The Institute could not accomplish its goals without the transfer of its expertise and research results to local, national, and international audiences for use in real-world applications. Technology transfer also communicates to the world who we are, raising the profile of the Institute and its research, and serves to educate students, policymakers, and the general public about ITS issues and solutions.

Our efforts in this area are far-ranging in order to reach a broad and diverse audience of researchers, students, practitioners, policymakers, and others among the general public. Over the past year, we have provided tours and demonstrations of our research and facilities, sponsored seminars, published printed pieces, and updated our Web site. But perhaps the most direct method of transferring technology has been to send graduating students out into the workforce.

This section of the annual report highlights some of our technology transfer activities over the past year.

**Professor works with county on ‘Smarter’ signals**

A University researcher’s work with Hennepin County could offer some relief for congested city streets. Assistant civil engineering professor Henry Liu’s project, “Development of a Real-Time Arterial Performance Monitoring System Using Traffic Data Available from Existing Signal Systems,” is researching and developing an online performance monitoring system that will allow traffic signals on arterial streets to adjust automatically based on traffic conditions.

The effort was funded by the ITS Institute and the Minnesota Local Road Research Board, with significant in-kind support from Hennepin County. Liu and his students began working on the project in July 2006 by developing the software and hardware necessary to collect signal data and calculate the performance measures.
The system they developed is called SMART-Signals, short for “Systematic Monitoring of Arterial Road Traffic Signals.” The technology has already been implemented on 11 signals along busy France Avenue in Edina and Bloomington, Minnesota (pictured, opposite page).

In areas where the project is being implemented, Hennepin County has allowed the SMART-Signal devices to be installed in signal controller cabinets, from which they count cars and record the traffic signal phases.

“We’ll know when a phase started, ended, when a vehicle crossed through the intersection, and over time, how many vehicles passed by,” said Liu. This will allow engineers to set individual signals to the right timing schedules.

Although Liu and his team designed and created SMART-Signals, Hennepin County has devoted a great deal of time to maintaining and operating the system. “The partnership with Hennepin County has been a key factor for the success of this project,” Liu said.

Hennepin County officials believe SMART-Signals will provide performance data that will help guide the development of effective strategies for dealing with oversaturated conditions. According to Eric Drager, traffic operations engineer for Hennepin County, the SMART-Signals program has already helped confirm the results of an engineering consulting firm’s signal timing study of the corridor, which found that the program helped improve efficiency and performance.

“The SMART-Signals project will be able to tell us how our systems are functioning in real time and at any time,” said Drager. “The county is looking to develop more ITS-related applications and implementations, so this project fits quite nicely with that goal.”

The SMART-Signals project is expected to be completed in October 2008. Thanks to an additional $111,000 from the National Cooperative Highway Research Program, however, Liu will continue this work as part of a new project, “Operation of Traffic Signal Systems in Oversaturated Conditions,” until 2010. (That project is led by Douglas Gettman of Kimley-Horn and Associates; Liu is a co-investigator along with Monty Abbas of Virginia Tech and Alex Skabardonis of the University of California, Berkeley.) Drager said Hennepin County will continue to provide technical support as well as access to the signal systems.

**FEDERAL VISITORS EXPERIENCE NEW TECHNOLOGIES FIRST HAND**

The ITS Institute welcomed visitors from the federal government’s Research and Innovative Technology Administration (RITA) and a delegation of Congressional staffers gathering information on transportation issues in May and June. Both groups of visitors had the opportunity to tour the Institute’s research facilities and see firsthand how new technologies are being developed and deployed to improve the nation’s transportation system.

RITA, a division of the U.S. Department of Transportation, is charged with administering the University Transportation Centers (UTC) program, under which the ITS Institute was established. RITA representatives carry out periodic site visits to UTC locations around the country to review their operations and consult with researchers about new and ongoing initiatives in research, education, and outreach.

In addition to hearing presentations by ITS Institute staff, the visitors toured the HumanFIRST Program’s advanced driving simulator and the Minnesota Traffic Observatory and rode a transit bus equipped with driver-assistive systems developed by the Intelligent Vehicles (IV) Laboratory. They also met with Professor Demoz Gebre-Egziabher of the Department of Aerospace Engineering, who presented his current work on uninhabited aerial vehicles for traffic surveillance and remote sensing.

RITA staff members accompanied the congressional staff delegation that arrived in Minnesota for a one-day tour of Institute facilities May 29. IV Lab director Craig Shankwitz; RITA staff Curt Tompkins, Tom Marchessault, and Lydia Mercado; and Institute staff Linda Preisen and Dawn Spanhake toured a bus outfitted with IV Lab driver-assistive technology.
Shankwitz led a demonstration of the Institute’s driver-assistive systems for bus rapid transit and explained the motivation for developing new technologies that can provide better transit options to urban and suburban residents.

Staff members experienced some of the bus’s systems by sitting in a second driver’s seat equipped with haptic feedback devices that transmit vibration when the bus deviates from its lane. The onboard wireless access point proved to be equally impressive, allowing the busy staffers to check their e-mail while riding—a feature that will be included on the “Bus 2.0” vehicles rolled out in the coming year by the Minnesota Valley Transit Authority.

**Speaker addresses future of vehicle safety**

Tomorrow’s safety systems, particularly those that prevent crashes, will save many lives, said Ronald Medford, senior associate administrator with the National Highway Transportation Safety Administration (NHTSA). Their widespread deployment, however, hinges on a key question: What level of reliability will convince consumers that the systems work and are worth the money—and persuade manufacturers to install them?

Medford spoke at the Center for Transportation Studies’ Winter Luncheon on February 13. The ITS Institute sponsors the annual event, which features a presentation on an ITS-related topic by a national policy or technology leader.

Among other things, Medford highlighted NHTSA’s work on ITS safety initiatives with the USDOT’s Research and Innovative Technology Administration. One research initiative is the Cooperative Intersection Collision Avoidance Systems (CICAS) program, of which the ITS Institute is a participant (see page 12 for more coverage of this project). CICAS brings together federal agencies, automobile manufacturers, and university transportation centers with the goal of developing new technologies to prevent collisions at intersections. The ITS Institute’s focus is on preventing crashes at rural unsignalized intersections.

Another research area is vehicle-infrastructure integration, which is intended to allow communication between the infrastructure and vehicles, and from vehicles to other vehicles.

For any system, accuracy is key, and it must be reliable and accurate over the life of a vehicle, Medford said. “We can’t have false positives. The public won’t accept it.”

**Institute researchers share expertise with media**

Civil engineering associate professor David Levinson was quoted in a September 10 article in the Star Tribune on how commuters have adapted to new traffic patterns since the I-35W bridge collapse. Levinson is one of three University of Minnesota researchers who received a grant from the National Science Foundation to study the issue.

Levinson was also quoted in a story on Minnesota Public Radio about how traffic around the University of Minnesota was affected by the loss of the bridge.

In a news story in November about one of the Twin Cities’ most notorious freeway bottlenecks, the local NBC affiliate KARE-11 TV turned to the Minnesota Traffic Observatory. John Hourdos, director of the lab, explained that congestion on the one-lane eastbound I-394 ramp connecting three lanes of that highway with three lanes of eastbound I-94 is, unfortunately, by design, since it removes pressure from the Lowry Tunnel just east of the bridge on I-94. The tunnel was constructed many years before I-394, and any improvement should start at the tunnel, he said. Hourdos and others at the MTO have been studying that section of highway for years, and the story noted that Hourdos may know more about this section of road than “anyone else on the planet.” The story went on to describe the challenges of the entire area and what it would take to fix the problem,
with insight offered from both Hourdos and Jerome Adams, a senior engineer with Mn/DOT.

Hourdos also contributed to an analysis of merging behavior among Twin Cities drivers broadcast in a May 1 story on local television Fox 9 News.

Institute director Max Donath was interviewed by KSTP-TV for a November 14 story on how interactive road signs and “smart cars” might help reduce the number of fatal crashes that occur at intersections. Donath is working with Mn/DOT to develop a sensor-fusion-driven interactive, graphically animated traffic sign to be used at dangerous intersections.

University researchers that included Frank Douma of the Humphrey Institute and David Levinson of the civil engineering department participated in a broadcast debate on Minnesota Public Radio February 13. The event, held at the UBS Forum, showcased their expectations for the future transportation system.

The Minneapolis StarTribune ran a story on HumanFIRST program research that explored the differences in driving behavior and attitudes between urban and rural drivers. Research fellow Michael Rakauskas noted that more rural drivers believe their risky driving behaviors—not wearing seat belts and driving after drinking—are not that dangerous compared to their urban counterparts. The story was picked up by other papers, including the Detroit (Mich.) Free Press and the Kanabec County (Minn.) Times.

HumanFIRST program director Michael Manser was quoted in a story that aired on WCCO-TV news in February. The story explored the differences in driving ability and behaviors between men and women, as well as the statistics. Manser, who directs research into human behavior when driving, noted that the issue was far more complex than a gender issue and that many other variables influence crash rates.

The opening of the new Minnesota Traffic Observatory, along with researchers Hourdos, civil engineering professor Gary Davis, and engineers Ted Morris and Chen-Fu Liao, was featured in an article in UMNnews (a University of Minnesota electronic newsletter highlighting University work) in April.

Institute research on teen driving and motorcycle safety was in the news in June, part of the coverage of a visit by U.S. Transportation Deputy Secretary Thomas Barrett. Barrett was on the University of Minnesota campus to announce the launch of a new national clearinghouse on rural transportation safety information. A StarTribune story titled “Teens who speed may soon meet cars that tattle” described the ITS Institute’s development of a teen driver support system (TDSS) that uses technology to monitor unsafe driving behavior—in this case, a cell phone that automatically sends a text message to the driver’s parents if he or she is speeding. Donath noted that the system, which he hopes to see in wide use in the next few years, might help reduce the high number of teenage driving deaths.

Local TV news affiliates KARE, WCCO, and KSTP as well as National Public Radio ran segments on Barrett’s visit that included coverage of the TDSS as well as research that is investigating the effects of alcohol impairment on motorcycle riding. HumanFIRST researcher Janet Creaser was among those interviewed (see related story on page 17).

**Evacuation research nets additional federal funds**

Shashi Shekhar, a professor of computer science, in collaboration with Henry Liu, an assistant professor of civil engineering, received a grant titled “Spatio-temporal Network Databases for Transportation Science” from the National Science Foundation (NSF). The grant is to further research into scalable computational methods for determining routes, schedules, and traffic management plans for evacuating metropolitan areas.

Two years ago Shekhar’s research team completed a system to coordinate local emergency evacuation plans in multiple communities. The system is designed to minimize potential congestion on major roadways, speed up
the evacuation process, and maximize safety for citizens.

The goal was to create a tool that would run more efficiently than the standard linear programming approach and allow users—such as transportation professionals and first responders—to quickly find the best escape routes, even for large scenarios. The result was a capacity-constrained route planning system with a simple, Web-based user interface. Mn/DOT used the software to develop a metro evacuation traffic management plan for the Twin Cities area.

Since then Shekhar has been refining his capacity-constrained routing software to make it more accessible and easy to use for the private sector.

**Publications, new Web sites highlight Institute work**

The Minnesota Traffic Observatory (MTO) and HumanFIRST Program launched new Web sites to provide information about research capabilities and projects.

The MTO is the ITS Institute’s dedicated traffic management laboratory, offering a range of capabilities in the areas of traffic data collection, simulation and modeling, and visualization. In addition to supporting University of Minnesota researchers, the facility partners with other universities and corporations to carry out traffic research. HumanFIRST focuses on human factors research, and operates one of the most advanced immersive driving simulators at any academic institution in the United States.

“Researchers who are interested in working with us will be able to see what we have to offer and what we have already accomplished. We have a lot of unique capabilities, and we’re eager to let people know about them,” says MTO director John Hourdos.

“Our Web sites are a key part of our communication strategy,” agrees HumanFIRST director Michael Manser. “As we look for research partners—both academic researchers and private firms—these new sites will continue to evolve and expand.”

A new Web site for the Intelligent Vehicles Laboratory is currently under development by the ITS Institute communications staff.

In addition to ongoing work on the Institute’s Web sites, electronic communications continue to play an important role in quickly disseminating information to its audience. Electronic mail announcements were used to publicize upcoming events, including Advanced Transportation Technologies Seminars, conferences, luncheon presentations, and other ITS-related events.

Eight ITS-related research projects were featured in the Center for Transportation Studies’ *Research E-news* electronic newsletter, which is mailed to about 4,000 subscribers and is available on the Web at www.cts.umn.edu/news/rnews. These articles also provided links to more information about the projects.

Institute print publications continued to raise awareness of its work in academic and professional communities and share the results of research. The *Sensor* newsletter covered Institute research activities, education and technology transfer activities, upcoming ITS-related events, and recently published research reports. The *Sensor* is available in print and online and reaches about 2,100 subscribers three times each year. It has been one of the chief vehicles...
for increasing the visibility of the ITS Institute, and its high circulation testifies to a broad interest in ITS research activities among academic and professional audiences.

The eighth annual report (fiscal year 2006–07), highlighting work by the Institute’s researchers and students, was published and mailed to more than 1,400 individuals and was also made available as a PDF file for download from the Institute’s Web site. The report won an American Graphic Design Award from Graphic Design USA in the annual reports category.

**Institute Shares Safety Efforts with International Officials**

Officials from the country of Georgia visited CTS and the ITS Institute in April as part of the U.S. State Department’s International Visitor Leadership Program. The officials, who are developing a traffic safety program in Georgia, also visited with Mn/DOT staff and experts in other U.S. cities.

Gina Baas, CTS director of communications and outreach, provided an overview of safety-related research and outreach activities within the Institute and other CTS programs.

The International Visitor Leadership Program is a national initiative facilitated in Minnesota by the nonprofit Minnesota International Center. Visitors are invited by the U.S. Department of State to come to this country for approximately three weeks to meet with their professional counterparts and experience American culture without publicity or protocol.

**Institute Researchers Share Views on Traffic Safety at National, Local Events**

In September, ITS Institute researcher Tom Horan spoke at the Toward Zero Deaths conference, an annual event that explores ways to reduce the number of fatalities and injuries on Minnesota’s roads. In a concurrent session on emergency medical services (EMS) response times and trauma, Horan, with the Humphrey Institute of Public Affairs’s Center for Excellence in Rural Safety, described his work toward improving EMS response in rural areas.

At the Center for Transportation Studies’ 20th anniversary celebration in October, several ITS Institute researchers were among the University of Minnesota faculty panelists who reviewed how the University has contributed to state and national transportation issues in the past two decades and suggested future research possibilities.

Max Donath, director of the ITS Institute, noted that the Institute’s philosophy has been to focus its work on the highest risk areas—and in this country, that means rural areas. Institute researchers have developed and deployed lane-keeping technology, including the first use of high-accuracy GPS, on snowplows and other vehicles. Another area of Institute research looks at the policy implications of technology. Teens make up 5 percent of drivers but 14 percent of fatalities, yet there is continued resistance to tools like seat belt ignition locks. “We are all concerned with privacy,” Donath said, “but is it a red herring, an excuse, for not allowing some of this technology into our daily lives?”

Gina Baas (third from right) with visitors from the country of Georgia, who toured CTS and ITS Institute facilities as part of an international leadership program
Panos Michalopoulos, a professor in the Department of Civil Engineering, discussed how CE researchers, due in part to support from CTS and the ITS Institute, have made contributions in many dimensions of transportation such as an improved ramp metering strategy for Twin Cities metro freeways. Since the strategy was implemented in 2003, he said, benefits in reduced fuel consumption and delays are estimated at $200 million per year. Other areas of research include traffic flow simulation, crash mechanics, and crash prediction.

Nikolaos Papanikolopoulos, director of the Security in Transportation Technology Research and Applications (SECTTRA) Program and a professor of computer science and engineering, noted how his video detection research, which began as a tool to detect drug dealers at bus stops, became a springboard for a $4 million grant from the Department of Homeland Security. Papanikolopoulos credits seed support from CTS and the Institute as enabling his work to be competitive at the national level.

Speakers explored the connections between rural transportation safety and community health at the Center for Excellence in Rural Safety’s annual Summer Institute, held last July at the University of Vermont in Burlington. Donath described human-centered technologies for reducing fatalities and life-changing crashes, and Mick Rakauskas, a research fellow with the HumanFIRST Program, discussed attitudes and behaviors associated with rural fatal crash risk. The two-day gathering of leading state and national transportation officials, researchers, policymakers, and professionals is aimed at sharing information, setting research priorities, and developing strategies for improving rural transportation safety.

Institute researchers were among those who presented their work at the Transportation Research Board’s 87th annual meeting, held in January in Washington, D.C. Presentation topics covered traffic monitoring and signal control techniques, privacy law and ITS technologies, safety research, congestion pricing, and traffic simulation. University of Minnesota faculty, staff, and student presenters included, among many others:

- Gary Davis, John Hourdos, David Levinson, Chen-Fu Liao, Henry Liu, Wenteng Ma, and Panos Michalopoulos, Civil Engineering
- Xinyu (Jason) Cao, Frank Douma, Lee Munnich, and Elizabeth Wilson, Hubert H. Humphrey Institute of Public Affairs
- Bibhu Aryal and Taek Kwon, Northland Advanced Transportation Systems Research Laboratories (NATSRL)

In May, NATSRL held its sixth annual Research Day, during which ITS researchers at the University of Minnesota Duluth presented their ongoing work in transportation. The event was held at Mn/DOT District 1 headquarters in Duluth. NATSRL director Eil Kwon opened the half-day event.

Among the UMD presenters and topics were:

- Xun Yu, Mechanical and Industrial Engineering (MIE), “Real-Time Non-intrusive Detection of Driver Drowsiness”
- Peter Willemsen, Computer Science (CS), “Rendering Falling Snow for Interactive Snowplow Simulation”
- Hua Tang, ECE, “A Video-Based Tracking System with Practical Applications”
- John Evans, Chemistry, “Detection of Water and Ice on Bridge Structures by AC Impedance and Dielectric Relaxation Spectroscopy”
- Richard Maclin, CS, “Early Warning System for RWIS Sensor Malfunctions”
Researchers receive honors, awards

Assistant Professor Henry Liu of the Department of Civil Engineering was the recipient of the 2007 New Faculty Award from the Council of University Transportation Centers (CUTC) and the American Road & Transportation Builders Association (ARTBA). The award is presented to an outstanding new faculty member in a field related to transportation who has not yet received tenure. He received the honor at CUTC’s Tenth Annual Awards Banquet in Washington, D.C.

Liu’s Institute-related research activities include arterial data collection and signal optimization, real-time traffic management for emergency evacuation, analytical dynamic traffic assignment, and application of microscopic traffic simulation models. In addition, Liu and CE associate professor David Levinson, a previous CUTC New Faculty Award winner, are leading a team that is analyzing traffic patterns after the loss of the I-35W bridge in Minneapolis, funded by a grant from the National Science Foundation, and a related project funded by Mn/DOT.

Elizabeth Wilson is a recipient of a 2008 McKnight Land-Grant Professorship. The goal of the program is to advance the careers of the University’s most promising junior faculty at a critical point in their professional lives. McKnight recipients are honored with the title McKnight Land-Grant Professor, a special award they will hold for two years. The award consists of a research grant in each of the two years, summer support, and a research leave in the second year.

Wilson is an assistant professor of energy and environmental policy and law at the Humphrey Institute of Public Affairs. Among other research, Wilson is investigating the implications for advances in transportation-related technology as it relates to school travel (see page 24 for more on this ITS Institute-sponsored effort).

Visiting researchers bring expertise, build partnerships

During the past year, the Institute continued to work with visiting researchers and instructors, allowing for an exchange of information and dissemination of research results to the visitors’ students and colleagues. The Fall 2007 Advanced Transportation Technologies Seminar Series provided an opportunity to host two national researchers. Louis Tijerina, a human factors researcher and driver distraction expert with the Ford Motor Company, presented an overview of recent research on driver distraction related to mobile electronic devices and on the more general issue of interface design for driving safety. Srinivas Peeta, director of the NEXTRANS Center at Purdue University, presented on methods for modeling the complex interdependencies among civil infrastructure systems.

Thomas Horan, an associate professor at Claremont Graduate University and visiting scholar at the Humphrey Institute of Public Affairs, is part of the Sustainable Technologies Applied Research (STAR) Initiative and the new TechPlan research program. Horan is investigating wireless emergency medical services (EMS) and telecommunication network planning and access in a rural context.

Other visiting researchers, all working with the Institute’s HumanFIRST Program, include Nobuyuki Kuge and Tomohiro Yamamura of Nissan, Jeff Caird of the University of Calgary, and Dick de Waard of the University of Groningen.