



NIATT

ANNUAL REPORT

National Institute for Advanced Transportation Technology



PREPARED FOR UNIVERSITY TRANSPORTATION CENTERS PROGRAM

RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION

U.S. DEPARTMENT OF TRANSPORTATION

FUNDING PERIOD JULY 1, 2002 THROUGH JUNE 30, 2003 - FY03



THEME: ADVANCED TRANSPORTATION TECHNOLOGY

MISSION

Our mission is to work with industry, government, and research institutions to develop, evaluate, and market technologies that will improve the design and operation of transportation vehicles and systems.

VISION

NIATT is a Center of Excellence for research and development of transportation technologies for the state of Idaho, the Pacific Northwest and Intermountain regions, and the United States.

- We educate and train university students and the professional engineering community in vehicle, infrastructure, and traffic control technologies.
- We assist the Idaho Transportation Department and other governmental agencies in meeting their responsibilities for the design, construction, and operation of transportation facilities.
- We work with industries and research institutions to develop and evaluate new transportation technologies and to bring these technologies to the marketplace.
- We seek collaborative research and development projects with the Idaho Transportation Department and other organizations.
- We work with university faculty to develop transportation research agendas and obtain funding for transportation research projects.
- We seek to educate the public about new transportation technologies.

Because of our geographic location, NIATT is able to serve a unique segment of the population. A number of other UTCs focus on transportation issues impacting metropolitan areas. NIATT, along with the regional University Transportation Center TransNow, serves the Pacific Northwest, where population centers are significantly smaller than in other parts of the country. With that in mind, NIATT's Center for Traffic Operations and Control chose to direct its research toward local government agencies and practicing engineers in medium to small cities with populations less than 150,000.

Much of the work completed by our Center for Clean Vehicle Technology relates to the area's environmental concerns of preserving national parks and other pristine areas, while continuing to provide for recreational uses of those same areas. We invest our research dollars in projects involved with alternative fuels and the next generation of vehicles in an attempt to protect and enhance communities and the natural environment affected by transportation.

Cover photo: During Traffic Signal Summer Workshop IV, students take a break and pose in front of the traffic controller cabinet being used by instructors Dale Moore and Shawn Niles (of Idaho Transportation Department) and Mike Boydston (of ADA County Highway District).

Ahmed Abel-Rahim works with a civil engineering student.



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This *Annual Report* highlights the activities and accomplishments NIATT has achieved over the past five years of funding as a University Transportation Centers Program.

The information presented here was gathered through interviews and correspondence with NIATT faculty, staff, students and partners in research.

To access this report on the Internet, please visit NIATT at <http://www.webs1.uidaho.edu/niatt>

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We must continue to keep our students at the center of all of our programs, to make sure that we are meeting their needs and are providing them with the tools that they need to become high quality professionals.

THIS IS A TIME TO BOTH LOOK BACK AND TO LOOK FORWARD.

As I write the introduction to this year's annual report, the U.S. Congress has started its debate on the new version of the legislation that authorizes our nation's transportation program. Many of the decisions that will form this legislation deal with the size and scope of our surface transportation system and how it will be planned, designed, operated, and maintained during the next six years. But one of the most important decisions that the Congress will consider relates to the research and education program that supports both the development of our future workforce and of the technology and knowledge base that will support the development of our 21st century transportation system.

We are proud of the contribution that we have made thus far to this research and education program during the five years that we have received funding from the U.S. Department of Transportation's University Transportation Centers Program. In this year's annual report, we look back to the students and faculty that have made our program such a success.

Today, nearly 200 University of Idaho students, faculty, and staff participate in one or more parts of NIATT's transportation education, research, and technology transfer program. In addition to the 35 faculty and staff, this number includes 44 graduate research assistants, 60 undergraduate students, and 52 team participants. Our annual research expenditures have increased by over 120 percent since 1999, with an annual level today of \$1.9 million. The UTC program accounted for about 40 percent of our total expenditures over the past five years.

To provide you with a perspective of what we've done during the past five years, we present five themes in this report, each covering one part of our program.

- We are bringing new professionals into the transportation workforce. The Federal Highway Administration has recently noted that more than 50 percent of today's transportation workforce will be retiring in the next five years. In addition, the nature of transportation is changing with an increasingly important focus on the role of technology. One of our biggest challenges is to make sure that we are producing the quantity of transportation professionals needed to meet our future challenges as well as ensure that the quality of these future professionals is high and based on a clear understanding of the importance (and limitations) of technology. In this report, our interns describe what their experiences have meant to them, while our former students of the year reflect on what their NIATT work has meant to their professional careers.
- We have made a significant contribution to traffic signal control technology through the development of our Controller Interface Device and the integration of this device into our education and research programs. The CID is used in our classroom and laboratories, in our short courses, and as a fundamental tool in our research program. Peter Kohl, of McCain Traffic Supply, notes how the CID project has given our students "the opportunity to turn theory into a real live product."
- We have developed vehicle technology to promote a cleaner environment and reduce our dependence on foreign oil. Our research on biodiesel fuels has been internationally recognized. We have worked with the private sector to develop and refine new catalytic ignition technology, a key component of lower temperature engines. We have tested these and other clean engine technologies on a variety of vehicle test beds.

- We have provided our students with the opportunity to test their engineering designs and research results in a variety of student competitions. Our students have won or placed highly in national hybrid electric vehicle competitions, in the Department of Energy's FutureTruck competition, and in the Society of Automotive Engineers Clean Snowmobile Competition.
- We have invested in our future by developing new laboratories and hiring new faculty. Our transportation laboratories, including two state-of-the-art traffic control laboratories, are now some of the best in the nation.

These successes over the past five years provide us with a solid base from which we can continue into the future. We look forward to working with the U.S. DOT, the staff of the Research and Special Programs Administration, and our fellow university transportation centers as the new UTC program is defined and implemented.

Most importantly, we must continue to keep our students at the center of all of our programs, to make sure that we are meeting their needs and are providing them with the tools that they need to become high quality professionals. I close with two quotes from two of our former students, both recent graduates of our Traffic Signal Summer Workshop.

Gene McHale, FHWA senior engineer and one of the first professionals to attend our workshop, had this to say:

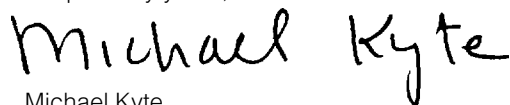
"I thought that the TSSW was an extremely rewarding experience. In addition to learning the basics of signal timing, the hands-on experience with the actual traffic signal controllers, video detection software, and loop detectors provides an unparalleled learning environment. The use of hardware-in-the-loop simulation using the controllers, the Controller Interface Device, and the CORSIM simulation software is a tool that I will be using in my current research activities at FHWA. I would highly recommend the TSSW."

"I feel the signal workshop was one of the best weeks in my life with so many good experiences. I am a better transportation engineer today as a result. The instructors were brimming with knowledge and expertise. I am grateful to each of them."

Bhargava Rama Chilukuri
MSCE, University of Utah
2002 Workshop Participant

I encourage you to turn the pages and discover more about the past five years and how we are continuing to move into the future.

Respectfully yours,



Michael Kyte
Director

We are bringing new professionals into the transportation workforce.

We have made a significant contribution to traffic signal control technology through the development of our Controller Interface Device

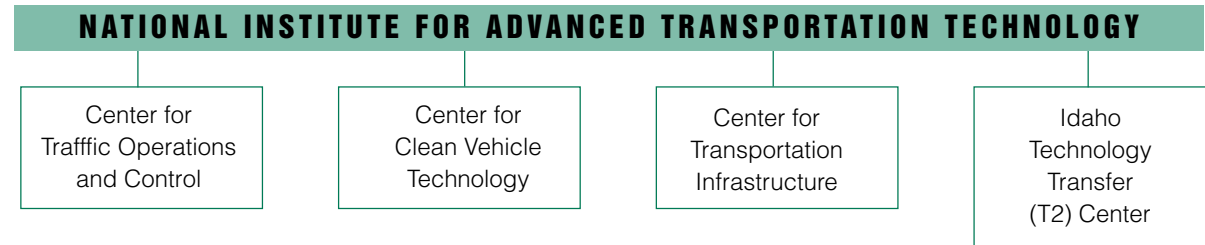
We have developed vehicle technology to promote a cleaner environment and reduce our dependence on foreign oil.

We have provided our students with the opportunity to test their engineering designs and research results in a variety of student competitions.

We have invested in our future by developing new laboratories and hiring new faculty.

MANAGEMENT STRUCTURE AND PRINCIPAL CENTER STAFF

The National Institute for Advanced Transportation Technology (NIATT) is one of six research institutes on the University of Idaho campus. Institute status was granted to NIATT in July 1998 in recognition of its university-wide, multidisciplinary activities. The institute, originally known as NCATT, was established in 1991 under the Intermodal Surface Transportation Efficiency Act (ISTEA).



Although the University Transportation Centers (UTC) program primarily supports the work of NIATT's Center for Traffic Operations and Control and the Center for Clean Vehicle Technology, the UTC funding has a positive impact on the entire institute and our ability to deliver transportation technology. UTC funds are supplemented from a variety of sources, including the Idaho Transportation Department (ITD), Idaho Department of Water Resources, the U.S. Departments of Energy and Defense, and the Federal Highway Administration. The research in the Center for Transportation Infrastructure is supported mainly by the cooperative agreement between NIATT and ITD. The Idaho T2 Center receives major funding from the Federal Highway Administration's Local Technical Assistance Program.

Management staff

Michael Kyte
 Director, NIATT
 Professor, Civil Engineering

Donald Blacketter
 Director, Center for Clean Vehicle Technology
 Professor, Mechanical Engineering

Judy B. LaLonde
 Assistant to the Director, NIATT

Deborah Foster
 Financial Technician, NIATT

Douglas Moore
 Director
 Idaho Technology Transfer (T2) Center

Bruce Drewes
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Ruthie Fisher
 Administrative Assistant II
 Idaho Technology Transfer (T2) Center

Irma Sixtos
 Administrative Assistant I

NIATT AFFILIATE FACULTY

Ahmed Abdel-Rahim
Visiting Assistant Professor, Civil Engineering

Fouad Bayomy
Professor, Civil Engineering

Steven Beyerlein
Professor, Mechanical Engineering

Kang-Tsung (Karl) Chang
Professor, Geography

Karen DenBraven
Professor, Mechanical Engineering

Michael Dixon
Assistant Professor, Civil Engineering

David Drown
Associate Professor, Chemical Engineering

Donald F. Elger
Professor, Mechanical Engineering

Brian He
Biological and Agricultural Engineering

Brian Johnson
Associate Professor, Electrical and Computer Engineering

James R. Jones
Professor, Agricultural Economics/Marketing Economics

James Kingery
Associate Professor, Range Resources

Axel Krings
Associate Professor, Computer Science

Stanley M. Miller
Professor, Geological Engineering



NIATT is located in the University of Idaho's Engineering Physics Building.

James R. Nelson
Professor, Agricultural Economics/Rural Sociology

Richard J. Nielsen
Associate Professor, Civil Engineering

Edwin Odom
Associate Professor, Mechanical Engineering

Paul Oman
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Charles Peterson
Professor, Biological and Agricultural Engineering

Karl Rink
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Associate Professor, Electrical and Computer Engineering

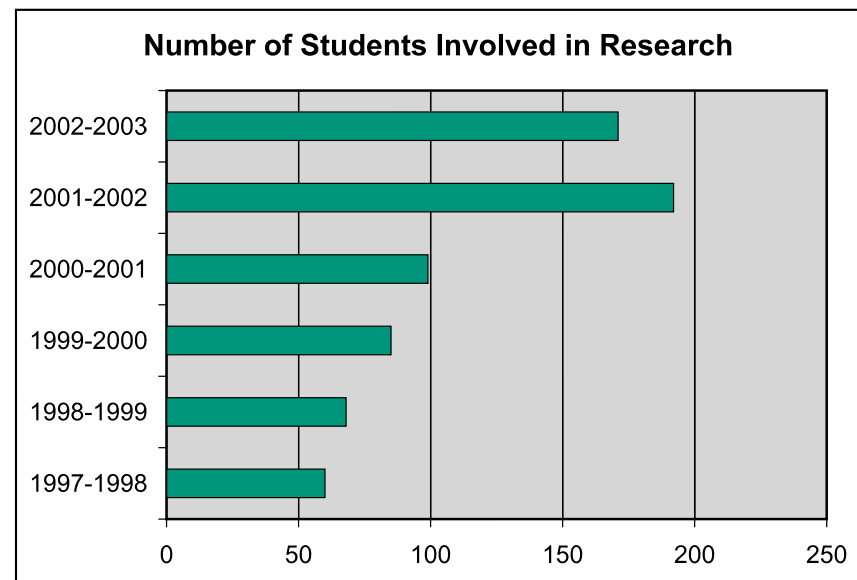
SECTION 1: BRINGING NEW PROFESSIONALS INTO THE TRANSPORTATION WORKFORCE

The need for engineers trained in the use of new transportation technologies is well documented. Over the past five years, NIATT has responded to this need by providing a multidisciplinary program of coursework and experiential learning for both undergraduate and graduate students.

The number of students in our program has dramatically increased from 60 in 1998 to 171 in 2002. Before the UTC grant, most students working on NIATT research projects were civil engineering students. Now, the 171 students represent a variety of engineering disciplines, as well as computer science.

In short, UTC funds have enabled us to engage more students in research. A number of those students have graduated and are now productive members of the transportation workforce.

Record of growth in graduate and undergraduate students, involved in NIATT research.



“IN THEIR OWN WORDS”: CAREERS IN TRANSPORTATION

We take pride in our strong educational program that provides a broad range of practical and real-life experiences in transportation. We believe that the stories about NIATT students in this section verify our success in combining research with education. In their own words, students claim that their work with NIATT faculty on research projects has broadened their knowledge and given them an appreciation for various aspects of transportation in the twenty-first century.

Undergraduate Internships Attract Students to Transportation

Over the last five years, NIATT was able to expand its internship program that provides hands-on experience to undergraduate transportation students. In 1998, only six undergraduate students served as interns. During this past academic year, 21 undergraduate interns worked on transportation projects funded either by the UTC program or the Idaho Transportation Department. The program expansion allowed us to offer internships during the past two summers and generated matching funds from UI's EPSCoR Program.

Each intern works with an advisor, sometimes as part of a team, on specific projects. At the end of the school year, interns either display the results of their work at the annual Engineering Exposition or make a presentation at an internship colloquium. Their research experience is a plus on their vitae when they seek their first engineering positions.

Undergraduate internships awarded yearly to students to work on transportation projects help NIATT fulfill several goals identified in our *Strategic Plan*. The research projects on which the students work most often involve the development of technology products that improve the transportation system of the Northwest or the nation. The internships also encourage students to make some aspect of transportation their career choice.

“For once, I was helping to produce an important product that would be of use.”

Joe Geigle
Intern, 2000

UNDERGRADUATE INTERNSHIPS LEAD TO PROFESSIONAL CAREERS

Christina Ryan works as a Staff Engineer, E.I.T., at Holladay Engineering in Payette, Idaho. In that position, she helped develop a transportation plan for Payette County and is currently working on a bridge replacement and landscaping project funded by the Federal Highway Administration.

She reports that working on a statewide travel model with Dr. Zaher Khatib helped her understand the transportation planning program in the Boise area. Christina writes that “working with NIATT on three projects throughout my time at UI helped reassure me that I did want to work in the transportation field.”

Joe Geigle left Idaho for North Carolina where he now serves as Traffic Operations and Safety Engineer in the North Carolina Division Office of the Federal Highway Administration. He describes his main responsibility as the reduction of the number of fatalities on the nation’s highways. He does this by “providing advice and guidance to the North Carolina Department of Transportation on general approaches, standards and criteria, and application of policies, designs, and concepts related to highway safety and traffic operations.”

Analyzing the usefulness of his internship experiences at NIATT, Joe says that they increased his knowledge and understanding of transportation-related practices. “For once, I was helping to produce an important product that would be of use.”



As an Associate Engineer, E.I.T., at MNS Engineers in Santa Barbara, California, **Craig Dierling** assists in designing and producing plans for various infrastructure projects, such as roads, channels, utility lines, and grading. Craig worked as an intern with Dr. Fouad Bayomy on projects for the Idaho Transportation Department. He believes his internships gave him a greater exposure to transportation engineering than he would have received simply by attending classes. The internships also helped him build a more impressive résumé.

Craig Dierling in the field during a Traffic Signal Summer Workshop.

Christina Ryan (left) joins other interns following the NIATT Internship Colloquium in 1999.



Ted Bush served as an undergraduate intern and continued working as a research assistant while he earned his MSCE. Ted currently works as a structural bridge designer at HDR Engineering, Inc., in Phoenix, Arizona. Ted said that without the internships with NIATT, he might have decided to go into a different, non-transportation related field.

After his year as an intern with NIATT, **Ryan Sherman** spent the summer working for the Ada County Highway District, developing a Synchro model for 90 signalized intersections in downtown Boise. He visited each intersection to collect the needed field data and entered that information along with the current signal timing information into the model. Ryan is currently pursuing his MSCE degree.

“Working with NIATT on three projects throughout my time at UI helped reassure me that I did want to work in the transportation field.”

Christina Ryan
Intern, 1999-2000

UNDERGRADUATE INTERNSHIPS ATTRACT STUDENTS TO GRADUATE SCHOOL

Another NIATT goal is to increase the number of students in transportation graduate programs. The internship experience serves as a recruitment tool, helping us increase the number of students who, after completing their undergraduate degrees, elect to attend graduate school.

Among those interns who “moved up” to graduate status in the past five years are

- Yuri Meresczak, now continuing his pursuit of an MSCE while working on a project funded through the National Cooperative Highway Research Program.
- Joseph Howard, who worked on an intelligent transportation system design for Ada County, Idaho.
- John Fisher, a member of the original multidisciplinary Controller Interface Device team.
- Dan Cordon, who is continuing his work with clean engine design and IEWorks.
- Jeremy Boles, who has been working on the FutureTruck projects.



A view inside the FutureTruck shows the ultra-capacitor storage system.

INTERNSHIP FUNDS MATCHED WITH EPSCoR DOLLARS

Because NIATT could provide matching funds, two interns received an additional \$1000 each from the University of Idaho’s EPSCoR Research for Undergraduates (REU) program, designed to expand opportunities for UI undergraduates in the sciences and engineering.

Troy Cuff worked with another computer engineering undergraduate and an electrical engineering intern to manage a network of traffic controllers in a lab environment. This group was part of the larger Controller Interface Device team, which included seven undergrad and four graduate students. Their work was integral to the development of NIATT’s new Traffic Controller Lab.

Eric Cegnar, a member of the Advanced Vehicles Concepts Team (AVCT), designed and built a one-of-a-kind boost converter for the ultra-capacitor energy storage system used on NIATT’s 2003 FutureTruck entry. The UI FutureTruck requires higher power levels, a need met by ultra-capacitors. The ultra-capacitors replace the batteries, which are heavier and have a limited life. To meet the challenge of having the capacitors function like batteries, Cegnar designed and built a microcontroller, which worked perfectly in the FutureTruck competition (see picture to left).

NIATT STUDENTS-OF-THE-YEAR IN THE WORKFORCE

Each University Transportation Center selects an outstanding student to be recognized by the U.S. Department of Transportation as their Student-of-the-Year. NIATT has enthusiastically participated in the student-of-the-year program. Five students have each been awarded a \$1000 scholarship and a sponsored trip to the annual Transportation Research Board meeting in Washington, DC.

This participation does not set us apart. But we continue to be proud of the students, not only for their outstanding work as graduate students, but also for their continuing contributions to the nation's transportation programs.

Their testimonials speak for our ability to combine a research program that meets critical transportation needs with educational opportunities that immerse our students in practical, learning-centered engineering environments.

Paul Coffelt (MSCE '97), NIATT student-of-the-year in 1999, recently joined the staff of the Oregon Department of Transportation. Paul works with a team of engineers and information specialists creating a statewide system for traffic, incident, and emergency management. His specific duties include identifying upgrades and designing the network connection for all ITS field devices to be used for traffic incident management. Part of his responsibility will be to recommend which NTCIP standard objects should be implemented, influencing the Oregon standards for ITS devices.

When asked, Paul identified three ways that working on NIATT projects influenced his growth as a professional:

1. Hands-on experience with traffic controllers, machine vision devices, and interface software.
2. Being a member of a multidisciplinary team.
3. Applying classroom and textbook work to practical, real-world situations.

"These and other experiences that I attribute directly to my academic background and work at NIATT have helped me to reach my goals of working with technology to improve transportation."

While at NIATT, Paul worked with Dr. Zaher Khatib developing an interface software tool that can be used to take results from transportation modeling programs for use on a traffic controller. "Paul had a real love of computers and devices," recalls Michael Kyte. "He was instrumental in helping build NIATT's first traffic control laboratory."

"Working on NIATT projects trained me to look for alternative solutions that others may not have thought of implementing."

Geoffrey Judd
2001 Student-of-the-Year

(NIATT Students-of-the-Year in the Workforce, cont.)

When **Dan Gerbus** (PhD ME '02) was selected in 2000 as student-of-the-year, he was working towards his master of science degree. Since then, he also completed his Ph.D., did some private consulting, and taught two mechanical engineering classes at the University of Idaho. Dan's dissertation topic involved optimized structural design and the complete fabrication of an electrically assisted bicycle, a NIATT project. He has submitted two papers concerning his thesis work to academic journals.

In the summer of 2003, Dan joined SDB Associates in Colorado Springs as a consultant. Most of SDB's projects involve engine and chassis dynamometers, work with which Dan became intimately involved at NIATT while working on the FutureTruck project.

NIATT recognized Dan especially for his work with Idaho Engineering Works (IEW), a leadership program that teams graduate students with undergraduate students to work on specific research projects. As a teaching assistant for senior design capstone courses, he trained and advised students in machine shop equipment operation, project management, solid modeling, team-based product design, and design for manufacturability. He has several publications that focus on the IEW model.

"NIATT projects provided me with the opportunity to develop communication skills while working with students and faculty in other disciplines," notes Dan. "These skills will be invaluable, as I will be working with people from a wide variety of backgrounds and education."

In his position as senior transportation analyst at Lancaster Engineering in Portland, Oregon, **Geoffrey Judd** (MSCE '01), 2001 student-of-the-year, helps prepare traffic impact studies and signal designs. The firm also has contracts with smaller cities to review projects and work when they do not have their own trained staff.

One of NIATT's early interns, Geoff continued in graduate school working with Zaher Khatib on a UTC project. He and Dr. Khatib presented a paper, "Control Strategy for Oversaturated Signalized Intersections" at the 80th annual TRB meeting.

Geoff has excelled, not only in transportation engineering, but also in the high jump. He remains the first and only person in Vandal track history to score in a conference meet as a walk-on athlete.

"Working on NIATT projects," says Geoff, "trained me to look for alternative solutions that others might not have thought about implementing. This ability has been especially valuable when trying to determine ways to improve operations along corridors."



Dan Gerbus (front right) with other members of the 2002 IEWorks group.

*David Alexander
confers with
advisor, Donald
Blacketter*



“NIATT’s support was instrumental in getting my ideas disseminated and helped me get in touch with other professionals in the field.”

David Alexander
2002 Student-of-the-Year

In January 2002, **David Alexander** (PhD '02) received NIATT’s student-of-the-year award. Dave began his NIATT research as a master of science candidate and was the primary developer of a logic-based, performance-driven electric vehicle software design tool, SmartHEV. The software was first used on the NIATT FutureTruck 2000 and continues to be used for modeling performance and emissions. As an IEWorks mentor, David worked with other students on a number of research projects supported by UTC funds.

“NIATT helped me as a professional,” David writes, “by supporting the presentation of my work at national conferences as well as local forums. This, more than anything, helped me to prepare for the type of work I do as a professional. NIATT’s support was instrumental in getting my ideas disseminated and helped me get in touch with other professionals in the field. In addition, I worked on research that was on the leading edge of technology.”

David recently joined Boster, Kobayashi, and Associates in Livermore, California, as a consulting engineer. The work he does involves the effects of vehicle dynamics and roadway designs on accidents at intersections. Traffic design and roadway visibility are significant issues of which he must be aware.

Philip Rust, NIATT's 2003 recipient of the student-of-the-year award, learned in June that he is a recipient of a 2003 Eisenhower Graduate Fellowship from FHWA. Ranked 17 out of 78 applicants in this fellowship competition, Phil already has an impressive résumé.

After completing his masters' thesis, which focuses on his research involving freeway and arterial operations in Boise, Idaho, during freeway incident detours, Phil will continue his graduate education in pursuit of a Ph.D. Phil has been an active member of the UI student chapter of the Institute of Transportation Engineers and mentor to new graduate students. He was a member of the winning Traffic Bowl team in Portland, Oregon, in 2001.

Phil spent the last three summers gaining practical transportation experience. He completed internships in 2000 with Whatcom County Public Works near Bellingham, Washington, and with Six Mile Engineering in Boise, Idaho, during the summer of 2001. He worked during the summer of 2002 at the FHWA Headquarters Office of Travel Management, developing a freeway ramp management and control handbook. This summer, Phil is traveling across the country with a team of students conducting nationwide field research on the operation, safety and design of modern traffic roundabouts for a National Cooperative Highway Research Program-sponsored project.

Phil claims that his work with NIATT has provided him the opportunity "to work on projects that have national significance and to work with top professionals in the field and learn from their knowledge and experience." Because the NIATT projects involve current transportation technology, he expects to graduate with "valuable expertise in emerging areas of transportation engineering."



Phil Rust (center) receives recognition at TRB Student-of-the-Year reception.

NIATT IS THE PLACE TO LEARN UP-TO-THE-MINUTE TRAFFIC SIGNAL TECHNOLOGY

TSSW “Graduates” 36 Participants

The Department of Transportation’s Intelligent Transportation System (ITS) program mandates that computing, communications, electronics, and other advanced technologies be applied to improving the capacity and safety of the nation’s transportation system.

In order to put these technologies into practice, new generation transportation engineers need a set of multidisciplinary engineering skills that are not typically included in a civil engineering-based education program.

In response to this need, NIATT developed Traffic Signal Summer Workshop (TSSW), an intensive five-day experience in which 12 top transportation engineering students from the U.S. and abroad have the opportunity to work hands-on with the latest traffic signal control hardware and software. The first workshop, called “Traffic Signal Summer Camp,” was held during August 2000, and others have been held the following two summers.

Instructors include Michael Kyte, Ahmed Abdel-Rahim and Mike Dixon (from UI); John Ringert from Kittelson & Associates in Boise; Joe Marek, Traffic Engineer from Clackamas County, Oregon; Mike Boydston from Ada County Highway District; Dale Moore from Idaho Transportation Department; and Darcy Bullock and Andrew Nicols from Purdue University.

As NIATT gears up for its fourth workshop, we look back with pride knowing that this program provided the hands-on experience that helped give participants the skills they need to become productive members of the current transportation workforce. The 36 students came from 21 universities in 17 states across the US (see map) to spend a week in Moscow learning up-to-the-minute traffic signal technology.



Traffic Signal Summer Workshop participants come from across the nation.



Dale Moore, Idaho Transportation Department Traffic Signal Electrician Foreman, in the field with Traffic Signal Summer Workshop participants.

TSSW Participants Work with Real World Situations

Each of the workshop's five days focuses on a specific aspect of advanced traffic signal systems. The days include a blend of lecture, lab, and hands-on exercises. The TSSW participants work in teams of two, with a great deal of interaction between groups.

The workshops have followed the same basic format, but with adaptations made by the individual instructors based on previous experiences. The first day, after an introduction to general traffic signal layout, the participants are driven to two different intersections in the City of Moscow where they look inside a working controller and study the layout of the intersections. When they return to the lab, they complete an engineering design for all aspects of the intersection's signal system.

The days' activities build on each other: the participants learn basic concepts of design and optimization first; then move on to more advanced operations; on Thursday they work with both video and loop detector systems, ending the day by building their own loop detector system.

On Friday, they work in NIATT's Traffic Signal Design Lab, where they use NIATT's Controller Interface Device along with computers and traffic controllers to test the signal control plans they develop for a corridor in the city of Moscow using hardware-in-the-loop (HILS) simulation.

Since the first workshop, the curriculum has included the materials developed in an earlier NIATT project, "Development of Traffic Signal Training Materials Integrating Hardware-in-the-Loop Simulation." A portion of the training materials also utilizes NIATT's Controller Interface Device (see pages 21-23). A traffic signal "Jeopardy" game at a closing banquet has challenged the students to recall what they learned during the week.

Where are Those Workshop Graduates?

Many of our workshop “graduates” are now full members of the transportation community. Here are a few examples:

Matt Melkerson	Transportation Engineer	Virginia Department of Transportation
Matt Wilson	Asst. Civil Engineer	Department of Transportation, County of Sacramento, CA
Jason DeWeber	Analyst, E.I.T.	Kimley-Horn & Associates, Memphis, TN
Carlos-Andres Ramirez	Traffic Engineer	Faller-Davis & Associates, Inc., Tampa, FL
Michael Hofener	Graduate Associate Researcher	Texas Transportation Institute
Sharon Schutz	Engineering Intern	Neel-Schaffer, Inc., Nashville, TN
Zorana Krnic McDaniel	Transportation Engineer	City of Calgary, Calgary, Alberta, Canada
Pam Zilius	Transportation Engineer	David Evans and Associates, Inc.
Mitch Bartelt	Transportation Engineer	Michigan DOT
Selman Altun	Intern	Mass Bay Area Transit Authority
Chhang Ream	E.I.T.	Halliday Engineering, Boise, ID
William Webb	E.I.T.	A.W. Murfitt Co., Anchorage, AK

A recent email from a 2001 participant echoes what other students have said about their experience:

I completed my Masters in Transportation and I worked on “SCOOT and Incidents: A Performance Evaluation in a Simulated Environment” for my Masters. I am currently working on my professor’s consultation projects and I am using a lot of the concepts I learned during the summer workshop in Moscow. I feel the signal workshop was one of the best weeks in my life with so many pleasant experiences. I was fortunate that I could attend and that made me a better transportation engineer today. Professors and instructors, brimming with knowledge and expertise, kindled a strong liking for transportation. I owe them my gratitude.

Bhargava Rama Chilukuri
MSCE, University of Utah

“I complete roadway designs and traffic signal designs for the State of Tennessee. Traffic Signal Summer Workshop gave me some practical experience in designing signalized intersections and working with intersection control equipment, which is very helping for designing traffic signals and systems.”

Jason Deweber
TSSW participant, 2001
Analyst, Kimley-Horn and Associates, Memphis, TN

SECTION 2: CONTRIBUTING TO TRAFFIC SIGNAL CONTROL TECHNOLOGY

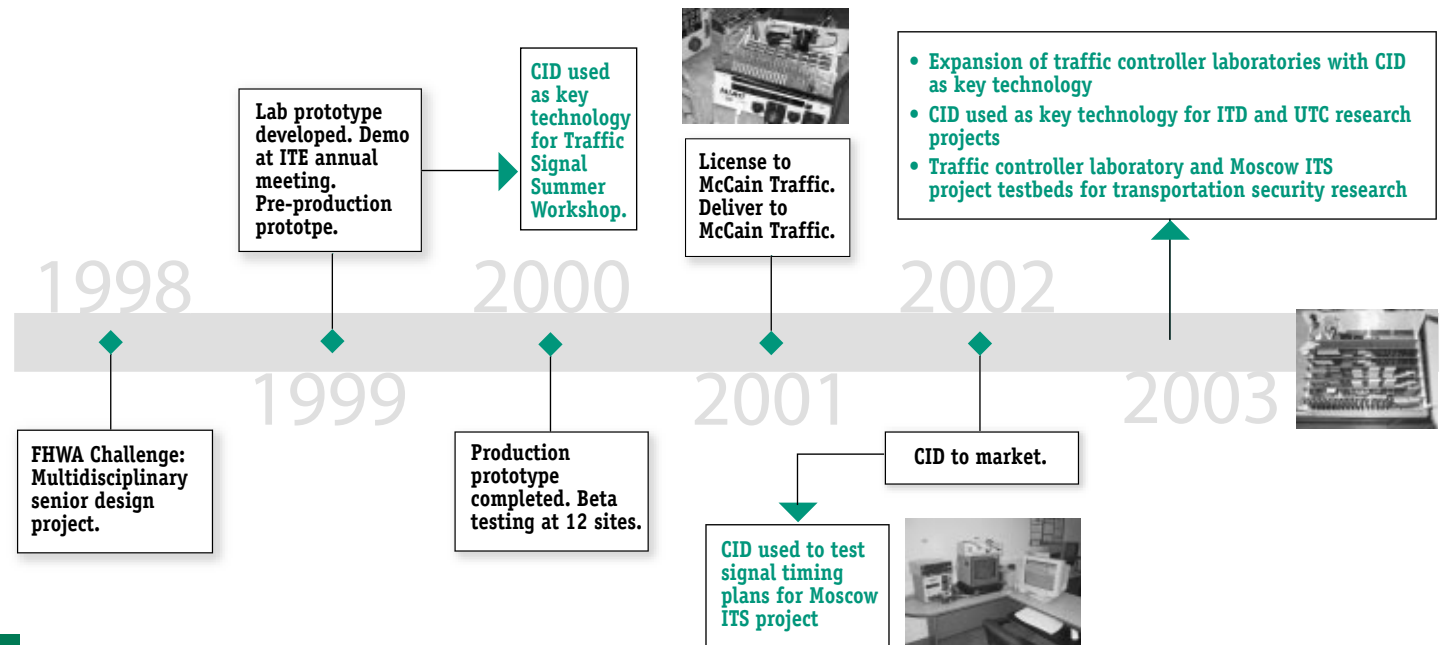
RESPONDING TO PRIORITIES ESTABLISHED BY FHWA

The development of NIATT's Controller Interface Device (CID) is a prime example of how we have responded to a challenge from the Federal Highway Administration (FHWA) and leveraged the resulting product into a key technology for our work in traffic operations and control. The CID is a communications device that allows researchers and practitioners to use actual traffic signal controllers in real time simulations, providing engineers the opportunity to test traffic signal timing plans in a laboratory environment before they are implemented in the field.

The CID projects began when FHWA acknowledged a need for a tool to test advanced traffic control systems under more realistic conditions. FHWA identified this technology as vital to the national ITS architecture and challenged NIATT researchers to develop a version of the CID that could be widely used.

With the support of NIATT's peer review panel and building on the pioneering work of Darcy Bullock of Purdue University and Tom Urbanik of the University of Tennessee, NIATT initiated a research project to design specifications and proof of concept prototypes for a CID that would provide a real time link between FHWA's CORSIM microsimulation model and a traffic signal controller.

In spring of 1999, a team of undergraduate electrical engineering students, working with a EE graduate student, developed a demonstration CID as part of their capstone senior design class. That summer, an interdisciplinary team of engineering students (representing electrical and computer engineering, mechanical engineering, civil engineering, and computer science) designed and built a laboratory prototype that was displayed at the 69th annual meeting of the Institute of Transportation Engineers in Las Vegas.



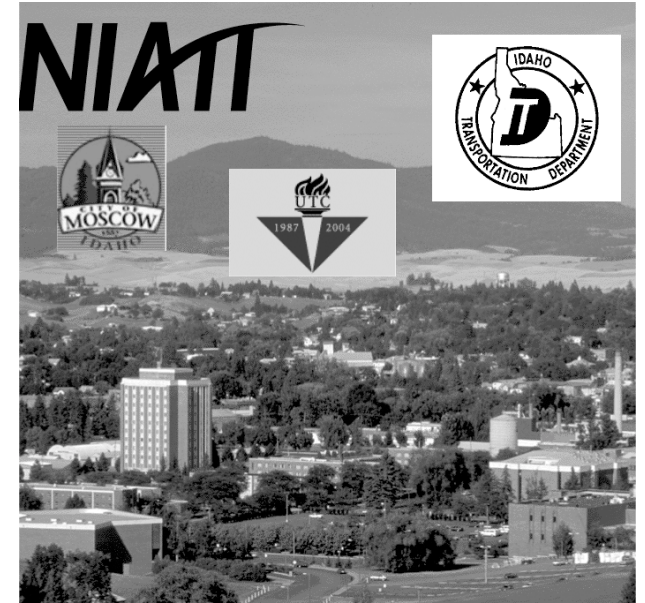
*Multidisciplinary team
that worked on the
first Controller
Interface Device
prototype.*



SUCCESS IN MEETING A NUMBER OF IDENTIFIED GOALS

During the past five years, we have:

- Completed the design for the CID hardware and software and licensed the CID to McCain Traffic Supply of Vista, California. The CID has now been on the market for nearly a year.
- Used the CID in our Traffic Signal Summer Workshop, in several short courses for professionals, and in our regular university transportation engineering courses, giving both students and professionals the opportunity to learn more about how traffic controllers work.
- Used the CID as an integral part of research projects in traffic control systems, Intelligent Transportation Systems, and network security.
- Expanded our traffic controller laboratories so that we can model networks of up to 20 signalized intersections, a capability that cannot be matched by any other laboratory or test facility in the world.
- Used the CID as the basis to develop and test new signal timing plans for the city of Moscow as part of an FHWA-funded ITS deployment project.



DEVELOPMENT OF WORLD CLASS FACILITY FOR RESEARCH AND EDUCATION UNDERWAY

As a consequence of our success in developing the Controller Interface Device, NIATT was awarded a \$1.5 million project in 2001 and 2002: Traffic Signal Systems Integration and Deployment—City of Moscow, Idaho. The purpose of the two-phase grant, from FHWA and the Idaho Transportation Department, is to upgrade the signal system in the city to improve long-term management of traffic flow.

Funds from the Moscow ITS project, along with UTC funds and donations from manufacturers, are being used to expand NIATT's traffic controller lab (see page 47). The new lab will provide a replica of Moscow's 15 traffic signals and allow engineers to test a variety of traffic signal designs in a lab environment instead of on the road.

Four workstations, which will be used by students, researchers, engineers, and technicians, will be able to test traffic networks of up to 20 intersections at a time.

The project has national significance since it will test the use of National Transportation Communications for ITS Protocol (NTCIP) standards, the development of a project and regional ITS architecture, and the use of FHWA's ITS Spec Wizard in a small-town setting.

Eventually, remote access to the lab will make it possible for Idaho Transportation Department managers and other students, researchers, and practicing engineers from outside the University of Idaho to utilize the lab for research and education.

CID LEADS TO IMPROVEMENTS IN TRANSPORTATION EDUCATION

As some NIATT researchers have worked to develop, test, and verify uses for the Controller Interface Device by practicing engineers, others have spent UTC dollars to develop training materials, hold workshops, and incorporate the hands-on technology into coursework. Using the CID with actual traffic controllers provides students and others with direct, hands-on experiences with the most up-to-date methods of traffic signal design.

On the Road

NIATT literally packed up its traffic control lab and set up six workstations in Jackson Hole, Wyoming, in May 2003, during the Institute of Transportation Engineers (ITE) Intermountain Section yearly meeting. During the conference, two sessions were held for approximately 20 professionals, who learned to program real traffic controllers, working with hardware-in-the-loop simulation to design traffic signal systems.

Idaho Transportation Department engineers took to the road themselves in April 2003, coming to NIATT to take part in a mini-traffic signal workshop. Four instructors from our Traffic Signal Summer Workshop (TSSW) walked 12 ITD engineers through a condensed version of some of the exercises developed from the TSSW.

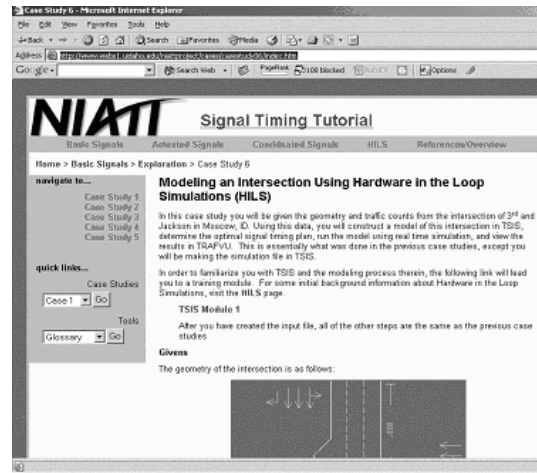
In the Classroom

Instructors for two civil engineering classes—Fundamentals of Transportation Engineering and Traffic Systems Design—take students into one of NIATT's traffic signal labs. There, using case studies, students learn how to use controllers and do traffic signal design.

The CIDs in the lab give students access to a traffic controller learning how they work by accessing the functions of a controller. During a multi-week design project in the Traffic Systems Design course, the undergraduates develop and test phasing plans and timing parameters using the real controllers.

“I feel that a number of parties have benefited from this venture. Perhaps the students themselves gained the most. The CID project gave them the opportunity to turn theory into a real live product. They got a taste of what happens to a design when certain components become obsolete and replacements needed to be found to avoid a redesign. They learned engineering practices and standards used in the industry. They learned that a design needs to be practical and cost effective, yet of first class quality, in order to succeed in the market place.”

Peter Kohl, Vice President for Business Development
McCain Traffic Supply, Vista, California



*Webshot of the
Signal Timing
tutorial.*

On the Internet

Traditionally, students learn about traffic signal operations in the classroom from textbooks. Working under the direction of faculty member Michael Dixon, undergraduate William Webb developed an on-line “Signal Timing Tutorial” to supplement normal classroom materials (<http://www.webs1.uidaho.edu/niattproject/>).

To help train students and practicing engineers in the basics of signal timing and controller programming, the site includes four modules: Pretimed Signals, Actuated Signals, Coordinated Signals, and Hardware-in-the-Loop Simulation (HILS). Each module gives users the background material and lab exercises that they need to make important connections between key intersection design parameters and constraints, such as signal timing plans, intersection configuration, and controller operations.

Furthermore, once instructors are comfortable with this training material, they can develop their own exercises and projects to better satisfy individual educational objectives. Dr. Dixon shared the material with educators and practitioners who met for two days in September 2002, in Portland, Oregon, at a NIATT-sponsored workshop to identify curriculum needs for traffic signal design and operations. A number of educators have shown an interest in using this material in their own courses.

CURRENT NIATT RESEARCH PROJECTS FOCUS ON CONTROLLER INTERFACE DEVICE

Over the past five years, the research centering on the CID has evolved from early, educated speculations about how such a device would operate, through its refinement, beta-testing, further improvements, and licensing.

Ongoing research focuses on ways to utilize the device in various traffic applications. Zhen Li, PhD graduate student who has been working on various aspects of CID development, now has six CIDs working simultaneously in the NIATT traffic signal lab. Part of his work is to identify those areas in which the CID can add value to the signal design process, to identify under what conditions the CID will be advantageous, and determine what software applications need to be developed to further its use by practitioners, educators and researchers.

With the CID, we can now test traffic control systems that require the use of an actual controller. An example is the use of a closed-loop or centralized system in simulated traffic networks in several cities in Idaho. This effort, funded through the Idaho Transportation Department and led by faculty members Ahmed Abdel-Rahim and Michael Dixon, is one of several new CID-related research projects.

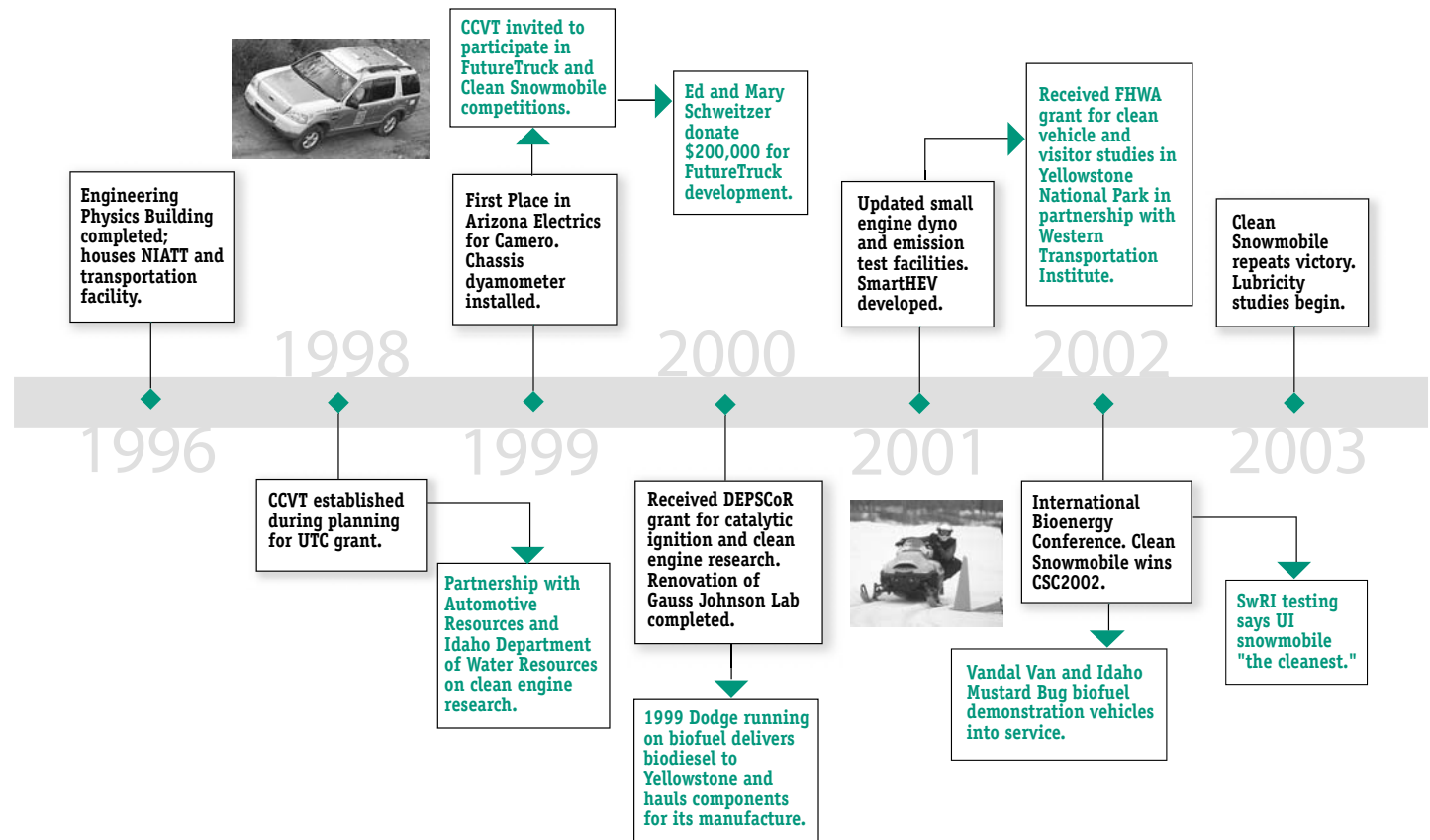


Graduate Student Zhen Li works on NIATT's Controller Interface Device

The CID project has been a successful collaboration among academic, government, and private industry partners. The product of this unique partnership is a new technology that offers tangible benefits to traffic engineers, students, and ultimately, to drivers across the nation.

Michael Kyte
NIATT Director

SECTION 3: ADVANCING VEHICLE TECHNOLOGY FOR A CLEAN ENVIRONMENT



NIATT research in clean vehicle technology has made great progress over the past five years that can be directly attributable to UTC support. We can date the beginning of our successes back to 1996 when the Engineering Physics Building was completed, in part with funds from ISTEA. This new building, along with the concurrent remodel of the Gauss-Johnson Engineering Laboratory, meant that instead of renting space off-campus for our research and student competitions, we now had modern and safe space on campus near both faculty members and students. These new facilities and the research funding from the UTC program allowed NIATT to bring together faculty members and students and in doing so helped us focus our clean vehicle research efforts.

Following approval of UTC funding in 1998 and the development of NIATT's *Strategic Plan*, the Center for Clean Vehicle Technology (CCVT) was established, facilitating a more intensive effort and collaboration between established resources and newer

faculty members. This collaboration, in turn, led to increased financial support for transportation research from the UI administration, the College of Engineering, the College of Agriculture, the Department of Mechanical Engineering, and the Department of Biological and Agricultural Engineering.

The renovation of the Gauss Johnson Engineering Laboratory, completed in 2000, greatly increased the capabilities of the CCVT. In the building, a new engine bay was reserved for clean vehicle research (i.e., hybrid electric cars and the FutureTruck). A design suite including a machine shop, computer stations with upgraded software, meeting room, and offices provided space for students involved in Idaho Engineering Works, many of whom were associated with CCVT research projects. This increase in infrastructure has allowed us to pursue additional external support above and beyond our UTC funding. Today we are a functioning and viable research center making contributions that increase our vehicle efficiency and help keep our environment clean. (See also pages 44-49.)

PRACTICAL SOLUTIONS TO INCREASE ENERGY INDEPENDENCE

A primary goal for CCVT research projects has been to find practical solutions to increase our nation's energy independence and to protect the environment. In support of this goal, we have obtained funding from outside sources that includes private donations of money and equipment, as well as grants from the Idaho Transportation Department, the Idaho Department of Water Resources, the Federal Highway Administration, and the Department of Defense/EPSCoR program.

As the research has evolved, CCVT has focused on three areas: demonstration vehicles as test-platforms, biofuels and biolubricants, and catalytic ignition for burning super-clean fuels. In many ways, the areas are complementary; for example, biodiesel fuel was used in our FutureTruck and Clean Snowmobile. These vehicles successfully demonstrate that biofuels work in a clean and practical manner. Our focus areas have both national and regional implications. The northwest is an excellent agricultural region to grow biomass. Also, considering the distances in the Northwest between cities and towns for individuals and delivery of goods and services, the use of clean and efficient vehicles is a key to preserving our pristine environment.

One of the CCVT's demonstration platforms, the Idaho Mustard Bug, which runs on biodiesel.



“The University of Idaho’s outreach efforts on biodiesel and Aquanol have been outstanding.”

John Crockett, Renewable Energy Specialist, Idaho Energy Division, Idaho Department of Water Resources and peer review panel member.

PARTNERSHIP BENEFITS STATE ECONOMIC DEVELOPMENT

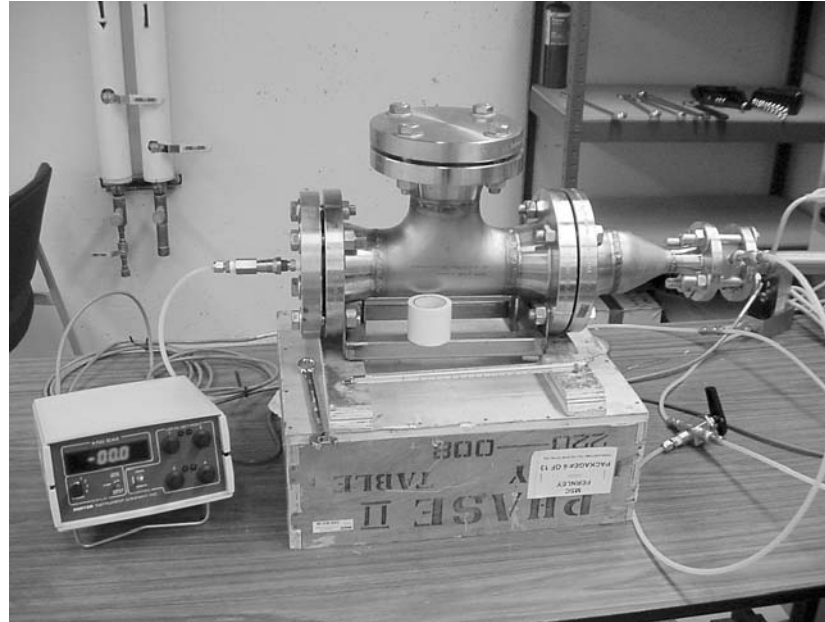
One particular project that has a significant potential impact on our northwest region is our research on catalytic ignition. Researchers Judi Steciak and Steve Beyerlein have directed a number of projects over the past five years exploring the catalytic ignition of alternative fuels. The purpose of the research has been to generate a base of experimental and analytical data that can be used to support the implementation of new low-emission engine concepts on integrated platforms, where engines are integrated into a system, such as an automobile.

Mark Cherry, CEO of Automotive Resources, Inc., Sandpoint, Idaho, (previously Aqualytics Technologies), who holds a patent on a catalytic plasma torch (CPT), has been an important partner in this research. Based on the results of the research completed by UI faculty and students on engines with the CPT, Cherry received \$750,000 in Phase 1 and Phase 2 funding from the Department of Defense Small Business Innovation Research (SBIR) Program.

The CPT igniter permits the combustion of very lean fuel mixtures in internal combustion engines. The resulting low temperature combustion, coupled with the catalytically assisted combustion, results in low emissions of pollutants such as nitrogen oxides (contributor to photochemical smog, atmospheric haze, and acid rain) and carbon monoxide. Furthermore, the CPT permits ethanol—which is readily produced from biomass—to be burned with substantial amounts of water (35 percent water, 65 percent ethanol, for example), thus reducing the production cost of the alcohol.

Previously, the US Army was convinced that it was “impossible” to operate a low-compression engine on diesel or JP-8 fuel. CPT technology defies this conviction as demonstrated by our successful conversion and operation of small gensets with JP-8. A genset is an integrated platform that consists of an internal combustion engine driving an alternator, with an output of electrical power. CPT holds strong potential for filling a vital niche to ensure the smooth operation of our military vehicles with only one fuel.

Catalytic reactor setup shown from the flow meter side. The mixing nozzle is held between the two flanges where the nitrogen stream is introduced for the nozzle response tests.



CATALYTIC REACTOR MODELS LIQUID FUELS

Mechanical engineering professor Judi Steciak and graduate student Xiangyang Wang have been working for five years to gain fundamental understanding of the ethanol-water gas phase and surface mechanisms. Interested in modeling as well as experimental issues, they have designed and constructed a plug flow reactor that can be pressurized to typical pre-ignition engine conditions.

The chemical kinetics computer program HCT (hydrodynamics, combustion and transport) is being used to model gas-phase combustion of ethanol-water-air mixtures. Xiangyang Wang continues to make modifications to HCT to accommodate surface reactions, developing subroutine interfaces to transfer parameters normally used for the general gas-phase reaction.

Ethanol promises to be an inexpensive, renewable fuel with distinct improvements in lowering nitrous oxides, carbon monoxide, and net carbon dioxide emissions. Using the catalytic reactor, detailed chemical kinetic modeling, coupled with experimental results, can provide a better understanding of catalytic ignition of aqueous ethanol. The experimental and analytical data collected is being used for the extensive on-road testing and comprehensive performance and emissions testing in other CCVT projects.

NIATT has shown that the Homogeneous Charge Compression Ignition is a viable clean IC engine to fill the immediate need for an environmentally sound, global warming friendly, fuel-efficient engine while the transportation industry waits for the commercial availability of the fuel cell. Furthermore this technology can easily be retrofitted to existing engines.

Mark Cherry, CEO
Automotive Resources, Inc.,
Sandpoint, Idaho

MAJOR STRIDES MADE IN COMBUSTION MODELING

More than a dozen graduate students and more than 100 undergraduate students have worked on the seven UTC-supported “cleaner-engine” projects during the past five years. The research involves alcohol/water fuels, catalytic ignition mechanisms, long-lived catalytic materials, system optimization, and over-the-road demonstration. Building on earlier work, the project teams have used UTC funds to show the feasibility of implementing new low-emission engine concepts on integrated platforms, including the FutureTruck and Clean Snowmobile (see pages 32-34). The success of these projects has led to opportunities for future funding to continue the work.

One very practical application has been on a transit vehicle for a non-profit local public transit authority, Valley Transit of Lewiston, Idaho. Valley Transit supplied our researchers with an 8500-pound, 13-passenger van that had been damaged by an engine fire. Building on our earlier work converting rotary and four-cylinder engines in generator sets and small private automobiles, the V-8 engine was rebuilt and converted into a dual fuel platform. A mechanical engineering senior design team and two graduate students succeeded in refurbishing the van for fuel-injected gasoline operation and for catalytic operation with aqueous fuels.

Using the van platform for testing, Dan Cordon and Jeff Williams, graduate research assistants in mechanical engineering, have demonstrated the feasibility of retrofitting a spark ignition engine for catalytic operation. Furthermore, by using the same vehicle running on two different fuels, head-to-head comparisons can be made. Long-term performance data have been collected and analyzed.

As a demonstration vehicle, the Valley Transit van helps increase public awareness of both the need and possibility to improve air quality and fuel consumption in fleet vehicles. The van will eventually be used on a daily basis as part of the Valley Transit van fleet in Idaho Transportation Department's Region 2.



Valley Transit van converted to a dual fuel platform with catalytic igniters.

*Used for special occasions, the UI Vandal Trolley runs on biodiesel.
(photo by Barbara Smith)*



BIOFUEL RESEARCH CONTINUES

Research using alternative fuels produced from plant material was already well established at the University of Idaho when UTC funding was initiated in 1998. Jack Brown (Plant, Soils and Entomological Sciences professor) and Charles Peterson (Agricultural Engineering professor) have been recognized leaders in the field since the late '70s. Brown focused on breeding a variety of feedstock for biodiesel, while Peterson's research helps prove that the use of biodiesel fuels can lower automobile emissions of hydrocarbons and carbon monoxide.

Peterson's work, supported with UTC funding, centered first on demonstration vehicles: a 1999 Dodge truck with a Cummins direct injection, 5.9 L electronically fuel-injected engine and a 2001 Volkswagen Beetle with a 1.9 liter, direct injection, four-cylinder engine. The 1999 Dodge has logged 26,219 miles, and the 2001 VW Beetle has logged 5,109 miles on biodiesel. Neither has experienced any problems, and both have more than adequate power and fuel economy.

The Dodge is used to deliver fuel to Yellowstone National Park, to transport oil from Great Falls, Montana, and to transport alcohol from the J. R. Simplot plant in Caldwell to Moscow. It was used to transport a display to the International ASAE meeting in Sacramento, California, in July and a Biodiesel Workshop in Superior, Montana, sponsored by Solar Energy International.

The "Idaho Mustard Bug" is being used to demonstrate the feasibility of using biodiesel in smaller vehicles and for urban use. The bright yellow Bug has been used in numerous demonstrations, schools, field days, and open houses, and was on display at the Renewable Energy Fair in Sun Valley and the Ethanol Conference at West Yellowstone. It has been particularly effective in teaching K-12 students about the advantages of alternative fuels.

In 2002, the Vandal Trolley began running on the UI campus. Peterson cooperated with campus transportation personnel to provide a blend of biodiesel and diesel to power the trolley. The silver and gold bus is a popular vehicle for campus events and provides an excellent platform for testing locally grown and produced biodiesel in typical bus service operations.

In the summer of 2003, research assistant Krista Kinsey began testing different blends of biodiesel fuels for lubricity. The UI-produced biodiesel uses feedstocks of economic significance to the state. Rapeseed, canola and yellow mustard are crops grown in northern Idaho. Kinsey has been combining rapeseed, canola and yellow mustard, and soy, a popular Midwest biofuel, in different strengths with ultra-low sulfur diesel. The object is to determine if any particular blend makes a significant improvement in lubricity.

"The benefits of using biodiesel include emissions that are less harmful to the environment, a more biodegradable product, and reducing US dependence on foreign oil. I'm always looking for ways of improving the economics of agriculture. I've always had a recognition that petroleum is a finite resource and won't be there forever."

Charles Peterson
Idaho Business Review
Innovator of the Year

SECTION 4: STUDENT COMPETITIONS — MORE THAN CONTESTS!

Trophies, awards, prize money and a “King-of-the-Hill” belt buckle create pride and excitement! But those are the least important of the desired outcomes for the NIATT researchers and student team members involved in the UTC-supported FutureTruck and Clean Snowmobile competitions. Merely the means to much more important ends, student competitions provide a number of benefits, some tangible and others less so:

- Competitions provide students with hands-on, team-oriented, and realistic engineering experiences that complement and refine the skills taught in the engineering curriculum.
- Vehicles used in competitions provide platforms used by students to develop, test and adapt new and emerging vehicle technologies.
- Competitions provide a setting in which new technologies can be developed and tested with little risk.
- Competitions raise public awareness of new technologies.
- Competitions provide opportunities for transfer of engineering advancements.
- Competitions allow students and professionals to exchange information and work toward a common goal.
- Competitions attract partners, outside funding and donations.

Besides these direct benefits, NIATT’s support of student competitions has led to improvements in the UI’s engineering infrastructure and the mechanical engineering curriculum, and has attracted a growing number of students, who have the chance to test themselves in a very competitive environment with teams from other universities. The value of their research has been recognized by others outside of the University as illustrated in their many and varied success stories that follow.

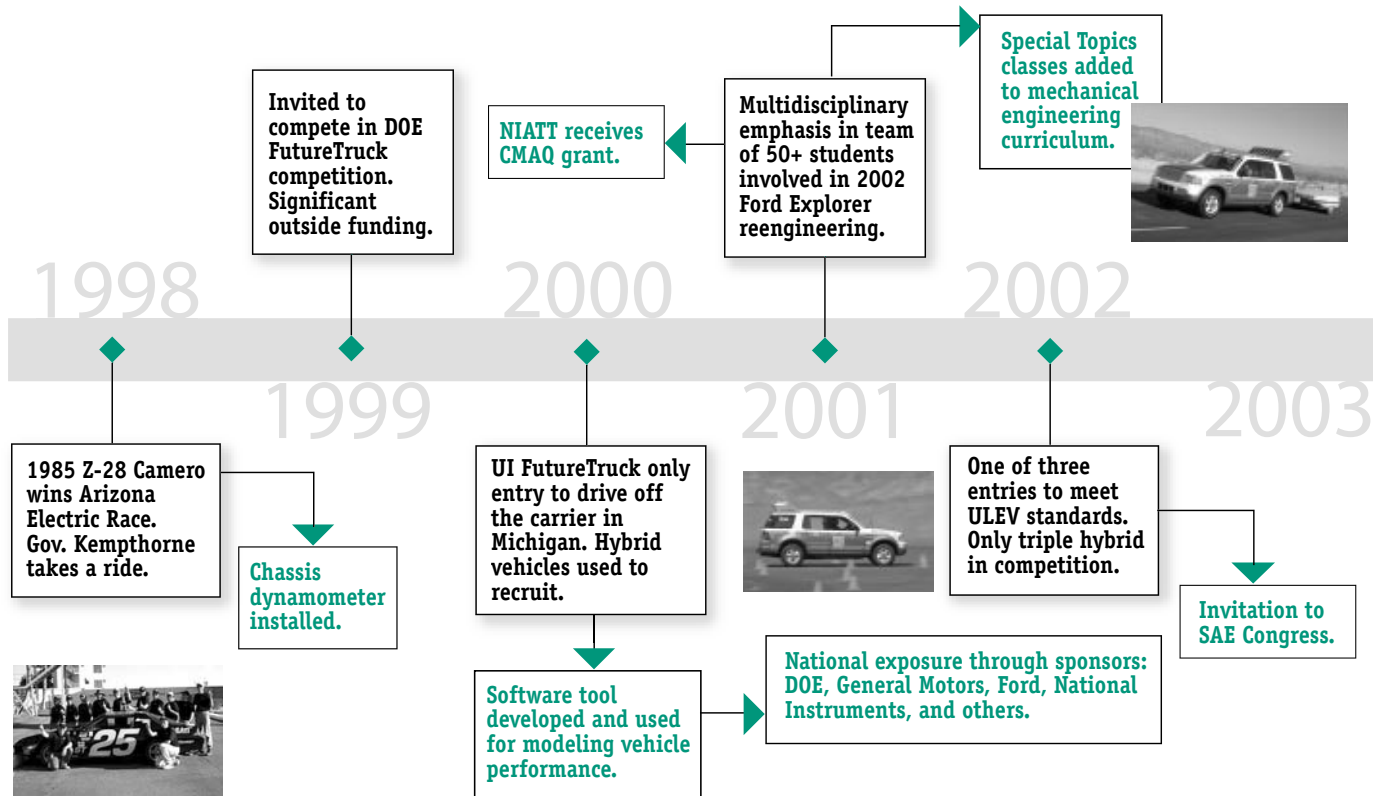


The FutureTruck competition includes a trailer tow event.



The NIATT clean snowmobile won “King of the Hill” during the 2002 competition.

FIVE YEARS OF HYBRID VEHICLE COMPETITION



The graphic on this page shows some of the highlights of the past five years and the following stories, along with those in Section 6 (2002-2003 Success Stories), illustrate how our students, the transportation industry, and the public reap the benefits listed on page 32.

FROM THE ARIZONA ELECTRICS RACE TO THE FUTURETRUCK COMPETITION

After several years of competition with a variety of electric automobiles, the Advanced Vehicles Concepts Team (AVCT) achieved their goal of winning first place at the Arizona Electrics Race in the spring of 1998. Because of this success, they were invited by the Department of Energy to join 14 other colleges in the FutureTruck competition. Since the summer of 1998, the students, along with faculty advisors, have designed and fabricated both a 2000 Chevrolet Suburban and a 2002 Ford Explorer to run as hybrid vehicles, completed extensive testing on both, and entered four FutureTruck competitions.

Each year the team has attracted a growing number of students—nearly 70 undergraduates from across the UI campus in 2002-2003. Commitment to this competition has led to an upgrade of the clean vehicle technology research facilities, including the installation of a chassis dynamometer and the addition of other capital equipment for testing. Contributions of cash, equipment, and services for the students' work have increased yearly, providing for more than a one-to-one match for this work alone. The vehicles serve not only as testbeds for research, but also as magnets drawing the attention of the public, legislators, industry representatives and students. Visitors to the UI campus have invariably asked to drive the electric car or to see the FutureTruck. Over the last twelve-month period, the UI FutureTruck website received an average of 30,000 hits per month (<http://www.idahofuturetruck.org/stats/index.html>).

“Programs such as the FutureTruck hold the promise of benefiting all Americans by developing newer technologies that can power our vehicles, and even our homes, more efficiently in the near future.”

Thomas J. Gross, Deputy Assistant Secretary for Transportation Technologies, Energy Efficiency and Renewable Energy, US Department of Energy

Sixth and seventh grade students from Pullman Christian School take a look at the FutureTruck.



FUTURETRUCK EMPHASIZES EDUCATION, ENGINEERING AND EVALUATION

Involvement in the FutureTruck program is about more than playing with engines and traveling to competitions. “Education, Engineering and Evaluation” are the three “E”s that students working on the NIATT FutureTruck project hear again and again.

The students *educate* themselves about the most current vehicle technology and they pass that knowledge on to the public. They become aware of national transportation problems. They learn to recognize the need for cleaner vehicles and the possibilities for greater fuel economy, and their enthusiasm for finding solutions, in turn, helps invigorate and educate the general public, legislators, and students of all levels.

The project follows an *engineering* process. The student teams learn to

- Define the problem
- Collect the facts
- Pick possible solutions
- Determine the best solution
- Implement the solution
- Test the solution

The third E is the all-important *evaluation*. The AVCT members take evaluation seriously—not only evaluating the engineering, but also evaluating themselves as productive members of a team.

The multidisciplinary teams over the past five years have included students not only from engineering disciplines, but also from communications, computer science, and marketing. Many of the students received academic credit through directed study projects or from enrollment in special topics courses added to the mechanical engineering curriculum. Students in different disciplines work together and bring completely new ideas to the process.

STUDENT EDUCATION ENHANCED BY NATIONAL INDUSTRIES' COMMITMENTS

By taking part in this national competition, the NIATT students involved in the FutureTruck program are constantly exposed to new technologies. Ford, Argonne National Laboratories, Cisco Systems, the U.S. Department of Energy, and the other 11 sponsors of the 2002 and 2003 competitions were constantly in contact with the students providing information, as were the sponsors of the competitions in 2000 and 2001.

MathWorks, one of the sponsoring companies committed to advanced vehicle technology, donated a ten-seat concurrent Mathlab License to the UI team. "The MathWorks supports the technological, educational, and environmental advances that FutureTruck facilitates," said Cleve Moler, Chief Scientist at the MathWorks and creator of MATLAB. The MathWorks believes their contribution "will encourage the ideas and skills of the students as they design innovative engineering solutions while improving the earth's atmosphere and saving natural resources."

Team members were able to attend special informational workshops conducted by sponsors. For example, six AVCT members were among the more than 150 representatives from government, industry, and academia gathered at the Ford Conference and Events Center in Dearborn, Michigan, in October 2002. Sponsored by National Instruments (NI), the workshop, featured presentations by Ford Motor Company, CTR staff at Argonne, Cisco Systems, and NI.

The NIATT students participated in a series of technical workshops and a sponsor trade show and reception. They also received special training in hybrid control strategies, powertrain cooling, high-voltage safety, and engine calibration. Representatives from DOE, Ford, Delphi, ArvinMeritor, National Instruments, The MathWorks, Ricardo, Visteon, Cisco, BP, and Natural Resources Canada participated in the event. Students are able to travel to these events because of UTC funding. When they return, the students hold workshops for the other students on the teams.

Several AVCT members show off the 2003 FutureTruck.



“National Instruments is committed to supporting educational initiatives in engineering and science. Students participating in FutureTruck apply theoretical knowledge they gain in the classroom towards a real-world engineering challenge with project deadlines and constraints.”

Ray Almgren, Vice President of Product Marketing and Academic Relations
National Instruments

NETWORKING WITH PROFESSIONALS

David Reiche (MSME '00) had an opportunity to talk with a Ford Motor representative during a social gathering at a FutureTruck competition. As a result, David is now an engine development engineer at Ford Motor Company in Dearborn, Michigan, and works with a group that focuses on developing engine hardware and software to lower engine emissions and fuel economy.

Because Ford does not recruit on the University of Idaho campus, David would not have had an opportunity to meet one-on-one with someone from Ford, who could actually see some of the work with which David was involved. His research assistantship and involvement with the FutureTruck project was instrumental in allowing him to network with professionals in the industry.

David's research connected with the FutureTruck project focused on estimating hybrid electric emissions and fuel economy. While doing the literature search for his work, David writes, he gained an extensive knowledge of the federal test procedures and emissions standards. "This gave me a solid background for the work I am involved in at Ford."

Involvement with the FutureTruck competition also allows students like David to put classroom theory into practice, as David confirms: "The modeling also increased my experience in working with the concepts I learned in the internal combustion engine class. I use those concepts every day as I evaluate engine combustion data."



The FutureTruck maneuvers during the competition's slalom event.

Edmund Schweitzer of Schweitzer Engineering and a significant contributor to the FutureTruck project (right) receives a complimentary FutureTruck T-shirt from CCVT Director, Donald Blacketter.

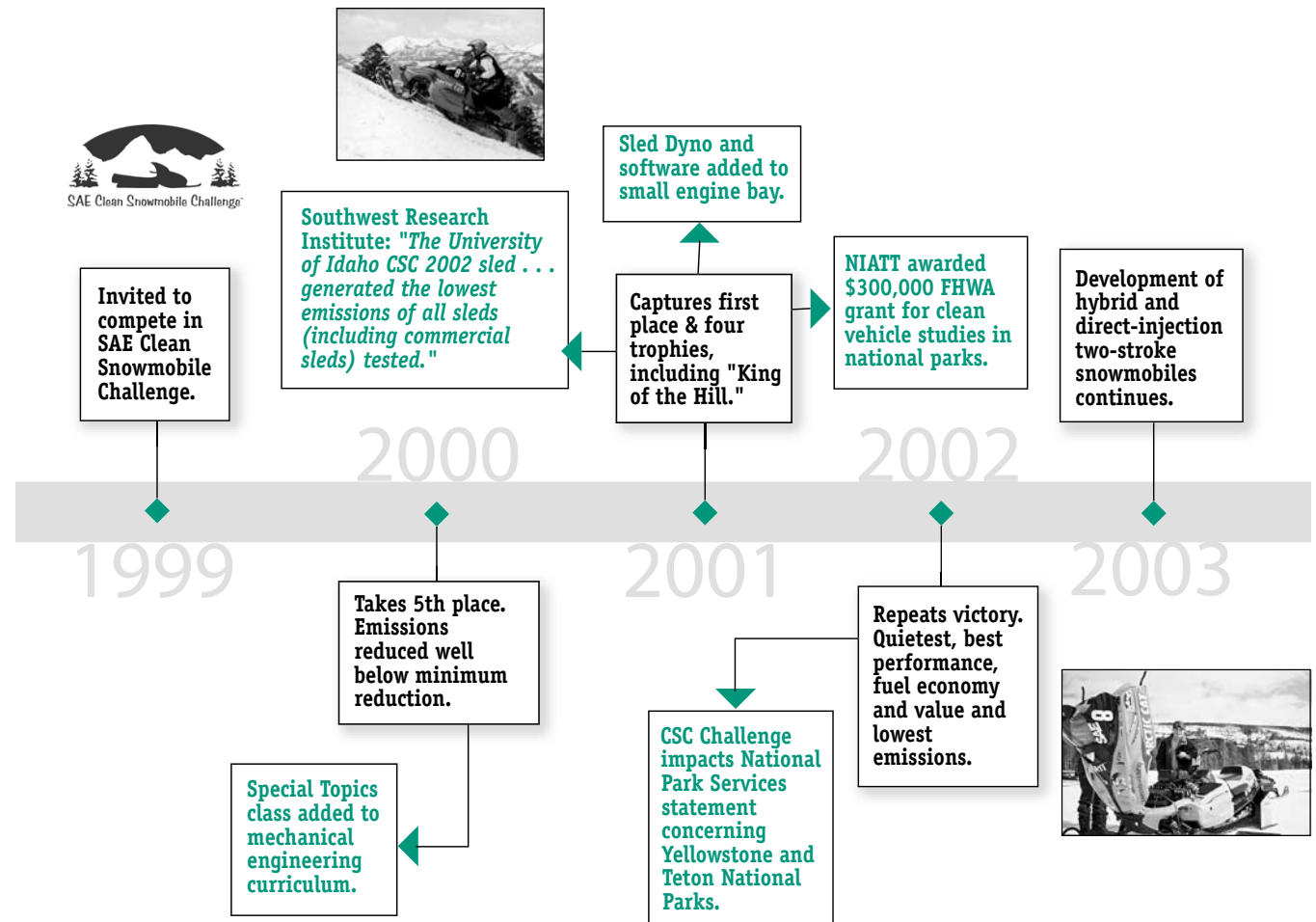


ENTHUSIASM FOR NEW TECHNOLOGY ATTRACTS FINANCIAL SUPPORT

Because FutureTruck is perceived to be exciting and interesting as well as forward looking, the NIATT team finds itself able to attract sponsors willing to donate dollars, services, and products.

Chief among those supporters over the past five years has been Ed and Mary Schweitzer, entrepreneurs and owners of Schweitzer Engineering Laboratories, who donated \$200,000 toward the conversion of the first FutureTruck, a Chevy Suburban. Although the Schweitzers made the single largest donation to this project, NIATT has continued to receive additional support. Most recently, Kent Fluid Power of Kent, Washington, donated an Eaton 46 series hydrastatic transmission with electronic stroke control, valued at \$7500, and BP Amoco donated 52 gallons of ethanol. Wholesale Hydraulics of Moscow, Idaho, donated equipment, shop time, and expertise valued at \$50,000 to help the team get their hydraulic launch assist system working. CCS of Brookfield, Wisconsin, donated a software compiler; and PTC of Nashua, New Hampshire, and Blue Ridge Numerics of Charlottesville, Virginia, donated specialized software packages.

BUILDING A CLEAN SNOWMOBILE FOR PRISTINE AREAS



CLEAN SNOWMOBILE CHALLENGE RESPONDS TO REGIONAL NEEDS

Response to increasing concern about snowmobile noise and air pollution in environmentally sensitive areas, the Montana Department of Environmental Quality (DEQ) partnered with others in 1999 to conduct a number of applied research projects to define the problems and probable solutions to concerns with two-stroke engine pollution. The purpose was to provide an unbiased evaluation for industry, local businesses and other agencies to help prevent pollution by investigating and demonstrating fuel and engine technologies that might reduce emissions.

To advance existing cleaner technologies, DEQ and its partners, including the Society of Automotive Engineers (SAE) developed a collegiate level competition—the Clean Snowmobile Challenge (CSC)—to develop snowmobiles for responsible recreation that maintain performance while reducing pollution and noise. The goal of the competition was to develop a snowmobile with improved emissions and noise characteristics that did not sacrifice performance. Modifications were expected to be cost-effective and practical.

In 2000, the University of Idaho's Center for Clean Vehicle Technology was offered a chance to join 14 other universities in the competition. Building on her knowledge of alternative energy sources and an interest in environmental issues in transportation, Dr. Karen Den Braven gathered undergraduates to form the first University of Idaho Clean Snowmobile team.

The graphic on the proceeding page shows some of the highlights of the past four years and the following stories, along with those in Section 6 (2002-2003 Success Stories), illustrate how our students, the transportation industry, and the public reap the benefits listed on page 32.

“The manufacturers are very supportive of the Clean Snowmobile Challenge, the students and the SAE. I think it’s great to get all these talented people together to work on these machines that we all love to build and ride. We hope some of the Clean Snowmobile Challenge team members will decide to join our ranks and actually work in the industry.”

Ed Klim, President
International Snowmobile
Manufacturers Association

UI SNOWMOBILE RESULTS BASIS OF SIGNIFICANT REPORT

The Montana Department of Environmental Quality (DEQ) and the Southwest Research Institute (SwRI), San Antonio, Texas, released a report in August 2002 on emissions-testing of student built and commercially available four-stroke snowmobiles. The report, "Laboratory Testing of Snowmobile Emissions" describes a number of firsts in the snowmobile emissions field. It is the first publicly available emissions data from four-stroke snowmobiles using the draft EPA test protocol. The report also states that results from the Clean Snowmobile Challenge Collegiate Design Series clearly demonstrate that the noise and emission problems associated with traditional snowmobiles can be solved through advances in engine, noise control, and emission control technology.

In May 2002, the DEQ partnered with the National Park Service, the Society of Automotive Engineers' Clean Snowmobile Challenge (CSC), the Institute of Science, Ecology, and Environment, Wyoming Ethanol, EPA and others to test the snowmobiles at SwRI. The report is the result of that work. The research was done to determine how clean the 2002 CSC student competition and commercial snowmobiles have become and to develop data to determine their impact on the environment.

The DEQ tested both first-place student challenge snowmobiles from the University of Idaho and Kettering University, Flint, Michigan. The CSC 2002 event results showed that the University of Idaho had lower emissions than Kettering, using a 1991 BMW 4-stroke motorcycle engine with a catalytic converter cleanup. The laboratory testing verified that the University of Idaho's sled produced lower emissions, the *lowest* emissions of any of the snowmobiles tested in this project.

Emissions from the student snowmobiles were compared with emissions generated from a commercially available 2002 Arctic Cat four-stroke Touring snowmobile and a 2002 Polaris Frontier four-stroke snowmobile using a pre-production engine. These two snowmobile engines were also tested using the industry-approved five-mode engine dynamometer test procedure published in the draft EPA snowmobile emissions regulations. The report shows these engines significantly reduce emissions of unburned hydrocarbons (UHC), carbon monoxide (CO) and particulate matter (PM) compared to emissions from two-stroke snowmobile engines.

The report contains results of the first laboratory correlation of snowmobile emissions with vehicle speed observed in the field. This procedure yielded emissions results on a grams-per-mile basis used in air quality modeling. The report is also the first to contain emissions results for a snowmobile fueled with E-85 fuel (the Kettering Clean Snowmobile), a blend of 85 percent fuel ethanol with 15 percent gasoline.

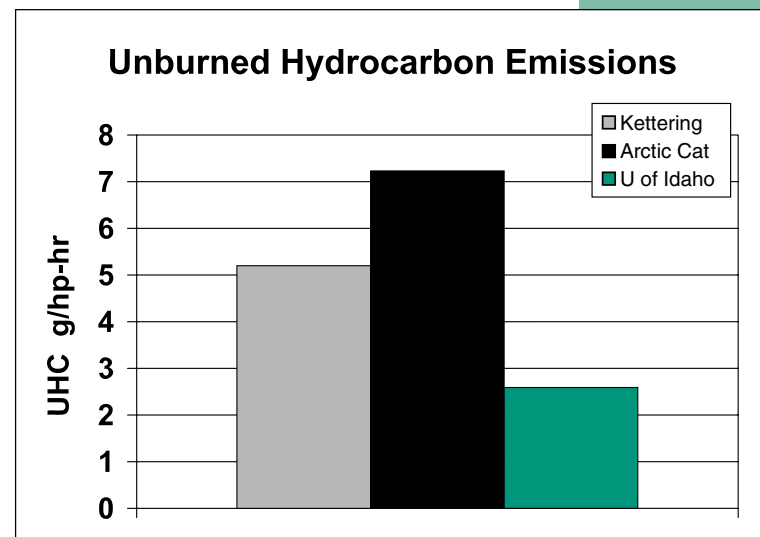
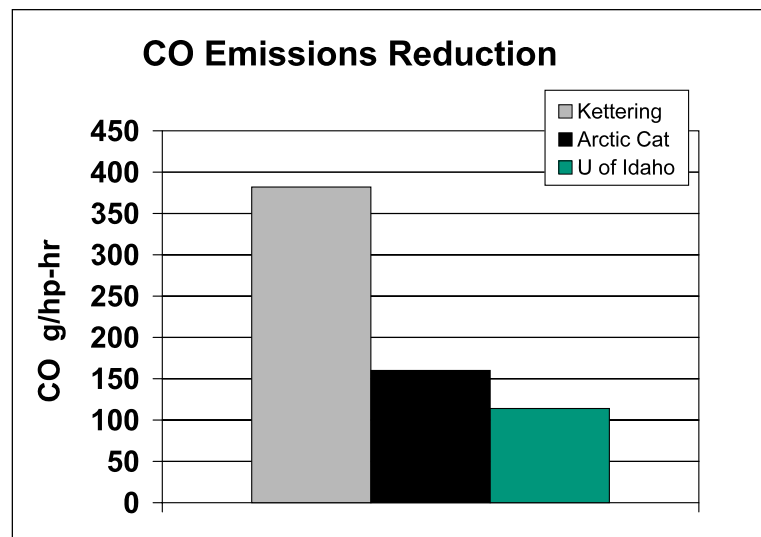
The report can be accessed online at <http://www.deq.state.mt.us/CleanSnowmobile/index.html>.

Results of the tests at SwRI suggest that a high-quality, well-running, properly tuned engine with a catalytic converter like NIATT's can go a long way toward cleaning up snowmobile emissions. The UI clean snowmobile had lower hydrocarbon and carbon dioxide emissions than the other student sled and both of the commercial ones, even when running on 90 percent gasoline and 10 percent ethanol rather than the E-85, which is generally accepted as a cleaner fuel.

The snowmobile also had lower NOx and particulates than all sleds tested.

“Our team had a cleaner snowmobile running on E-10 (90 percent gasoline and 10 percent ethanol) than the commercial sled, even when Kettering was using E-85. That was a real accomplishment!”

Karen Den Braven
Clean Snowmobile Advisor



Results of the testing for carbon monoxide (CO) and unburned hydrocarbons (UHC) on the UI and Kettering snowmobiles and a commercial Arctic Cat.

ALLOW SNOWMOBILES IN NATIONAL PARKS?

In the April 01, 2003 edition of its weekly newsletter, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) reported that "The SAE Clean Snowmobile Challenge holds particular significance" in light of the March 2003 decision by the National Park Service (NPS) to limit snowmobile use in both Yellowstone and Grand Teton National Parks.

The decision to set strict limits on both the emissions and numbers of snowmobiles allowed in Yellowstone and Grand Teton National Parks and the John D. Rockefeller Memorial Parkway ended years of planning efforts to determine how these three parks should be visited in the winter.

The National Park Service formalized a new snowmobile plan in November 2002. The proposal, which replaces an earlier plan to ban snowmobiles from the Yellowstone and Grand Teton National Parks, will allow only "cleaner and quieter" machines using the "best available technology" (BAT) and will require riders to be accompanied by a commercial guide or undergo a training program. Interior Department officials said their plan is based on a belief that four-stroke engines can significantly cut noise and reduce emissions of hydrocarbons by 90 percent and carbon monoxide by 70 percent. The plan became part of the National Park Service's Record of Decision allowing continued snowmobile use in those national parks.

Considered impractical just a few years ago—when the SAE CSC began—snowmobiles with four-stroke engines, like that of the UI, are now being produced by every manufacturer.

For more information, visit: http://www.eere.energy.gov/news/archive.cfm/date_enn=%7Bd%20'2003-04-02'%7D#552 or <http://www.nps.gov/yell/press/winteruserod.htm>

*Members of the UI Clean Snowmobile team proudly display their winning snowmobile and trophies at the 2003 Engineering Expo.
(photo by Barbara Smith)*



Each year of competition the University of Idaho's CSC team has produced a sufficiently robust entry to complete each competition, and succeeded in being the all-around first place winner. Using an engine that was in production for ten years, the CSC 2002 UI entry produced fewer emissions than any of the 2002 commercial four-stroke sleds at testing conducted at Southwest Research Institute. These UI machine test results have encouraged the National Park Service and others to develop rules and alternatives requiring cleaner and quieter commercial machines to help eliminate adverse impacts in Yellowstone and other environmentally sensitive areas.

Howard Haines
Montana Department of Environmental Quality

With the backing and clout of the Society of Automotive Engineers, this student competition changed the views of manufacturers and environmental groups who previously claimed cleaner vehicles could not be built.

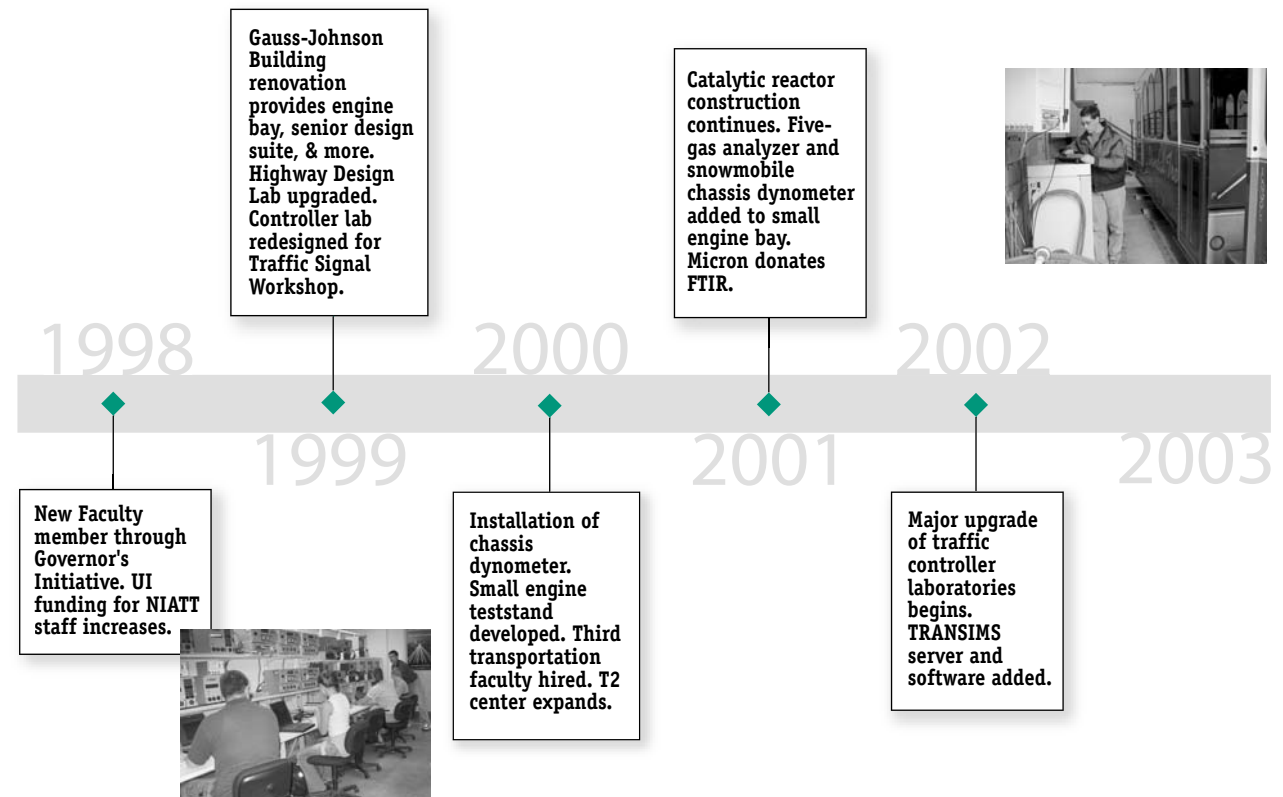
Howard Haines
Montana Department of Environmental Quality

Haines has been involved in the Montana DEQ's efforts to research snowmobile noise and air pollution. Among other articles, he has written a concise summary of Yellowstone emissions problems and the history of research on cleaner snowmobiles.

SECTION 5: IMPROVING THE UNIVERSITY'S TRANSPORTATION INFRASTRUCTURE

Access to well-equipped and modern infrastructure is crucial to a research program such as NIATT's that goes beyond theory to integrate education and research. Improvements made over the past five years to laboratories and testing equipment used by NIATT researchers leads to advanced technology and transportation products and facilitates education for students who contribute to the workforce. Funds from the University Transportation Centers program have helped us expand and improve the infrastructure that supports both our clean vehicle technology and our traffic control work.

People are the other vital element of the transportation infrastructure—students and laboratories need instructors/researchers/professors, and over the past five years, NIATT has attracted a growing number of researchers to transportation.



The chassis dynamometer in use.



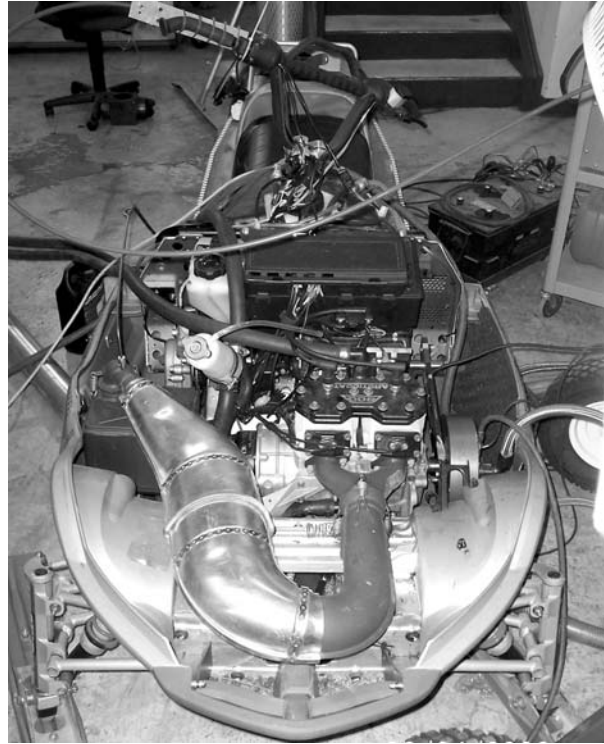
INFRASTRUCTURE FOR THE CENTER FOR CLEAN VEHICLE TECHNOLOGY

Because NIATT was awarded a UTC grant, additional funds were made available by the UI, the College of Engineering and the College of Agricultural and Life Sciences to improve the infrastructure needed for the clean vehicle technology work. The first of these improvements was the installation and upgrade of a chassis dynamometer that had been purchased years earlier but never installed because there was no place to put it. A complete renovation of the Gauss-Johnson Engineering Building was the second milestone. Improvements have continued over the next three years.

Four Walls and a Concrete Floor Transformed into a Small Engine Test Facility

When renovation of the University of Idaho's Gauss-Johnson Engineering Building was completed in 2000, we were able to report that new spaces were made available for a mechanical engineering student office (a majority of those students are involved in NIATT research projects), a design suite for the Idaho Engineering Works (IEWorks) program, and an engine bay and lab for development of hybrid electric vehicles. Improvements were also made to the machine shop. Commitment of funding from the UI College of Engineering, the Mechanical Engineering Department, and other outside sources for the renovation was directly related to the knowledge that UTC funds would be growing the research program in clean vehicle technology.

In another part of the Gauss-Johnson building, 1000 square feet was set-aside for the development of a Small Engine Research Facility (SmERF). That space, which began as four walls and a concrete floor, has been transformed over the past five years into a modern, small engine test facility. UTC funds have been used to build a cold test chamber and to integrate various engine-related instrumentation to a single dynamometer package that monitors and controls all aspects of engine testing. This system is capable of testing both small single-cylinder two-stroke engines and 800 hp 4-stroke engines. It provides feedback on emissions, fuel consumption, air-fuel ratio, as well as all critical engine parameters. UTC funds have also been used to improve the emissions measurement capabilities, including modifications to a Fourier Transform Infrared (FTIR) spectrometer donated by Micron Corporation, and to purchase a five-gas analyzer. A small snowmobile dynamometer was also added.



The Clean Snowmobile undergoes testing in the Small Engine Bay.

A hub of activity, the small engine test bay facilitates nearly all NIATT research done by students and their advisors for the Center for Clean Vehicle Technology (CCVT). On any one day, you might see

- Matt Walker using the cold test chamber to compare performance and emissions of gensets for the military.
- Patrick Hess and other members of the Clean Snowmobile Team testing and tuning the sled.
- Jeremy Boles working on FutureTruck emissions revolutionary exhaust after treatment system.
- Jeremy Olberding testing and tuning performance on the Formula SAE engine.
- Nathan Bradbury, a member of the Clean Snowmobile team, performing a dynamometer test on an engine from a Polaris rental snowmobile from Yellowstone Park.
- Forrest French, performing baseline tests on a two-stroke engine from a snowmobile that will be replaced with a four-stroke and electric motor as he constructs a parallel hybrid electric snowmobile.

The only testing equipment for the CCVT projects not located in the small engine bay or the FutureTruck garage is the large chassis dynamometer, which was installed in the Martin Laboratory. The dynamometer, purchased with \$85,000 of EPSCoR funds, sat in its shipping case for five years before being installed. Funds from departments within the College of Engineering and UTC financed its installation and upgrade.

INFRASTRUCTURE FOR THE CENTER FOR TRAFFIC OPERATIONS AND CONTROL

Three engineering laboratories used by students conducting research in NIATT's Center for Traffic Operations and Control have been significantly upgraded over the past five years. The upgrades have been made possible because of UTC funding, which then generates additional support from the University of Idaho and from vendors with whom we work. These labs provide space for research and instruction.

Using the Traffic Controller Laboratory

The fifth day of Traffic Signal Summer Workshop, students gather in NIATT's redesigned Traffic Controller Laboratory in the Engineering Physics Building and discover their objectives for the day:

- Calculate signal timing parameters
- Configure intersections in Econolite traffic controllers via keypad and computer
- Set up graphics in Aries software
- Hardware-in-the-loop simulation
- Processing simulation output
- Arrival type estimation exercise

Darcy Bullock, professor of civil engineering, and Andrew Nichols, PhD candidate, both from Purdue University, lead the participants through the exercises at six workstations fully equipped with a NIATT Controller Interface Device, a video tape player, an Autoscope video detection system, and a NEMA traffic controller.

Phil Rust, an incoming NIATT graduate student in the summer of 2000, and Albert Bové Chic, originally from Barcelona Spain, enter parameters in a traffic controller, during the first Traffic Signal Summer Workshop.



“Very few students get real hands-on experience with implementing traffic signal timing plans. NIATT’s traffic controller lab makes this possible.”

Darcy Bullock, Professor
Purdue University

MACHINE VISION LAB TAKES ON A NEW LOOK

The space that used to be called the Machine Vision Lab has become an extension of NIATT's Traffic Control Laboratory. The first goal of the project to convert the facilities was to define specific needs, since the lab will provide integral support for a new traffic control system being designed for the city of Moscow under a grant from FHWA and the Idaho Transportation Department.

As designs neared completion, an unused fume hood and sink were removed from the space and new wiring to support the electrical and Internet needs was installed. New racks to hold the equipment were purchased and installed, and bit-by-bit, traffic signal controllers, Controller Interface Devices, laptop and desktop computers, chairs, and other equipment are being added.

The lab will provide the infrastructure to allow NIATT researchers to provide a test for the implementation of NTCIP standards in a small-town traffic control system and to develop and apply a protocol for the design, implementation, and testing of traffic signal timing plans using real-time hardware-in-the-loop simulation.

The completed lab will also provide new training facilities for both transportation students and professionals.

The lab will be a world-class, one-of-a-kind addition to be utilized by the researchers and students at the University of Idaho and eventually, by the transportation community through remote access via the Internet.

HIGHWAY DESIGN LABORATORY USED BY STUDENTS AND PRACTICING ENGINEERS

The first upgrades to our Highway Design Laboratory in the Buchanan Engineering Laboratory were completed with funds from UTC, the UI Civil Engineering Department and the College of Engineering, and the Idaho Department of Transportation. The Highway Design Lab is used throughout the year by civil engineering students, by Idaho Transportation Department engineers taking special short courses, and by the participants in the Traffic Signal Summer Workshop. A state-of-the-art video projection system was added and computer stations were upgraded.

In 2003, the lab was remodeled to allow for better acoustics and software was again upgraded. Like the other labs, the Highway Design Laboratory is used for both research and instruction.

NIATT's Traffic Control Laboratory under development.



ATTRACTING FACULTY TO TRANSPORTATION

To be able to expand our educational and research programs, we needed to increase the number of researchers working on our projects. We have been able to do this, with the support of the State of Idaho and the UI. We have also attracted new faculty affiliates by showing how faculty outside of engineering can support transportation research.

Governor's Initiative Adds Faculty Member

In 1997, Idaho Governor Dirk Kempthorne established a fund to add faculty to promising research areas at the University of Idaho. Because our research center received confirmation of the UTC award, NIATT was chosen to receive Governor's Research Initiative Funds to hire a new transportation faculty member in 1999. Dr. Michael Dixon now holds that position. In 2002, Dr. Ahmed Abdel-Rahim was added as a third civil engineering faculty to work with transportation projects.

Expanding Work Attracts New Faculty

The Center for Traffic Operations and Control has added faculty by expanding areas of research into other engineering departments. Over the past five years, Dr. Brian Johnson, Dr. Richard Wells, and Dr. Richard Wall, all of Electrical and Computer Engineering have worked with projects related to the Controller Interface Device. This past year, Axel Krings and Paul Oman of the Computer Science Department recognized that their work on security issues in the electric power infrastructure could be applied to transportation networks, and they became members of the traffic group.

The faculty in the Center for Clean Vehicle Technology added Karen Den Braven when NIATT entered the Clean Snowmobile Challenge, and new UI mechanical engineering faculty Karl Rink began a project on with automobile safety this past summer. Brian He joined the biodiesel group.

SECTION 6: 2002-03 SUCCESS STORIES

We have presented an overview of the past five years of UTC funding in the previous sections of this report. We feel proud of the fact that our program continues to grow; that we are meeting the goals we set in our *Strategic Plan* and those of the University Transportation Centers Program. We are proud of the significant contributions we continue to make to the field of transportation in clean vehicle technology and traffic operations and control.

In this section, we invite you to share with us the highlights from this past year—continuing successes and new projects, building on others—as we continue to grow.

The UI Clean Snowmobile team with their winning sled during the 2003 competition.



CLEAN SNOWMOBILE REPEATS VICTORY

This year NIATT's Clean Snowmobile team repeated their first-place victory in the SAE Clean Snowmobile Challenge held this year in Houghton, Michigan. The team also captured awards for best fuel economy, quietest snowmobile, best performance, lowest emissions and best value. The UI team of engineering students competed with a dozen other teams from across the U.S. and Canada in March 2003. (See also pages 38-43.)

Idaho's faculty advisor Karen Den Braven said her championship team has never stopped trying. "The members are hardworking, dedicated and they're really learning how to do engineering," she said. "After each competition, they ask what needs to be improved, and they work on it." Examples of these improvements include increasing gas mileage by 131 percent, cutting carbon monoxide emissions by 93 percent and cutting unburned hydrocarbons by 98 percent, as compared to the control snowmobile.

Despite 30-degree rainy spring weather, the snowmobile teams were able to complete all the Challenge events. Events included an endurance trek, emissions, noise, acceleration, braking, handling and fuel economy testing and a handling event on the track. Teams also submitted written papers and made oral presentations detailing their engineering design work.

While eight of UI's team members went to the Challenge, as many as 15 worked throughout the year to build a new hood to reduce the noise, build a more powerful engine, improve cooling capacity, and redesign the electrical system. Project and team travel was funded through grants from the University Transportation Centers Program and the Federal Highway Administration.

Clean Snowmobile Sponsors

Associated Students of the University of Idaho

BMW Motorrad

Flagg Ranch Repair Shop

Idaho State Department of Water Resources

Mac's Cycle

Mac's RV

Melody Muffler

Millhorn Farms, Inc.

Startling Line Products

Tony's Repair

Tri State Outfitters

Union Bay Racing

*UI's FutureTruck
displayed at the
SAE World
Congress.*



TRIPLE-HYBRID INVITED TO SOCIETY OF AUTOMOTIVE ENGINEERS WORLD CONGRESS

The University of Idaho's Advanced Vehicle Concepts Team (AVCT)—the FutureTruck team—was invited to display its triple-hybrid, nicknamed “Summit,” at the Society of Automotive Engineers (SAE) World Congress to showcase their re-engineered Ford Explorer and take part in a discussion panel sponsored by National Instruments (NI) and Argonne National Laboratory (ANL). UI's was the only FutureTruck invited, exposing it to nearly 40,000 attendees during the four-day Congress. The team and truck were invited to the Congress because of the FutureTruck's uniqueness as a triple-hybrid. (See also pages 33-38.)

The SAE promotes the Congress as “the industry's one-stop shop for keeping pace with the rapid and pervasive changes affecting vehicle technology, automotive development, and the business of making cars.”

“We made some great contacts with various companies who could play a role in sponsorship or turn out to be prospective employers for students on the team. Speaking with people who have been in the automotive industry for tens of years reaffirmed our confidence of the quality of our ideas and provided some good thoughts on how we could improve the design.”

Eric Cegnar, Team Member and
developer of the FutureTruck's ultra capacitor array

UI FUTURETRUCK2003 ENGINEERED FOR NORTHWEST REGION

The Summit not only meets the requirements of the FutureTruck competition, but, according to Frank Albrecht, AVCT team advisor, the UI FutureTruck is the “only affordable” modified SUV competing. As designed, the vehicle could be put into production today and be cost affordable, as well as reducing fuel usage by 36 percent and having lower emissions than the stock Explorer.

The “standard” FutureTruck in competition is a high-voltage hybrid electric vehicle whose engines and other special body features are not currently available. A triple-hybrid, the UI FutureTruck uses off-the-shelf technology that is specifically designed for the hilly, agricultural Northwest region. The motor is driven by hydraulics, like farm machinery, and could be repaired anywhere in the country.

In a regular automobile engine, only 30 percent of the energy ever gets to the wheels—70 percent of the energy is lost in heat and exhaust. Normal hybrid vehicles capture electrical energy during deceleration, store the energy in batteries, and then reuse this energy.

The Summit uses both electrics and hydraulics for hybrid operation and stores energy in ultra-capacitors rather than in batteries. The engine runs on 85 percent ethanol, which helps reduce greenhouse gases. Emissions are also reduced because the catalytic converters are heated before the engine is started. This is done with salts—the same technology that keeps hands warm on the ski hills.

FUTURETRUCK CAPTURES CISCO'S SYSTEMS TELEMATICS AWARD

NIATT's FutureTruck 2003 joined entries from 14 other universities at Ford's Michigan Proving Grounds for two weeks in June 2003 to show their success at reducing emissions and improving fuel economy in a mid-size Ford Explorer, without sacrificing its existing performance, utility, safety, and affordability.

At the close of the competition, the UI team walked away with the award for 2nd place in Telematics, a smart vehicle technology, sponsored by Cisco Systems, and pride in a vehicle with affordable off-the-shelf technology that could be put directly into production. A unique control system, with sensors, computers, and displays, is the brain for the energy-efficient vehicle. The vehicle even has the capability for precise GPS tracking and Internet access.

Following the competition, the Summit and the other FutureTrucks were part of a vehicle display at the Ford Centennial celebration at Ford World Headquarters in Dearborn, Michigan.



“FutureTruck 2003 was a tremendous success because of the enthusiastic participation of more than 300 students (mechanical and electrical engineering, computer science, and other disciplines) from 15 dedicated teams; 17 sponsors providing hardware, software, training, and support; and hundreds of devoted organizers, judges, and volunteers.”

FutureTruck 2004 official website

CONTROLLER INTERFACE DEVICE ROLLS OFF ASSEMBLY LINE

The transfer of the hardware design and software suite for the Controller Interface Device (CID II) took place in spring 2002, and the first CIDs came off of the McCain assembly line in August 2002. A total of 21 CIDs are currently being used by engineers throughout the U.S.

Six of the CID units were sold to the University of Florida to support training and experimentation by interested agencies. According to Ken Courage, a series of workshops will be presented at various locations in Florida to explain the fundamentals of traffic models with an emphasis on hardware-in-the-loop simulation features.

At Northern Arizona University's lab, *AZTrans*, the CID is being used to test new preemption algorithms. The algorithms are part of a traffic signal system model under development, which aims to reduce the congestion caused by 60 to 100 trains that preempt a signal close to an at-grade railroad crossing affecting two arterials. The CID allows hardware-in-the-loop simulation to couple microsimulation models with actual traffic controllers.

At *AZTrans*, several tools and utilities will be developed to help potential users in getting started with CID technology. The units will be offered to interested agencies to deploy for a specified period (usually one month) to assimilate the technology and to conduct experiments of their own. The project staff will provide support during this period. At the end of the period, there will be an interview to assess the value of the technology in helping the agency carry out its mission. The results of the experiments will be compiled to develop guidelines for future deployment.

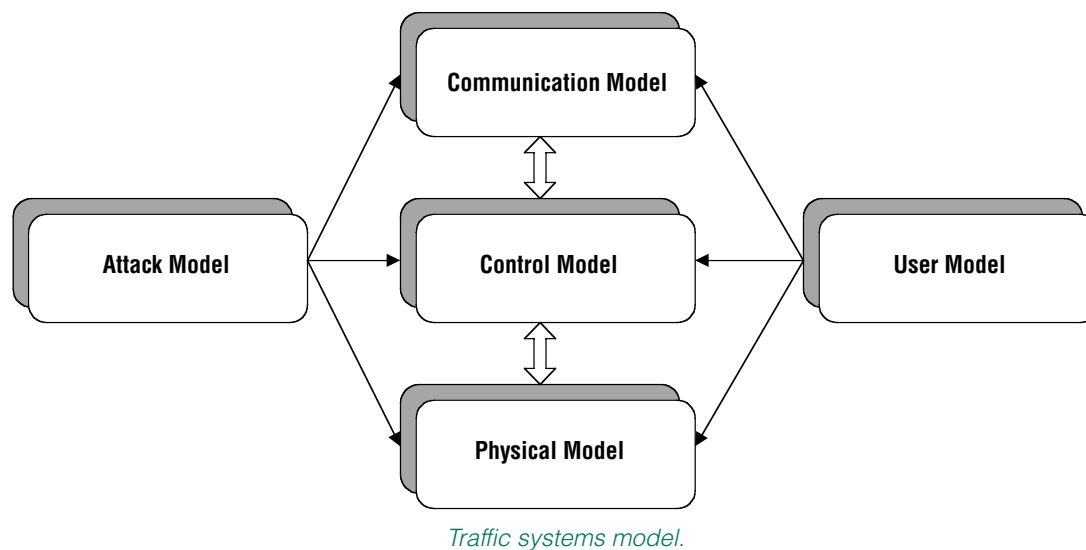
COMPLEXITY OF TRANSPORTATION NETWORKS A CHALLENGE TO SECURITY

Transportation networks are complex control systems that attempt to produce an outcome not only for the good of the individuals in the system, but also for the good of the overall network. Of course, this comes as no surprise to traffic engineers, but when network researchers Axel Krings and Paul Oman compared transportation control networks against other real-time control systems, such as those used for electric power and water, they recognized that this major difference introduced a whole new level of complexity.

Electric power, natural gas, and water transmission systems are transporting elements that are essentially passive; whereas traffic control systems not only react to external influences like weather and time of day; but they must also accommodate the active, sentient behavior of people operating within the traffic system. As such, traffic controls must take into consideration human behaviors including randomness, time-of-day patterns, malicious and self-destructive behavior, and event uncertainties.

The researchers are studying processes by which potential problems concerning the security and survivability of a transportation control network can be identified. Once identified, the system can be designed to handle those problems in the best possible manner. For example, what should happen if a trucker accidentally (or maliciously) runs over a controller? If the loss of the controller is anticipated, procedures can be established when failures occur.

The process developed in this research will first be used as NIATT researchers redesign the city of Moscow's signal system as part of a \$3 million, two-phase project that will put new ITS standards to the test.



NIATT RESEARCHER HONORED

Charles Peterson, professor and NIATT researcher on biofuels, was one of 12 recipients of the *Idaho Business Review's* Innovator of the Year Award in August 2002. Peterson's biodiesel research began in 1979 when he walked into a local grocery store and purchased a bottle of sunflower oil. The oil was used to run an agricultural tractor owned by UI. A switch to safflower oil and 100 hours of operation ruined the tractor engine, but launched the biodiesel research program.

Biodiesel is a substitute diesel fuel made from any vegetable oil or animal fat and alcohol. It is the product of a chemical reaction between the two resulting in alcohol esters (biodiesel) and glycerol. Peterson and fellow UI researcher Jack Brown have used the oils from rapeseed, canola, soybean, and mustard to create biodiesel. Biodiesel collaborators have included Yellowstone National Park and the Truck-in-the-Park project, the J.R. Simplot Co. running one of its Kenworth trucks over 200,000 miles on a 50 percent biodiesel blend, and Albertsons, Inc., running a blend of used deli fryer oil to power one of its transport refrigeration units.

The *Idaho Business Review* provides business news and information affecting Idaho's business marketplace. Believing that innovation is the key to business growth and is vital to Idaho's long-term well-being, *IBR* spotlights individuals who are advancement pioneers.



Charles Peterson, 2002 Idaho Innovator of the Year.

BIOENERGY CONFERENCE ATTRACTS INTERNATIONAL AUDIENCE

Research in biodiesel took on international proportions for NIATT's Charles Peterson during the Bioenergy 2002 Conference, "Bioenergy for the Environment," held in Boise, Idaho, on Sept. 22-26, 2002, sponsored in part by NIATT and the University of Idaho Department of Biological and Agricultural Engineering. Peterson co-chaired the conference along with John Crockett, Bioenergy Specialist in the Idaho Energy Division of the Idaho Department of Water Resources and NIATT peer review panel member.

International interest was much more intense than he expected, Peterson said. "One of the things which surprised me as co-chair is that a lot of people from around the world attended. Brazil, India, Canada, Denmark, Sweden, Japan, Russia and Bulgaria were among the countries represented." The organizers did something unusual for a technical conference—they invited the public to attend an evening of posters and exhibits because of the amount of interest in these topics.

The University of Idaho is deeply involved in many areas of alternative fuels research, ranging from work to use straw to fuel power plants and breed new mustard varieties for biodiesel production to the work of the UI National Institute for Advanced Transportation Technology to build a cleaner-running snowmobile. "Since 1979, there hasn't been a time that we haven't been doing some work or other on bioenergy," Peterson said. "The need and the interest are greater now than ever." UTC funds have supplemented the research that is continuing in this area.

The conference emphasized the use of biomass to reduce dependence on fossil fuels and supplement regional energy resources while benefiting the environment. The track of the conference focusing on alternative fuels provided an opportunity for NIATT researchers Dan Cordon, Steve Beyerlein, and Judith Steciak to present their engine/clean fuels research and for Charles Peterson and Joseph Thompson to discuss the value of biodiesel from yellow mustard oil.

The outcomes of the conference were numerous; it provided.

- An opportunity to showcase the contributions of the national regional biomass energy program and find new ideas to use in those programs.
- A forum for State contact meetings.
- Enthusiasm for the industry and recognition for the biomass energy community that is doing something significant for energy and for the environment.
- An opportunity for industry, utility and agricultural communities to confer with bioenergy technology providers.
- An awareness in the Pacific Regional Biomass Energy Program staff of their agency and joint capabilities.
- An opportunity for professionals in bioenergy to become familiar with the state-of-the-art in biomass energy.
- A chance for the public to participate in Citizen's Night, visiting exhibits, viewing posters and attending a question and answer session.
- Contacts for business and consulting opportunities in biomass energy.



Since 1979, there hasn't been a time that we haven't been doing some work or other on bioenergy. The need and the interest are greater now than ever."

Charles Peterson
Professor
Biological and Agricultural
Engineering

UI CIVIL ENGINEERING STUDENT WINS FIRST PLACE IN PAVEMENT RESEARCH CONTEST

Using the latest software to address the problem of cracks and thrusts in pavement, Hassan Salem, a UI civil engineering doctoral student, and his professor, Fouad Bayomy, developed a seasonal adjustment factor for the subgrade soil layer beneath asphalt pavement. This helps designers determine the subgrade's resilience during any season. For his achievement, Salem won first place and a \$1,500 prize in the graduate category in the American Society of Civil Engineers/Federal Highway Administration contest on long-term pavement performance analysis. His study was published in *Public Roads*.



Hassan Salem (left) with advisor, Fouad Bayomy.

UI CHAPTER OF INSTITUTE OF TRANSPORTATION ENGINEERS HAS ACTIVE YEAR

A team of ITE students, all of them NIATT interns or graduate assistants, captured second place in the annual Traffic Bowl held in Portland, Oregon in November 2002.

As part of the activities surrounding the Traffic Bowl, students toured the Union Pacific terminal in North Portland, the Interstate MAX Light Rail construction project City of Portland Traffic Management and Operations Center. They were treated to pizza at the consulting firm of David Evans and Associates, and a presentation about transportation engineering.

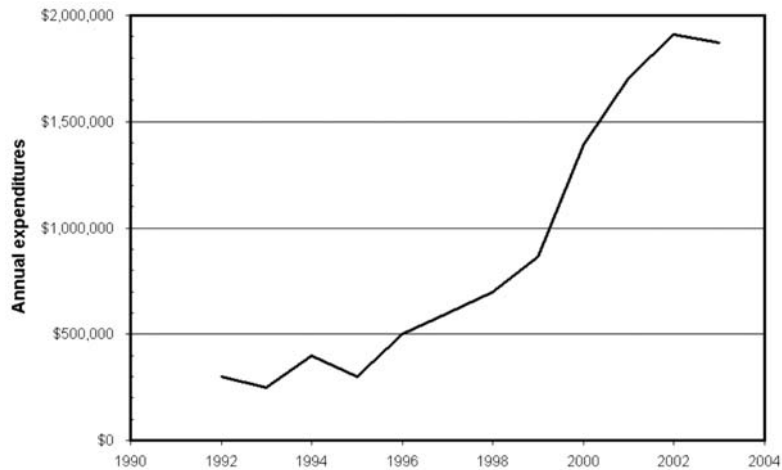
NIATT and the UI Department of Civil Engineering sponsored the ITE's annual field trip, which in 2003, was to Las Vegas. CH2M HILL proved they were one of the best companies to work for (*Fortune*, Jan. 6, 2003) as they acted as hosts for the students. Rather than the usual tourist activities, the students learned how civil engineers have been involved with a number of transportation projects around the city. The students visited the Las Vegas Monorail system, where they received an overview of the project, toured the current construction phase of the Monorail, and had an in-depth tour of the operations and maintenance facility.

CH2M HILL then took the students on two separate tours, the Las Vegas Beltway Project and the proposed Boulder City Bypass project. The Las Vegas Beltway Project highlighted engineering and environmental obstacles that must be overcome and the basics relating to the construction of a highway. The proposed Boulder City Bypass tour required a short hike to view the site, and then included a discussion on desert vegetation and the proposed improvements.

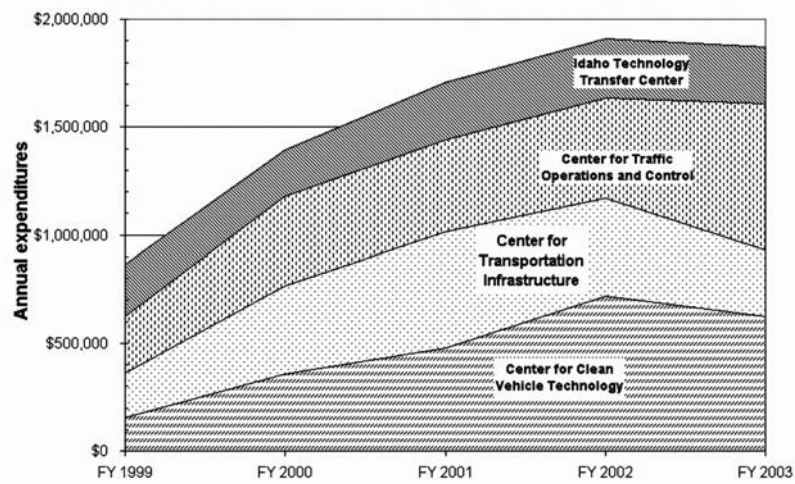


ITE members inspect the Las Vegas monorail.

NIATT EXPENDITURES



NIATT's growth is reflected in the increase of expenditures shown in the graph to the left. The expenditures include spending from all granting agencies, including UTC, ITD, FHWA and others. It does not include matching expenditures, gifts, or the value of gifts-in-kind.



Expenditures (of the same type as above) in the two centers in which UTC funding is used (the Center for Traffic Operations and Control and the Center for Clean Vehicle Technology) have shown the most growth, as reflected in the graph to the left.

NIATT

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