up project, the software (to be re-named Computer Assisted Ridership and Dispatching Software, or CARDS) will be tested by several other small transit providers in Montana.

Research Initiatives for 2004

Many of the new research projects selected for 2004 reflect an effort to expand on the successes described above. In this way, WTI can maximize the resources already developed and further build technical expertise in the subject area. New research projects will include:

- An effort to expand WTI's research in the area of highway infrastructure design and maintenance, including investigations involving field instrumentation, state-of-the-art research related to geosynthetic pavement design, and utilization of technological solutions and high performance materials in design.
- A project to develop guidelines for designing and evaluating North American wildlife crossing systems. The goal of this project is to provide transportation professionals with the best available information and current technologies on wildlife crossing systems for transportation projects.
- A project to test driver performance and behavior in the safety and controlled environment of the laboratory using a high fidelity driving simulator. It will serve as a laboratory supporting faculty, undergraduate and graduate student research projects addressing many of WTI's research focus areas.
- A project to evaluate common corrosion inhibited deicers, to improve the effectiveness of road maintenance activities during severe weather.

Education

"To develop a multidisciplinary program of coursework and experiential learning that reinforces the transportation theme of the center."

Education Program

As a University Transportation Center, WTI is able to offer a unique and integrated program of transportation educational activities to students. WTI recruits promising students to the field of transportation by providing attractive educational and research opportunities and generous financial support to students through paid research appointments; scholarships; and undergraduate, graduate, and professional advancement fellowships.

Transportation research activities at WTI are supported by a strong Civil Engineering transportation curriculum. Course offerings include highway engineering, transportation and traffic engineering, pavement and geometric design, transportation planning, safety management systems, statistical applications, and advanced ITS and traffic management.

Students are able to fund their education while participating in innovative interdisciplinary research projects at WTI, under the mentorship of experienced faculty and professional research staff. These projects provide students with invaluable opportunities to produce useful real-world research in areas related to improving rural transportation. WTI also funds student travel to attend and present papers at professional conferences, and to participate in technical tours.

During the past year, WTI has increased its student recruitment efforts through a wide range of activities, including participation at college recruitment fairs, outreach to elementary and middle school aged children, and implementation of a summer Research Experience for Undergraduates (REU) program for undergraduates from outside of MSU - Bozeman.

Student Research Opportunities

The graduate fellowship program is intended for exceptional students interested in pursuing an advanced transportation-related degree. The recipients are required to produce an approved thesis or professional paper based on a transportation project in which they have been actively involved. Graduate fellows receive a full tuition and fee waiver for three academic semesters and a monthly stipend. Six graduate students participated in the fellowship program during the past year and six more have been awarded fellowships for the upcoming academic year.

The professional advancement fellowship is awarded to working professionals seeking to return to school to pursue an advanced degree. Professional advancement fellowship recipients receive a tuition waiver and monthly stipend for a full academic year and must produce a thesis or dissertation on a transportation-related topic. One new professional advancement fellowship has been awarded for the upcoming year to a Ph.D. candidate in Industrial Engineering researching human factors in transportation.

The undergraduate fellowship is awarded to outstanding undergraduate students exhibiting a strong interest in transportation. Fellowship recipients are actively involved in transportation research projects at WTI and receive a full tuition and fee waiver for two academic semesters. Since the inception of the program, a number of undergraduate fellows have continued on to graduate school and expanded their WTI research into a thesis project. Two new undergraduate fellowships have been awarded for the upcoming academic year.

In addition to awarding fellowships, WTI provides research opportunities to undergraduate and graduate students from a diverse range of academic departments who are hired as research assistants on transportation projects. Home departments of student researchers currently working at WTI include Civil Engineering, Mechanical Engineering, Industrial and Management Engineering, Computer Science, Statistics, and Ecology.

During summer 2003, WTI initiated a new program for undergraduate students interested in transportation research. The Research Experience for Undergraduates (REU) program brings eight undergraduate students from various universities nationwide to WTI for a ten-week summer research program. Participants are matched with a specific project representative of WTI's diverse research focus areas. In addition to working on their research topics under the direction of their mentors, students have many opportunities to attend various training seminars, field trips, and presentations in order to improve their academic and professional skills and to further their knowledge of rural transportation research. At program end, students produce a final research report and provide a technical presentation on their projects to peers, WTI staff, and sponsors.

Student Research Involvement

Project	Undergraduate	Graduate
Artemis Clearinghouse	2	
Blackfeet Automated Accident Reporting		1
Bozeman Area Transit Planning	1	
Bozeman Bicycle Network Plan	1	
Bozeman Pass Wildlife CorridorStudy	1	
CANAMEX	2	
Compressibility and Heave Characteristics	2	1
Crack Sealing Cost Effectiveness	1	1
Development of Test Protocols		1
Dynamic Message Sign Guide for Montana	1	
Fish Passage at Road Crossings in Montana Watersheds	1	
Fredonyer Summit Evaluation	2	
Geosynthetic Pullout Behavior		3
Greater Yellowstone Regional Traveler and Weather Information System	3	2
Greater Yellowstone Rural Intelligent Transportation System	3	1
Lewis and Clark Kiosks	1	
Low Cost WIM at Armington Junction		1
Mobile Laboratory	2	
NOVIS Evaluation	3	1
Operation Impacts of Weather on Highway		1
Roadway Weather Severity Index		1
Saco Bridge Instrumentation	3	2
State Trucking Activities Reporting System (STARS) Evaluation		1
System Change	1	2
Transportation Toolkit for Federal Lands	2	1
US 93 Animal Crossing Evaluation	1	1
Video Surveillance Trailers		1
Weathershare	1	
Wind Warning Evaluation	1	1
Winter Surface Condition Forecasting		2
Winter Traction Materials	1	

Professional Travel Program

Students had extensive opportunities to visit notable transportation facilities, meet with transportation professionals in their work place, and travel to professional conferences over the past year. During 2002-2003, the MSU Institute of Transportation Engineers (ITE) Student Chapter coordinated a number of student trips that were made possible through WTI's Education Program.

Los Angeles, California

Twenty-one members of the MSU-ITE Chapter had the opportunity to travel to Los Angeles, California this year for a variety of transportation-related tours. Students were able to visit transportation professionals in their work place and observe state-of-the-art transportation facilities. At a tour of Union Station, students saw state-of-the-art intelligent transportation systems. Los Angeles is at the forefront of innovation in mass transit, utilizing modern technology to streamline bus transportation in an effort to make mass transit more appealing to the public. Students got a chance to tour the dispatch center where the scheduling, routing and tracking of mass transit takes place for the entire city.

Students also visited the Staples Center, where they had the opportunity to learn about some of the new technologies being used in parking. In the center of downtown, the Staples Center is faced with daunting traffic and parking problems whenever an event is held. The Center uses video and intelligent traffic routing measures to ensure efficient traffic movement and is a model of parking innovation.

Other technical tours included: Econolite Control Products, Inc., where traffic control devices are engineered and manufactured, the Hollywood Highland retail center, Disneyland's transportation and parking systems, and an ITE hosted vendor show.

Student Conference Travel

In addition to field trips, WTI supported student travel to attend conferences and professional meetings. Student interaction with professionals and experts from all over the country at national conferences provides them with exposure to the field of transportation as a career. WTI supported travel to professional conferences for 37 students this past year.

Date	Conference/Meeting	Student Attendance
January, 2002	Transportation Research Board *(Washington, DC)*	8
May, 2003	ITE Intermountain Section Meeting *(Jackson, Wyoming)*	16
August, 2003	ITE International Annual Meeting *(Seattle, Washington)*	13

Career Development Opportunities

Spring Engineering Festival

The 4th Annual Department of Civil Engineering Spring Engineering Festival was held on February 13 and 14, 2003 on the Montana State University-Bozeman campus. The American Society of Civil Engineers (ASCE), Bio-Resource Engineering (BREN), and Institute of Transportation Engineers (ITE) Student Chapters were involved in the organization and planning of the Festival. The two-day Festival allows professionals to: (1) gain continuing education credits in any of four technical tracks: environmental, structures, geotechnical and transportation; (2) network with peers at professional society meetings, and (3) interact with students both formally as part of the career fair and informally at the student/professional mixer. The Western Transportation Institute sponsored a speaker, Mr. Tim Boschert from the Utah Department of Transportation, for the 4-hour session on Access Management – Principles and Techniques. Approximately 140 professionals, mostly from around the State of Montana, attended the festival, which was highlighted by a luncheon keynote speech by Patricia Galloway, the first woman president-elect of the National American Society of Civil Engineers (ASCE).

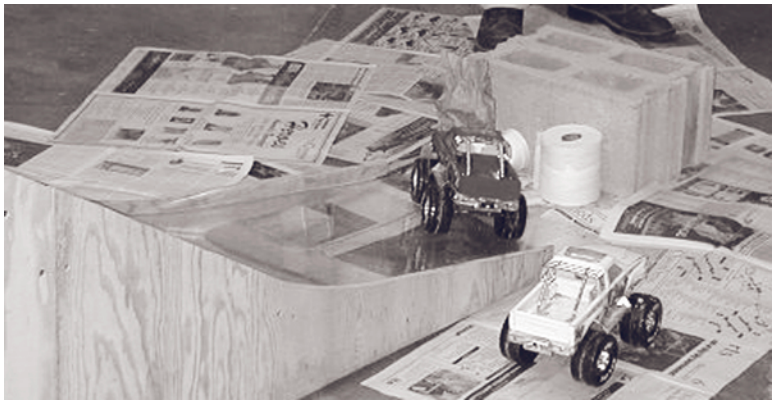
Outreach

WTI participated in a number of recruitment events in 2002-2003 with the goal of sparking interest among pre-college students in the study of transportation, as well as increasing the diversity of students pursuing transportation research and careers. Recruitment activities included three MSU Friday events where more than 400 pre-college aged students potentially interested in attending MSU come to campus for a day, and Rockin' the Rez college recruitment fairs for Native American students on the Crow, Northern Cheyenne and Flathead Reservations in Montana. WTI also participated in Catapalooza, a campus-wide two-day event to introduce incoming MSU students to the various extracurricular, employment, research and academic opportunities available to them.

This year, WTI also conducted numerous K-12 outreach activities designed to excite elementary and secondary school aged children about engineering and solving transportation challenges. Special effort has been paid to involving groups that have been traditionally underrepresented in the transportation and engineering professions. These activities are described below in greater detail.

Gear Up (Gaining Early Awareness and Readiness for Undergraduate Programs)

Thirty 7th and 8th graders visited WTI in April as part of Gear Up, which brings youngsters from low-income backgrounds to MSU to develop their academic interests and aspirations. The students had an opportunity to discuss highway safety issues and devices with research staff, and then to build and test their own crash attenuators using a ramp, toy truck, and eggs.

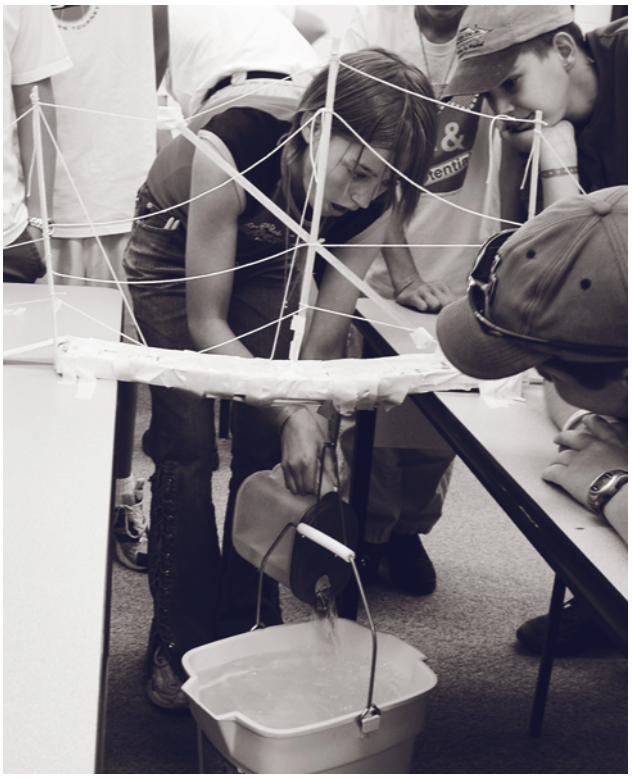


Crash Attenuators at WTI Gear Up Event

Peaks and Potentials

In June, sixteen 8th and 9th graders spent a week at WTI exploring the "Science of Making and Breaking" during Peaks and Potentials, a campus summer experience for high-potential students who wish to pursue special topics of interest. At WTI, the students discovered how engineers

design and build structures like roads and bridges and explored design software and other tricks of the engineering trade. The students then had the opportunity to get their hands dirty making their own concrete and bridges, and to test the strength of their creations by breaking them in the lab.



Expanding Your Horizons

Expanding Your Horizons is held each year at MSU for junior high school girls interested in math and science related careers. MSU's ITE Student Chapter prepared and facilitated a transportation demonstration as part of this year's event to exhibit the relationship between growth, development and transportation. Using computer applications and some carefully constructed scenarios, participants were able to see first-hand how transportation affects population, employment, and the environment.

Bridges and Dams Outreach

WTI, with additional funding from the Engineering Information Foundation, implemented an outreach program in the spring of 2003 aimed at increasing the recruitment and retention of women and minorities in engineering. The program, created by Montana State University-Bozeman Professors Jerry Stephens and Anders Larsson, involves two-hour workshops about bridges and dams that are designed to increase young girls' and minorities' interest in math, science, and engineering.

The Bridges and Dams outreach program is a collaborative effort between WTI and the Civil Engineering Department at Montana State University (MSU). Utilizing the MSU student base, WTI and the Civil Engineering Department recruited and trained eight female engineering students enthusiastic about K-6 outreach to conduct bridges and dams workshops for second through fourth graders. Local girls clubs were invited to participate in the outreach program as well as Native American schools in more remote tribal regions across Montana. The workshops involve an exploration of civil engineering as a discipline and incorporate a variety of hands-on activities. Six workshops were held from February to May 2003 and more than 100 second through fourth graders have participated in workshops so far.

Student Project Support

WTI financially sponsors many activities coordinated and conducted by the MSU-ITE Student Chapter, including student field trips, travel to conferences, scholarships, and outreach activities. In addition to ITE Student Chapter support, WTI initiated a small grants program to support other student groups pursuing transportation-related educational activities. In 2002-2003, WTI awarded the following grants for student transportation projects.

American Society of Civil Engineers (ASCE) Student Chapter Competition

WTI supported the MSU ASCE Student Chapter's construction of a steel bridge and concrete canoe. The students tested their designs at the ASCE Pacific Northwest regional competition held in April in Boise, Idaho. The canoe, which weighed approximately 150 pounds, earned the students second place overall in the competition. The steel bridge, 23 feet long and built in 16.3 minutes, took ninth place.

Technology Education's Electric Vehicle Project

Technology Education students at MSU are preparing for careers as secondary education teachers or professionals in technology-oriented industries. As part of their curriculum, students learn about transportation systems in a Transportation Technology course. This year, with assistance from WTI, students in this course were involved in the research, design and construction of an alternative energy vehicle. The class converted a 1986 pickup truck from MSU Facilities Services into an electric vehicle. The vehicle is now being used as part of Facilities Services' fleet. Vehicle use data is being collected concurrently with cost and longevity data. Secondary school students were able to follow the progress of the project via a website. A "How to" manual is also planned for public distribution.

Electrical and Computer Engineering Student Design Project

WTI sponsored Electrical and Computer Engineering students in a project that involves the design and construction of an intelligent navigation and control system for a wheeled vehicle. The project is the first stage for developing and demonstrating prototype computer-controlled systems relevant to transportation technologies.

Student of the Year Award

WTI's Danielle Reagor received the "Student of the Year" Award for 2003. The Research and Special Programs Administration of the U.S. Department of Transportation presents this award annually to one student at each University Transportation Center, based on accomplishments in technical merit and research, academic performance, professionalism and leadership.

Danielle completed her Masters of Science degree in Civil Engineering at Montana State University in December 2002. Supported by a Graduate Fellowship from the Western Transportation Institute, she conducted her thesis work on Montana's State Truck Activities Reporting System (STARS). The STARS program consists of weigh-in-motion (WIM) and automatic vehicle classification (AVC) systems deployed across Montana's highway system. The objectives of the program are to improve the efficiency of MDT's commercial vehicle enforcement program and to improve the quality and quantity of truck weight and classification data.

While in school, Danielle gained extensive experience in the fields of roadway design and traffic planning and engineering through her internships. As an undergraduate, she worked for the Montana Department of Transportation in the Road Design Unit at MSU, and during the summer of 2001, she was an intern at Kaku Associates in Santa Monica, California. Ms. Reagor is a member of Chi Epsilon, the National Civil Engineering Honor Society, and the Institute of Transportation Engineers (ITE). She also served as President of MSU's nationally-recognized ITE Student Chapter.

Education Success Stories

This year as in previous years, WTI students have been successful in securing national awards and recognition. WTI undergraduate research assistant and undergraduate fellowship recipient Trevor Iman received the transportation-related Coral Sales Scholarship, receiving $1000. MSU's ITE Chapter also received the honor of being selected Outstanding Student Chapter in the nation.

WTI students continue to be active in producing papers and reports. Peer reviewed publications co-authored by students include

"User Requirements for Information Systems to Support Alternative Vehicles in the National Parks" by M.J. Kelly and J.L. Moore published in the Proceedings of the Human Factors and Ergonomics Society 47th Annual Meeting, 2003

"Relative Performance of Crack Sealing Materials and Techniques for Asphalt Pavements" by E.V. Cuelho, S.K. Ganeshan, D.R. Johnson, R.B. Freeman, and P.L. Schillings published in the Proceedings of the Third International Symposium on Maintenance and Rehabilitation of Pavements and Technological Control, 2003.

Danielle Reagor (center) receives her Student of the Year Award from J. Richard Capka, Deputy Administrator FHWA and Ellen Engleman, Administrator Research and Special Programs Administration

Student paper presentations at professional conferences include Eric Eidswick presenting his paper on "Motorist Communication System Evaluation" to the ITS World Congress in October 2003.

Technical project reports prepared for sponsors with significant student input include:

"Valuation of Temporary Facility Use Losses" (Jeff Ryan and Jodi Carson for the Montana Department of Transportation)

"Evaluation of Low-cost Weigh-in-motion (WIM) at Armington Junction Weigh Station" (Ryan Bylsma and Jodi Carson for the Montana Department of Transportation)

"An Evaluation of Montana's State Truck Activities Reporting System" (Danielle Reagor, Melissa Harrington, Jerry Stephens and Jodi Carson for the Montana Department of Transportation).

Mike Kelly and Suzy Lassacher worked with six undergraduate students on a multidisciplinary senior design project. The students were charged with designing a traffic management center system to optimize the flow of traffic on a busy roadway in Bozeman. The ultimate goal is to establish a "smart corridor" on this roadway by utilizing advanced sensing, data processing, and communication systems. Students studied current traffic flow patterns on the road and determined appropriate sensor locations and queuing schemes.

Education Initiatives for 2004

WTI will continue to support education through student research opportunities, a fellowship program, support for professional conference travel, and multidisciplinary student project support. New initiatives planned for the coming year include the establishment of a joint fellowship program with the Wildlife Conservation Society to support a Native American graduate student in Ecology. The student will research wildlife/transportation interactions on the Flathead Reservation in conjunction with the U.S. Highway 93 reconstruction project.

Technology Transfer

"To increase the availability of research results to potential users in a form that can be directly implemented, utilized or otherwise applied."

Technology Transfer Program

After five years as a UTC, WTI has built up a wealth of valuable data and expertise; the challenge now is to make resources and technical assistance easily accessible to everyone in the transportation field.

WTI has always found great success with traditional technology transfer activities such as conferences and publications. In the past year, more innovative ways of sharing information have been pursued, such as joint websites with other organizations. Recognizing the importance of sharing experiences as well as data, WTI has also begun serving a "mentor" to other research organizations.

Conferences and Workshops

WTI Serves as Co-sponsor for ICOET 2003 Conference

The International Conference on Ecology and Transportation was held from August 24-29 in Lake Placid, New York. The theme of this year's conference was "Making Connections," with the goal of helping participants better understand the relationship between ecology and transportation. Activities revolved around focus areas such as restoring habitat connectivity, reducing animal-vehicle collisions, and establishing strong partnerships.

The conference has grown into a major educational and technology transfer event, showcasing research results, applications, and best practices that improve the way ecological concerns are considered in the nation's surface transportation programs. There were 300 participants from 13 countries. More than 100 papers were presented, and there was a broad diversity of participants, with a substantial increase in the number of engineers and international attendees. Highlights of the conference included a keynote address by grizzly bear expert Dr. Michael Proctor, two specialized workshops on environmental runoff into groundwater systems and engaging communities in wetlands conservation projects, and field trips into the Adirondacks.

WTI is sponsoring production of the proceedings which will be completed in December. Three WTI researchers presented papers at the conference, and two of these papers have been selected for special presentation at the 2004 Transportation Research Board Annual Meeting. The first was presented by Marcel Huijser on "Evaluation of Roadway Animal Detection System Along Highway 191 in Yellowstone National Park" and the second was presented by Anthony Clevenger on "Long-Term, Year-Round Monitoring of Wildlife Crossing Structures and the Importance of Temporal and Spatial Variability in Performance Studies."

ICOET 2005 will be held in California, although a date and location have not yet been selected.

Field Course Information Available On-line

Our 2002 Annual Report detailed the field course co-sponsored by WTI in Banff National Park. The course offered transportation officials a first-hand look at the extensive wildlife crossing structures and fencing installed along the Trans-Canada Highway, as well as the opportunity to hear presentations from the experts who developed the mitigation program. Course proceedings are now available on-line at www.itre.ncsu.edu/cte/gateway/home.html. From the home page, scroll down to "Education and Training" and click on the "September 2002 Wildlife Structures" link.

Peer Reviewed Publications

Anthony Clevenger

Chruszcz, B., Clevenger, A.P., Gunson, K. & Gibeau, M.L. 2003. Relationships among grizzly bears, highways and habitat in the Banff-Bow Valley, Alberta. Canadian Journal of Zoology 81:1378-1391.

Clevenger, A.P., Chruszcz, B. & Gunson, K. 2003. Spatial patterns and factors influencing small vertebrate fauna road-kill aggregations. Biological Conservation 109:15-26.

Forman, R.T.T., Sperling, D., Bissonette, J., Clevenger, A., Cutshall, C., Dale, V., Fahrig, L., France, R., Goldman, C., Heanue, K., Jones, J., Swanson, F., Turrentine, T. & Winter, T. 2003. Road ecology: Science and solutions. Island Press, Washington, DC

Eli Cuelho

Cuelho, E.V.; Ganeshan, S.K.; Johnson, D.R.; Freeman, R.B. and Schillings, P.L. (2003) "Relative Performance of Crack Sealing Materials and Techniques for Asphalt Pavements." Proceedings: Third International Symposium on Maintenance and Rehabilitation of Pavements and Technological Control, University of Minho, Guimãraes, Portugal, July 2003

Mike Kelly

Kelly, M.J. & Moore, J.L. (2003). User Requirements for Information Systems to Support Alternative Vehicles in the National Parks. In: Proceedings of the Human Factors and Ergonomics Society 47th Annual Meeting. Santa Monica: Human Factors and Ergonomics Society.

Steve Perkins

"A Design Model for Geosynthetic-Reinforced Pavements", Perkins, S.W. and Edens, M.Q., International Journal of Pavement Engineering, V. 4, No. 1, pp. 37-50, 2003.

"Finite Element and Distress Models for Geosynthetic-Reinforced Pavements", Perkins, S.W. and Edens, M.Q., International Journal of Pavement Engineering, V. 3, No. 4, pp. 239-250, 2002.

"Mechanistic-Empirical Models for Reinforced Pavements", Perkins, S.W., Cuelho, E.V., Eiksund, G., Hoff, I., Svanø, G., Watn, A., Christopher, B.R. and Schwartz, C.W., Proceedings of the Seventh International Conference on Geosynthetics, Nice France, Vol. 3, pp. 951-954, 2002.

"Material Models for Reinforced Unbound Aggregate", Eiksund, G., Hoff, I., Svanø, G., Watn, A., Cuelho, E.V., Perkins, S.W., Christopher, B.R. and Schwartz, C.S., Proceedings of the Sixth International Conference on the Bearing Capacity of Roads, Railways and Airfields, Lisbon, Portugal, Vol. 1, pp. 133-143, 2002.

Jerry Stephens

Stephens, J., Carson, J., Hult, D., and Bisom, D., "State Truck Activities Reporting System", Proceedings, 9th World Congress on Intelligent Transport Systems, Chicago, Illinois, October 14-17, 2002

Presentations

Ed Adams

- "Snow and Avalanches", IEEE Aerospace Conference 3/03 Big Sky, MT
- "Thermal Mapping of Roadway Temperatures" National Academy of Sciences, Committee on Weather Research for Surface Transportation, 6/03 Boulder, CO
- "Avalanche" Museum of the Rockies, 3/03 Bozeman, MT

Steve Albert

- "Rural ITS: Getting Started and Keeping it Going" National Rural ITS Conference, 8/03 Palm Harbor, FL
- "Partnering with the Universities for Technology Deployment" and " Wildlife Structures and Advanced Technology Applications" Technology and Innovation Funding Program Conference, 5/03 Vancouver, WA
- "ITS Resources at a National Level and State Chapters Council" ITE/WTS Rocky Mountain ITS Spring Transportation Symposium, 4/03 Denver, CO

Lisa Ballard

- "Montana Public Mobility: Low-cost, Low-tech Solutions" Nation Rural Its Conference, 8/03 Palm Harbor, FL

Tony Clevenger

- "Road and wildlife in the Canadian Rocky Mountains: Mortality, movements, and mitigation" UC Davis Institute of Transportation and Studies—"Road Ecology Workshop" 5/03 Davis, CA
- "A highway runs through it: highway mitigation in Banff National Park, Alberta" Banff National Park Science Workshop, 1/03 Banff, AB, Canada
- "Mitigation for road impacts on wildlife" Urban development Institute Workshop "Building Sustainable Communities: Living with Wildlife", 3/03 Canmore, AB, Canada
- "From afterthought to planning principle: Mapping the route towards connectivity in Banff Natinal Park" Yellowstone-to-Yukon Science Grants Symposium
- "Making science, making change in Y2Y", 5/03 Calgary. AB, Canada
- "Long-term, year-round monitoring of wildlife crossing structures and the importance of temporal and spatial variability in performance studies" International Conference on Ecology and Transportation 8/03 Lake Placid, NY
- "Performance and Benefits of Highway Fencing and Wildlife Crossing Structures: Considerations of Future Applications" Transportation on Association of Canada Annual Meeting, 9/03 St. Johns, NFLD, Canada
- "Living with highways: sharing the road with wildlife" Sandy Cross Conservations Foundation, Conservation Education lecture series, 2/03 Calgary, AB, Canada

Gregory Cross

- "Incident Management: Emergency Services & Transportation" Tri-State Transportation on Safety Conference, 4/03 Lake Morey, VT

Eli Cuelho

- "Relative Performance of Crack Sealing Materials and Techniques for Asphalt Pavements" 3rd International Symposium on Maintenance and Rehabilitation of Pavements and Technological Control, 7/03 Guimaraes, Portugal

Eric Eidswick

- "Motorist Communication System Evaluation" ITS World Congress, 10/02 Chicago, IL

Susan Gallagher

- "Developing Sustainable K-6 Engineering Outreach Programs" and "Exciting Children about Engineering through Interactive Exploration of Bridges and Dams" WEPAN National Conference, 6/03 Chicago, IL

Amanda Hardy

- "Yellowstone to Yukon Initiative and Roads and Wildlife Earth Systems Engineering Management" undergraduate course at U. of Virginia, Guest lecturer 3/03 Charlottesville, VA
- "Evaluating Wildlife Crossing Structures and Fencing on US 93, Flathead Reservation, Montana" Conservation Area Design Workshop, Craighead Environmental Research Institute , 10/02 Emigrant, MT
- "Evaluating Wildlife Crossing Structures and Fencing on US 93, Flathead Reservation, Montana" Flathead Resource Organization Meeting, 3/03 Ravalli, MT
- "Transportation System Wildlife Interactions" Pennsylvania Traffic Engineering and Safety Conference 11/02 College Station, PA
- "Planning for Wildlife Passages and Methods to Assess Their Performance" International Conference on Ecology & Transportation, 8/03 Lake Placid, NY
- "The Road is a Visitor: AN Ecological Perspective—Us 93 Reconstruction on the Flathead Reservation, Montana." 82nd Annual Meeting of the Transportation on Research Board, Ecology and Transportation on Wildlife Linkages sessions, 1/03 Washington, D.C.

Presentations *(continued)*

Jaime Helmuth

- "What are the Rural ITS Maintenance Issues? Improving the State-of –the-Practice" National Rural ITS Conference, 8/03 Palm Harbor, FL
- "511 Marketing Lessons Learned in Montana", "A 511 Design for National Parks," and "Caltrans RWIS: What We Learned from Other States" ITS Rocky Moutain Annual Conference, 10/02 Slat Lake City, UT

Marcel Huijser

- "Habitat linkage characteristics in Dutch agricultural landscapes" Conservation Area Design Workshop, Craighead Environmental Research Institute , 10/02 Emigrant, MT
- "Habitat linkages and road networks in Dutch agricultural landscapes" 82nd Annual Meeting of the Transportation Research Board, Ecology and Transportation on Wildlife Linkages session, 1/03 Washington, D.C.
- "Overview of Animal Detection Systems" Transportation Association of Canada Annual Meeting , 9/03 St. John's NFLD Canada
- "Challenges of advanced signing technology applications" Deer Vehicle Information Clearinghouse Workshop, Midwest Regional University Transportation Center, 2/03 Madison, WI
- "Wildlife Transportation Interactions: effects and mitigation measures" Mountains and Minds lecture series, Big Sky Institute, 2/03 Big Sky, MT
- "Overview of animal detection and animal warning systems in North America and Europe" International Conference on Ecology & Transportation (ICOET), 9/03 Lake Placid, NY

Ali Kamyab

- "Fluorescent Yellow-Green Background For Vehicle-Mounted Work Zone Signs" Transportation on Research Board Committee A3C04 Annual Meeting, 1/03 Washington, D.C.
- "Methods to Reduce Traffic Speed in High Pedestrian Areas" 82nd Annual Meeting of the Transportation on Research Board 1/03 Washington, D.C.
- "Synthesis of Best Practice for Increasing Protection and Visibility of Highway Maintenance Vehicles" Fourth Biennial Mid-Continent Transportation on Research Symposium, 8/03 Ames, IA

Manju Kumar

- "Rural ITS Maintenance: State of the Practice" ITSRM Annual Conference, 10/02 Salt Lake City, UT

Pat McGowen

- "Poster Session: Dynamic Animal Detection Systems"UC Transportation Center Conf., 2/03 Los Angeles, CA

Ladean McKittrick

- "Pavement/Terrain Temperature Modeling" Ninth Annual Workshop on Weather Prediction in the Intermountain West, 11/02 Salt Lake City, UT
- "Pavement/Terrain Temperature Modeling" Sixth Annual Great Divide Workshop, 10/02 Great Falls, MT

Steve Perkins

- "Current Design Model Development Research" North American Geosynthetic Society Past President Seminar, 11/02 Austin, TX
- "Geosynthetics in Transportation Infrastructure Applications" MDT Training Course, 1/03 Bozeman, MT
- "What Do We Know About Base Reinforcement" 82nd Annual Meeting of the Transportation Research Board, 1/03 Washington, D.C.
- "A Roadmap for Base Reinforcement Research and Implementation" North American Geosynthetic Society Past President Seminar, 11/02 Austin. TX

- "Results From Four Reinforced HVS Test Sections" 82nd Annual Meeting of the Transportation Research Board, 1/03 Washington, D.C.

Chris Strong

- "Traveler Information Via Cell Phones" ITS World Congress 10/02 Chicago, IL
- "Collection of Vehicle Speed Data Using Time-lapse Video Recording Equipment" TRB Annual Meeting, 1/03 Washington, D.C.
- "What are the Rural ITS Maintenance Issues? Improving the State-of-the-Practice" National Rural ITS Conference, 8/03 Palm Harbor, FL
- "Rural Challenges and ITS Applications" Mid-Atlantic Section ITE Annual Meeting, 9/03 King of Prussia, PA

Pat Wright

- "What is an ITS Project Architecture" and I-80n Smart Work Zone Alternatives" Nebraska i-80 Smart Work Zone Stakeholder Meeting, 4/03 Lincoln, NE
- "Building a Successful ITS Pennsylvania" Pennsylvania Traffic Engineering and Safety Conference, 11/02 College Station, PA

Conference Booths

National Rural ITS Conference a Success in Palm Harbor

Michael Pietrzyk
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This year's National Rural ITS (NRITS) Conference was held on August 10-13 at the Westin Innisbrook Resort in Palm Harbor, Florida. ITS Florida served as the local host for this national conference, with other conference sponsors including the Federal Highway Administration, ITS America, the Federal Transit Administration, the Florida Department of Transportation, and the Florida Commission for the Transportation Disadvantaged.

A sunset dinner cruise on the 180-foot StarShip dining yacht kicked off this year's conference. This unique "ice-breaker" event departed from the famous Tarpon Springs sponge docks, and provided a relaxing atmosphere for conference attendees to network as well as enjoying the Florida environment and preparing for a full conference schedule.

FTA Administrator Jennifer Dorn delivered the opening keynote address (the first FTA Administrator to be a keynote speaker for a national ITS conference). Her address focused on the special needs of rural transit and how ITS can serve those needs. She also congratulated the outstanding work of the ITS community in building recent partnerships with FTA for improving transit vehicle safety and overall system security.

This year's conference attracted representatives from 35 states, Africa, and Canada. Twenty-five exhibitors were also on hand to display the latest technology applications for rural mobility and safety, provide door prize give-a-ways, and participate in vendor "info-mercials".

Over a two-day period, the technical program consisted of three concurrent program tracks: Public Mobility, Traveler Information/Communication Systems, and Safety & Operations. "Mini-seminars" were also presented on Emergency Response Needs in Rural Areas, Improving the State of the Practice for Rural ITS Maintenance, and How to Start a Rural ITS Program.

A roundtable discussion, lead by 2003 NRITS Conference Program Chair Mike Pietrzyk, included local, state, and federal insights from three panelists on the future of rural ITS deployment. The background for this discussion was based on a recent USA TODAY article that illustrated how rural areas are fast becoming the "test cases for smart growth" in America.

Orange County (FL) Fire Chief Carl Plaugher entertained and enlightened conference attendees as the guest speaker for Tuesday's dinner and reception. Chief Plaugher's well-organized and thought-provoking discussion identified problem areas his department faces in rural incident management, and he challenged NRITS Conference attendees to develop the appropriate technological solutions to save lives and time; namely, quicker incident detection and verification, but also accurate location to enable his responders to react more effectively.

The NRITS Conference closing session included some candid observations on rural transportation from recently appointed Florida Department of Transportation Secretary, José Abreu. (This was also the first time an FDOT Secre-

tary served as a guest speaker for a national ITS conference.) Secretary Abreu highlighted recent ITS accomplishments of the FDOT that continue to keep the State of Florida recognized as a national leader in ITS. He also thanked the conference sponsors and indicated how very proud Florida was to host this premier rural ITS event.

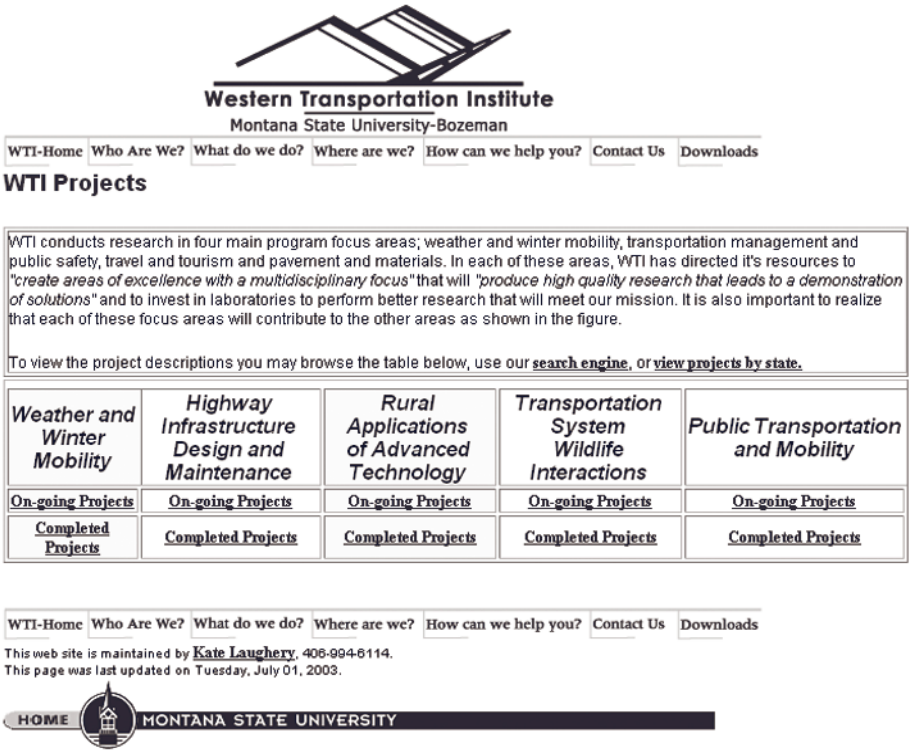
WTI staff members Steve Albert, Lisa Ballard, Jeralyn Brodowy, Jaime Helmuth, Suzy Lassacher, Xianming Shi, and Chris Strong attended the 2003 NRITS Conference. WTI also had the opportunity to play a very active role in the conference, with staff members making presentations in all three program tracks. Steve Albert was a discussant for the "Where do we go from here?" session in the Public Mobility Track. Also in the Public Mobility Track, Lisa Ballard moderated the "Institutions and Expectations" session and made a presentation entitled: "Montana Public Mobility" during the Project Profiles session. Steve was the discussant for the Traveler Information/Communication Systems Track "How to start a rural ITS program?" session. Chris Strong and Jaime Helmuth moderated the "What are the Rural ITS Maintenance Issues?" session in the Safety and Operations Track.

Next year's NRITS Conference will be held in Duluth, Minnesota, at the Duluth Entertainment & Convention Center on August 22-24, 2004. More information can be obtained at www.itsmn.org and www.visitduluth.com.

Website

Over the past two years the WTI website has been developing around the main four focus areas of research. However the addition of a focus area required the WTI website to be updated to include the new research focus area, Public Transportation and Mobility. Research projects falling in this focus area are now listed like the other focus areas, on a separate page, for ease of use.

Many of the focus areas contain overlapping elements such as incident management or safety. A doctoral student, Laura Stanley, has developed a sub-site template for those elements that encompass more than one focus area. For example, human factor elements are contained in many different research projects but are not considered a focus area at WTI. As such, a separate is site needed to disseminate this information. After an internal testing period the new sub-site will be published to gauge the interest. If the interest is high then additional sub-sites will be developed for areas such as safety and incident management.



In the past year, 15,519 people visited the main WTI site. Although this initially appears to be a decrease over last years visitation level, this number is a more accurate depiction of the actual number of unique visitors. Through the use of web tracking software, it is now possible to screen out repeat users as well as local users (i.e. WTI staff members) from the overall hit count. Continued use of the software will enable fine tuning of the website, tracking the information presented on the most popular pages as well as the most popular file downloads. This information can then be used to redesign the pages and their content making them more useful to the viewer.

Newsletters

The WTI newsletter was published in March and September 2003 to inform readers about our latest research and outreach activities. Both editions of the newsletter can be downloaded as pdf files from http://www.coe.montana.edu/wti/what/publications.html. The newsletter was sent to approximately 1900 readers. This surpasses our circulation goal by 35%.

The March 2003 edition included these articles:

- Unique Partnerships, Unique Opportunities
- International Collaboration Formed to Continue Wildlife Mitigation Research in Banff National Park
- WTI Helps MDT Launch 511 System in Montana
- Performance and Costs of Pavement Markings Reviewed for MDT
- Unique Partnership Produces Coordinated Transportation Handbook and Launches Pilot Project
- WTI Creates Webpages to Showcase ITS in OR
- Touch Screen Traveler Information Kiosks: Using Synergistic Partnerships to Implement Useful Technologies
- New Research Staff
- Education News
- Tech Transfer News
- Administration News

The September 2003 edition included these articles:

- Education Key to Workforce Development
- A Summer Success: The Research Experience for Undergraduate Program
- Student Transportation Projects: Hands-on Learning Teaches Valuable Skills and Engineering Principles
- Grade Schoolers Enthusiastic About Bridges/ Dams
- Outreach Targets Middle School Audiences
- Transportation Professor Joins MSU Faculty
- Mobile Laboratory: An Exciting Research and Educational Tool
- Infrared Cameras: A New Option for Monitoring Road Conditions?
- WTI Ecologists Track Critter Crossings of US 93
- New Research Focus Area: Public Transportation and Mobility
- ITS: Alternative Transportation Solutions for California National Parks
- Tech Transfer News
- New Research Staff

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MSU-Bozeman

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ADVANCING RURAL TRANSPORTATION THROUGH RESEARCH AND EDUCATION

Education Key To Workforce Development

It's no surprise that developing and maintaining a safe and efficient transportation infrastructure is critical to the economic vitality of the United States. What may be a surprise is that our country could soon have a serious shortage of professionals who are qualified to work in the field.

A key component of the shortage is the aging transportation workforce, particularly those employed by public agencies. According to some estimates, 32% of the federal workforce will be at retirement by 2004, with an additional 21% eligible for retirement. According to other studies, 40% of state and local government employees will be eligible to retire in the next 15 years. Many transportation associations recognize workforce development as one of the industry's most critical problems, and have identified it as a priority action issue.

WTI is also focused on expanding and nurturing the next generation of transportation professionals. Since our inception in 1994, WTI has always had a strong education program, with an eye toward getting young people excited about careers in transportation. More than 20% of the University Transportation Center funding we receive goes toward educational activities. At the university level, we have put a strong emphasis on multi-disciplinary programs in order to attract students with a broad range of majors, skills, and points of view. Among primary and secondary students, we have tried to reach students of all ages, with a special effort to include groups that traditionally have been under-represented in the transportation and engineering professions.

In this issue of the newsletter, we are excited to report on the newest addition to our education program. This summer, we held our first Research Experience for Undergraduates (REU) Program, thanks to a grant from the National Science Foundation. Eight students from around the country spent ten weeks here in Bozeman, conducting first-hand research and learning how to prepare written reports and oral presentations based on their results. The program shows tremendous promise for teaching research and communication skills that are essential to both advanced study and professional careers in transportation.

Other articles will describe some of our successful ongoing education programs, such as our sponsorship of research projects by student organizations on the MSU campus. These relatively small amounts of funding often make it possible for students to attend national science and engineering competitions, which have proven to be great motivators for teamwork, innovative thinking and creative design.

Many of our research projects also have a strong hands-on educational component. The update on our Mobile Laboratory describes how students were instrumental in getting the lab up and running. Now the lab serves as an excellent resource to many students conducting graduate level research.

In fact, nearly all of our research projects rely on assistance from students at one time or another. On average, thirty undergraduate and graduate students are working at WTI during the school year, with more during the summer. The number and variety of student research opportunities offered by WTI is probably our greatest contribution to the development of the transportation workforce of the future, and we look forward to continuing and expanding our efforts in this area.

College Of Engineering
Montana State University - Bozeman

Initiatives for 2004

In the coming year, WTI will pursue new ways to use technology transfer equipment funding to improve the research resources available to staff. The newly appointed Research Director can help identify equipment purchases that will be useful to numerous current and planned projects. The goal is to create a Research Resource Center, with equipment available to all researchers. The Center will facilitate both internal and external collaboration opportunities, and improve the quality of research results produced by WTI and shared with other organizations.

To document the body of research produced by WTI since its inception, technology transfer staff has recently produced individual fact sheets on more than 80 past and current projects. These facts sheets will be used to develop an interactive CD-Rom to promote increased dissemination of WTI research activities.

Technology Transfer Success Stories

Specialized Internet Sites Make WTI Research Results Available for Immediate Use

As a Technology Transfer tool, the Internet is very effective at making information about WTI's research readily available to interested parties across the country. WTI's own website (www.coe.montana.edu/wti) contains descriptions and staff contact information for every one of our research projects. Project information is being expanded to include links to annual and final reports, so that interested parties have access to the most recent research findings.

WTI's presence on the Internet, however, is beginning to extend well beyond our own website. Many of our projects now involve developing websites or material on behalf of other organizations, or collaborations to combine and organize research information into one website. For example, WTI created a website for the Montana Developmental Disabilities Planning and Advisory Council to provide easy access to a new handbook on transportation coordination. While the information on the website is aimed at local transportation providers, it could also be used by the public to find transportation services in their area. The Montana Coordinated Transportation Website is available at www.coe.montana.edu/wti/TrCoordn/index.html. The website will also be available on the Developmental Disabilities Planning and Advisory Council website at www.ddpac.org, and through links to other state departments.

Another WTI project resulted in a weather station website. WTI installed a remote weather station near Saco, Montana to provide weather data for a bridge instrumentation project nearby. The weather station includes sensors for wind speed and direction, temperature, humidity, and barometric pressure. The new website is linked to a database so real-time weather data is displayed as it is collected. Since the weather station is physically located at Saco High School, the website is of particular interest and use to students, who use the information for science classes and other school projects. The Saco website is available at http://wtigis.coe.montana.edu/saco/Saco_Current.htm.

As a final example, WTI has entered into a partnership with the USDA Forest Service and Utah State to develop a joint database called The Wildlife Crossing Structures Toolkit. Located at www.wildlifecrossings.info, the database will incorporate research findings on wildlife mitigation from WTI's ARTEMIS Clearinghouse Project. (The original ARTEMIS database also remains available at http://wtigis.coe.montana.edu/projects/animal/index.php

The Internet makes the findings from our UTC projects readily available on a national and even international basis. Since the specialized websites are providing valuable information to transportation professionals, government officials, education and the public, WTI is meeting UTC's goal of providing research results that can be "directly implemented, utilized, or otherwise applied." In the case of the UTC-funded Saco Bridge project, where the weather station website has become widely used by Saco High School students, this technology transfer success has the added benefit of enriching the educational programs of the community and exposing students to transportation research.

By working with other research organizations to develop joint websites, we can offer our knowledge and findings to our colleagues and build comprehensive databases of information. This allows us to save time and combine resources, thereby investing our UTC research dollars more efficiently.

WTI "Mentors" Alaska UTC to Help Develop Program

This spring, WTI Director Steve Albert traveled to University of Alaska – Fairbanks to provide guidance on how to rejuvenate and develop the UAF transportation research institute. The Director facilitated an all day meeting that included representatives from the University and the Alaska Department of Transportation (AKDOT). In addition to providing an overview of WTI's research, education and technology transfer activities, Mr. Albert focused on sharing lessons learned regarding development of a Governing Board, development of a strategic plan, building partnerships, building foundational skills, and ensuring accountability.

The meeting had many positive outcomes for all the participants, including:

- A proposed addition of UAF to the WTI Governing Board
- A proposed staff sharing arrangement to allow WTI to provide ongoing assistance to UAF with strategic planning, development, and partnerships
- Identification of common research interests and

partnership opportunities between UAF, AKDOT, and WTI. UAF's expertise in northern climate issues is of particular interest and value for the purposes of cooperative research.

Nurturing the development of other transportation centers expands the staff, academic, equipment, and knowledge resources available to all. Capable research centers increase the opportunities for collaborative partnerships on common issues, which facilitate cost-effective projects with high quality results. Specifically, building a productive relationship with UAK has the following benefits:

- UAF has strong research expertise in northern climate issues, which is of particular interest and value for the purposes of cooperative research.
- Proposed projects with UAF present opportunities to partner with Alaska's U.S. Representative Don Young, who chairs the House Transportation Committee.
- If UAF succeeds in its goal of becoming a UTC, WTI will have done its part to guide other centers toward fulfilling the UTC vision of recognized centers of excellence. Ensuring that each center is reaching its full potential improves the value and reputation of the entire system.