

# ROADWAY SAFETY INSTITUTE

Human-centered solutions to advance roadway safety

## Program Progress Performance Report for University Transportation Centers

**Recipient Organization**

Regents of the University  
of Minnesota  
200 Oak Street SE; Suite 450  
Minneapolis, MN 55455-2070

**Recipient Identifying Number**

CON# 042705

**DUNS and EIN Numbers**

DUNS: 55-591-7996  
EIN: 41-6007513

**Federal Grant Number**

DTRT13-G-UTC35

**Submitted to:**

Amy Stearns, Grant Manager  
Office of the Assistant Secretary for  
Research and Technology  
US Department of Transportation

**Submitted by:**

Max Donath, Director  
Roadway Safety Institute,  
University of Minnesota  
donath@umn.edu, 612-625-2304

**Grant Period:** 9/30/13 – 9/30/17

**Reporting Period:** 4/1/2014 – 9/30/2014

**Report term:** Semiannual

**Submission Date:** 10/30/2014

**Signature of Submitting Official:**



---

Max Donath, Director, Roadway Safety Institute

## CONTENTS

Accomplishments .....	1
Major goals and objectives of the program .....	1
Accomplishments .....	3
Opportunities for training and professional development .....	7
Dissemination .....	7
Plans for next reporting period .....	8
Products .....	12
Publications, conference papers, and presentations .....	12
Websites or other Internet sites .....	14
Technologies or techniques .....	14
Inventions, patent applications, and/or licenses .....	14
Other products .....	14
Participants and Other Collaborating Organizations .....	14
Organizations that have been involved as partners .....	14
Other collaborators or contacts .....	15
Impact .....	16
Impact on the development of the principal discipline(s) of the program .....	16
Impact on other disciplines .....	16
Impact on physical, institutional, and information resources .....	16
Impact on transportation workforce development and human resources .....	17
Impact on technology transfer .....	17
Impact on society beyond science and technology .....	17
Changes/Problems .....	17
Changes in approach and reasons for change .....	17
Actual or anticipated problems or delays and actions or plans to resolve .....	18
Changes that have significant impact on expenditures .....	18
Significant changes in use of care of human subjects, vertebrate animals, and/or biohazards .....	18
Change of primary performance site location from that originally proposed .....	18

## ACCOMPLISHMENTS

### Major goals and objectives of the program

The Roadway Safety Institute (RSI) draws on highly innovative researchers located across Region 5 to focus on targeted research, education, and technology transfer activities aimed at determining and delivering the next wave of transportation safety improvements.

Our objective is simple: improve safety for those who use the network, regardless of where they live or how they travel on it. To that end, user-centered transportation systems will be developed and deployed to focus our work on specific users of the system and on how systematic improvements can affect both key user groups and broader groups of travelers.

This objective will be accomplished by meeting the following goals in research, education and workforce development, and technology transfer activities, as well as through collaboration and diversity.

#### *Research*

The Institute will focus on traffic safety system approaches by researching design- and operation-related safety solutions that reduce fatalities and life-changing injuries across the nation. In addition, the Institute will address the following MAP-21 priorities to improve highway safety: rural road safety measures, human factor studies and measures, data collection and analysis, and safety policy studies. Research projects will, for example, examine enhanced law enforcement strategies, rail grade crossings, and operational safety in intersections.

The Institute will also focus on high-risk road users by addressing key safety issues for these groups through research and by examining public engagement strategies to help improve safety on tribal lands. Those at higher risk include vulnerable road users (for example, older drivers and visually impaired pedestrians), commercial truck drivers, impaired drivers, pedestrians, and bicyclists.

Countermeasures are effective tools for practitioners to use to improve roadway safety, and our research will work to develop these strategies that can be put to use. In addition, our research will investigate methodologies and metrics, in particular related to pedestrian and bicycle travel. Results of this work will provide practitioners with tools for better decision making, ultimately improving safety for those roadway users.

#### *Education and workforce development*

The Roadway Safety Institute will develop a variety of activities targeted to primary and secondary students throughout Region 5 that raise awareness of transportation safety topics and identify exciting career opportunities in related fields. Goals include leveraging the existing Transportation YOU program (a hands-on mentoring program supported by WTS that introduces girls to transportation careers) to encourage young female students throughout our region to pursue transportation-related degrees; demonstrating safe driving concepts to students in STEM summer camps using educational tools such as our Distraction Dodger game; and developing a roadway-safety-themed museum exhibit to be displayed at science, children's, and transportation



museums throughout Region 5.

We will continue to demonstrate a commitment to workforce development through activities that engage both students and practicing professionals. For students, we will enhance our university degree-granting programs by supporting user-centered transportation safety curriculum development that prepares students to take an integrated approach to this pressing transportation and public health issue. The Institute will also continue and adapt our transportation internship program to connect students to transportation employers in Region 5. For practitioners, we will provide continuing education for professionals through a seminar series and through programs with the Local Technical Assistance Programs in our region.

### *Technology Transfer*

RSI will expand our existing partnerships to foster research innovation and deployment that includes increasing public agency and private sector partners, and we will continue to pursue patents and license agreements with the private sector. We will also communicate research findings to the transportation community for their successful implementation. Our goals include creating a consortium website, electronic newsletter, policy briefs, research videos, and an Institute summary report at the completion of the grant. In addition, the Institute will leverage numerous channels to exchange information among partners and provide resources to practitioners, researchers, agencies, and other stakeholders in Region 5. Specific efforts will include communicating information at regional conferences, seminars, and workshops and through presentations and social media outlets.

### *Collaboration*

The Institute will bring together the diverse strengths, knowledge, and experience of our consortium members to work toward the shared goal of reducing fatalities and injuries on our roadways. Through collaboration, RSI will draw on and expand our many successful partnerships with public, private, academic, and not-for-profit entities. Our goal is to advance the roadway safety knowledge base, address critical workforce needs, implement research activities, and transfer research findings using our established relationships.

RSI will create a University Partners Committee to facilitate collaboration and communication with our researchers. An advisory board will also be created to convene regional and national leaders from a variety of external organizations to guide and oversee the delivery of our work. In addition, RSI will coordinate collaborative activities with other safety-related UTCs.

### *Diversity*

RSI will broaden participation and enhance diversity in the transportation sector by supporting female and minority STEM faculty, leveraging the existing Transportation YOU programs in our region, and expanding STEM opportunities for American Indians. Efforts will include identifying ways to support leadership development and recruitment, hiring, promotion, and retention of female and minority STEM graduate students and faculty, and connecting with tribal middle and high schools in Region 5 to engage students in STEM-related activities.

## Accomplishments

### Research

Our consortium draws on our members' safety-related expertise and complementary research strengths to achieve measurable gains in safety.

During this reporting period, 11 of 21 RSI work plans were peer reviewed and finalized with executed contracts. The remaining work plans and contracts are on track to be finalized in the next reporting period. Descriptions of all active projects have been added to the Transportation Research Board (TRB)'s Research in Progress (RiP) database as well as to our website. We will continue to update the RiP database and website as more projects become active.

Other highlights from our active research projects include:

- For his project Developing and Validating a Model of Left-Turn Crashes to Support Safer Design and Operations, Gary Davis has concluded that using both opposing vehicle distance and speed gives a better prediction of left-turn gap acceptance than does time gap.
- For Acquisition of Real-Time Relative Vehicle Trajectories to Facilitate Freeway Merging Using DSRC-based V2V Communication, M. Imran Hayee successfully completed field-testing of a GPS unit and determined that its relative accuracy was appropriate for lane-level resolution.
- For Implementation of a V2I Highway Safety System and Connected Vehicle Testbed, John Hourdos successfully obtained the first wave of necessary equipment for the connected vehicle testbed and began testing and validating the equipment.
- For Performance Measures for Bicycle and Pedestrian Safety: Methodologies for Monitoring Traffic Volumes and Assessing Exposure to Risk, Greg Lindsey confirmed the participation of two case study communities: Minneapolis/Hennepin County, MN, and Grand Marais, MN. He also hired two students to assist with his research.
- For Directional Rumble Strips for Reducing Wrong-Way Driving Freeway Entries, Albert C. J. Luo and his team completed initial field tests in Edwardsville, IL, collecting noise and vibration data from various types of rumble strips and smooth road surfaces.
- For Collaborating with American Indian Communities to Re-Interpret and Strategize about Transportation Safety Risks in Tribal Lands, Kathryn Quick secured Institutional Review Board (IRB) approval in August 2014 and began building relationships and attending quarterly meetings with her partners at the Minnesota Advocacy Council on Tribal Transportation. She and co-PI Guillermo Narvaez also made preliminary site visits to all 11 of Minnesota's reservations. Quick secured permission from the Minnesota Department of Transportation (MnDOT) to gain access to the Minnesota Crash Mapping Analysis Tool and dataset. Finally, Quick and Narvaez won a 2014 IDEA Multicultural Research Award from the Institute for Diversity, Equity, and Advocacy at the University of Minnesota for their initial work on this project.
- For Novel Collision Avoidance System for Bicycles, after conducting simulations and developing a position and orientation estimation system, Rajesh Rajamani found that a quad arrangement of magnetic sensors and a variable sampling-rate sonar sensor are needed for quicker prediction of imminent collisions.

## *Education and workforce development*

The following accomplishments, which occurred during this reporting period, will help us meet our goals of attracting and preparing future transportation professionals and expanding the knowledge of current practitioners:

- In June 2014, RSI sponsored “Advancing Pedestrian Safety: Countermeasures that Work,” a seminar given by Ron Van Houten to about 25 attendees representing local, state, and academic organizations. Van Houten reviewed pedestrian safety assessments and potential treatment options that target the behavior of both pedestrians and drivers to improve safety. He also described a number of successful countermeasures aimed at improving pedestrian compliance at crossings. Following the presentation was a discussion on pedestrian safety issues in Minnesota.
- We have also developed a seminar series featuring RSI researchers discussing their safety-related work in disciplines that include mechanical, civil, and electrical engineering; human factors; statistics; policy and risk analysis; and computer science as well as planning, social, and behavioral issues. All 11 speakers have been invited and confirmed, and the first three events were held, attracting 128 people. The seminars are open to the public and can be taken as a one-credit course at the University of Minnesota; currently, six students are taking the course for credit. We’re also live-streaming the events on the web and posting webcast recordings on our website.
- In July 2014, Nichole Morris participated in an Exploring Careers in Engineering and Physical Science day camp at the University of Minnesota. The week-long program offered a hands-on introduction to science, technology, engineering, and mathematics career opportunities to high school students on campus at the University of Minnesota. Morris taught a course called Introduction to Human Factors Psychology and Engineering, which highlighted the research area of transportation safety, for 25 high school students.
- In August 2014, Chen-Fu Liao and Stephen Zitzow hosted a group of approximately 15 middle school students from Minnesota’s Red Lake Indian Reservation at the University of Minnesota. As part of a federally funded National Summer Transportation Institute, the students learned some basic traffic engineering principles and received a tour of the Minnesota Traffic Observatory.
- We continue working to develop a safety-themed museum exhibit. Institute staff met with the director of traveling exhibits program at the Science Museum of Minnesota and learned that the scope of their exhibits is beyond our Institute’s available resources. Based on this, our staff contacted The Works Museum in Bloomington, MN, which engages kids through exhibits and programs about science, technology, and engineering to make learning memorable and fun. The Works is eager to learn more, and an exploratory meeting will be held next period. We have also developed a list of museums in the region that may be interested in hosting a safety-themed exhibit.
- Our Institute will be awarding up to 15 travel scholarships for graduate students from our consortium to attend the TRB Annual Meeting in Washington, DC, in January 2015. During this reporting period, a process to announce the scholarships and select winners was established. Students will receive up to \$1,000 toward travel and conference expenses.
- We will also select one Outstanding Student of the Year from our consortium. We

established the application and review process for the award for which faculty will nominate students. The selected student will receive a \$2,000 monetary award as well as travel expenses to attend the TRB Annual Meeting in Washington, DC, in January 2015, where he or she will be honored at a reception hosted by the USDOT.

- RSI staff began discussions to expand a summer student internship currently offered through the University of Minnesota in order to create safety-focused student positions. The MnDOT Office of Traffic, Safety, and Technology agreed to host an intern in a safety position the summer of 2015. We also contacted our partner institutes to help us find potential employers in Region 5; our goal is to place at least one student in a safety internship outside of Minnesota (preferably in that student's home state).

### *Technology transfer*

Roadway users will be safer when our research findings are put into the hands of those who can use them to reduce fatalities and injuries. Working toward that goal, the following technology transfer activities occurred during this reporting period.

- Kevin Womack, Associate Administrator for the USDOT, invited two RSI representatives to attend a workshop on pedestrian and bicycle safety in Washington, DC, on September 29, 2014. Institute researchers have previously executed significant research in these two areas, both of which are high priorities for U.S. Secretary of Transportation Anthony Foxx. The Roadway Safety Institute was one of only seven UTCs to attend the event, and RSI director Max Donath and researcher Greg Lindsey were able to discuss our consortium with representatives from other UTCs, NHTSA, the FHWA, and the USDOT.
- We were asked by the USDOT to submit an article on Chen-Fu Liao's work for inclusion in the September 2014 issue of the *UTC Spotlight* e-newsletter. To improve safety for pedestrians who are blind or visually impaired, Liao and his team developed a smartphone app that can detect upcoming work zones and provide routing instructions to the user.
- RSI staff developed and distributed two e-newsletters during this reporting period, one in May 2014 and one in September 2014. Each issue was sent to approximately 1,400 subscribers, with an average open rate of 24 percent. The issues featured updates on RSI activities, an in-depth look at several research projects, and researcher profiles.
- On August 18, 2014, several RSI researchers participated in Congressional Staff Day at the University of Minnesota. The event informed national and Minnesota congressional staff of the broad range of transportation research, education, and outreach initiatives important to Minnesota. RSI director Max Donath along with researchers Janet Creaser, Tom Horan, Chen-Fu Liao, Greg Lindsey, Lee Munnich, and Andrew Owen shared their safety-related work with attendees.
- We updated the RSI website to include all active and in-process research projects. We also redesigned the website for the HumanFIRST Laboratory, the University of Minnesota's driver psychology and human factors lab that is frequently used by several RSI researchers.
- RSI staff further developed branding for the Institute, creating an e-mail template used to promote events and a PowerPoint template for researchers giving presentations. We also delved into the world of social media by establishing Roadway Safety Institute Facebook

- and Twitter accounts as well as a LinkedIn group.
- We wrote an article about the Institute for the summer issue of the Minnesota Local Technical Assistance Program (LTAP) *Technology Exchange* e-newsletter, which was shared with 58 LTAP and Tribal Technical Assistance Program (TTAP) centers. The nearly 1,200 recipients were professionals working in local transportation agencies.
- We began the planning process for a half-day RSI workshop, tentatively scheduled for May 2015 in St. Paul, MN. The workshop, which will focus on safety and highlight RSI researchers, may be held in conjunction with the Center for Transportation Studies (CTS) Annual Research Conference and will be open to regional participants.
- Several RSI researchers presented on safety-related projects at the 2014 CTS Annual Transportation Research Conference in May 2014. Presenters included Janet Creaser, Gary Davis, Chris Edwards, John Hourdos, Chen-Fu Liao, Lee Munnich, Guillermo Narvaez, and Stephen Zitzow.
- On July 16, 2014, Janet Creaser participated in a panel titled The State and Future Direction of Automated Vehicle Human Factors at the 2014 Automated Vehicle Symposium in San Francisco, CA. The symposium, sponsored by TRB, focused on challenges and opportunities related to the increasing automation of motor vehicles as well as the environments in which they operate,
- In September 2014, the Roadway Safety Institute was featured as part of ITS Minnesota's exhibit at ITS World Congress in Detroit. Our staff developed handouts that we distributed at the event, allowing us to promote RSI to an international audience. Researcher Janet Creaser shared her work at the event by participating in a panel titled Human Factor Challenges of Vehicle Automation.

### *Collaboration*

Solving the problem of roadway injuries and fatalities requires multiple approaches from multidisciplinary perspectives. To help the Institute meet this challenge, several efforts were completed during this reporting period.

- We held the first meeting of the University Partners Committee in September 2014. Comprised of RSI researchers, the committee identifies opportunities to collaborate, provides a forum for discussion of consortium priorities, and shares expertise and discusses research needs/issues within the region. All 19 RSI principal investigators were able to attend the first meeting.
- We confirmed the structure and framework of the RSI Advisory Board and created a list of potential members.
- To expand the reach and impact of its work, the Roadway Safety Institute began exploring the idea of establishing a pooled-fund project for which states in our region could contribute money for safety-related research. During this reporting period, we determined a potential structure for the pooled fund and drafted a list of goals, which include conducting safety-related research of regional interest, strengthening the RSI's relationship with regional DOTs, generating non-federal match funding, and positioning researchers for future funding. We also met with MnDOT and the Minnesota division of FHWA, both of whom are open to collaboration. MnDOT has agreed to lead the pooled fund, and Minnesota state safety engineer Brad Estochen has e-mailed his peers in other Region 5 states. If there is interest, we hope to have the pooled fund posted by the end of

the year.

- We developed a list of current education and workforce development activities within Tribal Technical Assistance Programs (TTAPs) in order to identify any gaps that our Institute could fill. The information was presented at the TRB Standing Committee on Highway Safety Workforce Development meeting in July 2014.

### ***Diversity***

A commitment to broadening participation and enhancing diversity in the transportation sector is a critical component of all our activities. The following examples demonstrate how our consortium's activities will increase the participation of groups currently underrepresented in STEM fields.

- In August 2014, Chen-Fu Liao and Stephen Zitzow hosted a group of middle school students from Minnesota's Red Lake tribal community and gave them a tour of the Minnesota Traffic Observatory. Red Lake Nation College, which provides higher education opportunities for tribal members living on and near the Red Lake reservation, received federal funding to host a National Summer Transportation Institute (NSTI).
- RSI staff worked with WTS Minnesota's Transportation YOU mentoring program to begin planning a session at Blaine High School. The curriculum will introduce female high school students to traffic safety and the science behind driver behavior. Transportation YOU's mentoring program introduces girls age 13–18 to a wide variety of transportation careers and encourages them to take courses in math, science, and technology.
- RSI staff met with representatives from WTS Minnesota to discuss two additional potential collaborations. One would pair a female American Indian student, to be identified by RSI, with a transportation mentor, to be identified by WTS. The second project would be a half-day, jointly developed safety-training module to introduce students to transportation safety careers and professionals in the field. RSI would like to use this curriculum for both the WTS Transportation YOU mentoring program and a potential partnership with a tribal-led National Summer Transportation Institute program. We could also potentially share the curriculum with other WTS chapters in Region 5.

### **Opportunities for training and professional development**

Accomplishments are reported in the education and workforce development section.

### **Dissemination**

For the data-based findings and practices resulting from Institute work to effect positive change—specifically, safer roadways—these findings must be delivered to those who can effectively implement them in everyday practice. Our Institute strives to disseminate information not only broadly, but also purposefully. To that end, the following activities occurred during this reporting period.

- The Institute's website is a primary vehicle for distributing information to stakeholders. In this period, the site received 2,668 visits and 15,205 views of individual pages. (This is

a marked increase from the last reporting period, when we attracted 421 visits and 3,837 individual page views.) The most popular pages were the home, faculty, and research pages. The site has recently been redesigned to improve user engagement and navigation, and we continue to update the site with newly approved research projects, events, and publications as needed.

- Seven PIs from our consortium captured media attention in stories highlighting their work in roadway safety.
  - On April 9, 2014, the local ABC affiliate in Minneapolis—KSTP-TV—aired a story featuring Chen-Fu Liao’s research, which focuses on using GPS and Bluetooth technology for smartphone apps to help visually impaired pedestrians navigate work zones. Liao’s work was also featured in a June 29, 2014, Minneapolis *Star Tribune* article that described how the app works and explained Liao’s field-testing process. Finally, the St. Paul *Pioneer Press* ran a brief article about the app on July 15, 2014, in which Liao shared his plans to test the app at an intersection of the University of Minnesota campus.
  - On April 25, 2014, Michigan’s Capital News Service website posted an article about Michigan’s unclear crosswalk safety rules featuring Ron Van Houten. Van Houten described the impact of distracted driving and walking on crashes at crosswalks and explained how various types of crosswalk signs might serve as an effective countermeasure.
  - On June 27, 2014, the website Streets.mn promoted Ron Van Houten’s workshop, Advancing Pedestrian Safety: Countermeasures that Work.
  - On August 18, 2014, the local FOX affiliate in Minneapolis—KMSP-TV—aired a report featuring John Hourdos and Frank Douma that looked at an emerging vehicle-to-vehicle communication technology aimed at helping drivers avoid crashes.
  - On September 5, 2014, the National Conference of State Legislatures blog posted an article featuring Janet Creaser’s Teen Driver Support System (TDSS), which uses a smartphone to alert teens and their parents when a risky driving behavior has occurred. The system can be loaded with state-specific laws as needed.
  - KSTP-TV has contacted Kathryn Quick regarding a series of news pieces on pressing transportation issues in Minnesota. The affiliate plans to cover Quick’s RSI project when results are available.
  - William Schneider shared the goals and objectives of his project with local administration of the Ohio State Highway Patrol.

### **Plans for next reporting period**

There have been no changes to the Roadway Safety Institute’s approved application plans. We anticipate the following activities will take place in the next reporting period (October 1, 2014 – March 31, 2015).

### **Research**

We will finalize the work plans, complete the peer review process, and execute the contracts of all remaining projects. We will also update research project descriptions for all projects as appropriate.

The Institute is requiring all researchers to submit nine-month review reports. In the next reporting period, we will finalize the nine-month review process and start collecting the reports.

- Rahim Benekohal will develop a new accident prediction model for railroad grade crossings as well as an algorithm for the analysis of data from accident reports (Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 1: Accident Prediction Models using Macro and Micro Scale Analysis).
- Daniel Work will conduct a literature review of delay prediction algorithms, including a survey of the availability of train position datasets in the US. (Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 2: Accurate Prediction of Train Arrival Times for Emergency Response Management and Driver Decision Support). They will also develop a statistical algorithm to predict future delays using Gaussian process regression.
- Yanfeng Ouyang will develop mathematical models and techniques to determine the optimal deployment and required capacity of emergency response facilities (Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 3: Positioning, Planning and Operation of Emergency Response Resources, and Coordination between Jurisdictions). They will also design emergency response systems that operate efficiently and cost-effectively while facing uncertainty from rail incidents.
- Stephen Burks will work with RSI staff to finalize his work plan and execute his contract (Exploring Links Between Medical Conditions and Safety Performance in Tractor Trailer Drivers). He will also begin work on his first task, extending a previous program that screens motor vehicle operators for obstructive sleep apnea to a new component—examining the effects of the program on medical insurance utilization and costs incurred by the drivers.
- Janet Creaser will work with RSI staff to finalize her work plan and execute her contract (Design and Evaluation of Human–Machine Interfaces to Support Transfer of Control During Automated Driving). She will also begin work on her first task, using automated driving use cases to develop two human–machine interface designs for future evaluation.
- Gary Davis will complete development of a left-turn crash simulation model and compare the simulation model’s performance to a prediction model developed in one of his previous studies (Developing and Validating a Model of Left-Turn Crashes to Support Safer Design and Operations).
- Frank Douma will complete stakeholder identification, create an initial stakeholder map and interview script, and conduct the majority of the interviews (Identifying and Reconciling Stakeholder Perspectives in Deploying Automated Speed Enforcement).
- Christopher Edwards will work with RSI staff to finalize his work plan and execute his contract (Identifying Driver Warning Strategies to Prevent Bus–Pedestrian Crashes at Left-Turn Intersections). He will also begin work on his first task, which involves identifying intersections with a high frequency of crashes and conducting a review of relevant literature and crash reports.
- M. Imran Hayee will focus on making two varieties of DSRC (Dedicated Short-Range Communication) boxes work with each other to exchange basic safety messages, and on designing the algorithm to determine the relative trajectories of the relevant vehicles (Acquisition of Real-Time Relative Vehicle Trajectories to Facilitate Freeway Merging

Using DSRC-based V2V Communication).

- Thomas Horan will review and assess current uses, data, and interests in using GIS for transportation safety in Minnesota, Wisconsin, and Michigan (Using GIS to Improve Tribal Traffic Safety). Activities will include a comprehensive literature review and interviews and focus groups with tribal safety experts and recommended contacts in the tribal community. An analysis of current and potential data sources will also be conducted, including but not limited to data from such sources as county safety plans and statewide crash analyses.
- John Hourdos will complete equipment testing and finalize his deployment scenario, install and deploy data collection devices, and create a preliminary report on sensor deployment (Implementation of a V2I Highway Safety System and Connected Vehicle Testbed).
- Chen-Fu Liao will begin development of a Bluetooth low-energy prototype system (A Positioning and Mapping Methodology Using Bluetooth and Smartphone Technologies to Support Situation Awareness and Wayfinding for the Visually Impaired).
- Greg Lindsey will develop GIS layers for his chosen case study communities (Performance Measures for Bicycle and Pedestrian Safety: Methodologies for Monitoring Traffic Volumes and Assessing Exposure to Risk). The layers will include attributes such as road or sidewalk networks and land use.
- Albert C. J. Luo will develop a conceptual design for a directional rumble strip that generates stronger vibrations and louder noise for one directional movement and less vibration and noise for the other directional movement (Directional Rumble Strips for Reducing Wrong-Way Driving Freeway Entries).
- Nichole Morris will work with RSI staff to finalize her work plan and execute her contract (Older Driver Support System (ODSS) Usability and Design Investigation). We anticipate Morris will be on maternity leave between December 2014 and March 2015 and will start work on her project when she returns.
- Lee Munnich will form a technical advisory group, review state highway safety plans and Toward Zero Deaths programs, and conduct interviews with key stakeholders in six Midwest states (Assessing Factors Affecting Policy Leadership in Adopting Road Safety Countermeasures).
- Andrew Owen will finish collecting traffic volume data, collect and calculate independent variable data, and collect existing non-motorized crash, injury, and fatality data (Safety in Numbers? Accessibility, Traffic, and Safety of Non-motorized Travelers).
- Kathryn Quick will continue conducting interviews in Minnesota and Washington, DC, and begin preliminary data analysis (Collaborating with American Indians to Re-Interpret and Strategize About Transportation Safety Risks in Tribal Lands). She will also begin the selection process for in-depth study sites.
- Rajesh Rajamani will finish the instrumentation of a Schwinn bicycle with magnetic and sonar sensors and then use estimation algorithms to conduct significant experimental work on the instrumented bicycle (Novel Collision Avoidance System for Bicycles).
- William Schneider will update the crash database to reflect the most current available data (Alcohol Related Hot Spot Analysis and Prediction). Additionally, the study areas will be defined and historical crashes will be mapped.
- Ron Van Houten will work with RSI staff to finalize his work plan and execute his contract (Pedestrian Safety Training Development). He will then begin developing a

pedestrian safety workshop for state and city safety engineers.

### *Education and workforce development*

- The RSI Seminar Series will continue through early December 2014. All presentations will be web-streamed and video recordings will be posted to our website. Grades will be submitted for the students enrolled in the one-credit course at the University of Minnesota. In early 2015, we will begin to explore offering future seminar series for credit at our partner institutions.
- We'll continue to develop our plans for the museum exhibit and will select an initial host museum. We will also reach out to museums in the region to determine their interest in hosting a safety exhibit.
- In November 2014, Student Travel Award winners will be selected. The selected students will attend the TRB Annual Meeting in January 2015, and we will reimburse them upon their return. Students will be required to write a summary of their experiences at TRB. An article will be included in the RSI newsletter announcing the student winners.
- The Outstanding Student of the Year winner will be announced in November 2014 and will attend the TRB Annual Meeting in January 2015 to accept the award. We will process and distribute the student's monetary award and travel reimbursement. An article will be included in the RSI newsletter featuring the student.
- We will finalize the process and structure for the internship program, solicit applications, confirm employers, and select students for summer 2015, with a goal of placing at least one safety internship in Minnesota and one in another state within the region.
- A work plan will be finalized with Ron Van Houten to design and deliver a workshop to train traffic safety professionals on how to change the driving and walking culture of motorists and pedestrians to increase pedestrian safety in urban areas.

### *Technology transfer*

- Relevant content will be added to the RSI website as it becomes available.
- We will participate in the ITS Minnesota Fall Forum by providing event support and by sending two RSI researchers to share their work: RSI director Max Donath, presenting "The Roadway Safety Institute's Research Program: A Connected Vehicles Testbed on I-94," and Frank Douma, presenting "Self-Driving Vehicles: Opportunities and Challenges for Minnesota."
- We will redesign the website of the Minnesota Traffic Observatory, a University of Minnesota laboratory led by John Hourdos and Chen-Fu Liao.
- We will develop and distribute two issues of the *Roadway Safety Institute News* e-newsletter, e-mailing in November 2014 and February 2015.
- We will actively post content and engage with our followers on Facebook, Twitter, and LinkedIn.
- We will finalize details for an RSI workshop, tentatively scheduled for May 2015 in conjunction with the CTS Annual Transportation Research Conference. Planning activities will include determining content, marketing the event to Region 5 participants, and inviting and confirming speakers.
- It's likely that many RSI researchers will deliver podium or poster presentations at the TRB Annual Meeting in January 2015.

### *Collaboration*

- We will schedule and hold virtual meetings of the University Partners Committee in November 2014 and February 2015 and plan an in-person meeting for May 2015.
- We will finalize the list of members for the RSI Advisory Board, confirm their participation, and hold a meeting by the end of 2014. We'll also begin planning for a second meeting in May 2015.
- We will confirm interest from Region 5 DOT safety engineers in a potential pooled-fund project on safety-related research. If confirmed, we will post a solicitation.
- Staff will investigate activities currently under way at other safety-related and/or regional UTCs and look for opportunities to collaborate. For example, in October 2014, RSI staff plan to meet with representatives from Iowa State, the lead institution for the Region 7 UTC, to discuss potential collaborations and joint activities as well as the sharing of research expertise.
- William Schneider will meet with the Minnesota State Patrol in November 2014 to share details about his RSI project and discuss potential collaborations.

### *Diversity*

- The Institute has confirmed participation in the WTS Transportation YOU program and will provide curriculum for a session at Blaine High School in December 2014. The curriculum will introduce female high school students to traffic safety and the science behind driver behavior.
- We will continue discussions with WTS on two potential collaborations: connecting a female American Indian student with a transportation mentor, and jointly developing a half-day safety training module to introduce students from the tribal community to transportation safety careers.
- In December 2014, an RSI staff member plans to attend the Region 2 Tribal Road Safety Peer Exchange in Albuquerque, NM, to build relationships and explore opportunities to collaborate.
- We plan to connect with a University of Minnesota extension professor who currently teaches a class to students from the White Earth reservation, located in northern Minnesota, and explore the idea of adding traffic safety into her program.
- We will support female and minority STEM faculty by initiating conversations and planning with faculty and staff in the College of Science and Engineering at the University of Minnesota.

## **PRODUCTS**

### **Publications, conference papers, and presentations**

The following presentations were given during this reporting period:

- Janet Creaser. "Preliminary Results of the Teen Driver Support System Field Operational Test." CTS Annual Transportation Research Conference. St. Paul, MN. May 22, 2014.
- Gary Davis. "Estimating the Crash Reduction and Vehicle Dynamics Effects of Flashing

LED Stop Signs.” CTS Annual Transportation Research Conference. St. Paul, MN. May 21, 2014.

- Gary Davis. “Using Naturalistic Driving Data to Characterize Driver Behavior in Freeway Shockwaves.” CTS Annual Transportation Research Conference. St. Paul, MN. May 21, 2014.
- Christopher Edwards. “Safer Teen Cars: Effects of In-vehicle Feedback on Teen Drivers’ Risky Behaviors.” CTS Annual Transportation Research Conference. St. Paul, MN. May 22, 2014.
- John Hourdos. “Evaluation of the Effects of Signage and Striping on Safety at a Multilane Roundabout.” CTS Annual Transportation Research Conference. St. Paul, MN. May 22, 2014.
- John Hourdos. “An Examination of Safety and Mobility at Open Versus Closed Access High Occupancy Toll Lane Facilities in Minnesota.” CTS Annual Transportation Research Conference. St. Paul, MN. May 21, 2014.
- Stephen Zitzow. “Investigation of the Impact of a Variable Speed Limit System on Safety and Shockwave Generation Along I-94.” CTS Annual Transportation Research Conference. St. Paul, MN. May 21, 2014.
- Janet Creaser, Christopher Edwards, Nichole Morris, and Max Donath. “Supporting New Teen Drivers During Independent Driving.” National Conference of State Legislatures Legislative Summit. Minneapolis, MN. August 18, 2014.
- Janet Creaser. “Teenage Driver Cellular Phone Use During the First Months of Driving.” Fourth International Symposium on Naturalistic Driving Research. Blacksburg, VA. August 26, 2014.
- Janet Creaser. “Supporting New Teen Drivers During Independent Driving.” RSI Seminar Series. Minneapolis, MN. September 11, 2014.
- Huaguo Zhou. “Emerging Safety Countermeasures for Wrong-Way Driving Crashes.” RSI Seminar Series. Minneapolis, MN. September 18, 2014.
- Greg Lindsey. “Performance Measures for Bicycle and Pedestrian Safety: Challenges in Monitoring Traffic and Assessing Exposure to Risk.” RSI Seminar Series. Minneapolis, MN. September 25, 2014.

The following reports were published during this reporting period:

- Brian Davis and Max Donath. “Development of a Sensor Platform for Roadway Mapping: Part A - Road Centerline and Asset Management.” Center for Transportation Studies, June 2014.
- Nichole Morris, Alice Ton, Jennifer Cooper, Chris Edwards, and Max Donath. “A Next Generation Non-Distracting In-Vehicle 511 Traveler Information Service.” Center for Transportation Studies, October 2014.

The following papers have been submitted for publication:

- Mudgal and Davis. Gap selection behavior at permitted left-turn indications on an urban arterial. Submitted to the Transportation Research Board.
- Quick, Narvaez, and Saunders. Explaining elevated crash risks in tribal lands: a review of the literature and proposed research agenda. Submitted to *Transportation Research Review*. Publication contingent on paper’s acceptance for the TRB Annual Meeting in

January 2015.

### **Websites or other Internet sites**

The Roadway Safety Institute website ([roadwaysafety.umn.edu](http://roadwaysafety.umn.edu)) includes information on research activities, events, news, and key personnel. We have also developed the structure to display research project descriptions and final research reports on the RSI website as they are finalized.

In addition, the Institute's website reaches a wider audience through links to it from the Center for Transportation Studies (CTS) at the University of Minnesota. CTS ([cts.umn.edu](http://cts.umn.edu)) strives to solve persistent transportation problems in innovative new ways by convening diverse communities to brainstorm, debate, share, learn, and act. CTS also partners with local and global transportation professionals, stakeholders, businesses, and leaders to move new ideas from research to reality.

The redesigned HumanFIRST website ([humanfirst.umn.edu](http://humanfirst.umn.edu)) features the work of RSI principal investigators who use the laboratory to conduct psychology and human factors research.

The website of the Connected Vehicles Research Laboratory at the University of Minnesota Duluth ([d.umn.edu/ee/cvrl/](http://d.umn.edu/ee/cvrl/)) includes information on the research of M. Imran Hayee.

### **Technologies or techniques**

Nothing to report.

### **Inventions, patent applications, and/or licenses**

Nothing to report.

### **Other products**

Nothing to report.

## **PARTICIPANTS AND OTHER COLLABORATING ORGANIZATIONS**

### **Organizations that have been involved as partners**

The following partner organizations have committed to providing financial support, in terms of match funding, to the Institute.

- Minnesota Department of Transportation, St. Paul, MN
- Vice President for Research, University of Minnesota, Minneapolis, MN
- College of Science and Engineering, University of Minnesota, Minneapolis, MN
- Humphrey School of Public Affairs, University of Minnesota, Minneapolis, MN
- University of Minnesota Morris

- University of Minnesota Duluth
- University of Illinois at Urbana-Champaign
- Western Michigan University, Kalamazoo, MI
- Southern Illinois University Edwardsville
- University of Akron
- Metro Transit, Minneapolis, MN
- Esri Corporation, Redlands, CA
- City of Kalamazoo, MI
- City of Portage, MI
- City of Detroit, MI
- Michigan Department of Transportation, Lansing, MI
- City of Gainesville, FL

### Other collaborators or contacts

The following organizations have been in collaboration or contact with the Institute during this reporting period.

- RSI director Max Donath has discussed partnering opportunities with the Minnesota Local Road Research board to further advance the work of our Institute and safety across our region.
- RSI staff met with Metro Transit, a transportation service provider for the Twin Cities that offers an integrated network of buses, light rail, and commuter trains, to discuss potential future partnerships aimed at reducing the incidence of collisions between left-turning buses and pedestrians.
- Hugo Zhou met with MnDOT's Freeway Operations Engineer, Brian Kary, at the Regional Traffic Management Center in Roseville, MN.
- Kathryn Quick presented her research to the Advocacy Council on Tribal Transportation in July 2014.
- The Civil Engineering Department at Auburn University has contributed the use of facilities and is participating in collaborative research with Albert C. J. Luo.
- In his project Performance Measures for Bicycle and Pedestrian Safety: Methodologies for Monitoring Traffic Volumes and Assessing Exposure to Risk, Greg Lindsey forged partnerships with key contacts for his case study communities: Kristin DeArruda Wharton and Maren Webb (Sawtooth Mountain Clinic, Grand Marais, MN); Jason Pieper and Nadine Chalmers (Hennepin County, Minneapolis, MN); and Simon Blenski (Minneapolis Department of Public Works).
- RSI Director Max Donath and William Schneider met with representatives from the Minnesota Bureau of Criminal Apprehension in May 2014 to discuss Schneider's work on alcohol-related hot spot analysis. The Minnesota BCA is currently working on a similar project to locate impaired motor vehicle operators before a crash occurs.
- William Schneider has shared the goals and objectives of his project with local administration of the Ohio State Highway Patrol.
- RSI director Max Donath is collaborating with Otter Tail, Washington, St. Louis, and Carver counties in Minnesota on a project called Development of a Digital Highway Framework to Facilitate Crash Avoidance.

## IMPACT

### **Impact on the development of the principal discipline(s) of the program**

The work of the Roadway Safety Institute will provide society with solutions to improve safety and public health for all users of our region's and nation's roadways. By identifying critical areas of focus such as automated speed enforcement, intersections, rail grade crossings, and speeding, our team's efforts will help to prevent fatal and serious-injury crashes for those users—whether pedestrians, bicyclists, motorcyclists, commercial truck drivers, impaired drivers, or tribal land travelers—who have a greater risk propensity. Specific guidance will be created that state and national agencies can use to address these priorities and improve roadway safety.

Our work will also help state departments of transportation and other agencies implement design- and operation-related safety solutions that reduce fatalities and life-changing injuries. Specifically, we will focus on issues that have been inadequately addressed to date. Our projects will examine policy issues, operational safety, rail grade crossings, and automated speed enforcement.

Regarding his project Pedestrian Safety Training Development, Ron Van Houten anticipates that his work will have an impact on traffic engineering by introducing new ways to use the R1-6 sign more effectively and by imparting a better understanding of how to use the pedestrian countdown timer, the rectangular rapid-flash beacon, and the pedestrian hybrid beacon.

### **Impact on other disciplines**

Regarding her project Collaborating with American Indian Communities to Re-Interpret and Strategize about Transportation Safety Risks in Tribal Lands, Kathryn Quick says the project will impact public health in that the methods she is using are designed to complement previous population-level, epidemiological studies of the elevated crash rate among American Indians.

For his project Pedestrian Safety Training Development, Ron Van Houten anticipates that his work will influence planning by helping planners to use engineering, enforcement, and education to change driving culture and improve pedestrian safety.

### **Impact on physical, institutional, and information resources**

Regarding her project Collaborating with American Indian Communities to Re-Interpret and Strategize about Transportation Safety Risks in Tribal Lands, Kathryn Quick says her research team is seeking to complement ongoing efforts by the University of Minnesota to improve collaborative relationships, strengthen models and patterns of engaged scholarship, and provide training opportunities for American Indian tribal governments and community members. They have been communicating with others at the University involved in research with American Indian communities about how to proceed thoughtfully in this work and plan to reach out to other relevant faculty and centers on campus.

## **Impact on transportation workforce development and human resources**

RSI's education and workforce development efforts will offer opportunities to engage future transportation professionals in safety-related concepts and careers, enrich the educational experience of university students, and provide professionals with the tools and resources they need to improve roadway safety. The outcomes associated with these activities will support the development of a diverse transportation workforce.

During this reporting period, we have provided transportation-related educational activities for middle school, high school, and graduate students via tours and summer camp courses as well as our weekly seminar series. Through Ron Van Houten's June 2014 workshop, we have educated professionals in the field about effectively using countermeasures to improve pedestrian safety.

In his project Performance Measures for Bicycle and Pedestrian Safety: Methodologies for Monitoring Traffic Volumes and Assessing Exposure to Risk, Greg Lindsey has hired two students to work a combined 15 hours per week. The students will gain both research and practical work experience.

## **Impact on technology transfer**

RSI's technology transfer activities will lead to the implementation of research results and promote a safer transportation system. Through partnerships, RSI faculty and researchers will be successful in technology transfer.

## **Impact on society beyond science and technology**

The Institute's work will result in real-world applications—such as policy approaches as well as engineering and technology solutions—to mitigate the human and economic toll of traffic crashes and traffic-related fatalities by improving safety on our roadways.

## **CHANGES/PROBLEMS**

### **Changes in approach and reasons for change**

In lieu of his original research project, we made the strategic decision to redirect Ron Van Houten's expertise towards developing a pedestrian safety workshop for state and city safety engineers. We believe this effort will result in reaching more practitioners to implement the results of his extensive previous research, which will have a greater impact on pedestrian safety, and therefore is a better use of the Institute's time and funding.

Although we originally identified the Science Museum of Minnesota as a venue for our safety-themed museum exhibit, a meeting with that museum's staff has determined that the scope of exhibits there is beyond our Institute's available resources. We will therefore be working to identify alternate venues in both Minnesota and Region 5.

Regarding his project Identifying and Reconciling Stakeholder Perspectives in Deploying



Automated Speed Enforcement, Frank Douma notes that the task of stakeholder mapping may progress more in parallel with interview script development, as research into the latter may also inform perspectives useful to the former.

For his project Acquisition of Real-Time Relative Vehicle Trajectories to Facilitate Freeway Merging Using DSRC-based V2V Communication, M. Imran Hayee has decided to order two additional 10 Hz Savari DSRC boxes instead of using older 1 Hz units. Using the more advanced boxes assists in GPS positioning.

### **Actual or anticipated problems or delays and actions or plans to resolve**

Regarding his project Implementation of a V2I Highway Safety System and Connected Vehicle Testbed, John Hourdos explains that there will be a delay in procuring a complete set of required sensors. While enough sensors exist to begin feasibility tests, the full set will not be available until January 2015 or later.

For his project Assessing Factors Affecting Policy Leadership in Adopting Road Safety Countermeasures, Lee Munnich reports a delay in both hiring a project assistant and setting up a technical advisory group. His project timeline will be adjusted accordingly.

### **Changes that have significant impact on expenditures**

A research engineer has resigned from John Hourdos' project, Implementation of a V2I Highway Safety System and Connected Vehicle Testbed. Because of his replacement's higher salary, efforts will need to be redistributed. Hourdos does not anticipate that this change will have a major impact on the overall project budget.

### **Significant changes in use of care of human subjects, vertebrate animals, and/or biohazards**

For her project Collaborating with American Indian Communities to Re-Interpret and Strategize about Transportation Safety Risks in Tribal Lands, Kathy Quick has decided to pursue an optional Certificate of Confidentiality from the National Institute of Health. In concert with the project's IRB-approved consent procedure, which was obtained in August 2014, the optional certificate will give a greater level of protection for study participants.

### **Change of primary performance site location from that originally proposed**

Nothing to report.