ITS Institute research is centered on safety-critical technologies and systems for efficiently moving people and goods in the following areas:

- human performance and behavior
- technologies for modeling, managing, and operating transportation systems
- computing, sensing, communications, and control systems
- social and economic policy issues related to ITS technologies

The Institute’s research program joins technologists—for example, engineers and computer scientists—with those who study human behavior to ensure that new technologies adapt to human capabilities, rather than requiring drivers to adapt to technology.

The Institute's geographic location gives it a unique advantage for developing research applicable to transportation in a northern climate and transportation in rural environments in addition to the metropolitan Twin Cities area. The ITS Institute research program includes research projects funded by various partners, including federal funds from the USDOT Research and Innovative Technology Administration’s University Transportation Center program, the Federal Highway Administration, the Federal Transit Administration, the National Highway Traffic Safety Administration, the National Park Service, and the Department of Homeland Security. Other funding partners include the Minnesota Department of Transportation (Mn/DOT), Minnesota Local Road Research Board, Metropolitan Council, Hennepin County, Metro Transit, and the Minnesota Valley Transit Authority in addition to local governments, agencies, and private companies that contribute funding and in-kind match.

Activities undertaken by the Institute support all ITS-related research projects, regardless of funding source; all current ITS-related projects are listed in this annual report. The research section comprises two parts. The first highlights in detail a selection of projects under way, while the second lists all Institute projects either recently completed, in progress, or selected to begin this coming year.
Motor vehicle crashes are the leading cause of teenage deaths. In 2008, teen drivers aged 16 to 19 accounted for 12.4 percent of all crashes in Minnesota, even though they represented only 6.8 percent of the driving population. Speeding, seat belt non-compliance, and distractions are the primary reasons for this high fatality rate.

Mandatory driver training programs have not reduced fatalities. Graduated driver’s licensing programs have been somewhat effective, but they are difficult to enforce because they rely heavily on parents to impose restrictions on their teens.

Intelligent speed adaptation, however, has the potential to reduce teen crash rates. This in-vehicle technology, which monitors and in some circumstances enforces speed limits, has been tested primarily in Europe on adult populations. Although some existing commercially available off-the-shelf systems appear to reduce risky driving behavior, few provide real-time feedback to help drivers change their behavior as they drive.

The first Teen Driver Support System (TDSS) prototype, developed by Institute researchers in 2006, gave drivers real-time auditory and visual feedback, but the system was bulky and complicated to install.

More recently a team of researchers created a smaller, more mobile system. A team that included researcher Janet Creaser, graduate student Richard Hoglund, HumanFIRST director Michael Manser, and ITS Institute director Max Donath used a "smart phone" to create a TDSS prototype that provides drivers with real-time auditory and visual feedback. The prototype can also send real-time text messages to parents about infractions and upload data to an online reporting system.

The smart phone is used to provide an in-vehicle display and is placed on the dashboard in such a way that the driver can readily see both the phone’s screen and the road. Four different items are displayed on the screen: vehicle speed, the quality of the GPS signal, the name of the street the vehicle is traveling on, and a traffic sign icon.

The traffic sign icon displays various traffic control signs that correspond to the actual driving environment. For example, if the driver is driving at or below the speed limit, a white speed limit sign is shown. If the driver exceeds the limit, the sign turns red and the speed limit value flashes. Stop signs and yellow diamond curve signs can be displayed as well.

In addition, the phone communicates with the Road/Weather Information Service server so drivers are alerted to low visibility, high wind, snow, rain, hail, or ice by pre-recorded auditory messages stored on the phone. When the weather warrants a reduction in speed, the speed limit sign in the picture box turns blue and shows the recommended speed.

To evaluate this TDSS prototype, the researchers completed a small usability study. The 16 participants were licensed drivers aged 18 and 19. Among them, they had a total of 11 previous moving violations—one for inattentive driving and the rest for speeding. Participants also reported a total of seven previous crashes for which they were considered at fault.

The participants drove an 8.7-mile circuit in Hennepin County both with and without the TDSS. They received visual and audio feedback, and text messages were sent (to one of the researchers) when they failed to alter their behavior. In general, the TDSS encouraged lower speeds in this group of drivers—although this may have been due, at least in part, to the presence of a researcher in the vehicle. The participating teens reported that very
little mental effort was required to interact with the TDSS while driving, but they also reported that the system made driving more stressful.

Still needed is a more detailed field study to determine whether the system really changes driver behavior over the long term. “We want to see if drivers simply rely on the warnings provided by the system, or if the feedback really helps them learn to monitor their own behavior,” Creaser says.

During the next phase of the project, researchers will determine what information should be presented to parents in real-time text messages and uploaded into a weekly report. Ideally, the TDSS would help parents mentor their teens in safe driving behavior. If used in this way, the TDSS could be a useful tool for improving compliance with graduated driver’s licensing programs and reducing risky driving behavior.

**Generational Perspectives on Teen and Older Drivers on Traffic Safety in Rural and Urban Communities**

When planning crash-reduction programs, one size does not fit all, according to a team of researchers investigating how differences in attitude affect crash risk. Michael Manser, director of the ITS Institute’s HumanFIRST Program, and colleague Michael Rakauskas worked with researchers from the Minnesota Center for Survey Research on a study that compared the attitudes of urban and rural Minnesotans of various ages toward driving safety. Former HumanFIRST director Nic Ward, now at Montana State University, also contributed to the study while still in Minnesota.

Expanding on earlier work that investigated broad differences between the attitudes of urban and rural drivers, the researchers’ recent work focused on differences between older and younger drivers’ attitudes toward safety. Specifically, researchers wanted to learn how drivers perceived crash risk, safe driving practices, driving ability, and the importance of personal mobility to their quality of life.

The researchers also wanted to learn how drivers perceived various safety interventions, such as graduated driver’s licensing (GDL) programs and geographically focused campaigns targeted toward specific behaviors such as driving while impaired.

The first phase of the study consisted of a series of 12 focus groups. A total of 116 participants recruited from one rural area and one urban area of Minnesota were divided into three subgroups: teen drivers, senior drivers (age 65 and over), and parents of teen drivers.

During the second phase of the study, researchers evaluated surveys completed by participants before attending the focus

Researchers compared the attitudes toward safety of urban and rural Minnesota drivers of various ages.
The surveys included questions about the participants’ driving behavior, their perceptions of driving risk, and their thoughts about the effectiveness of traffic safety interventions. The questions were formulated in consultation with the Minnesota Department of Public Safety and officials affiliated with the Toward Zero Deaths program of the Minnesota Departments of Public Safety, Transportation, and Health.

Researchers learned that teen and senior drivers in both urban and rural areas rely on driving to preserve their independence and avoid inconveniencing others. In rural areas, driving may also be a necessity due to lack of public transportation or for unique purposes such as hunting or emergency transportation. Although teens and seniors drive for the same basic reasons, researchers found differences in how each group perceived driving risk and behavior:

- Rural residents, regardless of age, reported less frequent use of seat belts.
- Urban drivers reported more frequent driver errors and traffic violations.
- Teens driving in urban environments reported more episodes of aggressive and impaired driving, moving violations, and driver distraction.
- Seniors attributed crashes to slower reaction times, poorer vision, less acute hearing, or other physical problems.

Researchers found that teens and seniors also had different perceptions of safety strategies. Teens were far less receptive to enforcement as a safety intervention. They liked the idea of using “smart” technology to monitor driving behavior but wanted programs to balance cost, robustness, and limitations on driving patterns. Teens were uncertain about whether the state’s GDL program had made them safer drivers and were against limits on the number of passengers and nighttime driving for newly licensed drivers.

Senior drivers were more receptive to transportation and mobility services provided by private, nonprofit community organizations. They also tended to favor mandatory license retesting if it was convenient, fairly administered, and related to driving behavior, not age.

As a result of the study, the research team developed some potential policy recommendations and suggestions for future research. These include:

- Targeted safety campaigns in rural areas to encourage seat belt use.
- Development of a safety policy for teen drivers that addresses driver distraction, especially in urban areas.
- Development of a safety policy for senior drivers that focuses on sensory-motor functioning.
- Identification of ways to tailor the GDL program to better meet the needs of teens and their parents.
- A feasibility study of unique concepts for providing transit services (such as the Independent Transportation Network, which provides transportation to seniors through private, nonprofit organizations), especially in rural areas.

“This research has helped us understand drivers’ attitudes and behavior, as well as their receptivity to various safety interventions,” Manser says. “And that’s an essential part of creating effective traffic safety programs.”

Researchers found differences in how teen and senior drivers perceived driving risk and safety strategies.
Driver fatigue is believed to be a factor in many heavy truck crashes. The lack of safe, available truck parking on interstate highways may contribute to fatigue. According to a recent survey, most truck drivers prefer truck stops for overnight rests.

It is important and in some occasions absolutely necessary for drivers to have updated information on parking spot availability as they approach nearby truck stops. This will enable them to make timely rest decisions so that they do not exceed the legal limits of continuous driving hours set by the Federal Motor Carrier Safety Administration. Moreover, the availability of timely parking spot vacancy information may deter drivers from parking on the shoulders of highways or ramps, which creates a safety hazard for all motorists. Finally, parking in truck stops ensures the drivers get uninterrupted sleep.

Existing truck stop directories provide helpful information, but drivers could additionally benefit from a system that dynamically informs them of which stops have parking spaces available. Vehicle detection—a core technology component in these systems—presents distinct challenges when operating throughout the day and night. It is imperative that vehicle detection functions reliably under all weather conditions and at all times—especially at night, when demand for parking peaks.

Transportation professionals have introduced or proposed a wide range of technologies to develop parking information systems. After reviewing the most commonly used technologies, Professor Nikolaos Papanikolopoulos, Pushkar Modi, and Vassilios Morellas, all from the Department of Computer Science and Engineering, have determined that machine vision is currently the most practical and reliable technology.

In its simplest form, machine vision uses digital video cameras and image processing software to perform narrowly defined tasks such as counting objects on a conveyor belt or reading serial numbers—or in this case, counting empty spaces at a truck stop. However, this is not always so simple.

The researchers are developing a prototype system that would use video cameras suspended 30 to 60 feet above the parking area on rooftops or poles. Each parking spot would be monitored by more than one camera, which would increase the reliability of the system. The cameras would “see” by noting the percentage of pixels that are occluded, or covered, by a foreground object—in this case, a truck. Each camera would send these data to a computer, which would determine parking availability by using pattern recognition. Since the system does not require a high-quality representation of each truck, it is quite efficient and can compute up to 10 frames per second on a standard laptop computer.

Unlike more rigid systems, the machine vision system could be recalibrated to accommodate a change
in parking layout. The system administrator could also improve the accuracy of the system by adding more cameras.

The research team is working on locating a test site that would yield the data needed to create an accurate knowledge base for pattern recognition. An ideal data set would be based on video feeds of one or more truck stops, with coverage of the same areas from more than one angle, in different light and weather conditions. Currently, the team is working with images from Live Maps, Microsoft’s Web mapping service. These maps offer reasonable “bird’s eye views” of truck stops from all four directions.

Truck design also poses a challenge. Detection of certain trucks may not be designated as a compact image region but as a collection of disconnected non-compact components (e.g., as a hollow frame), which makes these vehicles harder to identify and classify. Other trucks have highly reflective surfaces. On a sunny day, this surface could reflect light rays directly into the camera lens, leading to an overload of the optical sensor that would temporarily hamper the functioning of the camera. To prevent this, the researchers plan to rely on a secondary camera overlooking the same parking spot from a different angle. Good-quality optical filters might also solve this problem.

Additionally, the researchers must determine how best to broadcast space availability to truck drivers, since availability is likely to change by the time the driver arrives. “For example,” Papanikolopoulos explains, “if a truck stop has five spaces left, and 30 drivers converge on the truck stop based on a broadcast of that information, 25 of those drivers would end up being unhappy.”

**Cellular Wireless Mesh Sensor Network for Comprehensive Spatial Traffic Movement Detection and Data Fusion**

Engineers analyzing intersection traffic are often forced to rely on manual data collection—workers recording the movements of vehicles through the intersection using handheld data loggers, an approach that is both tedious and error-prone. Research by electrical and computer engineering professor Taek Mu Kwon aims to automate the process with small wireless sensor nodes that are easy to install temporarily on the road surface. Kwon also directs the Transportation Data Research Laboratory (TDRL) on the University of Minnesota Duluth campus and has led several research projects to improve traffic data collection and develop new sensor systems.

Kwon’s sensor nodes are designed to be installed in groups, with each sensor responsible for detecting vehicles in a single lane of traffic. Once in place, the sensor nodes automatically configure themselves as a “mesh” network, moving the raw data to a processing unit that extracts vehicle trajectories. The sensors are particularly suitable for short-term installation because each one is powered by its own battery and mounted on the road surface with an adhesive, but they can also be connected to an external power source for longer-term applications.

A mesh network is defined by multiple links between nodes. In a mesh topology, data can hop from node to node to reach a destination, rather than being transmitted directly to and from a central point. In a full
Research

mesh network, the number of links increases rapidly as more nodes are added. Kwon’s sensor network strikes a balance between flexibility and complexity via a partial-mesh topology, in which each sensor is connected to at least two other nodes in order to provide alternative data routes, but not to every other node in the system.

The prototype sensor nodes are similar in size and shape to typical raised pavement markers, and the fiberglass housings are strong enough to protect the sensitive electronics inside when vehicles drive over them. Nodes can be deployed quickly by simply attaching them to the pavement with sprayable adhesive; when data collection is complete, they can be pried off the pavement with a screwdriver and used again.

In operation, each sensor node in an intersection registers the magnetic disturbance caused by a vehicle passing directly over it and transmits the exact time of that event through the mesh network to a data logger positioned nearby. The nodes’ communication protocol ensures that their internal clocks are synchronized, so the timing of every vehicle detection event is recorded accurately.

The tracking algorithm used by the mesh sensor system is a type of multiple target tracking (MTT) algorithm. Originally developed for military applications such as radar tracking of multiple aircraft, MTT algorithms are now used in commercial data collection systems due to the availability of powerful and inexpensive hardware and software technology. The MTT system partitions incoming data into sets of observations—tracks—produced by the same source. Based on these tracks, an MTT system can determine the number of current objects being tracked, compute their velocities, and predict likely future trajectories.

To monitor an intersection, a single sensor is responsible for each lane of traffic. Taking into account the geometry of the intersection, each node is designated either an “entrance” or an “exit” node. The tracking algorithm then matches events recorded by entrance nodes to events recorded by exit nodes, producing a set of node-to-node trajectories representing the movements of individual vehicles.

Testing of the sensors and tracking algorithm in both a traffic simulator and a real intersection installation have shown that the system can be a useful tool for engineers to count vehicle turning movements, according to Kwon. Future refinements of the tracking algorithm and the physical sensor design have the potential to make the system even more accurate and useful.
Modeling Traffic Impact on Denali Park Road

Every year, hundreds of thousands of visitors flock to Denali National Park for a spectacular glimpse into Alaska’s wilderness. They pile onto buses and travel the park’s single road, hoping to see wildlife and gaze at the 20,320-foot summit of Mount McKinley. But to do this, they have to find a spot on one of the 10,512 vehicle trips allowed into the park on the restricted Denali Park Road each year.

About four decades ago, not many visitors made the trip to Denali National Park. The only way to reach it was by train or by a bumpy, remote road. But when a major highway was built to the park, everything changed. In the past three decades, the number of visitors coming to Denali has grown nearly 200 percent—creating increased pressure to reevaluate the vehicle trip limit.

The National Park Service wanted to investigate how a change in the annual trip limit would affect the park’s wildlife and park visitors’ experience. To answer these complicated questions, they turned to researchers at the Institute’s Minnesota Traffic Observatory (MTO).

“The question that arose was, should this annual trip limit be different?” says MTO lab manager Ted Morris. “We needed to figure out if we could protect the park’s natural surroundings, park wildlife, and the visitor experience all at the same time by adding trips, or if we could change the system to make it better.”

The MTO researchers partnered with a multidisciplinary team to analyze three critical factors. The first was tracking wildlife movement and sightings. Buses were equipped with special devices so drivers could easily log the reason for a stop—including the type of wildlife they were stopping to view. Grizzlies and Dall sheep were also given tracking collars, allowing researchers to document their movements.

The second factor was visitor experience. Visitors were asked detailed questions about how their experience was affected—for better or worse—by crowding at rest areas and at wildlife sightings on the roadway.

Researchers then analyzed those results. The final task was to design a traffic simulation that combined the factors of wildlife movement, visitor experience, and the park road’s traffic patterns. MTO researchers created a complex traffic model that accounted for the unique traffic patterns in the park including traffic flow, bunching, and traffic density. Their model even accounts for some rather unusual research findings, such as the fact that buses stop an average of three to six minutes longer for a bear than for any other type of wildlife.

The result of this study was a traffic simulation tool that will allow park managers to make informed decisions about vehicle trip limits in Denali National Park. For example, they can use the simulation to evaluate trade-offs between visitor experience and visitor capacity. They can also test various alternatives to see how those choices would affect the park’s wildlife.

In the future, researchers hope the findings of this study can help protect and preserve not only Denali, but other parks as well—while keeping them accessible to visitors. The traffic simulation from the Denali Park study can be used as a framework for a tool to help any park facing crowding and capacity issues assess the potential impacts of visit limits.

Morris says their research may shape how the park is used for decades to come. “It is so important that wilderness areas are preserved,” he says. “In Alaska, 13 percent of the entire economy is tied to Denali Park, and also, Denali is one of the few true wilderness areas left for future generations to experience.”
The collapse of the Interstate 35W bridge over the Mississippi River on August 1, 2007, resulted in a tragic loss of life and a major disruption of the Twin Cities’ transportation system. As University of Minnesota structural engineers began to investigate the causes of the collapse, another group of researchers recognized a unique opportunity to study how metropolitan travel patterns respond to the sudden loss of a major transportation link.

In the weeks immediately following the collapse, civil engineering (CE) associate professor David Levinson, CE assistant professor Henry Liu, and human factors researcher Kathleen Harder received funding from the National Science Foundation (NSF) Small Grants for Exploratory Research program to gather traffic data, perform a preliminary analysis, and identify further research needs. They received subsequent funding from the NSF to study the traffic equilibration behavior after network disruption.

The NSF-supported effort also helped the researchers win funding for additional research. With support from the Minnesota Department of Transportation, their project, “Traffic Flow and Road User Impacts of the Collapse of the I-35W Bridge Over the Mississippi River,” led by Levinson, aims to understand the effect of the bridge closure on observed travel behavior, shifts in traffic flows, and resulting effects on alternate routes.

The researchers are developing models of local travel behavior before and after the reconstruction of the bridge using data from surveys of travelers affected by the collapse as well as route-choice data gathered with GPS vehicle-tracking units. These models will enable the researchers to predict the distribution of traffic flows and impacts on alternate routes. The observations and models will also be used to estimate road user costs associated with the bridge collapse.

Another current project, “BRIDGE: Behavioral Response to the I-35W Disruption—Gauging Equilibration,” funded by the NSF and led by Liu, is studying how an extensive traffic system responds to a sudden, major network disruption. Equilibration refers to the process of establishing equilibrium—a stable condition that is assumed to characterize normal operation in many complicated transportation systems. Following a serious disruption, the researchers theorize, the Twin Cities surface transportation system is likely to settle into a new state of equilibrium as thousands of users adapt their behavior to the new demands of getting from place to place. On the other hand, the possibility that the system will remain chaotic for a long time cannot be ruled out without gathering detailed data.

“The problem of traffic flow evolution after a major network disruption has not been well-studied in transportation science,” said Liu. “We hope to fill in the gap.”
Research: Social and Economic Policy Issues Related to ITS Technologies

ITS and Transportation Safety: ITS and EMS System Data Integration for Safety, Emergency, and Crisis Response Planning

The federal Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy of Users (SAFETEA-LU) enacted in 2005 mandates that each state develop a Strategic Highway Safety Plan to reduce the number of roadway fatalities and crashes resulting in serious injury. Plans must be collaborative, comprehensive, and based on accurate and timely safety data.

Yet transportation planners have difficulty identifying and using new data sources beyond traditional crash data systems. They also find it challenging to identify strategies for sharing a wide range of data across multiple agencies. As a result, there has been little focus on studying how emergency medical services (EMS) and trauma systems could provide safety-related data for both real-time benefits and retrospective analysis that could improve planning and performance.

Tom Horan, executive director of Claremont Graduate University’s School of Information Systems and Technology and a visiting researcher at the Humphrey Institute of Public Affairs, has examined how information systems (IT) and intelligent transportation systems (ITS) are used to respond to vehicle crash emergencies and for evidence-based safety planning as required by SAFETEA-LU.

Horan, along with his colleague Benjamin Schooley, took a holistic approach. They studied the emergency response process from beginning to end—from crash notification to patient care and recovery. They began by reviewing previous research on the use of IT and ITS to integrate data about emergency response and treatment. They looked at automatic crash notification systems, next-generation 911 systems, the National Emergency Medical Services Informations System (NEMSIS), EMS and trauma communication systems, electronic medical records, and the Crash Outcome Data Evaluation System (CODES). The review confirmed that these systems operate in silos. Linking them is a technological challenge that requires organizational and policy-level attention.

As a second step, the researchers analyzed several Strategic Highway Safety Plans. They found that state-level efforts focus either on crash notification, identification, and location or on improved data and systems collaboration between EMS and trauma agencies. Conversations with leaders in state and federal departments of transportation also revealed that many plans did not have new tactics for addressing emergency response practice and improvement.

The researchers next carried out two in-depth case studies—one at the state level and one on the local level. In the state-level analysis, the researchers conducted a series of focus group discussions and follow-on interviews with decision makers in Minnesota to learn how crash, EMS, and trauma information is integrated and used.

Participants described organizational and policy challenges to information sharing. All agreed, however, that an integrated, secure system would improve patient care, reduce crashes, and decrease fatalities and disabilities, along with the associated costs to the state.

The local case study focused on the Mayo Clinic trauma information system in Rochester, Minnesota. Researchers conducted three focus group sessions at Saint Marys Hospital, one of two hospitals associated with Mayo. Participants included personnel from

The emergency response process is especially critical in rural states, where crashes often occur miles from the nearest hospital.
emergency communications, medical transport, corporate communications, and IT. Also participating were emergency medicine physicians and a trauma surgeon. The sessions revealed a range of technological, organizational, and governance challenges to information sharing.

Finally, Horan and Schooley developed the concept and normative architecture for an Integrated Crash Trauma Information Network. This network of emergency responders, health care professionals, and IT/ITS systems would collect and share real-time data. These data could be used immediately to care for trauma victims and would also be valuable for retrospective analysis.

Within the next year, Horan plans to validate the Minnesota case studies by conducting comparative case studies in another state. Findings from this cross-case comparison will be used to create an initial prototype of the network. The researchers will then present the prototype to focus groups of stakeholders in Minnesota and elsewhere to demonstrate its potential value and get feedback.

“We want to spotlight the emergency response process, especially in rural states like Minnesota where accidents often occur miles from the nearest hospital,” Horan says. “Better coordination across the entire system has the potential to save many lives and improve traffic safety in general.”

Technology and Collaboration in Effective Transportation Policy

A collaboration of disparate organizations formed to respond to a proposal by the USDOT is the focus of an analysis by researchers from the Public and Nonprofit Leadership Center at the Hubert H. Humphrey Institute of Public Affairs. The study was sponsored by the ITS Institute through the Humphrey Institute’s TechPlan program.

In 2006, federal funding became available for the USDOT’s Urban Partnership Agreement (UPA). The goal of the program is to reduce urban traffic congestion. When the request for proposals was officially announced, the Minnesota Department of Transportation (Mn/DOT) applied for a grant in collaboration with the Metropolitan Council (Met Council), which operates the bus transit system for the Twin Cities region.

Proposal development was overseen by an interagency steering committee. Despite disagreements, the steering committee and outside advocates eventually came to consensus. Their proposal focused on a series of projects aimed at reducing congestion on Interstate 35W, on Highway 77/Cedar Avenue, and in downtown Minneapolis through a combination of transit, road pricing, technology, and telecommuting. In August 2007, the USDOT awarded the Twin Cities metro area $133.3 million. A local match of $50.2 million was secured in the 2008 legislative session.

In addition to the USDOT’s Federal Highway Administration, Mn/DOT, and the Met Council, other key stakeholder partners in this complex collaboration were:
- Metro Transit
- the City of Minneapolis
- the Minnesota Valley Transit Authority
- the University of Minnesota’s Center for Transportation Studies, the Hubert H. Humphrey Institute of Public Affairs, and the ITS Institute
- Anoka, Dakota, Hennepin, and Ramsey Counties
- transportation management organizations

Additional stakeholders in this effort included the Minnesota governor’s office, the state legislature, the I-35W Solutions Alliance, the Citizens League, and Transit for Livable Communities.

Humphrey Institute researchers John Bryson, Barbara Crosby, Melissa Stone, and J. Clare Mortensen interviewed 26 people closely involved with the UPA. Their analysis of
the collaboration included the external forces affecting it; the internal processes, structures, and competencies that allowed it to operate; and its accountability mechanisms.

Their study confirms previous research on collaboration but also highlights new findings:

- **The role of technology as solution, motivator, and facilitator.** Dynamic pricing and other elements of the UPA are pragmatic solutions to the problem of congestion. The success of previous dynamic pricing helped skeptics to accept tolling, and technology attracted people interested in cutting-edge work. Communications technology, such as e-mail and broadband connections to both workplace and home, allowed people to work together on a complex proposal with tight timelines.

- **The importance of linkages connecting high-level federal policymaking to local, operational details.** The UPA existed primarily within a complex intergovernmental system. Both horizontal and vertical relationships were critical.

- **Emphasis on multiple roles played by sponsors, champions, neutral conveners, process designers, and technical experts.** All needed to play their parts well for the collaboration to succeed. Especially important to the process were designed and managed forums that promoted and stabilized horizontal relationships.

- **The importance of specific competencies.** These include leadership skills, the ability to frame issues persuasively, coalition-building, grant writing, technical expertise, and an understanding of the transportation field.

- **The role of rules and routines as drivers of collaboration.** On the one hand, the UPA request for proposal process drove innovation and new collaboration. On the other, the use of normal planning, decision-making, and accountability mechanisms allowed the partners to meet tight timelines.

- **The importance of organizational ambidexterity.** Partners had to manage tensions such as stability versus change, hierarchy versus lateral relations, and the existing power structure versus power sharing. To do this, they used both a strategy of spatial separation—keeping some things stable while changing others—and a strategy of temporal separation—relying primarily on lateral relations during the planning phase while operating more with formal hierarchies during implementation.

Bryson and his colleagues focused on the period from late 2006, when stakeholders began collaborating on the proposal, through June 2008 or the first phase of implementation. The researchers plan to continue studying this cross-sector collaboration through the completion of the final project in October 2010. The team also plans to look at UPA collaborations in other metropolitan areas.

“*A multi-agency collaboration like [the] UPA is a complex assemblage of human and non-human elements. It is not an easy answer to hard problems, but rather a hard answer to hard problems,*” Bryson says. “*We hope that our findings will be useful to departments of transportation as they design and implement other large cross-sector collaborations.*”