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Contents

Accomplishments ................................................................. 1
  Major goals and objectives of the program ................................................................. 1
Accomplishments ................................................................. 2
Opportunities for training and professional development ............................................... 7
Dissemination ............................................................................. 7
Plans for next reporting period ....................................................................................... 8

Products .................................................................................. 11
  Publications, conference papers, and presentations ....................................................... 11
  Websites or other Internet sites ..................................................................................... 12
  Technologies or techniques .......................................................................................... 12
  Inventions, patent applications, and/or licenses ........................................................... 12
  Other products ........................................................................................................... 12

Participants and Other Collaborating Organizations ..................................................... 12
  Organizations that have been involved as partners ....................................................... 12
  Other collaborators or contacts .................................................................................... 13

Impact ...................................................................................... 13
  Impact on the development of the principal discipline(s) of the program ....................... 13
Impact on other disciplines ............................................................................................ 14
Impact on physical, institutional, and information resources ........................................... 14
Impact on transportation workforce development and human resources ....................... 15
Impact on technology transfer ....................................................................................... 15
Impact on society beyond science and technology ......................................................... 15

Changes/Problems ..................................................................... 15
  Changes in approach and reasons for change ............................................................... 15
  Actual or anticipated problems or delays and actions or plans to resolve ....................... 16
Changes that have significant impact on expenditures .................................................... 16
Significant changes in use of care of human subjects, vertebrate animals, and/or biohazards 16
Change of primary performance site location from that originally proposed ................... 16
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 is focusing 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 is addressing 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 are, for example, examining enhanced law enforcement strategies, rail grade crossings, and operational safety in intersections.

The Institute is also focusing 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 is working to develop strategies that can be put to use. In addition, our research is investigating 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 is developing 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, or 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 are enhancing our university degree-granting programs by supporting user-centered transportation safety curriculum development that prepares students to take an integrated approach in addressing transportation safety as a public health issue. The Institute is also continuing and adapting our transportation internship program to connect students to transportation employers in Region 5. For practitioners, we are providing continuing education for professionals through a seminar series and through programs with the Local Technical Assistance Programs in our region.
Technology Transfer
We are working to 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 are also communicating research findings to the transportation community for their successful implementation. We have created a consortium website and electronic newsletter and plan to create policy briefs, research videos, and an Institute summary report. In addition, the Institute is leveraging numerous channels to exchange information among partners and provide resources to practitioners, researchers, agencies, and other stakeholders in Region 5. Specific efforts include communicating information at regional conferences, seminars, and workshops and through presentations and social media outlets.

Collaboration
The Institute is bringing 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.

Diversity
We are working to 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 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.

Programmatic research accomplishments include:

- During this reporting period, the seven remaining RSI work plans were peer reviewed and finalized with executed contracts. Descriptions of all 18 active projects are available on our website as well as in the Transportation Research Board (TRB)’s Research in Progress (RiP) database.
- In the past six months, we’ve identified 11 projects as eligible for match funding; all projects are funded by the Minnesota Department of Transportation (MnDOT). We’ve also identified 16 additional projects that may count as match; we plan to verify their eligibility during the next reporting period.
- As part of their contracts, RSI researchers are required to submit Nine-Month Progress Reports. These reports undergo peer review to determine whether a project will receive a second year of funding. During this reporting period, six researchers submitted their reports, and two have been peer-reviewed and approved to receive continued funding.
- RSI director Max Donath was selected to lead a new project titled Test and Demonstration of Connected Vehicles Applications to Maintenance Operations. The project, which focuses on the use of commercially available connected vehicles technology for coordinated and cooperative vehicle applications, will serve as the basis for MnDOT’s Connected Vehicles Pilot Demo Proposal to the USDOT. This project builds on previous work accomplished by the Roadway Safety Institute and the former ITS Institute.
Highlights from active research projects include:

• **Developing and Validating a Model of Left-Turn Crashes to Support Safer Design and Operations:** Gary Davis concluded that the natural logarithm of the time gap was the best predictor of whether a driver accepts a gap. He also found a significant positive correlation between the duration of an accepted gap and the time used to complete a left turn.

• **Development and Demonstration of Merge-Assist System using Connected Vehicle Technology:** Imran Hayee completed field testing to determine the relative accuracy of GPS units and found the results sufficient for lane-level resolution. He also developed a Dedicated Short-Range Communications (DSRC) interface for an Android-based tablet that shows relative trajectories in real time.

• **Implementation of a V2I Highway Safety System and Connected Vehicle Testbed:** John Hourdos developed an initial, limited version of an infrastructure-based Q-WARN system that can be used to demonstrate the final project goals.

• **A Positioning and Mapping Methodology Using Bluetooth and Smartphone Technologies to Support Situation Awareness and Wayfinding for the Visually Impaired:** Chen-Fu Liao developed a trilateration algorithm that estimates a user’s location based on multiple Bluetooth low-energy signals. He also identified several commercially available BLE modules that may fit the project’s needs.

• **Performance Measures for Bicycle and Pedestrian Safety: Methodologies for Monitoring Traffic Volumes and Assessing Exposure to Risk:** Greg Lindsey confirmed four case study communities in Minnesota: Minneapolis, Duluth, Bemidji, and Grand Marais. Research is nearly completed on the Minneapolis case study, which includes identifying trail crossings that may need traffic controls or site investigations. Preliminary research results have been shared with MnDOT, which will soon begin funding a network of 30 to 50 automated bicycle and pedestrian monitors around the state to collect further data.

• **Directional Rumble Strips for Reducing Wrong-Way Driving Freeway Entries:** Albert Luo conducted an initial field test of rumble strips and used the results to develop a mechanical model that predicts vibrations of the vehicle and its passengers. The team also developed several new conceptual designs for directional rumble strips, one of which they’ve already determined to be unusable.

• **Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 3—Reliable Planning and Coordination of Emergency Responses to Railroad Incidents:** Yanfeng Ouyang has developed models to address complexities associated with disruptions to correlated transportation networks often seen after railroad incidents and the impacts on the emergency response system. He’s currently drafting two related papers for publication.

• **Safety in Numbers? Accessibility, Traffic, and Safety of Non-motorized Travelers:** Andrew Owen collected pedestrian network data, block-level job count data, and block-level pedestrian accessibility to jobs for 50 metro areas in the United States.

• **Collaborating with American Indian Communities to Re-Interpret and Strategize about Transportation Safety Risks in Tribal Lands:** Kathy Quick and Guillermo Narvaez report that four tribal governments in Minnesota have agreed to participate in case studies. Quick and Narvaez are currently working with the Red Lake Band of Chippewa Indians and the Fond du Lac Band of Lake Superior Chippewa to finalize formal research agreements, and they will secure formal agreements with the Mille Lacs Band of the Ojibwe and the Leech Lake Band of the Ojibwe during the next reporting period. After analyzing data from initial interviews with tribal representatives, Quick and Narvaez have also identified several patterns in perceived sources of risk, including coordination problems among jurisdictions, inconsistent use of safety restraint systems, and poverty and isolation.

• **Novel Collision Avoidance System for Bicycles:** Rajesh Rajamani has developed an initial collision warning system that can reliably estimate vehicle position and orientation for two scenarios: rear collision and right-turning vehicles at an intersection. He’s also discovered that laser sensors are more suitable than magnetic sensors for his purposes.
- **Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 2—Real-Time Prediction and Monitoring of Potential Conflicts at Grade Crossings**: Daniel Work discovered a delay pattern in data obtained from Amtrak. Delays occur more frequently at some points on the track than others, and once a delay occurs it tends to increase in severity rather than immediately dissipating. Finding this pattern will help Work develop a machine-learning algorithm to estimate delays.

Finally, during this reporting period, RSI personnel received the following awards:
- Nichole Morris received the Best Practices in Traffic Records Award from the Association of Transportation Safety Professionals in October 2014. The award honors projects that improve data capture, manipulation, and evaluation related to traffic records. Morris’s winning project, *Computerized Crash Reports Usability and Design Investigation*, is being used as match for our UTC grant.
- Max Donath, director of the Roadway Safety Institute, received the Kathy Swanson Outstanding Service Award at the Minnesota Toward Zero Deaths Conference in November 2014. The award was given in recognition of Donath’s exceptional leadership in efforts to improve traffic safety in Minnesota, build partnerships, and mentor others in the field.

**Education and workforce development**
During this reporting period, here’s what we accomplished toward meeting our goals of attracting and preparing future transportation professionals and expanding the knowledge of current practitioners.
- We delivered the remainder of our seminar series, which featured RSI researchers discussing their safety-related work in a variety of disciplines. Between October 1 and December 6, 2014, eight events were held that attracted 237 people. The seminars were open to the public and also live-streamed on the web. The RSI Seminar Series was also offered as a one-credit course at the University of Minnesota, and six graduate students in the College of Science & Engineering completed it. Recordings of the events can be found on our website.
- In January 2015, RSI staff presented a roadway safety lesson to 90 students in grades 3–4 during the Creativity Festival, a program that introduces students to the value of creative thinking across a wide array of fields ranging from engineering to art. During RSI’s lesson, students traveled on “roads” throughout a mock town and were given time to brainstorm and implement various ways to lower collisions and congestion. Through this hands-on activity, students explored how engineers, planners, and policymakers work creatively to promote safe roadways.
- In January 2015, we met with representatives from The Works Museum in Bloomington, MN, to partner and plan for an upcoming exhibit on roadway safety. The Works engages kids through exhibits and programs on science, technology, and engineering.
- In February 2015, RSI staff participated in Tech Fest, a daylong activity for young children and families hosted by The Works Museum. We offered hands-on activities related to roadway safety, including pedestrian and bike counting sensors that demonstrated engineering technology to the children attending and a road sign art project that helped them consider how signs influence people’s behavior or provide safety information. More than 1,000 people attended the event.
- The Institute awarded 13 travel scholarships to master’s and doctorate students to attend the TRB Annual Meeting in January 2015. The scholarships, which awarded up to $1,000 toward travel and conference expenses, exposed students to current transportation research and provided important networking opportunities.
- At the TRB Annual Meeting, Stephen Zitzow, a graduate student in the University of Minnesota’s Department of Civil, Environmental, and Geotechnical Engineering, was named our Outstanding Student of the Year. Zitzow’s master’s thesis focuses on the layout of high-occupancy toll lanes, culminating in a tool for practitioners to design facilities for either an open- or closed-access framework.
• We secured a safety-related summer internship in MnDOT’s Office of Traffic Safety and Technology for a University of Minnesota undergraduate student. The internship will begin in early June 2015 and provide the student with hands-on professional experience. Participants work on transportation-focused projects and are provided with mentoring, training, and development opportunities.

• Janet Creaser led an all-day human factors workshop—“Design Principles for Highly Automated Driving: Practical Lessons from Research”—at the TRB Annual Meeting. The workshop taught participants about the key design issues related to human-machine interfaces for automated vehicles and engaged them in an educational design process.

See the Diversity section for further updates related to education and workforce development.

**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. Toward that goal, we spread this information in varied ways to reach both specific groups and broad audiences—from conference presentations to social media. During this reporting period, we engaged in the following technology transfer activities:

• To promote our work, we developed two one-page handouts—one that gives an overview of the Institute, and another that describes RSI research projects and educational initiatives related to tribal roadway safety. The handouts have been shared in a variety of venues, including safety-related meetings at TRB; a Minnesota County Engineers Association meeting in January 2015; and the Region 2 Tribal Road Safety Peer Exchange in Albuquerque, NM, in December 2014. The handouts are also available on our website.

• During this reporting period, RSI staff developed and distributed two issues of our e-newsletter covering research progress, seminars and educational activities, and researcher expertise, among other content. One issue was published in December 2014 and one in February 2015. Each issue was sent to 1,492 subscribers, with an average open rate of 23.5 percent. We also sent e-announcements relating to the seminar series and our upcoming safety-themed conference.

• We redesigned the Minnesota Traffic Observatory (MTO) website with a more inviting design, easy-to use navigation, and updated content. The MTO is a transportation laboratory that tests and evaluates new transportation management and operational strategies and traveler information technologies. The lab is used frequently by several RSI researchers.

• We created a news feed on the Institute’s blog and home page that displays recent headlines from around the nation related to the Institute’s focus areas. We also posted regular news updates to the RSI Facebook, Twitter, and LinkedIn accounts.

• We developed a featured research web page describing Chen-Fu Liao’s current and previous work on safety for pedestrians with visual impairments.

• We secured the date and location for the Roadway Safety Showcase—Thursday, May 21, 2015, at RiverCentre in St. Paul, MN. This safety-themed, RSI-sponsored conference will include traditional lecture presentations in sessions titled “Improving Road Safety in Tribal Nations” and “Improving Railroad Grade Crossing Safety at the Regional Level,” as well as brief, “rapid fire” project updates in sessions titled “Technology and Roadway Innovations” and “Safety Policy and Human Factors.”

• RSI director Max Donath wrote an editorial for *Conversations*, a blog hosted by the Center for Transportation Studies at the University of Minnesota. “A solution needed NOW to keep drivers from texting” argued that the wireless and transportation industries should work together to develop systems that prevent drivers from texting while driving.

• In March 2015, Donath attended “A Summit of University Transportation Centers for Safety.” The summit, organized and hosted by Carnegie Mellon University, brought together multiple safety-focused UTCs along with government and industry leaders including Greg Winfree, Assistant Secretary of the USDOT for Research and Technology, to share ideas and develop partnerships. Donath gave a brief presentation on RSI research and educational initiatives.
In March 2015, Donath led a tour of the Minnesota Traffic Observatory for representatives from General Motors including Ken Kelzer, Vice President of Global Vehicle Components and Subsystems; Gary Smyth, Executive Director of Global R&D Laboratories; and Cynthia Bay, Director of Active and Passive Safety Electronics and Controls. Donath shared details on the traffic safety research being conducted by the Institute and discussed potential collaborations with Kelzer, Smyth, and Bay.

Greg Lindsey’s work on nonmotorized traffic monitoring research was featured in the FHWA’s Livable Communities Case Study Series. The case study can be found online at fhwa.dot.gov/livability/case_studies/minneapolis/index.cfm.

Janet Creaser, Max Donath, Frank Douma, David Levinson, Nichole Morris, and Lee Munnich served as moderators and panelists for an October 2014 conference on autonomous vehicles held at the University of Minnesota. The conference, titled “Autonomous Vehicles: The Legal and Policy Road Ahead,” convened a multidisciplinary group of leaders from academia, government, industry, and civil society to explore the legal, ethical, technical, and policy dimensions of automated and autonomous vehicles at the local, state, and national levels.

Kathy Quick and Guillermo Narvaez attended the December 2014 Tribal Transportation breakfast hosted by the USDOT as part of the annual White House Tribal Summit, as well as the Wisconsin Tribal Transportation Safety Summit in October 2014. At the events, they shared information about their project and distributed the Institute’s tribal safety one-pager.

In December 2014, RSI staff member Jim Grothaus attended a Region 2 Tribal Road Safety Peer Exchange in Albuquerque, NM, to share information about the Institute’s tribal-related initiatives with tribal safety professionals.

In January 2015, Jim Grothaus attended the annual meeting of the Minnesota County Engineers Association to give a brief presentation on the Institute and its initiatives. There were 150 people in attendance, representing 82 of Minnesota’s 87 counties.

**Collaboration**
Solving the problem of roadway injuries and fatalities requires multiple approaches from multidisciplinary perspectives. To help the Institute meet this challenge:

- We’ve invited and confirmed 14 members for the RSI Advisory Board. The members include transportation professionals and legislators from Region 5 and the federal government. The first meeting of the Advisory Board was held in December 2014, and plans are underway to hold future meetings in May and October 2015.

- We gathered members of the University Partners Committee via conference call in December 2014 and in March 2015. Made up of RSI researchers, the committee identifies opportunities to collaborate, provides a forum for discussing consortium priorities, shares expertise, and discusses research needs and issues within the region. We also scheduled future meetings for July and November 2015 and made plans to hold a dinner meeting in conjunction with the Roadway Safety Showcase in May 2015.

- The Institute moved forward with plans for a potential pooled-fund project for which states in our region could contribute money for safety-related research. In October 2014, RSI director Max Donath made phone calls to the Region 5 state safety engineers to gauge their interest. The reaction was positive, and we spent the rest of the fall developing outreach materials and generating research ideas. In February 2015, Minnesota state traffic safety engineer Brad Estochen led a conference call for his peers to further discuss this opportunity and identify the highest priority research areas. Representatives from all Region 5 states have been engaged in the discussion. We plan to hold another conference call in early April 2015 to select a research idea and review a draft pooled-fund solicitation.
• In January 2015, Kathy Quick presented “Research and Training to Improve Tribal Area Transportation Safety” to the Advocacy Council on Tribal Transportation (ACTT). This presentation included an overview of the Institute’s two tribal-related research projects as well as related educational and outreach initiatives. Through her work with ACTT, Quick has formed agreements with four tribal governments to participate in case studies for her project.

• During this reporting period, William Schneider had several meetings with representatives from the Ohio DOT to discuss potential research ideas and collaborations, including the Region 5 pooled fund. His team also discussed their research with the Stark County (OH) OVI Task Force, the California Highway Patrol, and NHTSA. Lastly, Schneider met with the Minnesota State Patrol in November 2014 to share details about his RSI project and discuss potential collaborations.

Diversity
The Institute is committed to broadening participation and enhancing diversity in the transportation sector through all our activities. Here are some ways we’re working to increase participation by groups currently underrepresented in STEM fields.

• We have contacted all of the WTS chapters in Region 5 to look for partnership opportunities related to STEM education. After inventorying their current K-12 STEM curriculum, we gauged interest in creating a toolkit of pre-made safety curriculum for a variety of ages. Several chapters expressed interest in having RSI serve as a resource to collect, create, and share curriculum and best practices for engaging K-12 youth.

• In December 2014, Janet Creaser visited Blaine High School to present her research on the Teen Driver Support System and invite participants to share their own ideas about how to promote safe driving behavior. The event was organized in partnership with Transportation YOU, a mentoring program sponsored by WTS Minnesota. Though discussion, videos, and interactive activities, the 10 student attendees explored this challenging issue.

• RSI is planning a curriculum for the White Earth Summer Academy of Math and Science in June 2015. This program is offered for American Indian students on the White Earth Reservation in northern Minnesota. During this reporting period, we have been building a relationship with the program organizers and beginning to plan one day of program content.

Opportunities for training and professional development
Accomplishments are reported in the Education and Workforce Development section.

Dissemination
For the results of Institute work to effect positive change—specifically, safer roadways—they must be delivered to those who can effectively implement them in everyday practice. We strive to communicate this information broadly and purposefully through the following activities.

• The Institute’s website is a primary vehicle for distributing information to stakeholders. In this period, the site received 3,415 visits and 13,582 views of individual pages. The most popular pages were the home, research, and seminar series pages.

• Six PIs from our consortium captured media attention in stories highlighting their work in roadway safety.
  o On November 6, 2014, the local ABC affiliate in Minneapolis aired a story about Minnesota’s transportation infrastructure featuring Kathy Quick. Drawing on her expertise facilitating government–general public problem solving, Quick explained the challenges of finding funding for infrastructure improvement. The story aired as part of a larger investigative series titled “Rebuilding Minnesota.”
On February 5 and 6, 2015, five separate media outlets featured Janet Creaser’s Teen Driver Support System, a smartphone app that alerts teen drivers and their parents when the teen engages in risky behaviors such as speeding or texting while driving. The local ABC, CBS, and FOX affiliates in Minneapolis aired video interviews and demos with Creaser; Minnesota Public Radio broadcast a 4-minute audio feature; and the Minneapolis Star Tribune published a newspaper article.

On February 18, 2015, the local ABC affiliate in Minneapolis 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. The app is being distributed by MnDOT, which funded Liao’s research.

On February 22, 2015, the Minneapolis Star Tribune published a story titled “The Drive: Why we don’t have more flashing yellow arrows.” The article featured Gary Davis, who is developing a statistical model to determine whether a flashing yellow arrow is appropriate for various intersections.

On February 23, 2015, the Star Tribune also announced that Greg Lindsey had been named MnDOT’s first “Scholar-in-Residence.” [See the Other Collaborators or Contacts section for more information.]

On March 25, 2015, the University of Minnesota’s student newspaper, the Minnesota Daily, published an article describing a study by Frank Douma on whether exempting low-level speeding tickets from a driver’s record has any impact on travel reliability, safety, or efficiency. Douma concluded that omitting these tickets does not improve safety and may increase a driver’s insurance premiums.

### 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 (April 1, 2015 – September 30, 2015).

### Research

- During the next reporting period, 12 more PIs will submit their Nine-Month Progress Reports in an effort to secure continued funding for their projects.
- We will verify the eligibility of 16 additional projects that may count as match.
- Rahim Benekohal will continue to develop a new crash prediction model for railroad grade crossings and an algorithm for a dynamic tree structure to analyze crash trends (Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 1—Accident Prediction Models Using Macro and Micro Scale Analysis).
- Stephen Burks will begin analyzing related medical and pharmaceutical insurance claims costs and develop more sophisticated statistical models if needed (Exploring Links between Medical Conditions and Safety Performance in Tractor Trailer Drivers). He will also begin drafting a paper on this topic for submission to a relevant medical journal.
- Gary Davis will reconstruct samples of left-turn crashes from NHTSA’s National Automotive Sampling System and Crashworthiness Data System. He will then compare characteristics of simulated crashes to those of the reconstructed crashes (Developing and Validating a Model of Left-Turn Crashes to Support Safer Design and Operations).
- Frank Douma will complete all stakeholder interviews, analyze interview transcripts, and draft a report of his initial findings (Identifying and Reconciling Stakeholder Perspectives in Deploying Automated Speed Enforcement).
- Imran Hayee will verify that his DSRC devices are working across multiple platforms (Development and Demonstration of Merge Assist System using Connected Vehicle Technology). He will then conduct field tests on the freeway to acquire simultaneous relative trajectories of multiple lanes.
Tom Horan will conduct interviews with tribal safety experts, analyze his data sources, develop a preliminary traffic safety prototype, and assess initial reactions from tribal representatives (Using GIS to Improve Tribal Traffic Safety).

John Hourdos will deploy the full complement of sensors, conclude the Q-WARN application, and demonstrate its operation with a test vehicle (Implementation of a V2I Highway Safety System and Connected Vehicle Testbed).

Chen-Fu Liao will develop a smartphone application to collect data and test a new BLE prototype system (A Positioning and Mapping Methodology Using Bluetooth and Smartphone Technologies to Support Situation Awareness and Wayfinding for the Visually Impaired). He will also design a database system that includes BLE tag information.

Greg Lindsey will complete his Minneapolis case study and submit a research paper for peer review and publication (Performance Measures for Bicycle and Pedestrian Safety: Methodologies for Monitoring Traffic Volumes and Assessing Exposure to Risk). He will also execute bicycle and pedestrian counting in the other case study communities.

Albert Luo will continue to develop and test conceptual designs for directional rumble strips (Directional Rumble Strips for Reducing Wrong-Way Driving Freeway Entries). He’ll also conduct field tests of transverse rumble strips and collect related sound and vibration data.

Nichole Morris will conduct focus groups and interviews with older drivers (Older Driver Support System (ODSS) Usability and Design Investigation) and will start work on an ODSS interface display survey.

Lee Munnich will continue interviews and initiate roundtables with key stakeholders in six Midwest states (Factors Affecting the Adoption of Evidence-based Approaches to Road Safety by State Policymakers).

Yanfeng Ouyang will develop a mathematical model to determine how to optimally deploy emergency vehicles (Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 3—Reliable Planning and Coordination of Emergency Responses to Railroad Incidents). He will begin work on designing an emergency response system that operates efficiently while facing uncertainty from rail incidents.

Andrew Owen will calculate network centrality metrics for each link in the pedestrian networks in his study (Safety in Numbers? Accessibility, Traffic, and Safety of Nonmotorized Travelers). He will also finish collecting existing nonmotorized crash, injury, and fatality data.

Kathy Quick and Guillermo Narvaez will finalize written agreements with three tribal governments, develop work plans for their case studies, and begin collecting data (Collaborating with American Indian Communities to Re-Interpret and Strategize about Transportation Safety Risks in Tribal Lands). The team will continue to build relationships with tribal transportation leaders and share their research at the National Indian Affairs Council’s Tribal Leader Scholar Forum in June 2015.

Rajesh Rajamani will enhance the instrumentation of his test bicycle and begin significant experimental work at real-world intersections (Novel Collision Avoidance System for Bicycles).

William Schneider will use updated historic crash data to better determine significantly clustered crash areas (Alcohol-Related Hot Spot Analysis and Prediction for Improving DWI/OVI Law Enforcement). The areas identified will then be used to help optimally deploy safety campaigns.

Daniel Work will apply a regression model to computed historical data (Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 2—Real-Time Prediction and Monitoring of Potential Conflicts at Grade Crossings), then propose an online regression model to estimate train travel time delays.

**Education and workforce development**

We will plan for and begin delivering the Fall 2015 Seminar Series. Like last fall, we will offer the series for credit at the University of Minnesota. We will also explore offering the series for credit at our partner institutions.
We will move forward with our museum exhibit at The Works by holding focus groups for kids ages 5–12 to test traffic safety concepts and gather feedback. We’re specifically interested in their base knowledge about intersection and road crossing safety and will use the results to develop the exhibit content. Over the summer, we’ll develop a formal workplan and budget, with the goal of opening the exhibit in spring 2016. We hope to eventually have a presence at other Region 5 museums and so will explore the possibility of a traveling exhibit or replica installations.

The paid summer internship at MnDOT’s Office of Traffic Safety and Technology will run from June 3 to August 11, 2015. The undergraduate student intern, Caitlin Nuce, will receive hands-on experience working on transportation-related projects and learning from professionals in the field.

Over the summer, we will work with Ron Van Houten to develop and deliver his pedestrian safety training workshop to transportation professionals throughout the region. Van Houten will share current pedestrian safety issues, including safety assessments, and potential treatment options that target the behavior of both pedestrians and drivers to improve safety. Following the presentation, a facilitator will lead the group in a discussion to identify current pedestrian safety concerns.

Technology transfer
- We will develop featured research web pages and fact sheets summarizing research in the areas of rail grade crossing safety and connected vehicles.
- We will distribute two issues of our e-newsletter, in May and August 2015. E-announcements will be sent as appropriate.
- We will continue to update our safety news feed; the RSI, HumanFIRST, and MTO websites; and the RSI social media channels.
- The Roadway Safety Showcase will be held on Thursday, May 21, 2015, in St. Paul, MN. The daylong program will include a panel on tribal safety moderated by Greg Winfree and presentations by 19 RSI researchers on their safety-related work.
- We will work with the Tribal Technical Assistance Programs to add RSI links in the resource sections on their websites. We may also pursue a similar initiative with Local Technical Assistance Programs in Region 5.

Collaboration
- The RSI Advisory Board will meet on May 28, 2015, on the University of Minnesota campus in Minneapolis.
- University Partners Committee members who attend the Roadway Safety Showcase will gather for a dinner meeting with Greg Winfree on May 20, 2015. We will also hold an all-day UPC meeting on July 16, 2015, in Minneapolis.
- The Region 5 state safety engineers will meet via conference call on April 7, 2015, to prioritize research areas and review a draft solicitation for the safety-related pooled fund. We plan to have the solicitation posted in late spring or early summer.
- RSI director Max Donath has been invited by the University Transportation Research Center—the Region 2 UTC—to speak before the New Jersey DOT in July. The group will discuss potential collaborations between the regions.

Diversity
- We will continue to strengthen our relationships with Region 5 WTS chapters and develop tools to share best practices and STEM curriculum across the region.
On June 16, 2015, we will deliver a day of curriculum at the White Earth Summer Academy of Math and Science. The program will be delivered to approximately 45 students in grades 4 through 8. Activities will focus on teaching them to be safe road users as pedestrians, vehicle passengers, and bicyclists. Throughout these lessons, students will be introduced to STEM careers, meet tribal transportation professionals, and connect their cultural heritage to today’s safety practices. Over the summer, we plan to initiate discussion with the University of Minnesota’s College of Science & Engineering (CSE) about bringing female and minority STEM faculty to campus. If successful, the Institute would sponsor a faculty member to travel to campus to give a talk as part of CSE’s Distinguished Women Scientists and Engineers Speakers Program.

**PRODUCTS**

**Publications, conference papers, and presentations**

RSI researchers gave the following presentations during this reporting period:


At the TRB Annual Meeting in Washington, DC, 16 RSI researchers delivered lectern and poster presentations on their work. A full list of presentation is available on our website: [www.roadwaysafety.umn.edu/publications/ostr/documents/2015_trb_presentations.pdf](http://www.roadwaysafety.umn.edu/publications/ostr/documents/2015_trb_presentations.pdf).
The following papers have been published or submitted for publication during this reporting period:

- Yanfeng Ouyang, S. Xie, X. Li. “Decomposition of general facility disruption correlations via augmentation of virtual supporting systems.” Will be published in *Transportation Research Part B* after revisions are complete.

**Websites or other Internet sites**

The Roadway Safety Institute website (roadwaysafety.umn.edu) includes information on research activities, events, news, and key personnel. During this reporting period, we developed a web page for each research project that includes both the research project description and a downloadable UTC Project Information Form. We will post final research reports on the RSI website as they are completed.

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) strives to solve persistent transportation problems in innovative ways by convening diverse communities to brainstorm, debate, share, learn, and act.
- The recently redesigned Minnesota Traffic Observatory (MTO) website (mto.umn.edu) notes its affiliation with RSI on its home page. MTO is run by RSI researcher John Hourdos and is used frequently by other RSI personnel.
- The HumanFIRST website (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/) includes information on the research of M. Imran Hayee.

**Technologies or techniques**

For his project *Safety in Numbers? Accessibility, Traffic, and Safety of Nonmotorized Travelers*, Andrew Owen has developed a technique to calculate a block-level accessibility-to-jobs dataset for 50 metropolitan areas in the United States. Summary data will be shared on the Accessibility Observatory website (access.umn.edu).

**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**

Please see the table on page 17 for a list of partner organizations.
Other collaborators or contacts

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

- In December 2014, Max Donath traveled to Washington, DC, and met with representatives from NHTSA, including Senior Associate Administrator Brian McLaughlin. After Donath presented on the University of Minnesota’s Teen Driver Support System, the group discussed NHTSA’s approach to reducing driver distractions, including the Distracted Driving Guidelines released in April 2013.

- Greg Lindsey was recently appointed as the first scholar-in-residence at the Minnesota Department of Transportation and will work there one or two days a week until his sabbatical ends in June 2016. His residency will advance a variety of initiatives, including his RSI work on nonmotorized transportation monitoring and measurement of exposure to risk, with the goal of developing tools that practitioners can use to prioritize investments for infrastructure to increase biking and walking safety.

- RSI staff members met with Jean Kulsrud, the UPS St. Paul Division Manager who has implemented many safety-related initiatives at the company. They discussed potential safety-related opportunities, including UPS’s Road Code program.

- Tom Horan is working with Teresa Martin at MnDOT on a potential presentation for the Minnesota Tribes & Transportation Conference in October 2015.

- Chen-Fu Liao had a preliminary discussion with Hennepin County (MN) about using his application for visually impaired pedestrians at intersections in Minneapolis. He will hold a follow-up meeting that includes City of Minneapolis traffic engineers.

- Kathy Quick and Guillermo Narvaez are in frequent communication with other scholars at the University of Minnesota who conduct research with American Indian communities, with the intention of improving collaborative relationships and strengthening models of scholarship in this area.

- In his work on pedestrian safety, Ron Van Houten has received in-kind support and personnel exchanges from the Michigan Department of Transportation; the cities of Detroit, Kalamazoo, and Portage, Michigan; and the City of Gainesville, Florida.

- Daniel Work met with a representative from an unnamed Class I railroad to discuss the possibility of data sharing for his project. Further discussions are ongoing.

IMPACT

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

The outcomes of our work will give society ways to improve safety and public health for everyone who uses 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 efforts will help prevent fatal and serious-injury crashes for those users who have a greater propensity for risk. Specific guidance will be created to help state and national agencies address these priorities. Our work will also help state departments of transportation and other agencies implement design- and operation-related safety improvements. Specifically, we are focusing on issues that have been inadequately addressed to date through projects that examine policy issues, operational safety, rail grade crossings, and automated speed enforcement.

For specific projects:

- **Exploring Links between Medical Conditions and Safety Performance in Tractor Trailer Drivers:** Stephen Burks foresees an impact on both public policy and managerial economics, possibly leading the Federal Motor Carrier Safety Administration and motor carriers to institute new obstructive sleep apnea screening requirements for motor vehicle operators.
• **Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 2—Real-Time Prediction and Monitoring of Potential Conflicts at Grade Crossings**: Daniel Work anticipates making an impact on railroad engineering. His proposed method will estimate train arrival times at grade crossings, which will improve safety by enabling effective management of emergency response resources. It will also support driver alerts at unsignalized grade crossings in personal navigation devices.

• **Integrated Approach to Improve Railroad Grade Crossing Safety at Regional Level, Component 3—Reliable Planning and Coordination of Emergency Responses to Railroad Incidents**: Yanfeng Ouyang anticipates an impact on complex transportation systems. His project is the first to address the vulnerability of network systems under correlated disruptions due to disasters.

• **Safety in Numbers? Accessibility, Traffic, and Safety of Nonmotorized Travelers**: Andrew Owen anticipates an impact on accessibility analysis. His project demonstrates how publicly available data sources can be used to calculate detailed walking and biking accessibility to jobs. This approach will help resolve challenges identified in existing research of nonmotorized travel safety.

• **Ron Van Houten’s work on pedestrian safety influences traffic engineering**. He’s developed new and effective ways to use the R1-6 sign, as well as shared best practices on using the Pedestrian Countdown Timer, Rectangular Rapid-Flash Beacon, and the Pedestrian Hybrid Beacon.

### Impact on other disciplines

The interdisciplinary nature of our research means outcomes will reach beyond our core focus areas to impact safety approaches in other disciplines.

For specific projects:

• Yanfeng Ouyang’s work may influence network optimization. His project will develop new methods to analyze and optimize reliable resource allocation under multiple dimensions of uncertainty.

• Regarding **Collaborating with American Indian Communities to Re-Interpret and Strategize about Transportation Safety Risks in Tribal Lands**, Kathy Quick and Guillermo Narvaez anticipate that their project will have an impact on public health. The methods being used in the project are designed to complement previous population-level epidemiological studies of the elevated crash rate among American Indians.

• Ron Van Houten’s work affects planning in that the results teach professionals how to use engineering, enforcement, and education to change the driving culture and improve pedestrian safety.

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

Our work’s impact on physical, institutional, and information resources will enable stakeholders to access training and better perform their jobs.

For specific projects:

• John Hourdos’s project has greatly enhanced the capabilities of the Minnesota Traffic Observatory, whose facilities now have greater capacity for data collection and the analysis of vehicle trajectories. Several other projects have already benefitted from the new sensors and software.

• Greg Lindsey’s case studies may lead to the installation of new traffic controls at select trail crossings in Minneapolis.

• Andrew Owen’s block-level jobs accessibility dataset is now available for download and use by other researchers.

• Daniel Work’s data and algorithm source codes will be licensed as “open source” and posted on Github, a source code repository, for others to use.
Impact on transportation workforce development and human resources

Our 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 results of these activities will support the development of a diverse transportation workforce.

Fourteen out of eighteen RSI-funded projects have enlisted undergraduate or graduate student assistants. These jobs provide a total of 30 students with research and practical work experience related to roadway safety. PIs supervising students include Stephen Burks, Gary Davis, Frank Douma, Imran Hayee, John Hourdos, Chen-Fu Liao, Greg Lindsey, Albert Luo, Yanfeng Ouyang, Andrew Owen, Kathy Quick, Rajesh Rajamani, William Schneider, and Daniel Work.

Impact on technology transfer

Our 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.

For specific projects:
• Greg Lindsey anticipates that MnDOT traffic safety engineers will use his case study results to develop training materials.
• Daniel Work anticipates that the algorithms he develops could be reused by Class I railroads or Amtrak, and notes that open source software codes reduce the burden for private companies to leverage the resulting algorithm.

Impact on society beyond science and technology

The Institute’s work will result in real-world applications—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.

For specific projects:
• Stephen Burks’s project has the potential to reduce the rate of heavy truck crashes due to untreated obstructive sleep apnea; it is estimated that between 7 and 20 percent of these crashes result from driver fatigue.
• Chen-Fu Liao’s project will help visually impaired pedestrians safely reach their destinations. His smartphone application, which uses Bluetooth low-energy devices to transmit messages, will be especially useful in places with poor GPS coverage, such as skyways and subways.
• Yanfeng Ouyang’s project will generate policy and engineering guidelines that will improve public knowledge and decision-making practices, subsequently improving social welfare through enhanced safety, economic, and environmental conditions.

Changes/Problems

Changes in approach and reasons for change

Project PIs Janet Creaser and Chris Edwards have left the University of Minnesota for new positions. Their projects will be canceled and the funding reallocated to other Institute needs.
For specific projects:

- **Exploring Links Between Medical Conditions and Safety Performance in Tractor Trailer Drivers**: Stephen Burks is considering the feasibility of using data from the Federal Motor Carrier Safety Administration’s medical qualifying exam as an additional means of identifying safety-relevant medical conditions in participating drivers.

- **Developing and Validating a Model of Left-Turn Crashes to Support Safer Design and Operations**: Gary Davis has decided to adapt his crash reconstruction models to effectively use data from event data recorders.

- **Implementation of a V2I Highway Safety System and Connected Vehicle Testbed**: John Hourdos has had to modify the original sensor deployment plan because MnDOT requires professional sensor installation for certain locations, which the project budget can’t accommodate. The modified plan will circumvent these requirements while maintaining the integrity of the project.

- **Performance Measures for Bicycle and Pedestrian Safety: Methodologies for Monitoring Traffic Volumes and Assessing Exposure to Risk**: One of Greg Lindsey’s graduate students has left the project and a new student will be starting by May 2015.

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

Regarding his project **Development and Demonstration of Merge Assist System Using Connected Vehicle Technology**: Imran Hayee notes that two of the team’s DSRC devices malfunctioned and caused a three-week delay; the delay, however, should not impact the overall project schedule.

**Changes that have significant impact on expenditures**

Nothing to report.

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

Nothing to report.

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

Nothing to report.
### ORGANIZATIONS THAT HAVE BEEN INVOLVED AS PARTNERS

<table>
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<tr>
<th>Organization Name</th>
<th>Organization Location</th>
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<tr>
<td>Minnesota Department of Transportation</td>
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