

PROGRAM PROGRESS PERFORMANCE REPORT

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PPPR #2

SAFE-D: SAFETY THROUGH DISRUPTION UNIVERSITY TRANSPORTATION CENTER




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Accomplishments

Major Goals of the Program

Fueled by the inevitable changes in our transportation system, the Safety through Disruption (Safe-D) National University Transportation Center (UTC) endeavors to maximize the potential safety benefits of disruptive technologies through targeted research that addresses the most pressing transportation safety questions. With the outstanding leadership of the Virginia Tech Transportation Institute (VTTI) and the Texas A&M Transportation Institute (TTI) in a mentoring collaboration with the new transportation research group at San Diego State University (SDSU), a Hispanic-Serving Institution known for educating the transportation workforce, our geographically balanced consortium encompasses the largest collection of transportation safety researchers in the nation and provides unparalleled expertise, facilities, and resources to conduct impactful research towards our long-term vision. The Safe-D National UTC focuses its efforts in three key areas: (1) cutting-edge research by leading transportation safety experts and their students; (2) education and workforce development with programs for all levels from grade school through college and extending to continuing education for professionals; and (3) fully supported technology transfer, including practitioner training partnerships, social networking, commercialization, and intellectual property management.

Accomplishments During This Reporting Period

Project Awards and Activity

During this reporting period, the Safe-D National UTC held its second Call for Proposals. Directly preceding this call, Safe-D held its first workshop for researchers interested in proposing ideas for UTC funding. This workshop ran from September 5-11, 2017 and was facilitated online via WebEx; consortium members VTTI, TTI, and SDSU also provided optional physical meeting spaces. The four sessions held during the course of this workshop were:

- Safe-D Overview, Current Projects, and Q/A Session,
- Safe-D Proposal and Budgeting Process,
- Safe-D Education and Workforce Development (EWD) and Technology Transfer (T2) Program Overview and Project Inclusion, and
- Meet & Greet Session: a special session during which researchers were invited to give a "lightning talk" about their research interests in order to foster collaboration across the three consortium universities.

The Fall 2017 Call for Proposals was opened following the workshop. Safe-D received 78 total proposal submissions, including 14 collaborative submissions across two or more consortium institutions. After the two-phase proposal submission/review process was completed, Safe-D awarded 10 additional research projects, totaling over \$2.9 million dollars and including over \$1.3 million in matching funding from non-federal sources. In addition to this competitive award cycle, additional projects were awarded during the reporting period among the consortium

institutions focused specifically on areas such as education and resource development.

At the end of this reporting period, the Safe-D National UTC had a project portfolio totaling over \$7.5 million dollars, with nearly half of project funding sourced from non-federal matching funds. Safe-D projects are selected according to their focus on the four Center theme areas: automated vehicles, connected vehicles, big data analytics, and transportation as a service. The coverage of Safe-D theme areas by project portfolio to-date can be seen in Figure 1.

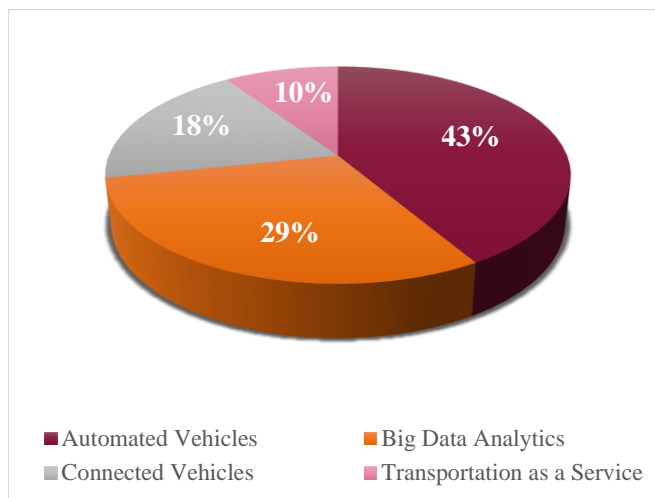


Figure 1. Portfolio of Safe-D Projects by Theme Area

The Safe-D Leadership Team feels strongly that the projects that were selected and awarded during this reporting period contribute to the overall Safe-D vision and mission, and are excited about the potential impacts that this research in disruptive technologies will have on maximizing the safety of these technologies as they are integrated into our transportation system.

Safe-D research projects awarded during this reporting period, along with respective theme area(s) and short descriptions, are reported below [*denotes lead institution]. Note that Safe-D projects are identified using a numbering scheme where the first number refers to the award round (e.g. “Project 01-xxx” denotes a project awarded under the first competitive award cycle). Research statement submissions are also numbered as they are received by Safe-D, without regard to the award round, and are identified by the second number.

Project 03-036: [Modeling Driver Responses During Automated Vehicle Failures](#)

Institution(s): TTI, VTTI; Award Round: Fall 2017; Theme Area(s): Automated Vehicles, Connected Vehicles*
Automated and connected vehicle technologies, like truck platoons, offer tremendous promise for driving safety, efficiency, and productivity. Some projections even go as far to suggest that these technologies will eliminate all traffic fatalities. However, the benefits of these technologies will only be realized if they are designed for the human beings that interact with them. This project will develop a model of human behavior during automation failures that may be integrated into current and future design processes for automated vehicles. This model will be used to generate a set of design guidelines for future automated vehicle following technologies that will promote safety and reduce automated driving crashes.

Project 03-040: [Examining Senior Drivers Adaptation to Level 2-3 Automated Vehicles: A Naturalistic Study](#)

Institution(s): VTTI; Award Round: Fall 2017; Theme Area(s): Automated Vehicles*

The aging of society will continue to impact all of society’s major institutions in a variety of ways for decades to come. Major areas which will be affected include finance, housing, health, and transportation. Automated vehicle technology (AVT) has the potential to assist older drivers by reducing exposure to hazards. AVT can help to fill this need by compensating for declining functional health and related abilities often seen in seniors. This project will examine seniors’ attitudes towards AVT prior to any substantive exposure or use, then again after having the opportunity to explore and use AVT in the real world.

Project 03-049: [Data Fusion for Non-Motorized Safety Analysis](#)

Institution(s): TTI; Award Round: Fall 2017; Theme Area(s): Big Data Analytics*

Data-driven approaches play a critical role in developing safety improvement investment decisions. However, for non-motorized travel, exposure to risk has often been the missing piece of the puzzle. This project aims to develop effective methodologies to fuse together different data sources to develop accurate and reliable exposure estimates for safety analysis.

Project 03-050: [Design and Evaluation of a Connected Work Zone Hazard Detection and Communication System for Connected and Automated Vehicles \(CAVs\)](#)

Institution(s): VTTI; Award Round: Fall 2017; Theme Area(s): Connected Vehicles, Automated Vehicles*

Roadside work zones (WZs) present imminent safety hazards for roadway workers as well as passing motorists. In 2016, 764 fatalities occurred in work zones in the United States due to motor vehicle traffic crashes. A number of factors (aging highway infrastructure, increased road work, increased levels of traffic and more nighttime WZs) have led to an increase in WZ crashes in the past few years. This project aims at addressing this problem by delivering a specification for a wearable worker localization and communication system prototype that utilizes ultra wide-band (UWB) technologies to facilitate real-time threat detection and warning algorithms.

Project 03-051: [Response of Autonomous Vehicles to Emergency Response Vehicles](#)

Institution(s): TTI; Award Round: Fall 2017; Theme Area(s): Automated Vehicles*

The autonomous vehicle in the presence of an emergency vehicle must have the ability to accurately sense its surroundings in real-time and be able to safely yield to the emergency vehicles. System safety is the main theme where we work with TEEX Law Enforcement and Security Training, and through them with local police/fire department. The objective of this project is to explore how an autonomous vehicle must safely respond to different classes of emergency vehicles using sound, vision and other onboard sensors.

Project 03-064: [Automated Vehicle Behavior Monitoring for Vulnerability Management](#)

Institution(s): VTTI; Award Round: Fall 2017; Theme Area(s): Automated Vehicles, Connected Vehicles, Big Data Analytics*

It is clear that autonomous vehicles will penetrate the marketplace in the next few years. It is unclear how prepared these systems will be to withstand cyber-attacks that pose a serious threat to the safety of vehicle occupants and other road users. Safety threats might be mitigated if one could quickly identify attacks, but it is not at all clear that traditional cybersecurity threat detection approaches are well-suited to connected and autonomous vehicles. This project seeks to develop algorithms for identifying when a vehicle has been compromised in a cybersecurity attack, and new approaches to designing and evaluating such techniques.

Project 03-072: [Preventing Crashes in Mixed Traffic with Automated and Human-Driven Vehicles](#)

Institution(s): TTI, SDSU; Award Round: Fall 2017; Theme Area(s): Automated Vehicles, Connected Vehicles*

While safety is the ultimate goal of designing connected automated vehicles (CAVs), in many instances, CAVs' decisions do not match the expectations of human drivers. This project will identify the factors that contribute to crashes in mixed traffic with automated and human-driven vehicles through data analysis, simulation, and field tests. Moreover, it will develop measures and guidelines to minimize the risk of such crashes. The findings of this study are expected to significantly enhance the safety of operating CAVs.

Project 03-073: [Autonomous Emergency Navigation to a Safe Roadside Location](#)

Institution(s): VT, VTTI; Award Round: Fall 2017; Theme Area(s): Automated Vehicles*

In general, modern autonomous vehicles are capable of tracking lanes effectively in normal operation; however, when emergencies occur, these vehicles simply stop in the lane, creating safety problems for themselves and other vehicles. The proposed research is to enable the vehicle to navigate autonomously to stop out of the travel path of following vehicles. The research carried out in this project will enhance traffic safety of automated vehicle systems when road emergencies take place.

Project 03-082: [Assessing Alternative Approaches for Conveying Automated Vehicle ‘Intentions’](#)

Institution(s): VTTI; Award Round: Fall 2017; Theme Area(s): Automated Vehicles, Transportation as a Service*

The project will focus on the development and evaluation of an augmented reality interface integrated into a dynamic HMI intended to increase situational awareness of the driving system and environment. Users will experience the enhanced HMI system in a transit-like, automated vehicle across realistic scenarios while gauging situational awareness, response selection, response performance, and comfort. As a secondary focus, the project will explore different emergency stop mechanisms for the automated vehicle, of which the user has full control, in the event that there is a system failure in either the vehicle’s control or sensing mechanisms.

Project 03-087: [Big Data Visualization and Spatiotemporal Modeling of Aggressive Driving](#)

Institution(s): SDSU, VTTI; Award Round: Fall 2017; Theme Area(s): Big Data Analytics*

More than half of fatal traffic crashes occur due to aggressive driving according to AAA (American Automobile Association) Foundation for Traffic Safety. Ubiquitous technology has made it possible to monitor driver behavior at a high frequency for a long period of time. This provides an opportunity for researchers to investigate risky driving behavior at a large scale. This project aims to develop a big data analytics framework and visualization tool to conduct spatiotemporal modeling and classify and visualize aggressive driving behavior using data from emerging technology.

Additional Projects

Beyond competitive research projects, consortium members VTTI and TTI also funded directed projects, including one project focused on educational tool development (TTI) and three projects designed to enhance Safe-D program research performed (VTTI). These directed projects include the following projects which TTI funded in consultation with the Safe-D management team, leveraging external funding:

Project TTI-01-05: K-12 STEM Program: Exploring the Science of Retroreflectivity

Institution(s): TTI; Award Round: Directed 2017 Projects; Theme Area(s): Big Data Analytics*

Over the past 10 years, Texas A&M Transportation Institute (TTI) researchers have developed many educational activities for elementary and middle school students (K-8) that provide an opportunity to gain hands-on experience and insight into what transportation engineering and other STEM careers have to offer. This educational development project will take previously developed in-class activities that show real-world applications, link them to academic concepts and standards, and create curriculum and associated materials that can be used by teachers and other professionals across the nation. To get the students thinking about the future of transportation, the relationship between traffic control devices (e.g., signs and pavement markings) and automated vehicles will also be included in the curriculum.

Project TTI-Student-03: [Developing Systems for Autonomous Vehicles to Identify and Localize Emergency Vehicles](#)

Institution(s): TTI; Award Round: Directed 2017 Projects; Theme Area(s): Automated Vehicles*

Within the CAST (Connected Autonomous Safe Transportation) Program, one of the projects is exploration to determine how an autonomous vehicle should respond to emergency vehicles on the road. The end-goal of the project is to lead to a formal proposal for sustained research into this important safety consideration for autonomous vehicles, namely, how should the autonomous vehicles respond to emergency vehicles on the road.

Project TTI-Student-04: [Motorcycle Crash Data Analysis to Support Development of a Retrofit Concrete Barrier System for Freeway Ramps](#)

Institution(s): TTI; Award Round: Directed 2017 Projects; Theme Area(s): Big Data Analytics*

The objectives of this project were to review and analyze existing crash data on motorcycle related accidents, as well as to conduct a detailed literature review on existing motorcycle testing standards and various protocols that foreign Countries have developed throughout the years. This UTC project provides the ability to perform detailed research

and data investigation complementing an existing TxDOT project (490027-3 – internal #). The funded TxDOT project aimed at exploring design options for a retrofit concrete barrier system to be deployed at appropriate bridge locations to address errant motorcycle rider’s safety. The objective of this project includes the design, development, and evaluation through computer simulations of an improved retrofit barrier system(s) that has the capability to safely contain errant motorcycle riders during an impact event.

Completed Projects

During this reporting period, the following two projects completed their activities:

- **TTI-Student-03:** [Developing Systems for Autonomous Vehicles to Identify and Localize Emergency Vehicles](#)
- **TTI-Student-04:** [Motorcycle Crash Data Analysis to Support Development of a Retrofit Concrete Barrier System for Freeway Ramps](#)

The products of these projects are currently under review and are expected to be published as per the Safe-D data management plan (DMP) and grant requirements in the next reporting period.

Safe-D Programming

As noted in the original proposal, Safe-D has commenced a number of programs targeting our Leadership, Education and Workforce Development, Technology Transfer, and Diversity initiatives. The following sections highlight major accomplishments under these directives.

Professional Skills Training Series

During this reporting period, Safe-D began its Professional Skills Training series. Geared toward graduate students, these seminars commenced in November 2017 and will continue for the duration of the Safe-D grant award. Consortium member TTI coordinates the webinars, which are held in association with the Center for Advancing Research in Transportation Emissions, Energy and Health (CAR-TEEH). These seminars are held via web-conferencing software and are available to students across each consortium institution, with physical meeting spaces reserved at VTTI, TTI, and SDSU to help facilitate group interaction even in a digital forum. The seminars that have been presented to-date are listed in Table 1.

Table 1. Seminar Series Information

Date	Seminar Title	Speaker
11/13/2017	Avoiding Landmines in Your Reports	Michelle Benoit, Research Editor, TTI Gretchen Stoelje, Assistant Research Scientist, TTI
3/20/2018	CAREER READINESS: Practical Tips to Help You Find a Job	Roland Block, Associate Director, Engineering and Experiential Education, TAMU
5/21/2018	CAREER READINESS: Leveraging Social Media for Business	Roland Block, Associate Director, Engineering and Experiential Education, TAMU

Seminar Series

As part of an initiative to develop new EWD activities, Safe-D hosts periodic visits by leaders in the transportation field to convey the new challenges and opportunities in transportation to students and faculty. Safe-D has capitalized on scheduled visits by external researchers, largely facilitated by Safe-D researchers. For example, Safe-D researcher Justin Owens invited Michael Clamann of Duke University’s Humans and Autonomy Lab to present on recent vehicle-to-pedestrian communication research; and Safe-D researcher Johan Engstrom invited Tobias

Vogelpohl, a visiting researcher and part of the project team for the Driver Modelling project, to present his recent research on human factors in automated driving. Seminars by leaders in the field such as these are expected to continue throughout the grant period.

Visiting Scholars Program

Under our efforts to bolster leadership programming, Safe-D seeks to facilitate the development of mentoring relationships between experienced senior research faculty and junior faculty through our Visiting Scholars Program. During this reporting period, VTTI researcher Jeff Hickman visited TTI to collaborate on the Modeling Driver Responses During Automated Vehicle Failures and Formalizing Human-Machine Communication in the Context of Autonomous Vehicles Safe-D projects. In addition, VTTI researcher and Safe-D T2 Coordinator Dr. Mike Mollenhauer visited TTI to collaborate on the Safe-D project Preparing Work Zones for Automated and Connected Vehicles. In addition, Associate Research Engineer at TTI, Marcus Brewer, visited VTTI as a guest lecturer in December 2017. On December 8, 2017, Mr. Brewer led a seminar related to geometric design in the context of new transportation paradigms, “Effects of Geometric Design on Operations, Safety, and Human Factors”, and engaged in group as well as one-on-one discussions with various researchers at VTTI during his visit. In addition, Safe-D researcher Justin Owens visited TTI in March 2018. During his visit, he also presented his work on the Safe-D projects *Factors Surrounding Child Seat usage in Ride-Share Services* and *Data Mining to Improve Planning for Pedestrian and Bicyclist Safety* to TTI’s Center for Transportation Safety and Traffic Operations and Roadway Safety Divisions. With the success of these initial visits, it is expected that other inter-consortium faculty visits will be supported under this program in future reporting periods.

Student Awards Program

During this period, Safe-D recognized Maryam Shirinzad from Texas A&M University as the 2017 Outstanding Student of the Year at the CUTC Awards Banquet. Ms. Shirinzad was nominated due to her excellence as a student researcher. In 2017, she supervised data collection activities and co-authored an associated research report and paper. She also developed microscopic simulation models assessing vehicle weaving activities between interchange terminal intersections and downstream signalized intersections. These models will lead to subsequent work focusing on intersection spacing, access point density, traffic volume, and roadway geometric configurations.

Also of note during this reporting period, Safe-D PhD student, Sirajum “Silvy” Munira, received a scholarship from the Women’s Transportation Seminar Houston chapter. Ms. Munira won the Helene M. Overly Memorial Scholarship which encourages women to pursue career paths in transportation. This \$7,000 competitive scholarship is awarded to women pursuing graduate studies in transportation or a related field and is based on the applicant’s specific transportation involvement and goals, job skills, and academic record.

Safe-D is proud of our students' accomplishments and continues to encourage students to seek opportunities such as this, including the Eno Leadership Development Program, the Eisenhower Fellowship Program and other student leadership development opportunities which arise.

Educational Courses Taught and Students Supported

Safe-D researchers are actively engaged in teaching efforts at each of the consortium universities and in supporting students through the conduct of research activities. While formal metrics are reported annually in October in the Program Performance Indicators, the following is a description of the metrics gathered regarding courses taught and student support provided through the Safe-D program.

During this reporting period, researchers involved in Safe-D research projects reported teaching 15 graduate courses, reaching 218 students, and teaching 16 undergraduate courses, reaching 758 students. Research teams reported supporting 54 university-level students during this reporting period, including 20 students from underrepresented populations. This 69% increase in students funded is related to the increase in research

activities from the Initial and Spring 2017 projects awarded, as well as the Fall 2017 competitive and directed projects initiated in this second year of the UTC grant. In addition, research teams reported three students graduating during the course of research activities, including two which were placed for employment in the private sector. The breakdown of the students supported are presented in Table 2.

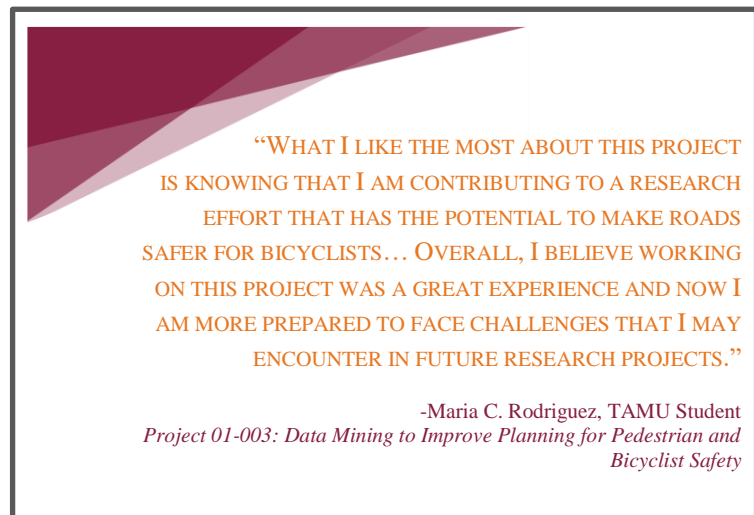


Table 2. Description of Students Supported under Safe-D Research Activities

Academic Level	Total Number of Students Supported	Number of Underrepresented Students Identified
Undergraduate	10	5
Masters	23	8
PhD	21	7

EWD & Other Outreach Activities

K-12 Outreach

The Safe-D leadership team continued its efforts to enhance public understanding and spur interest in transportation careers through K-12 outreach programs. For example, Safe-D researcher and EWD Coordinator Miguel Perez worked with stakeholders in Radford City Public Schools (Virginia) in Fall 2017 to discuss hands-on learning opportunities (e.g., internships)

under Safe-D. Safe-D researcher Andy Schaudt worked with 5th-grade students in the Montgomery County Public School system to complete a passion project on autonomous vehicles. Safe-D student Alexis “Lexi” Basantis supported a request from VDOT Chief Engineer to showcase and demonstrate an automated vehicle from the VTTI fleet to students at an elementary school in Manassas, VA. Costin Untaroiu and graduate student Yunzhu Meng incorporated the results of the Safe-D project entitled “Implications of Truck Platoons for Roadside and Vehicle Safety Hardware” into a booth at the West Salem Elementary STEM Night on March 27, 2018.

Virginia Tech Science Festival

On November 4, 2017, Safe-D researchers hosted a booth at the Virginia Tech Science Festival, which attracted over 5,000 people of all ages. Entitled “Transportation in a Disrupted World: Traveling Safe!”, the booth taught visitors about transportation safety and current innovations in transportation. VTTI personnel demonstrated instrumented helmets and wristbands that monitor motorcycle riders and collect real-time driving data along with facial recognition software developed at VTTI. Another hands-on demonstration highlighted the importance of retroreflective materials in roadway signage and markings. In addition to the indoor booth, Safe-D personnel showcased some of VTTI’s experimental vehicles, including an instrumented motorcycle used to collect naturalistic driving data and the Ford transit vehicle used in VTTI’s undercover “seat suit” study, where attendees could try on the suit for themselves. Before the festival, Dr. Perez and Lexi Basantis attended workshops to prepare for a Safe-D exhibit at the Virginia Tech Science Festival. Part of the workshop focused on developing exhibits tailored towards children with autism.

VDOT Transportation Career Fair

Safe-D is committed to supporting partners at our respective state DOTs. On October 5, 2017, the Virginia Department of Transportation (VDOT) held their 13th annual Transportation Career Fair. This event targets high school students from the surrounding areas to introduce them to careers involving the transportation industry. Over a hundred different exhibitors, spanning all across the industry (construction, military, government, etc.) were in attendance. Dr. Miguel Perez and graduate student Lexi Basantis spoke with hundreds of students about the mission of Safe-D and VTTI, the types of projects that are conducted, and about careers in transportation as a whole. The event was a great way not only to display the innovative endeavors currently happening within the transportation industry but also to inform students and excite them about the future of transportation.

Political Outreach

On Wednesday, September 27, 2017, Safe-D Director Dr. Zac Doerzaph served as a subject matter expert at the 3M Connected Roads Senate Panel entitled “Paving the Way for the Connected Roads of Tomorrow.” During this panel, Senators John Thune and Amy Klobuchar joined John Riccardi, Vice President and General Manager of 3M’s Transportation Safety

Division, and a panel of policy and industry experts to discuss how to prepare our country's infrastructure for the connected roads and autonomous vehicles of the future.

Diversity

As outlined in our grant proposal, Safe-D recognizes the importance of diversity and has interwoven diversity efforts throughout the group that our programs. Safe-D believes that hands-on funded research experience is a great mechanism for attracting young underrepresented students to the transportation profession and maintaining that interest throughout their attainment of advanced degrees and rewarding careers. As part of this commitment, Safe-D Program Manager Leslie Harwood was accepted into a pilot program jointly offered by Virginia Tech's Office of the Vice President for Research and Innovation and University Organizational and Professional Development to obtain the Diversity Ally Certificate. This certificate program seeks to provide a curricular path for faculty, administrators, and staff to want to develop competency in diversity in inclusion content and practice. During this reporting period, Ms. Harwood completed all coursework toward this certificate, which will be awarded in July 2018.

During this reporting period, Safe-D also provided support to a group of eight Virginia Tech students to attend a Women in Transportation Seminar (WTS) event during women's history month on March 13, 2018. This event celebrated women in transportation and featured keynote talks from female executives within the USDOT along with breakout sessions (<https://www.vtti.vt.edu/wts.vt.2018/>). On November 7, 2017, Safe-D Program Manager Leslie Harwood presented at a meeting of the Virginia Women's Club. An overview of Safe-D was presented to members of the Club, along with engaging group discussions of ongoing research projects, including integrated EWD and T2 outputs. The presentation culminated in a tour of VTTI facilities used for Safe-D research activities, including the Virginia Smart Roads.

Dissemination of Results

Research Project Results

Research results from Safe-D projects began to be finalized during this reporting period. Safe-D researchers have been submitting and publishing results of their projects in peer-reviewed journals and presenting results at conferences nationwide. The publications and presentations which researchers have reported thus far are listed in the All research projects awarded by Safe-D are required to submit EWD and T2 plans, identifying specific products from their projects for development and dissemination. In order to ensure that EWD and T2 plans for each project receive continued attention, the Safe-D EWD and T2 Coordinators contact each of the research teams shortly after the project start date. The purpose of this initial communication is to establish a point of contact within the research team, clearly lay out expectations, offer help and guidance, and encourage research teams to expand their activities in this area as much as possible. During this reporting period, many EWD and T2 products from Safe-D research projects have begun to emerge. These products are described in the sections below; those currently under development are also described in the Research Project Results section of this document.

Publications, Conference Papers, and Presentations section of this report. In addition, as all Safe-D projects are required to have both an EWD and T2 component, research teams are continuing to work diligently toward the dissemination of these products through direct communication with project stakeholders and outreach to promote their project's educational components.

As part of the EWD plan for the Safety Perceptions of Transportation Network Companies by the Blind and Visually Impaired project, team members worked with the National Federation of the Blind - Austin Chapter to select blind and visually-impaired (BVI) individuals to assist with the recruitment of focus group members who were engaged during the course of the project. With their assistance, recruitment for the study focus group was a success. The Countermeasures to Detect and Combat Driver Inattention While Driving Partially Automated Systems research team created a demonstration as part of their EWD plan during this period. This demonstration included hardware and simulation software, and will be used for the USA Science and Engineering Festival in April 2018. Safe-D project K-12 STEM Program: Exploring the Science of Retroreflectivity developed a draft STEM curriculum and associated materials. Allen Academy 5th and 6th grade science classes used and evaluated this curriculum and materials developed to introduce students to the scientific principles of visible light (including retroreflectivity). These materials were also used during the VT Science and Engineering Festival in October 2017, as described in EWD & Other Outreach Activities.

T2 products of Safe-D research projects are currently under development, including:

- Data Mining to Improve Planning for Pedestrian and Bicyclist Safety: developing a vision-based application using MATLAB for counting pedestrians.
- Countermeasures to Detect and Combat Driver Inattention While Driving Partially Automated Systems: developing a system to automatically control the user interface of a driving simulator, in order to implement an "auto-pilot" driving environment.
- Analysis of an Incentive-Based Smartphone App for Young Drivers: the extensive amount of data resulting from the deployment of a smartphone app (developed using funds from another source) was analyzed under this project during this period.

Additional information about research project result and product dissemination may be found in Products. Many other EWD and T2 components from Safe-D projects were submitted during this reporting period, and are expected to be finalized during the next reporting period.

Plans for the Next Reporting Period

Safe-D Fall 2018 Workshop and Call for Proposals

During the next reporting period, Safe-D plans to hold the Fall 2018 Workshop and Call for Proposals. Based on the structure implemented during the previous reporting period, this workshop will be held via web conferencing with physical spaces available at each institution. Based on feedback received during the first workshop, the Fall 2018 workshop will consist of a half-day workshop with multiple sessions, versus the previous format of the sessions occurring

over multiple days. The workshop is expected to be held in September, during a time which will be reasonable for all consortium member time zones, during regular business hours.

During the Fall 2017 workshop, members of the Safe-D Leadership Team provided overview presentations on Safe-D, EWD and T2 programs, and proposal and budgeting processes. Recordings of these sessions were posted to the Safe-D Researcher Portal soon after for review during the proposal process. As these overviews are still available to any new researchers, workshop sessions held during Fall 2018 will not repeat this information in detail, but rather build upon that base. It is expected that workshop sessions will be held which focus on development of EWD and T2 plan details, IRB processes, and the Safe-D Data Management Plan (DMP) and upload of project data to the Safe-D section of the VTTI Dataverse. Following the workshop, research teams will be encouraged to submit their research for award under the Fall 2018 Safe-D Call for Proposals. The awards for this call will be made in December 2018, and will be reported in the PPPR for that period.

Outreach Activities Planned

Science of Retroreflectivity Curriculum

Under Project TTI-01-05, Safe-D sponsored the development of a K-12 school visit curriculum and kit on the topic of the Science of Retroreflectivity as described in Research Project Results. Consortium member TTI led this effort and hired a fifth-grade science teacher to work during the summer of 2017 to improve existing demonstration materials. The student also identified state and federal curriculum elements that are fulfilled by the demonstrations in the areas of engineering and optics. During this reporting period, the materials have been used in multiple outreach activities, including the VT Science Festival, and are expected to be used during the following reporting period(s), including at the USA Science and Engineering Festival.

Transportation Career Fair

During the next reporting period, Safe-D will participate in the Virginia Department of Transportation (VDOT) Northern Virginia District 14th Annual Transportation Career Fair to be held in Manassas, Virginia on October 4, 2018. Last year, the career fair provided numerous hands-on opportunities for a record 1,500 area high school students. Safe-D will join approximately 100 engineering firms, organizations, agencies, and contractors from across Virginia to encourage students to learn about careers in transportation-related fields, such as civil engineering, architecture, technology, construction, and environmental engineering.

U SA Science and Engineering Festival

Safe-D researchers from both VTTI and TTI will attend the USA Science and Engineering Festival in April 2018. This event attracts several hundred thousand K-12 students and features over 500 exhibitors. Safe-D has planned three activities related to transportation safety and innovative transportation technology. The hands-on demonstrations will include retroreflective materials (described below), facial recognition software, and a vehicle simulator that can be “driven” by participants (described in Research Project Results).

Products

All research projects awarded by Safe-D are required to submit EWD and T2 plans, identifying specific products from their projects for development and dissemination. In order to ensure that EWD and T2 plans for each project receive continued attention, the Safe-D EWD and T2 Coordinators contact each of the research teams shortly after the project start date. The purpose of this initial communication is to establish a point of contact within the research team, clearly lay out expectations, offer help and guidance, and encourage research teams to expand their activities in this area as much as possible. During this reporting period, many EWD and T2 products from Safe-D research projects have begun to emerge. These products are described in the sections below; those currently under development are also described in the Research Project Results section of this document.

Publications, Conference Papers, and Presentations

The following are the publications, conference papers, and presentations which were submitted, accepted, or published during this reporting period.

Presentations

- Manser, M. (2017, November). Driver Education and Training for Automated Driving Systems Technology. Presentation at the annual conference of the Driving Schools Association of the Americas, Albuquerque, NM.
- Shirazi, M., and D. Lord (2017). Characteristics Based Heuristics to Select a Logical Distribution between the Poisson Gamma and the Poisson Lognormal for Crash Data Modeling. Paper presented at the 97th Annual Meeting of the TRB.
- Shirazi, M., and D. Lord (2017). An Approach Towards Automation Of Model Selection. Poster presented at the 2017 INFORMS Annual Meeting, Oct. 22nd-Oct. 25th, 2017, Houston, TX
- Tsou, M., Nara, A., Jahangiri, A., Ghanipoor, S. (2018). Developing Web-based Spatiotemporal Analytics Software Tools for Analyzing Connected Vehicle Data and Aggressive Driving Behaviors, NSF SI2-S2I2 Conceptualization: Geospatial Software Institute (GSI), First Workshop on Geospatial Software: Connecting Big Data with Geospatial Discovery and Innovation, University of Southern California Los Angeles, CA, Jan 28-30, 2018. (Presented).
- Hasani, M., Jahangiri, A. Utilizing extrapolation methods to estimate average annual daily bicyclist and pedestrian volume from short-term count data in the City of San Diego, CA. Student Research Symposium, San Diego State University, March 2, 2018.
- Zhang, C., Jahangiri, A. Adopting cumulative learning to develop a real-time vision-based monitoring system for detecting and tracking vulnerable road users. Student Research Symposium, San Diego State University, March 2, 2018.
- Basantis, A., Miller, M., Doerzaph, Z., & Neurauter, L. (2018). Assessing Alternative Approaches for Assessing Automated Vehicle 'Intentions' Paper presented at the 17th Annual Graduate Student Research Symposium.
- Liang, D., Baker, S., Lau, N., and Antin, J. (2018). Examining Senior Drivers Adaption to Mixed Level Automated Vehicles: Focus Group Results from a Naturalistic Driving Study. Naturalistic Driving Research Symposium, Blacksburg, VA (submitted).
- Jin, H., Sharma, R., Meng, Y., Untaroiu, A., Silvestri Dobrovolny, C., Untaroiu, C. Evaluation of the injury risks of truck occupants involved in a crash as a result of errant truck platoons" LS-Dyna User Conference (2018, June).

- Jin, H., Sharma, R., Meng, Y., Untaroiu, A., Silvestri Dobrovolny, C., Untaroiu, C. Evaluation of the injury risks of truck occupants involved in multiple crashes as a result of errant truck platoons" IRCOBI Conference (2018, September).
- Sirajum Munira, Russell H. Henk & Stacey Tisdale. An Incentive-Based Teen Driver Smartphone App: Results of 2017 Pilot Project. Presented January 9, 2018 at the 97th Annual Transportation Research Board Meeting, Washington, D.C. (podium presentation).
- Russell H. Henk, Sirajum Munira & Stacey Tisdale. An Incentive-Based Teen Driver Smartphone App: Results of 2017 Pilot Project. Accepted for podium presentation (set for April 24, 2018) at the 2018 Lifesavers Conference – National Conference on Highway Safety Priorities, San Antonio, Texas.
- Huang, W., Engström, J., Miller, A., Dreger, F., Soccolich, S., de Winter, J. and Ghanipoor Machiani, S. (submitted). Analysis of differential crash and near-crash involvement based on naturalistic driving data. Abstract submitted to the Seventh International Symposium on Naturalistic Driving Research (NDRS 2018) in Blacksburg, Virginia on August 28-30, 2018.

Publications

- Roediger, M., Hickman, J.S., & Geller, E.S. (2018, submitted). Exploring human-vehicle communication to balance transportation safety and efficiency. Paper to be presented at the 7th International Symposium on Naturalistic Driving Research, Blacksburg, VA.
- Eick, E., Faunce, C., Roediger, M., Hickman, J.S., & Geller, E.S. (2018). Safety-related pedestrian behaviors among University students: Naturalistic observations from a moving vehicle. Paper presented at the annual Virginia Association of Behavior Analysis in Roanoke, VA.
- Roediger, M., Eick, E., Faunce, C., Hickman, J.S., & Geller, E.S. (2018). Behavioral Impact of an Autonomous Vehicle: A naturalistic study of pedestrian-vehicle communication and pedestrian behavior. Paper presented at the annual Virginia Association of Behavior Analysis in Roanoke, VA.
- Basantis, A., Miller, M., Doerzaph, Z., & Neurauter, L. (2018). Assessing Alternative Approaches for Assessing Automated Vehicle 'Intentions'. Paper presented at the 17th Annual Graduate Student Research Symposium.
- Shirazi, M., Dhavala, S. Lord, D., Geedipally, S. (2017). A methodology to design heuristics for model selection based on the characteristics of data: Application to investigate when the Negative Binomial Lindley (NB-L) is preferred over the Negative Binomial (NB). *Accident Analysis and Prevention*, (107), 186-194.

Thesis/Dissertations

The following Safe-D projects have identified that they have contributed to a thesis and/or dissertation during this reporting period:

Project 01-001: [Big Data Methods for Simplifying Traffic Safety Analyses](#)

Ph.D. dissertation: Advanced Statistical Methods for Analyzing Crash Datasets with Many Zero Observations and a Long Tail: Semiparametric Negative Binomial Dirichlet Process Mixture and Model Selection Heuristics by Ali Shirazi. (Successfully defended in January 2018 and is graduating in August 2018)

Project 02-014: [Formalizing Human-Machine Communication in the Context of Autonomous Vehicles](#)

Roediger, M. Exploring human-vehicle communication to balance transportation safety and efficiency: A naturalistic field study of pedestrian-vehicle interactions.

Website(s) or Other Internet Sites

Safe-D Researcher Portal

With 173 users at the end of this reporting period, the Safe-D Researcher Portal continues to successfully facilitate inter-consortium collaboration and access to Center-level resources across our geographically dispersed universities. During this reporting period, the Safe-D leadership

team used the portal to disseminate information regarding the Fall 2017 Workshop and Call for proposals, including video recordings from the workshop sessions for future researcher review. Information on the portal is continually kept up-to-date, so that research project team members can be aware of upcoming reporting deadlines, processes for submission of deliverables, and other Safe-D project requirements.

Safe-D Website

During this reporting period, the [Safe-D National UTC website](#) was updated to include projects awarded during the Fall 2017 Call for Proposals, project products including EWD and T2 outputs, and Safe-D outreach activity descriptions. As our primary method of external interfacing, Safe-D is committed to providing up-to-date information via our public website through a modern, minimalist approach to rapid information sharing.

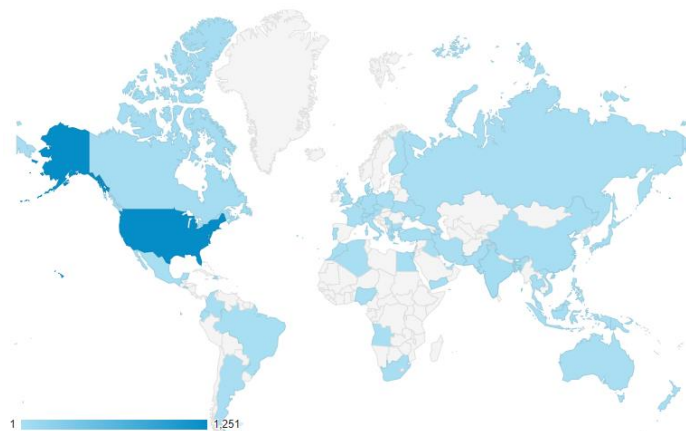


Figure 2. Website visitors by country.

The Safe-D website averaged 182 users per month, with 1,537 new users during this period. Users viewed pages 10,104 times during this period, visiting an average of 3.79 pages per session. Figure 2 shows the worldwide website traffic by country for this reporting period.

Safe-D Collection on VTTI Dataverse

During this reporting period, the Safe-D Leadership Team worked with the VTTI Center for Information Technology and Center for Data Reduction and Analysis Support to publically publish the Safe-D National UTC collection on the VTTI Dataverse (<https://dataverse.vtti.vt.edu/dataverse/safed>). This data repository is maintained by VTTI based on the Dataverse platform. As outlined in the Safe-D DMP, the VTTI Dataverse meets the criteria outlined in the Guidelines for Evaluating Repositories for Conformance with the DOT Public Access Plan. As described in the Safe-D DMP, the Safe-D site on the VTTI Dataverse will house all of the digital data produced by Safe-D research projects during the course of the grant and will allow interested parties to download and use the publically-available data produced to continue to build on research results.

Technologies and Techniques

Nothing to report. Note that several applications and tools are currently under development, some of which are described in Research Project Results. It is expected that as these technologies and tools are finalized, results will be reported in this section during future reporting periods.

Inventions, Patent Applications, and/or Licenses

Nothing to report.

Other Products

Nothing to report.

Participants and Collaborating Organizations

Partners & Collaborators

Collaboration is a key part of the Safe-D program, and collaborative research is prioritized when selecting projects for award. Of the 10 competitive and directed research projects awarded during this reporting period, 3 are collaborative across university partners. During this reporting period, Safe-D has worked to promote partnerships and collaborations with academic institutions, other nonprofits, industrial or commercial firms, state and local governments, school or school systems, and other organizations. Many collaborations have begun during this reporting period on Safe-D projects. During this same process, the Safe-D Leadership Team has been gathering support and interest for the Safe-D Stakeholder Advisory Board. The Board is expected to convene its first meeting and review proposed research during the next reporting period. The domestic and international collaborations formed as part of Safe-D research projects during this reporting period are summarized below.

Domestic Collaborators

Project 03-064. Automated Vehicle Behavior Monitoring for Vulnerability Management. To develop algorithms for identifying when a vehicle has been compromised in a cybersecurity attack, VTTI is collaborating with a domestic industry partner known for in cybersecurity research and development.

Project 02-020. Behavior-based Predictive Safety Analytics: Pilot Study. In this collaborative project, VTTI and SDSU are working with SmartDrive, a driver safety and transportation intelligence company, to explore the use of large naturalistic datasets in commercial programs designed to achieve behavioral change.

Project TTI-01-05. K-12 STEM Program: Exploring the Science of Retroreflectivity. To develop a curriculum for K-12 educational modules on the science of retroreflectivity, TTI has collaborated with industry representatives to obtain demonstration materials along with K-12 teachers. The primary teachers involved were Stephanie Hanover, a 6th-grade science teacher at Allen Academy (a private school in Bryan, Texas), and Jamie Scott, a 5th-grade science teacher at Allen Academy.

Project 02-010. Safety Perceptions of Transportation Network Companies by the Blind and Visually Impaired. Safe-D researchers at TTI collaborated with the following individuals to evaluate how the blind and visually impaired (BVI) perceive and use transportation network companies (TNCs): Dr. Anne Corn, Independent Consultant; Dr. Robert Wall Emerson, Western Michigan University, Panel Member; Donna Dean, Stephen F. Austin University, Panel Member; and Aaron Fox, Lyft, Panel Member. The National Federation of the Blind and the Texas School for the Blind and Visually Impaired also participated in the focus

group, and researchers worked with representatives of TNCs (Ride Austin, Fasten, Lyft, and Uber).

Project 01-003. Data Mining to Improve Planning for Pedestrian and Bicyclist Safety. The project team partnered with the city of San Diego and San Diego Association of Governments (SANDAG) and Urban Systems Associates, Inc. to obtain access to video feeds at several intersections within the city of San Diego.

Project TTI-01-01. Analysis of an Incentive-Based Smartphone App for Young Drivers. In this project, the TTI team partnered with Cambridge Mobile Telematics, who provided the smartphone application for analysis.

Project 01-005. Factors Surrounding Child Seat Usage in Ride-Share Services. To analyze the current state of child passengers and child safety seat use in ride-share vehicles, VTTI and TTI have collaborated with representatives of a prominent ride-share company.

International Collaborators

Project 02-020. Behavior-based Predictive Safety Analytics: Pilot Study. This project involves ongoing collaboration with the Delft University of Technology (Dr. Joost de Winter and Felix Dreger). Mr. Dreger visited VTTI as a student as part of this project in December 2017.

Project 03-03. Modeling Driver Responses during AV Platooning Failures. In this project, VTTI and TTI are collaborating with Dr. Gustav Markkula of Leeds University (U.K.) and Dr. Mark Vollrath of the Braunschweig University of Technology. Dr. Markkula provides insights at research team meetings and will play a key role in updating our model based on data he has collected under a parallel project. Dr. Vollrath's graduate student, Tobias Vogelpohl, visited VTTI in March 2018 to assist in naturalistic driving data analysis.

Impact

Impact on Transportation Safety

Safe-D focuses on the Fixing America's Surface Transportation (FAST) Act priority area of "Promoting Safety." Safe-D believes that innovative research on emerging technology will advance the methods of evaluation and improvement of transportation safety. During this reporting period, Safe-D awarded 10 new research projects focused on transportation safety via the four theme areas of the Center. As previously noted, each of these projects is required to produce EWD and T2 products, beyond a final report. These products began to emerge during this reporting period, with many educational tools generated, publications and presentations submitted, accepted, or published/presented, and more products under development.

Safe-D researchers reported 18 publications and presentations, and contributions toward two theses and/or dissertations. In addition, research teams reported many technologies and applications under development, as listed in Research Project Results. Project teams are working closely with stakeholders in both the public and private sectors to ensure that their research is meeting the needs of those that are expected to implement their findings. In addition, during the next reporting period, Safe-D will hold the first meeting of the Stakeholder Advisory Board. This

board will be instrumental in not only guiding the research at Safe-D, but also helping to ensure that the findings from each project are transferred into the hands of those leading implementation. It is through this close collaboration between the Safe-D researchers and stakeholders that the products of Safe-D research will make a dramatic impact on transportation safety.

Impact on Other Disciplines

The impact of Safe-D research is expected to extend beyond the principal discipline of the program. As noted in previous reports, Safe-D encourages collaborative research projects, both inter-consortium and extending to collaboration with domestic and international contacts outside of the Center. Many project teams are also interdisciplinary, with research faculty and students with backgrounds in engineering, computer science, architecture and urban planning, and many other disciplines. For example, Safe-D project Big Data Visualization and Spatiotemporal Modeling of Aggressive Driving includes faculty and students from the Geography departments VT and SDSU; the researchers involved in this project are transferring knowledge between the transportation and geography disciplines in order to tackle the complicated problem of identifying areas where aggressive driving behavior occurs and its relationship to the surrounding physical (topographical) environment. The interdisciplinary nature of many Safe-D research projects allows for the Safe-D program to impact and to stimulate entry into the transportation field from a broader array of disciplines.

Impact on the Transportation Workforce Development

At all levels of education from K-12 to college undergraduates to graduate students, Safe-D activities aim to inspire and educate the next generation of transportation professionals. At the K-12 level, various Safe-D programs have engaged young students through hands-on demonstrations to spur interest in transportation careers. As mentioned earlier, during this reporting period, Safe-D researchers participated in the VDOT Transportation Career Fair, Virginia Tech Science Festival, and West Salem Elementary STEM night. Additional efforts are underway to develop engaging primary school demonstrations and curricula related to vehicle automation and retroreflectivity. By increasing awareness of transportation technologies and developing effective educational materials for young students, Safe-D efforts are helping spur interest in transportation careers.

At the collegiate level, Safe-D researchers at Virginia Tech, Texas A&M, and SDSU teach a variety of undergraduate- and graduate-level courses related to transportation safety. In this reporting period, Safe-D researchers taught 15 graduate courses and 16 undergraduate courses, reaching a total of 976 students. Safe-D also supported 54 undergraduate, Masters, and PhD students working on transportation-related projects, including 20 members of underrepresented groups. These activities are expected to encourage college graduates in engineering and other STEM fields to pursue careers in transportation; during this reporting period, three students sponsored by Safe-D graduated, with two reporting employment within the private sector.

To further prepare students for careers in transportation, Safe-D also sponsored two seminar series: a Professional Skills Training Series geared towards professional preparation for graduate students, and an additional seminar series in which external researchers highlight new challenges and opportunities relevant to faculty and students in the transportation field. These seminars along with the Safe-D Visiting Scholars Program, which facilitates relationships among faculty and students at different Safe-D consortium institutions, are expected to continue throughout the grant period. In this way, Safe-D activities are encouraging students to pursue transportation careers and preparing them for the workforce.

Impact on Physical, Institutional, and Information Resources

The USDOT grant which created the Safe-D National UTC has afforded consortium universities with great opportunities to make an impact on physical, institutional, and information resources that would otherwise be unsupported or under-supported. As described in the previous report, the VTTI Internship Hub continued development during this reporting period. The Internship Hub will be strongly supported by Safe-D through the EWD program. During this reporting period, talks began with industry partners which will be involved in supporting student internships involved in this program and the first internships are expected to begin during the next reporting period. While industry partners will support these students during the first summer term, it is expected that Safe-D will bolster the initiative by funding interns which will participate in Safe-D research beginning in the Fall 2018. Students across all consortium universities are expected to participate in this initiative, with a projected impact of 15 undergraduates and 3 graduate students per year. Without the UTC grant funding of Safe-D, it is unlikely the VTTI Internship Hub would be developed and this impact on university resources would not be realized.

In addition, during this reporting period, Safe-D supported a group of eight Virginia Tech students to attend a Women in Transportation Seminar (WTS) event. As previously described, this event celebrated women in transportation and featured keynote talks from female executives within the USDOT along with breakout sessions. Where organizational support was not available to these students and many would have been unable to attend due to the cost that would have had to be covered by the students themselves, Safe-D was able to cover the expenses so that these students could attend such an important event. The Safe-D Leadership Team is excited to be able to provide support through this grant to student organizations such as this which encourage underrepresented groups to pursue education and training in transportation fields.

The Safe-D consortium was formed with the explicit goal in mind of providing mentorship and knowledge transfer across universities. A primary focus has been that VTTI and TTI would use their broad expertise and capabilities to promote and mentor SDSU, as Associate Director Dr. Sahar Ghanipoor Machiani led efforts to build the transportation research program at that institution. With this partnership and the recognition that Safe-D has brought to the SDSU transportation program, SDSU has been able to negotiate a better-quality student and research lab for the Transportation group with the Dean of College of Engineering during this reporting period. The lab is currently under renovation and is slated for completion in Fall 2018. Through

opportunities for growth such as this, the impact of the Safe-D UTC grant has been broad across all member institution physical, institutional, and information resources and is expected to continue throughout the life of the grant.

Impact on Technology Transfer (T2)

Safe-D research is designed to generate implementable results that can be commercialized or otherwise applied quickly after project completion. Each Safe-D research project is accompanied by a T2 plan that details the expected products and their target audience. Safe-D T2 Coordinator Dr. Mike Mollenhauer coordinates with Safe-D researchers and potential stakeholders while the project is ongoing to ensure the quick implementation of research results.

During this reporting period, many Safe-D researchers engaged with stakeholders directly to ensure that research projects address the most pressing transportation needs and that the results will be immediately applicable in practice. For example, in Project 02-010 (Safety Perceptions of Transportation Network Companies by the Blind and Visually Impaired), TTI researchers are working with Lyft and Uber along with the National Federation of the Blind and the Texas School for the Blind and Visually Impaired to ensure that the results will be relevant and easily implemented. TTI has also partnered with a low vision podcast to disseminate the results of this project. This type of collaboration with both public and private organizations through targeted T2 activities will facilitate the rapid implementation of research findings into public policy and practice, resulting in significant positive impacts on our future transportation system.

Impact on Society Beyond Science and Technology

The research conducted by Safe-D continues to make an impact beyond the bounds of science, engineering, and the academic world. Safe-D Director Dr. Zac Doerzaph recently highlighted the importance of Safe-D research in a U.S. Senate panel focused on preparing our nation's infrastructure for future connected and autonomous vehicles. This type of political outreach is critical to the implementation of research results in policy to achieve societal benefits. Safe-D researchers are also working to engage underrepresented groups in transportation issues. During this reporting period, Safe-D provided support for eight women to attend a Women in Transportation Seminar event in Washington D.C., and Safe-D Program Manager Leslie Harwood led a discussion of Safe-D research at a meeting the Virginia Women's Club. Club members were also given a tour of VTTI facilities used for Safe-D research activities. Additional planned outreach activities such as the demonstrations prepared for the USA Science and Engineering Festival, which is expected to attract over 300,000 children and adults, will further educate the public and encourage informed decision making.

Furthermore, individual Safe-D projects are expected to have significant societal benefits beyond advancements in science and technology. As mentioned in Participants and Collaborating Organizations section, Safe-D researchers are working with state DOTs and other governmental organizations along with private companies to ensure that research results translate into policy and societal benefits. For example, projects 01-005 (Factors Surrounding Child Seat Usage in

Ride-Share Services), 02-016 (Older Drivers and Transportation Network Companies: Investigating Opportunities for Increased Safety and Improved Mobility), and 02-010 (Safety Perceptions of Transportation Network Companies by the Blind and Visually Impaired) have the potential to greatly improve transportation safety by transforming how ride-sharing services are used by children, the visually impaired, and the elderly. In this way, Safe-D projects are expected to improve the safety and reliability of transportation nationwide.

Changes/Problems

Changes in Approach

Nothing to report.

Actual/Anticipated Problems/Delays

Nothing to report.

Changes Affecting Expenditures

Nothing to report.

Changes in Study Protocols

Nothing to report.

Changes in Performance Site Location

Nothing to report.

Additional Information Regarding Products and Impacts

Outputs

Nothing to report.

Outcomes

Nothing to report.

Impacts

Nothing to report.

Special Reporting Requirements

N/A