



SAPR Report for University Transportation Centers

This is a semi-annual report of program progress and performance for the Collaborative Sciences Center for Road Safety, a national UTC focused on safety.

SAPR #2 reporting period: 4/1/20 - 9/30/20

Grant No. 69A3551747113

DUNS: 608195277

EIN: 56-600-1393

Project/grant period: 11/30/16 - 9/30/22

Submitted to:

Robin Kline, Grant Manager
University Transportation Centers Program (RDT-30)
Office of the Assistant Secretary for Research and Technology
U.S. Department of Transportation
1200 New Jersey Avenue, SE, Work Station E33-466
Washington, DC 20590-0001

Submitted by:

Collaborative Sciences Center for Road Safety
Laura Sandt Ph.D., Center Director

sandt@hsrc.unc.edu

919-962-2358

Submission date: October 30, 2020

Table of Contents

1. Accomplishments.....	3
1.1 What are the major goals and objectives of the program?.....	3
1.2 What was accomplished under these goals?.....	3
1.3 What opportunities for training and professional development has the program provided?.....	11
1.4 How have the results been disseminated?.....	11
1.5 What do you plan to do during the next reporting period?.....	11
2. Participants and Collaborating Organizations.....	12
2.1 What organizations have been involved as partners?.....	12
2.2 Have other collaborators or contacts been involved?.....	13
3. Outputs.....	13
3.1 Publications, conference papers, and presentations.....	13
3.2 Policy Papers.....	15
3.3 Website(s) or other Internet site(s).....	15
3.4 New methodologies, technologies, or techniques.....	15
3.5 Inventions, patent applications, and/or licenses.....	16
3.6 Other products.....	16
4. Outcomes.....	16
4.1 Increased understanding and awareness of transportation issues.....	16
4.2 Passage of new policies, regulation, rulemaking, or legislation.....	16
4.3 Increases in the body of knowledge.....	17
4.4 Improved processes, technologies, techniques, and skills in addressing transportation issues.....	17
4.5 Enlargement of the pool of trained transportation professionals.....	17
4.6 Adoption of new technologies, techniques, or practices.....	17
5. Impacts.....	18
5.1 Impact on the effectiveness of the transportation system.....	18
5.2 Impact on the adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company.....	18
5.3 Impact on the body of scientific knowledge.....	18
5.4 Impact on transportation workforce development.....	19
6. Changes/Problems.....	19
6.1 Changes in approach and reasons for change.....	19
6.2 Actual or anticipated problems or delays.....	20
6.3 Changes that have a significant impact on expenditures.....	20
6.4 Significant changes in use or care of animals, human subjects, and/or biohazards.....	20
7. Special Reporting Requirements.....	20

1. Accomplishments

1.1 What are the major goals and objectives of the program?

The goals and objectives from our [Strategic Roadmap](#) provide context for our accomplishments in this document.

1.2 What was accomplished under these goals?

Selected highlights for this performance period include:

- Sought out and engaged in research and training activities to explore the impact of the COVID-19 pandemic on transportation safety, including development of a [COVID-19 project data set](#).
- Launched a new [CSCRS webinar series](#).
- Rescheduled the [NaTMEC](#) event and began planning for a virtual format to be held in 2021. Also, launched a NaTMEC webinar series in conjunction with the Institute of Transportation Engineers (ITE).
- Planned for the fall 2020 North Carolina Research & Innovation Summit.
- Launched a new research project looking at implementation of Vision Zero plans in the U.S. Also, concluded several CSCRS research projects, with several more nearing completion.
- Generated more than 33 CSCRS research-related peer-reviewed publications, 9 reports or policy papers, 36 presentations, 4 websites, and other new resources, including fact sheets, a [Vision Zero Guidebook](#), a [micromobility injury coding poster](#), and an SAE standard.
- Taught 26 transportation safety-related university courses and engaged hundreds of undergraduate, graduate, and doctoral students in CSCRS research, education, and professional development projects.

The bulleted sections below describe the accomplishments according to specific goals and objectives of CSCRS.

Goal 1:

To support Goal 1—ensuring that Safe Systems and systems science principles and approaches are shared, understood, and adopted by traffic safety professionals—we performed activities related to the following objectives:

Objective 1-1: Conduct research to generate a model(s) for what a Safe Systems approach, enhanced with systems science tools, can look like now and in the future and identify promising policies/practices that can be adopted to reduce fatalities and serious injuries.

- [Project R21](#) aims to develop a system dynamics simulation model that can be used as a learning tool to explore the pedestrian safety impacts of New York City's congestion pricing policy.
 - PI: Becky Naumann, UNC IPRC / Co-PIs: Kristen Hassmiller Lich, UNC Gillings School of Global Public Health; Laura Sandt, UNC HSRC; and Steve Marshall, UNC IPRC
 - Drafting scoping review of congestion pricing policies and their safety-related impacts; building the structure of and synthesizing data to parameterize a system dynamics simulation model of potential safety effects of congestion pricing policy implementation on vulnerable road user safety.
- [Project R22](#) aims to use integrated data to examine characteristics of pedestrian and bicyclist injuries.
 - PI: Katie Harmon, UNC HSRC / Co-Investigator: Laura Sandt, UNC HSRC
 - Motor vehicle crash and emergency department visit data have been cleaned and integrated. Demographic, crash circumstance, roadway, and vehicle characteristics have been examined for pedestrians in relation to crash injury severity, as assessed using clinical indicators. The COVID-19 pandemic has made the dissemination of study results challenging.
- [Project R24](#) aims to develop a framework to quantify the overall protective capability of the system and will be benchmarked against the desired capability of the system, as established by the policy makers.
 - PI: Offer Grembek, UCB

- Developed a set of case studies demonstrating the value of using kinetic energy as the focal variable to represent the magnitude of a crash. Collecting data to create a small but representative database of crash magnitudes across the U.S., for pedestrian crashes.

Objective 1-2: Lead training, outreach, and professional development related to Safe Systems approach and related policies and practices.

- CSCRS’s new webinar series was launched on September 30 with the presentation “Assessing Tesla Model 3’s Autopilot Interactions with the Driver Monitoring System” by Missy Cummings, Duke. 79 attendees.
- After postponing the biennial National Travel Monitoring Exposition and Conference ([NaTMEC](#)) from June 2020 to June 2021, the NaTMEC planning committee decided during this period to transition the meeting to a virtual format. CSCRS staff spent considerable amounts of time during this period on notifying attendees of the changes, coordinating refunds, canceling contracts, surveying attendees and vendors, and reconfiguring budgets for alternative meeting scenarios.
- CSCRS also launched a joint webinar program between NaTMEC and ITE. The first webinar, entitled “Pedestrian Safety, Travel Monitoring, and Relating the Two,” was held Sept. 15, attended by 246 people.
- Offer Grembek and Lisa Peterson, UCB, partnered with ITE and VZN to develop online speed management workshops for interested local communities in California. The purpose of the project is to build appreciation of the value of managing speed for safety and understanding of the most effective strategies to do so, and to support well-informed, effective practical actions and policy needs in the realm of speed management.
- CSCRS staff managed the planning for the virtual NCDOT Research & Innovation Summit, to take place October 2020, offering a platform to bridge UTC research into state and local practice.

Objective 1-3: Integrate Safe Systems principles into other road safety/public health/planning initiatives.

- CSCRS continued work with the Core Learning Community Systems National Peer Learning Team, a working group that meets regularly to explore defining a systems approach to road safety. On September 28, the group hosted a webinar about incorporating systems tools into injury prevention, engaging an audience of public health and transportation professionals.
- CSCRS researchers participated in leadership committee for the Road to Zero Coalition, which completed development over the summer of its Safe Systems Action Plan, prioritizing key coalition activities to develop, adopt, and disseminate Safe Systems resources. CSCRS researcher Wes Kumfer was appointed to lead a new Road to Zero working group, *Connecting Prioritizing Safety with Transportation Equity*.

Objective 1-4: Facilitate states and cities in implementing a Safe Systems approach in different contexts, utilizing the tools and research from CSCRS.

- CSCRS staff are engaged with multiple agencies, particularly in consortium member states and cities, to determine the needs of state and local governments in implementing Safe Systems. For specific projects bridging research to local practice, see Objective 2.3.

Goal 2:

To support Goal 2—ensuring that cutting-edge research, tools, data, and resources compatible with a Safe Systems approach are developed and utilized—we performed activities related to the following objectives:

Objective 2-1: Perform road safety research that explores core safety issues and transformational changes (i.e., from technology, ride-sharing services, etc.) and integrates public health concepts and methods.

- Continued [Project R9](#) to explore the operational needs and characteristics for an AV dispatch center.

- PI: Missy Cummings, Duke
- Final report is in CSCRS review. Elucidated several concepts of operation and developed various simulation models for examining dispatcher workload and testing the impact of mixed traffic of autonomous vehicles and human-driven vehicles.
- Continued [Project R10](#) to investigate how machine learning techniques can be used to design countermeasures that improve system safety.
 - PI: Missy Cummings, Duke / Co-Investigator: Michael Clamann, UNC HSRC
 - Final report is in CSCRS review.
- Continued [Project R11](#) to examine the moderating role of the built environment on the relationship between crash incidence and socio-economic status.
 - PI: Yanmei Li, FAU / Co-Investigator: Eric Dumbaugh, FAU
 - Final report is in CSCRS review.
- Continued [Project R12](#), which aims to provide a more accurate picture of California traffic injuries by utilizing medical data to fill in where police crash reports may have limited information, and to get a more accurate picture of California emergency medical services response times.
 - PI: David Ragland, UCB / Co-Investigator: Chris Cherry, UTK
 - Project complete (Report complete and data being organized for submission).
 - Project has led to collaboration with California Center for Medical Outcomes (CMOD) on a follow-up project to extend matching collision and hospital data to increase knowledge of under-reporting based on crash data. CMOD has used the analytic strategy described in our report to guide their matching analyses and achieve a higher matching rate than previous efforts.
 - Project has led to potential collaboration with CITRIS, a research center at UC Berkeley (Center for Information Technology in the Interest of Society) on improving triage strategies for more effective EMS response. One possible strategy under development by CITRIS is telemedicine that would allow improved on-site treatment of injury.
 - Through participation in the California Strategic Highway Safety Plan, we have proposed a Statewide analysis of EMS response times at the zip code level that will provide a basis for improving resource allocation for improved times.
- Continued [Project R13](#), which assesses how technological change embodied by shared mobility services impacts road safety.
 - PI: Noreen McDonald, UNC DCRP / Co-Investigator: Tabitha Combs, UNC DCRP
 - Manuscript completed and sent out for journal article peer review.
- Continued [Project R15](#) to help policymakers and transportation safety professionals evaluate safety impacts of the transportation system and identify neighborhoods with a higher risk of traffic crash involvement.
 - PI: Chris Cherry, UTK / Co-Investigator: Louis Merlin, FAU
 - Final report is in CSCRS review.
- Continued [Project R16](#), which aims to provide evidence to provide insight into the impact of prescribing opioids for acute pain relief after a traffic crash, and for transportation professionals to help understand the systems impact of opioid use on traffic safety.
 - Final report is in CSCRS review.
- Continued [Project R18](#), which entails an examination of national trends in light rail safety performance and an investigation of the factors related to light rail-related crash risks.
 - PI: Eric Dumbaugh, FAU / Co-Investigator: Candace Brakewood, UTK
 - Final report is in CSCRS review.
- Continued [Project R20](#), which explores the impacts of various treatments that can be explored using the Motorcycle Crash Causation Study data, collected by the US Department of Transportation.
 - PI: Asad J. Khattak, UTK / Co-Investigator: Arthur Goodwin, UNC HSRC

- Final report is in CSCRS review.
- [Project R25](#) aims to advance crash investigation with connected and automated vehicle data.
 - PI: Michael Clamann, UNC HSRC / Co-Investigator: Asad Khattak, UTK
 - Completed a national survey of law enforcement professionals on how to improve investigations with automated vehicle data, thereby completing data collection for the project.
- [Project R26](#) aims to accelerate shared learning around micromobility safety impacts.
 - PI: Chris Cherry, UTK / Steve Marshall, Becky Naumann, UNC IPRC, and Susan Shaheen, UCB
 - Assembled and summarized state and other data sources on micromobility incidents and safety-impacting events. Developed, tested, and pre-launched a survey exploring user safety perceptions.
- [Project R27](#) aims to investigate how to effectively test connected and automated vehicles using physical and simulation tests.
 - PI: Subhadeep Chakraborty, UTK / Co-Investigator: Asad J. Khattak, UTK, Co-Investigator: Mary (Missy) Cummings, Duke University
 - The Phase I report is under CSCRS review. A research paper on the use of LiDAR, camera, and radar data is in preparation.
 - The project has conducted literature reviews on safety of connected and automated vehicles, analyzed automated vehicle crashes, and developed simulation environments using SUMO and CARLA software. Mixed real-life and synthetic sensor data generated for vehicle simulations.
 - Data from a pilot test with 3 Tesla Model 3 vehicles has been analyzed. A poster from this study will be presented at the NCDOT Research & Innovation Summit.
- [Project R28](#) aims to apply evidence-based countermeasures to reduce injuries in motorcycle crashes.
 - Jerry Everett, UTK / Co-PI: Asad Khattak, UTK
 - The project is underway to enable evidence-based practice, shorten the research-to-practice cycle, and focus on assisting stakeholders with diverse backgrounds, motorcycle safety practitioners, and advocates in applying the outcomes of CSCRS research and information synthesized from the literature. The research team is working to update the 2015 TN Motorcycle Strategic Safety Plan.
- [Project R30](#) evaluates impacts of urban freight on safety through detailed spatial and longitudinal analyses.
 - PI: Noreen McDonald, UNC DCRP
 - Collected and analyzed data on determinants of crash severity for crashes between vulnerable road users and commercial vehicles. Predicted factors contributing to crash severity, analyzed time series, and mapped crashes, comparing to population density and freight-producing employment.
- [Project R31](#) examines crash risk for at-risk population segments and underlying risk factors.
 - PI: Diana Mitsova, FAU / Co-Investigator: Eric Dumbaugh, FAU
 - Database assembly nearing completion.
- [Project R32](#) seeks to develop novel methods for safety education and outreach targeted to lower-income and minority children in Miami, FL.
 - PI: Eric Dumbaugh, FAU
 - This project, which entails public engagement activities, has been prevented from proceeding due to restrictions on public gatherings associated with COVID-19.

Objective 2-2: Develop research-driven tools, resources, and data sets to support problem identification and understanding.

- Continued [Project R19](#), which is developing a deeper understanding of human errors that lead to crashes.
 - PI: Asad J. Khattak, UTK / Co-Investigator: Eric Dumbaugh, FAU
 - Final report is in CSCRS review.
- [Project R23](#) explores how to measure driver-vehicle-roadway volatilities using naturalistic driving study data and driving simulator.

- PI: Asad Khattak, UTK /Subhadeep Chakraborty, UTK, and Michael Clamann, UNC HSRC
- Final report is in CSCRS review. The project has integrated data from drivers' biometrics, vehicle kinematics, and roadway environments to explore driving volatility and leading indicators of driver impairments. Data from SHRP2 naturalistic driving study was analyzed as part of this project.

Objective 2-3: Translate research knowledge to support the development of comprehensive programs, policies, and practices that are proven to reduce fatalities and severe injuries.

- Continued [Project R8](#), a two-year effort developing tools to assist parents of new drivers.
 - PI: Arthur Goodwin, UNC HSRC
 - Work on this project has been delayed because of COVID-19 restrictions on new driving training.
- Continued [Project R17](#), which aims to strengthen existing and facilitating new Vision Zero plans.
 - PI: Kelly Evenson, UNC Gillings School of Public Health / Co-I's: Seth LaJeunesse, UNC HSRC, and Steve Marshall and Becky Naumann, both with UNC IPRC
 - Completed "Guide for Vision Zero Plans;" revised per expert feedback. [Final Guide](#) now available.
 - Utilized matching funds to produce two documents: [Vision Zero Milestones Implementation Checklist](#) and [Vision Zero Safety Procedures](#). Both are companion documents to support NC Vision Zero communities in understanding where they stand with implementation in relation to eight safety procedures with documented safety efficacy and political viability worth implementing.
- Started new [Project RR2](#), which aims to assess how Vision Zero is being implemented nationwide.
 - PI: Kelly Evenson, UNC Gillings School of Public Health / Co-I's: Seth LaJeunesse, UNC HSRC, and Becky Naumann, UNC IPRC
 - Developed and administered survey to assess Vision Zero implementation across the U.S.; trained 6 people on its use and measured reliability to maintain consistent assessment across raters. Abstractions are ongoing – when complete, will have an assessment of Vision Zero work across 788 U.S. municipalities from July-October 2020.
 - Created interview guide and protocol for follow-up interviews, submitted to UNC IRB in 9/2020.
- [Project R22](#) aims to use integrated data to examine characteristics of pedestrian and bicyclist injuries.
 - PI: Katie Harmon, UNC HSRC / Co-Investigator: Laura Sandt, UNC HSRC
 - Utilized matching funds to hold an annual Motor Vehicle Crash Injury Data Linkage Stakeholder meeting on June 22, 2020, engaging multiple stakeholders, including North Carolina GHSP, NCDOT, Hospital Association, and others on issues related to data integration in the state.

Objective 2-4: Broadly disseminate research products and findings, with emphasis on reaching new and non-traditional audiences:

Objective 1.2 covered many efforts to disseminate research, specifically relating to systems-oriented projects and work that CSCRS is producing. Table 1 highlights additional presentations made in this reporting period to disseminate research findings to diverse groups.

Table 1: Select CSCRS outreach highlights

Duke	Cummings, M. (2020, May). <i>Future pitfalls and promises of safety in autonomous systems</i> . [Presentation]. The NTSB Speaker Series.
	Cummings, M. (2020, July). <i>When humans meet automation: What the research tells us</i> [Panelist]. PAVE (Partners for Automated Vehicles Education) event.
	Cummings, M. (2020, August). <i>Future pitfalls and promises of safety in autonomous systems</i> . [Presentation]. Santa Fe Institute seminar series.
	Cummings, M. (2020, August). <i>Assessing Tesla Model 3s' autopilot interactions with the driver monitoring system</i> . [Presentation]. National Transportation Safety Board.
	Cummings, M. (2020, August). <i>Assessing Tesla Model 3s' autopilot interactions with the driver monitoring system</i> . [Presentation]. National Highway Traffic Safety Administration.

	<p>Cummings, M. (2020, August). <i>Assessing Tesla Model 3s' autopilot interactions with the driver monitoring system</i>. [Presentation]. Amazon Robotics.</p> <p>Cummings, M. (2020, September). Rethinking testing AV safety. [Keynote address]. The International Telecommunication Union workshop on AI for Autonomous and Assisted Driving.</p> <p>Cummings, M. (2020, September 30). <i>Assessing Tesla Model 3s' autopilot interactions with the driver monitoring system</i>. [Webinar]. Safe Systems Approach to Road Safety.</p> <p>Bauchwitz, B. (2020, September) <i>Assessing Tesla Model 3s' autopilot interactions with the driver monitoring system</i>. [Lecture]. Humans and Autonomy Lab, Duke University.</p>
FAU	<p>Dumbaugh, E., Li, Y., and Saha, D. "Income Disparity, Crash Risk, and the Built Environment." Bridging Transportation Researchers (BTR) Online Conference. August 12, 2020.</p>
UCB	<p>Grembek, O. (2020, September 10). The safe system approach: Considerations for developing a multi-layered system. [Keynote address]. The 28th Annual Conference of the Research Institute of Human Factors in Road Safety of the Bar Ilan University, Israel.</p> <p>Offer Grembek, UCB, was interviewed by Jenn Fox, Vision Zero Network, for an installment of their People Behind the Progress Series for "Talking with Offer Grembek, Transportation Researcher, about Safe Systems & Speed" which was published on July 4, 2020.</p> <p>Offer Grembek, UCB, participated in the UC Berkeley MEng Capstone Info Fair as an advisor for the "Crowdsourcing Perceived Hazardous Pedestrian Locations" Project. Approx. 5 students participated.</p> <p>Offer Grembek, UCB, co-authored "The Transportation Safety Pandemic" which was featured in the September 1, 2020 issue of the Institute of Transportation Engineers (ITE) Journal.</p>
UNC	<p>UNC DCRP Research Assoc Tabitha Combs shared findings from her work on cities' efforts to adapt streets to accommodate increased demand for safe spaces to walk and bicycle during the COVID-19 pandemic (partially supported through DCRP's CSCRS operations budget) in local, national, and international outlets:</p> <ul style="list-style-type: none"> • Tabitha Combs, Dan Gelinne, & Heyden Black (2020). "Research in Action: Trends in how municipalities are addressing increased demand for safe public space." Webinar, America Walks. (~1200 registered participants) • Aidil Ortiz, Tabitha Combs, & Warren Logan (2020). "How travel is changing in the time of COVID-19," Webinar, Bike Durham. (~60 participants) • Tabitha Combs (2020). "Pop-up infrastructure around the world." Presented at the Post-Corona Mobility Conference (virtual) presented by Syklistenes Landsforening. Oslo, Norway. <p>Sandt, L. (July 6, 2020). <i>Micromobility Safety Data: Existing tools, practices, and identified gaps</i>. Presentation to NTSB.</p> <p>Harmon, K. (July 8, 2020). <i>Micromobility Safety Data: Injury Surveillance Considerations</i>. Presentation to NTSB.</p> <p>Sandt, L. (June 29, 2020). <i>A Research Roadmap for Transportation and Public Health</i>. NCHRP webinar.</p> <p>Sandt, L. (July 15, 2020). <i>Designing a Safer System for Pedestrians</i>, Presentation at the USDOT Pedestrian Safety Summit.</p> <p>Harmon, K. (September 25, 2020), <i>Selected characteristics and injury patterns by age group among pedestrians treated in North Carolina emergency departments</i>, Presented at the AAAM Virtual Meeting.</p> <p>Harmon, K. (September 15, 2020). <i>Injury Surveillance Considerations Regarding E scooter & Other Micromobility Devices</i>. Consumer Product Safety Commission Micromobility Forum.</p> <p>Kumfer & LaJeunesse (September 29, 2020). Safe Systems and Asset Mapping in Rural Areas. Presented at the 3rd National Summit on Rural Road Safety.</p> <p>Waller & Harmon. (September 2020). "Linking emergency department (ED) and motor vehicle crash (MVC) data for pedestrian and bicyclist injury." Presented at the Council of State and Territorial Epidemiologists Injury Presentation Series 1.</p> <p>Peticolas & Harmon (September 2020). "Building an integrated crash surveillance system: A North Carolina case study." Presented at the Safe States Alliance Annual Conference.</p> <p>Koonce, P., Combs, T., Kumfer, W., and Gelinne, D. (2020). Evaluating Innovations in Traffic Impact Assessment to Facilitate Safety and Operations Integration. Workshop at ITE 2020 Annual Meeting and Exhibition.</p> <p>Thomas, L., Heiny, S., and Kumfer, W. (2020). Speed Safety Cameras: Recent Guidance for Speed Management. Workshop at ITE 2020 Annual Meeting and Exhibition.</p> <p>Kumfer, Combs, & LaJeunesse (August 2020). Effective travel survey design. Presented an NC Traffic Safety Conference and Expo webinar: https://ncvisionzero.org/expo/training/.</p>
UTK	<p>Cherry, C. (2020, May 25) <i>Policy Approaches to e-bikes and other micromobility. Smart Sustainable Mobility and Cycling</i>. [Webinar]. School of Planning and Architecture, Bhopal India.</p> <p>Wen, Y., Cherry, C., & Aryal, S. (2020, September 30). <i>Sustainability analysis of shared micromobility in Knoxville, Tennessee</i>. [Presentation]. North American Bike Share Association Annual Meeting.</p> <p>Cherry, C. (2020, August 10). <i>Safety data for micromobility</i>. [Presentation]. Traffic Records Forum, Nashville, TN.</p> <p>Cherry, C., Macarthur, J., & Yee, R. (2020, September 15). <i>Standards in the world of new mobility</i>. [Presentation]. Consumer Product Safety Commission Micromobility Forum.</p> <p>Cherry, C. (2020, September 15). <i>Safety data limitation and opportunity for micromobility</i>. [Presentation]. Consumer Product Safety Commission Micromobility Forum.</p> <p>Cherry, C. (2020, July 28). <i>Safety data limitations and opportunity for Vision Zero</i>. [Webinar]. Walk Bike Nashville Vision Zero, A Data Driven Approach.</p> <p>Cherry, C. (2020, July 23). <i>Safety data limitation and opportunity for micromobility</i>. [Presentation]. National Transportation Safety Board Micromobility Safety Data Meeting.</p>

Goal 3:

To support Goal 3—to ensure that a growing body of students and future leaders are engaged and well-trained in road safety principles, Safe Systems approaches, and systems science methods—we performed activities related to the following objectives:

Objective 3-1: Develop and deliver courses at consortium member universities that integrate CSCRS concepts. (Note: Many of these were transitioned to online formats.) Highlights:

- UCB Spring 2020 graduate courses:
 - Traffic Safety and Injury Control. Instructors: David Ragland & Offer Grembek. (12 students)
 - Transportation Sustainability. Instructor: Susan Shaheen. (55 students)
- UCB Fall 2020 graduate courses:
 - Injury Prevention and Control. Instructors: David Ragland & Glenn Shor. (5 students)
 - Sustainable Mobility. Instructor: Daniel A. Rodriguez. (32 students)
- UNC DCRP Spring 2020 graduate courses:
 - Roadways for a safer future. Instructor: Tabitha Combs (19 students)
 - Complete streets. Instructor: Tabitha Combs (29 students)
 - Planning for freight. Instructor: Charles Edwards (11 students)
 - Transport policy. Instructor: Allie Thomas (16 students)
- UNC DCRP Fall 2020 graduate courses:
 - Transportation planning methods. Instructor: Noreen McDonald (24 students)
 - Public transit. Instructor: John Tallmadge (24 students)
 - Urban analytics. Instructor: Nikhil Kaza (9 students)
- UNC IPRC Fall 2020 graduate course: Injury as a Public Health Problem. Instructor: Steve Marshall; guest lecture on road safety and systems thinking by Becky Naumann and the epidemiology of pedestrian injury by Seth LaJeunesse. (12 students)
- FAU Spring 2020 undergraduate course: Designing the City. Instructor: Eric Dumbaugh. (60 students)
- FAU Spring 2020 graduate/undergraduate course: The Future of Urban Mobility. Instructor: Louis Merlin. (11 students)
- FAU Fall 2020 graduate course: Transportation Planning. Instructor: Louis Merlin. (3 students)
- FAU Fall 2020 undergraduate course: Introduction to Transportation. Instructor: Louis Merlin. (14 students)
- Duke University Spring 2020 undergraduate/graduate course: Design of Experiments. Instructor: Mary (Missy) Cummings. (23 students)
- UTK’s Civil and Environmental Engineering faculty offered 10 transportation courses during Spring 2020, Summer 2020, and Fall 2020 covering transportation engineering (I and II), transportation lab, traffic characteristics, geometric design, transportation planning, public transportation, transportation seminar, analysis techniques for transportation systems, intelligent transportation systems. (Enrollment varies)

Objective 3-2: Engage students through student-directed activities and professional opportunities:

Table 2 describes additional key student engagement and awards offered during this reporting period.

Table 2: Select CSCRS student engagement activities

UCB	UCB awarded 5 graduate students CSCRS Road Safety Graduate Student Fellowships, providing the opportunity to generate high quality CSCRS research pertaining to road safety topics.
	2 graduate student researchers spent the summer revising/validating the codebook for the National Pedestrian and Bicycle Safety Data Clearinghouse and recoding over 2,300 of the datasets.
Duke	For R9, 1 undergraduate student and one research assistant worked on the simulation and data analysis.
	For R27, 1 Ph.D. student did the pilot testing with a research assistant and worked on the data cleaning and analysis. Another research assistant worked together to develop a steering wheel detection algorithm.

FAU	1 research assistantship, Sibel Bode, involved in research projects.
UNC	UNC Injury Epidemiology Ph.D. students, Bhavna Singichetti and Nandi Taylor, supported with research assistantships to conduct road safety policy and Vision Zero-related research.
	MSCR students Luke Lowry, Eve Lettau, Katie Hillis, and Sarah Brown worked on Project RR2, gaining knowledge of U.S. Vision Zero work.
	17 UNC DCRP students were awarded Transportation Leadership Fellowships for spring 2020. This fellowship recognizes and supports students who are committed to bridging gaps between road safety and other dimensions of planning in their educational and professional careers.
	2 UNC DCRP students, Riqui Guo and Tory Gibler, received Road Safety MP Scholarships to support master's projects that incorporate CSCRS themes or content.
	3 UNC DCRP students received fellowships to support development proposals for master's projects that address road safety: Lucy Laird, Luke Lowry, and Sam Boswell.
	UNC DCRP postdoc Torrey Lyons presented findings from R30 to NCDOT, Sept 2, 2020. (10 participants)
UTK	UTK has 17 students working toward their PhDs. Three recent students finished their Ph.D. in Civil & Environmental Engineering: <ul style="list-style-type: none"> • Dr. Ramin Arvin, Application of Big Data in Transportation Safety Analysis Using Statistical and Deep Learning Methods, Chair of Ph.D. Committee: Dr. Asad Khattak. • Dr. Yuandong Liu, Real-time Traffic State Assessment Using Multi-sources Data, Chair of Ph.D. Committee: Dr. Lee Han. • Dr. Zhihua Zhang, Exploring the Potentials of Using Crowdsourced Waze Data in Traffic Management: Characteristics and Reliability, Chair of Ph.D. Committee: Dr. Lee Han.
	UTK's recent graduate students who have finished their MS in Civil & Environmental Engineering include the following: <ul style="list-style-type: none"> • Shah, N.R. Big Data and Unsupervised Machine Learning Approach to Understand Why People Ride E-scooter in Nashville, Tennessee. MS Thesis. Civil & Environmental Engineering, The University of Tennessee, 2020. • Hoque A. Providing Real-Time Driver Advisories in Connected Vehicles: A Data-Driven: Approach Supported by Field Experimentation. MS Thesis. Civil & Environmental Engineering, The University of Tennessee, 2020.
	UTK partnered with ITE and WTS to host 8 ITE meetings, 4 transportation seminars and a series of virtual happy hours.
	UTK students selected to receive best student paper by ACP-20 TRB.

Objective 3-3: Develop mentorship and internship opportunities for students to engage in critical thinking about road safety issues from a variety of perspectives and connect with traditional and non-traditional partners.

- UTK Civil & Environmental Engineering Department held Weekly Graduate Student Researcher meetings with graduate students to support mentoring and share best practices for effectively communicating research, making presentations, and utilizing social media.
- Weekly Graduate Student Researcher Group Meetings (UCB): This weekly meeting includes 5 graduate students and provide various opportunities for professional development, including best practices for effectively communicating your research, research presentations, observation visits with practitioner organizations, and utilizing social media to support professional activities. Students are from City and Regional Planning, Transportation Engineering, and Engineering and Project Management.
- CSCRS created a [Jobs Board](#) of student and post-graduation opportunities.

Objective 3-4: Provide exposure to road safety principles in K-12 settings, to enhance early interest in traffic safety.

- Offer Grembek and Lisa Peterson, UCB, continued their partnership on a project with UC Berkeley's Center for Cities + Schools educational initiative, Y-PLAN, to develop resources and educational content on traffic safety and vision zero/safe systems principles to integrate into their curriculum as part of a 10 week program for the Engineering Leadership Academy high school students at Oakland High School, Oakland, CA. On April 24, 2020 they participated in the final student presentations online for the client, Oakland Department of Transportation (approx. 60 guests, instructors, clients, and students participated).
- Wes Kumfer, UNC HSRC, presented felt road virtual demonstration "Designing and Planning a Roadway for All" to the NCA&T Summer High School Transportation Institute (with support from LaJeunesse). Summer camp students designed their own miniature safe road by adding safety-related features like bike lanes, signs, streetlights, and more.
- Began work on CSCRS STEM resources web page.

1.3 What opportunities for training and professional development has the program provided?

Myriad teaching, training, and learning opportunities have been showcased in this report (see Table 1 and 2). Additionally, a weekly traffic safety seminar at SafeTREC is held every Friday, 10:00 - 11:00 AM. It serves as a platform to discuss various research works happening, including CSCRS and Safe Systems topics such as:

- May 15: Offer Grembek, UCB, presented “Injury Crashes During COVID-19”. (18 staff and students)
- June 26: Offer Grembek, UCB, presented “COVID-19 and Safe Systems”. (13 staff and students)
- Sept. 4: Lin Yang, UCB, presented “Evaluating Impacts of Kinematic Waves on Freeway Collisions”. (16 staff and students)

1.4 How have the results been disseminated?

Results are being disseminated in accordance with the CSCRS [Technology Transfer Plan](#). The Consortium coordinated to co-promote CSCRS news/updates on their websites, in newsletters, and on social media. Communications staff continuously maintained the CSCRS Twitter feed, which now has 557 followers. A recent month’s analytics showed 9,968 impressions, an increase of more than 55% over the previous month. Staff also maintained the CSCRS Facebook page. CSCRS staff updated project descriptions, titles, and end dates on the [CSCRS website](#) and in the Transportation Research Board Research in Progress (RiP) Database, tagged as UTC research. CSCRS researchers engaged with the Advisory Board as well as attended a UTC roundtable event hosted by NCDOT in July 2020 to share its research activities and findings. Project-related publications and presentations from this reporting period are listed in the Products section.

1.5 What do you plan to do during the next reporting period?

CSCRS is evaluating research opportunities and needs, including those related to the pandemic, and plans to continue implementation of its strategic research agenda. The following section provides additional examples of what CSCRS plans to complete during the next reporting period (10/1/2020-3/31/21) to accomplish its goals:

- **Research activities planned:**
 - Implement Year 5 call for research, including: finalize the call, evaluate research proposals received in a peer-review process, and select projects for funding during the next reporting period.
 - Completion, posting, and reporting of several current CSCRS research projects.
- **Professional development activities planned:**
 - Continue planning and hold the NCDOT Summit, October 13-14, 2020.
 - Continuation of the CSCRS Webinar series.
 - Dozens of presentations as part of the virtual Transportation Research Board 2021 Annual Meeting.
 - Planning for virtual NaTMEC in June 2021; continuation of the NaTMEC/ITE webinar series.
 - Present information on characteristics of at-risk pedestrians and bicyclists to Florida Department of Transportation based on preliminary results from R31.
 - Expand training and connections with practice through TN Local Technical Assistance Program, housed at UTK Center for Transportation Research.
- **Teaching and student enrichment activities planned:**
 - Continue planning and hold the NCDOT Summit, October 13-14, 2020.
 - Nominate a student to be CSCRS’s 2020 Student of the Year.
 - Introduce round 5 of the UCB CSCRS Graduate Student fellowship for UC Berkeley graduate students conducting independent research on relevant to traffic and road safety.
 - Teach several college courses, as well as incorporate CSCRS research findings and opportunities into other/existing courses and seminars.
 - Provide instruction on safety and community design for 2021 FAU course, Designing the City.
 - NaTMEC 2021 will incorporate activities for students, including opportunities to present.

- Plan for participation in the 2021 UNC Science Expo, which is expected to be virtual.
- Continue work on CSCRS STEM resources page.

In addition to activities specific to the three goals, we will continue conducting administrative functions that support all Center activities, including managing the Center’s website, communications platforms, engaging with the Advisory Board, responding to USDOT or other requests, and developing efficient project management systems.

2. Participants and Collaborating Organizations

2.1 What organizations have been involved as partners?

The following organizations, including 3 that are *new, have been involved as CSCRS partners:

Table 3: Select CSCRS Collaborator and Sponsor Organizations

Business
AT&T Fleet Complete, Atlanta, GA (Financial Support)
SoftServe, Inc., Austin, TX (Financial and Collaborative Support)
PhD Posters, Durham, NC (Financial Support)
Toyota Motor North America, Saline, MI (Financial Support)
Uber, San Francisco, CA (Financial Support)
VHB, Watertown, MA (Financial Support)
Volkswagen Group of America, Herndon, VA (Collaborative Support)
Foundation
Health Foundation of South Florida, Miami, FL (Collaborative Support)
John D. and Catherine T. MacArthur Foundation, Chicago, IL (Financial Support)
Local Government
Town of Chapel Hill Staff, Chapel Hill, NC (Collaborative Support)
Other Non-Profits
American Institute of Architects, Miami, FL (Collaborative Support)
America Walks, Portland, OR (Collaborative Support)
American Planning Association, Chicago, IL, and Washington, DC (Collaborative Support)
American Public Health Association, Washington, DC (Collaborative Support)
Association of Pedestrian and Bicycle Professionals, Lexington, KY (Collaborative Support)
Broward Metropolitan Planning Organization, Fort Lauderdale, FL (Collaborative Support)
Dream in Green, Miami, FL (Collaborative Support)
Institute of Transportation Engineers, Washington, DC (Collaborative Support)
Insurance Institute for Highway Safety, Vehicle Research Center, Ruckersville, VA
The Miami Center for Architecture and Design, Miami, FL (Collaborative Support)
Miami-Dade Transportation Planning Organization, Miami, FL (Collaborative Support)
Mobility Lab, Arlington, VA (Collaborative Support)
National Association of City Transportation Officials, New York, NY (Collaborative Support)
National Cooperative Highway Research Program, Washington, DC (Financial Support)
National Indian Justice Center, Santa Rosa, CA (Collaborative Support)
National Local Technical Assistance Program Association, US (Collaborative Support)
North Carolina Center for Automotive Research, Garysburg, NC (Collaborative Support)
Palm Beach Transportation Planning Agency, West Palm Beach, FL (Collaborative Support)
Palm Beach Planning Congress, Palm Beach, FL (Collaborative Support)
The Road to Zero Coalition/The National Safety Council, Itasca, IL (Financial and Collaborative Support)
Transportation Research Board Standing Committee on Pedestrians, Washington, DC (Collaborative Support)
Transportation Research Board Standing Committee on Transportation Safety Management, Washington, DC (Collaborative Support)
Vision Zero Network, San Francisco, CA (Collaborative Support)
WTS International, Washington, DC (Collaborative Support)
School District
Knox County School District, Knoxville, TN (Collaborative Support)

State Government
California Emergency Medical Systems Authority (Collaborative Support, Data Request)
California Center for Medical Outcomes, California Department of Public Health, Sacramento, CA (Collaborative Support, Data Request)
*New this period: Florida Department of Transportation (Collaborative Support)
North Carolina Department of Transportation, Raleigh, NC (Financial Support)
North Carolina Governor’s Highway Safety Program, Raleigh, NC (Collaborative and Financial Support)
North Carolina Turnpike Authority, Raleigh, NC (Collaborative Support)
Tennessee Department of Transportation, Nashville, TN (Matching Request & Data)
Tennessee Dept. of Safety & Homeland Security, Nashville, TN (Data Request)
Tennessee Department of Health, Nashville, TN (Data Request)
Tennessee Technology Access Program, Nashville, TN (Collaborative Support)
U.S. Agency
National Science Foundation, Washington, DC (Sponsor of Projects)
Centers for Disease Control and Prevention, Atlanta, GA (Collaborative Support)
U.S. Facility
Oak Ridge National Laboratory, Oak Ridge, TN (Collaborative Support)
U.S. Government
U.S. Dept. of Energy, Washington, DC (Collaborative Support)
U.S. Dept. of Transportation, Washington, DC (Sponsor of Projects & Collaborative Support)
University
Duke Initiative for Science & Society Science Policy Tracking Program, Durham, NC (Financial Support)
East Tennessee State University, Johnson City, TN (Collaborative Support)
North Carolina State University Institute for Transportation Research and Education, Raleigh, NC (Collaborative Support)
Planning Society @ FAU, Boca Raton, FL (Collaborative Support)
Renaissance Computing Institute, Chapel Hill, NC (Collaborative Support)
*New this period: University of Aveiro
*New this period: University of Miami
University of Tennessee Chattanooga, TN (Collaborative Support)
Various Jiaotong Universities in China (Collaborative Support)
North Carolina Central University, Durham, NC (Collaborative Support)

2.2 Have other collaborators or contacts been involved?

Nothing to report beyond the table above.

3. Outputs

CSCRS included two performance measures related to outputs in its Technology Transfer Plan:

- Organize and hold conferences through 2021.
- Annual journal manuscripts, publications, articles, posts, media stories, etc.

As mentioned, we will continue planning for virtual TRB and NaTMEC in 2021, and will manage the 2020 NCDOT Research & Innovation Summit. Sections 3.1-3.3 present the significant number of outputs related to CSCRS research and tech transfer.

3.1 Publications, conference papers, and presentations

Presentations given during this reporting period (36) are summarized in Table 1 (page 7-8) of this report. Following are select highlights of publications produced by CSCRS team members:

Table 4: Select CSCRS publications

Peer-Reviewed Publications
Arvin, R., Khattak, A., Kamrani, M., & Rios-Torres, J. (Forthcoming). Safety evaluation of automated vehicles in mixed traffic with conventional vehicles at intersections. <i>Journal of Intelligent Transportation Systems</i> .
Behbahani, H., Amiri, A. M., Nadimi, N., & Ragland, D. R. Increasing the efficiency of vehicle ad-hoc network to enhance the safety status of highways by artificial neural network and fuzzy inference system. <i>Journal of Transportation Safety & Security</i> . 12(4). 501-521.
Combs, T., & McDonald, N. (Accepted). Driving change: Exploring the adoption of multimodal local traffic impact assessment practices. <i>Journal of Transport and Land Use</i> .
Cummings, M.L., & Li, S. (In press). Subjectivity in the creation of machine learning models. <i>Journal of Data and Information Quality</i> .
Dumbaugh, E., L. Merlin, and D. Saha. (Accepted). Towards Safe Systems: Traffic Safety, Cognition, and the Built Environment. <i>Journal of Planning Education and Research</i> .
Hoseinzadeh, N., Arvin, R., Khattak, A. J., & Han, L. D. (2020, July). Integrating safety and mobility for pathfinding using big data generated by connected vehicles. <i>Journal of Intelligent Transportation Systems</i> , 24(4), 404–420. https://doi.org/10.1080/15472450.2019.1699077
Jia, S., Hui, F., Li, S., Zhao, X., & Khattak, A. J. (2020, April). Long short-term memory and convolutional neural network for abnormal driving behaviour recognition. <i>IET Intelligent Transport Systems</i> , 14(5), 306–312. https://doi.org/10.1049/iet-its.2019.0200
Kamrani, M., Srinivasan, A., Chakraborty, A. & Khattak, A. (2020, June). Applying Markov decision process to understand driving decisions using basic safety messages data. <i>Transportation Research Part C: Emerging Technologies</i> , 115, 102642.
Kontou, E., McDonald, N., Brookshire, K., Pullen-Seufert, N., & Lajeunesse, S. (2020). U.S. active school travel in 2017: Prevalence and correlates. <i>Preventive Medicine Reports</i> 17.
Lyons, T., & McDonald, N. (Under review). Innovative strategies in last-mile urban freight delivery: A systematic review. <i>Transportation Research Record</i> .
MacLeod, K. E., Thorhauge, M., Villalobos, V., van Meijgaard, J., Karriker-Jaffe, K. J., Kelley-Baker, T., Ragland, D. R. (2020, July). To drive or not to drive? A study of travel behavior for a recent drinking occasion. <i>Travel Behaviour and Society</i> . 20, 74-82.
Mahdinia, I., Arvin, R., Khattak, A. J., & Ghiasi, A. (2020, May). Safety, energy, and emissions impacts of adaptive cruise control and cooperative adaptive cruise control. <i>Transportation Research Record: The Journal of the Transportation Research Board</i> , 2674(6), 253–267.
McDonald, N., & Combs, T. (2020). Reinventing TIA: Contemporary approaches to addressing the traffic impacts of urban development. <i>ITE Journal</i> 90(9): 46-49.
Nadimi, N., Ragland, D. R., & Amiri, A. M. (2020, August). An evaluation of time-to-collision as a surrogate safety measure and a proposal of a new method for its application in safety analysis. <i>Transportation Letters: The International Journal of Transportation Research</i> . 12(7).
Naumann, R. B., Kuhlberg, J., Sandt, L., Heiny, S., Apostolopoulos, Y., Marshall, S. W., & Lich, K. H. (2020, April 1). Integrating complex systems science into road safety research and practice, part 1: Review of formative concepts. <i>Injury Prevention</i> . 26(2).
Naumann, R.B., Kuhlberg, J., Sandt, L., Heiny, S., Kumfer, W., Marshall, S.W., & Lich, K.H. (2020). Integrating complex systems science into road safety research and practice, Part 2: Applying systems tools to the problem of increasing pedestrian death rates. <i>Injury Prevention</i> , 26.
Naumann, R.B., Sandt, L., Kumfer, W., Lajeunesse, S., Heiny, S., & Lich, K.H. (In press). Systems thinking in the context of road safety: Can systems tools help us realize a true “Safe Systems” approach? <i>Current Epidemiology Reports</i> .
Pan, R., Yang, H., Xie, K., & Wen, Y. (2020, June). Exploring the Equity of Traditional and Ride-Hailing Taxi Services during Peak Hours. <i>Transportation Research Record: The Journal of the Transportation Research Board</i> , 2674(9), 266–278.
Porter, A., Kontou, E., McDonald, N., & Evenson, K. (2020). Perceived barriers to commuter and exercise bicycling in US adults: The 2017 National Household Travel Survey. <i>Journal of Transport and Health</i> 16.
Saha, D., E. Dumbaugh, and L. Merlin. (Accepted). A Theoretical Framework to Understand the Role of Built Environment on Traffic Crashes: Implications for Transportation Planning and Policy Practice. <i>Journal of Safety Research</i> .
Saha, D. P. Alluri, E. Dumbaugh, and A. Gan. (2020). Application of the Poisson-Tweedie Distribution in Analyzing Crash Frequency Data. <i>Accident Analysis and Prevention</i> , 137.
Sandt, L. S., Proescholdbell, S. K., Evenson, K. R., Robinson, W. R., Rodriguez, D. A., Harmon, K. J., & Marshall, S. W. (2020, July). Comparative analysis of pedestrian injuries using police, emergency department, and death certificate data sources in North Carolina, U.S., 2007–2012. <i>Transportation Research Record: The Journal of the Transportation Research Board</i> . 2674(9).
Dannenberg, A., Rodriguez, D.A., and Sandt, L. (In review). Advancing Research in Transportation and Public Health: A Selection of Twenty Project Ideas from a U.S. Research Roadmap. <i>Journal of Transport and Health</i> .
Shah, N., Buckner, I., & Cherry, C. (Forthcoming). A jughandle design will virtually eliminate single-bicycle crashes at a railway crossing. <i>Journal of Transport and Health</i> .
Sharma, I., Mishra, S., Golias, M. M., Welch, T. F., & Cherry, C. R. (2020, June). Equity of transit connectivity in Tennessee cities. <i>Journal of Transport Geography</i> , 86, 102750. https://doi.org/10.1016/j.jtrangeo.2020.102750
Singichetti, B., Naumann, R.B., Sauber-Schatz, E., Proescholdbell, S., & Marshall, S.W. (In press). Potential injuries and costs averted by increased use of evidence-based behavioral road safety policies in North Carolina. <i>Traffic Injury Prevention</i> .
Wali, B., & Khattak, A. J. (2020, May). Harnessing ambient sensing & naturalistic driving systems to understand links between driving volatility and crash propensity in school zones – A generalized hierarchical mixed logit framework. <i>Transportation Research Part C: Emerging Technologies</i> , 114, 405–424.
Wali, B., & Khattak, S. (Forthcoming). The relationship between driving volatility in time to collision and crash-injury severity in a naturalistic driving environment. <i>Analytic Methods in Accident Research</i> .
Wali, B., Khattak, A., & Ahmad, N. (Forthcoming). A hybrid text analytics and heterogeneity-based statistical modeling approach for analysis of trespassing crashes at non-crossings involving vulnerable users. <i>Accident Analysis and Prevention</i> .
Wolfe, M. & McDonald, N. (2020). Innovative health care mobility services in the US. <i>BMC Public Health</i> 20: 906.

Wolfe, M., McDonald, N., & Holmes, G. M. (2020). Transportation barriers to health care in the US: Findings from the NHIS, 1997-2017. <i>American Journal of Public Health</i> 110(6): 815-822.
Wolfe, M., McDonald, N., Arunachalam, S., Baldauf, R., & Valencia Arias, A. (Accepted). Impact of school location on children's air pollution exposure. <i>Journal of Urban Affairs</i> .
Ziedan, A., & Brakewood, C. (2020, June). Longitudinal analysis of light rail and streetcar safety in the united states. <i>Transportation Research Record: The Journal of the Transportation Research Board</i> , 2674(9), 83–95. https://doi.org/10.1177/0361198120927004

3.2 Policy Papers

- Wen, Y., C. Cherry (2020) Shared Micromobility Recommended Policies. Report to the University of Tennessee Sustainability Office.
- Wen, Y. C. Cherry (2020) Shared Micromobility Sustainability Implications. Report to the University of Tennessee Sustainability Office.
- Shah, N., C. Cherry, C. Brakewood, F. Proulx (2020). Bicycle and Pedestrian Counting: Best Methodologies Assessment. Report to Tennessee Department of Transportation.
- Shah, N., C. Cherry, C. Brakewood, F. Proulx (2020). Bicycle and pedestrian count program guidance manual. Report to Tennessee Department of Transportation.
- Golias, M., S. Mishra, C. Cherry, A. Kohls, D. Murray, D. Giampouranis. (2020) Truck Parking Needs in Tennessee. Report to Tennessee Department of Transportation.
- Cherry, C. R., Azad, M., MacArthur, J., & Rose, W. (2020) Alternative Vehicles for Last Mile Freight Report to Tennessee Department of Transportation.
- Assessing and Addressing the Mobility Needs of an Aging Population: The Impact of COVID-19—Report, David R. Ragland, Glenn Shor, & Grace Felschundneff – Safe Transportation Research and Education Center, UC Berkeley (in final review).
- Mobility Needs of an Aging Population in the COVID Era. Policy Brief, David R. Ragland, Glenn Shor, & Grace Felschundneff – Safe Transportation Research and Education Center, UC Berkeley (in final review).
- Waller, Harmon, Redding, LaJeunesse, Peticolas, Schiro, Thomas (August 2020). Motor Vehicle Crash and Health Outcome Data Integration Recommendations for North Carolina.

3.3 Website(s) or other Internet site(s)

- The Light Electric Vehicle Education and Research Initiative, a consortium of Light Electric Vehicle (LEV) researchers and educators: <http://LEVresearch.com>
- The [National Pedestrian and Bicycle Safety Data Clearinghouse](#) (a product of [R14](#)) was visited by 501 unique visitors during this period.
- Website for the NCDOT Research & Innovation Summit: <https://www.hsrc.unc.edu/ncdot-ri-summit/>
- The CSCRS website, www.roadsafety.unc.edu, was regularly updated with new information regarding research, educational and professional development research, resources, and opportunities. The site had around 1,500 unique visitors from all over the U.S. and the world during this period.

3.4 New methodologies, technologies, or techniques

These new techniques were utilized this reporting period:

- Applications of Artificial Intelligence techniques in transportation safety.
- Application of data generated by Automated Vehicles in crash investigation.
- Analysis of Camera, LiDAR, and RADAR data for safe automated vehicle development.

Other new technologies or techniques are documented in the final reports published by each completed project and highlighted in a “Research Brief” that is posted next to the final report on the CSCRS website.

3.5 Inventions, patent applications, and/or licenses

None to report for this period.

3.6 Other products

- As part of [R22](#), created a fact sheet titled “Pedestrian Fatalities among Veterans in North Carolina.”
- As part of [R26](#), maintain and share a dataset of fatal e-scooter crash events. Also produced an updated version of the [micromobility injury coding poster](#). The poster has been featured in other organization newsletters and distributed to Duke Health, WakeMed Health & Hospitals, Atrium Health, the State Trauma Advisory Committee, the NC Office of EMS, and more than 25 e-scooter injury stakeholders across the US. Work related to R26 has supported the development of SAE Standard J3230 (WIP): Kinematic Performance Metrics for Powered Standing Scooters.
- UNC-DCRP’s Tab Combs led the development of the [Walking and Biking During Social Distancing](#) dataset, which evolved into a collaborative effort with multiple partners to the [Shifting Streets dataset](#). It has over 1,200 actions in 526 locations around the world to track immediate responses to changing demands on public space during COVID-19.

4. Outcomes

CSCRS included two performance measures related to outcomes in its Technology Transfer Plan:

- Average annual number of opportunities/instances to share transportation safety expertise at conferences, professional meetings and through media. (Please see presentations listed in Section 3.1 and media described in Section 4.1.)
- Annual number of adoptions, use or reference to CSCRS products, or influence on national or state research agendas (see Section 4.6).

4.1 Increased understanding and awareness of transportation issues

The Safe Systems approach to road safety was featured prominently in the [May issue of ITE Journal](#). It was also a key theme in the USDOT [Pedestrian Safety Summit](#), which featured CSCRS researchers in its presenter lineup.

CSCRS staff engaged with high-profile and local media outlets. Key examples:

- Noreen McDonald, UNC DCRP, was interviewed for NPR’s The State of Things about the importance and challenges of public transportation during the COVID-19 pandemic.
- Offer Grembek, UCB, was interviewed by Jose Feroso from Oaklandside about the development of Slow Streets in Oakland, CA and data related to pedestrian and bicycle collisions on July 8, 2020.
- Missy Cummings was interviewed by multiple media outlets about the safety of Tesla’s automated vehicle technology.
- Tab Combs, UNC DCRP, was interviewed as part of a [series](#) “Viewpoints on Resilient and Equitable Responses to the Pandemic” by the Center for Urban and Regional Studies at UNC. Her work on creating a COVID-19 dataset was also covered by the National League of Cities, Streetsblog, WSKG, and other media.

In addition, CSCRS has been coordinating with other key stakeholder groups and national initiatives in order to share research and to increase understanding of key transportation issues.

4.2 Passage of new policies, regulation, rulemaking, or legislation

CSCRS researchers at Duke and UNC were engaged in the process of crafting legislation, NC Senate Bill 739, related to the safety of personal delivery devices in June 2020. CSCRS staff also provided information on pedestrian safety

research in a U.S. Government Accountability Office (U.S. GAO) inquiry held in August 2020, which is anticipated to result in additional recommendations for NHTSA-related regulation and/or rulemaking.

4.3 Increases in the body of knowledge

CSCRS researchers supported to the increase in transportation safety knowledge in a variety of ways, documented throughout this report. Additionally, CSCRS staff:

- Responded to requests for information on detailed vehicles miles traveled data for various road users and geographies, an inquiry from the Director of Research at Transportation Alternatives in New York City.
- Aided an initiative promoting underride crash prevention meeting on using systems tools to facilitate a transportation policy meeting.
- Presented research on micromobility safety and data gaps (from project R26) at the invitation of the National Transportation Safety Board (NTSB) in July 2020. Researchers also shared information with regulators at the Consumer Product Safety Commission Forum held in September 2020.
- Presented research on automated vehicle technology safety testing (from project R27) and needs related to safety standardization and testing to NTSB, and also via the CSCRS webinar series.

Beyond these, CSCRS's contributions to the body of scientific knowledge continue to build. Final reports (distilled down into easily digestible info briefs), numerous journal articles, regular presentations at professional conferences, webinars, and many more dissemination avenues are continually increasing CSCRS's reach.

4.4 Improved processes, technologies, techniques, and skills in addressing transportation issues

Developments in this area are documented in the Final Reports published by each completed project and highlighted in an "Info Brief" that is posted next to the Final Report on the CSCRS website.

4.5 Enlargement of the pool of trained transportation professionals

CSCRS's university programs and student activities continue to attract new students to each campus and enlarge the pool of future professionals that are invested in improving safety. The presentations and other tech transfer activities implemented are also anticipated to have expanded the number of trained professionals in the field.

4.6 Adoption of new technologies, techniques, or practices

Safe Systems and systems thinking principles, literature, and tools that emerged from CSCRS work continue to be integrated broadly into policies and practices observed at national, state, and local levels. For example, in addition to the [Washington State Strategic Highway Safety Plan 2019](#) (which we previously reported), we have observed states or cities/regions in several places—including Louisiana, South Carolina, Washington, Oregon, California, Texas, North Carolina, and Maryland—that are soliciting additional research or technical assistance in the development of systemic approaches that build upon the guidance developed by CSCRS. CSCRS leadership through the Road to Zero Coalition has directly influenced Safe Systems literature developed and shared widely by the Institute of Transportation Engineers, and our research reports are integrated into their Safe Systems [professional development resource hub](#) as well as their Safe Systems Action Plan.

Some projects have resulted in specific actions taken in the states in which CSCRS consortium members are performing research in collaboration with state and local partners. For example, the R-12 project designed to improve data integration has involved the California Center for Medical Outcomes (CMOD), which has initiated a follow-up project to extend matching collision and hospital data to increase knowledge of under-reporting based on crash data. CMOD has used the analytic strategy described in the CSCRS report to guide and improve their matching

analyses. In project R-28, the research findings are directly supporting the update of the Tennessee Motorcycle Strategic Safety Plan. Projects R-17 and RR2 have led to North Carolina GHSP-funded work to strengthen NC Vision Zero coalitions and provide support to local entities, who are utilizing the [Vision Zero Guidebook](#) recently produced.

As part of [Project R26](#), in 2019 researchers proposed a new set of standardized e-scooter injury codes to the National Center for Health Statistics, which were officially accepted in early 2020 and will be included in the new International Classification of Diseases, Tenth Revision, Clinical Modification ([ICD-10-CM](#)), which rolls out on October 1, 2020. These official coding guidelines are used by hospitals around the world and will result in a more standardized method for classifying injuries involving emerging micromobility devices, which will enable safety researchers and health clinicians to develop more comparable assessments of injury frequency and severity across geographies if the codes are used correctly. During this reporting period, we developed a new resource offering [guidance for coding e-scooter injuries with the forthcoming ICD-10-CM codes](#) and shared with hospital systems and stakeholders across the US in advance of the October 1 roll out date of the new codes.

5. Impacts

CSCRS included two performance measures related to impacts in its Technology Transfer Plan:

- Annual instances integrating CSCRS research results into agency or stakeholder practices that demonstrate use of research results in practice (see Section 5.1).
- Annual instances integrating CSCRS research results into organizational/workforce capacity building that demonstrate use of research results in capacity building activities conducted by local, regional, state, or national level agencies (see Section 5.2).

5.1 Impact on the effectiveness of the transportation system

Findings from CSCRS research projects provided insights into Safe Systems practices and evidence of effectiveness around the world. CSCRS continues seeing engagement with decision-makers in the transportation safety realm and adoption of Safe Systems methods and tools developed by our consortium members (described in Section 4.6). The ability to estimate specific impacts of these policy changes will require time and additional resources, but we anticipate positive safety effects based on prior research findings and the experiences in other countries.

5.2 Impact on the adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company

No start-up activities to report. CSCRS is early in the process of being able to measure the impact of the adoption of new practices described in Section 4.6. We continue working with communities to design and put into place evaluation frameworks and data collection efforts needed to estimate impacts in the future.

5.3 Impact on the body of scientific knowledge

Using the numerous and varied methods listed previously, CSCRS is continuing efforts to contribute to the body of knowledge surrounding Safe Systems and systems-science approaches to road safety. Evidence of our impact on the body of scientific knowledge can be found through appointments that recognize our expertise and provide opportunities to influence scientific discourse. New appointments this reporting period include:

- Laura Sandt began serving as chair of the TRB Pedestrian Committee (ACH10) in April 2020. In September, she accepted an invitation to serve on the ITE Health and Transportation committee.
- Asad Khattak, UTK, served as a Board Member of TennSMART, a Tennessee-based consortium of transportation CEOs, research institutions and government officials. In addition, he is working with

Tennessee DOT and other Tennessee universities on connected and automated vehicle technologies, and he served on the advisory board of TEMA, the Centre for Mechanical Technology and Automation at University of Aveiro in Portugal.

- Asad Khattak also served as: Editor-in-Chief of Journal of Intelligent Transportation Systems, Associate Editor of International Journal of Sustainable Transportation, Special Advisor to the UT-based and SCI-indexed Journal of Transportation Safety & Security, and Board member of Analytical Methods in Accident Research.
- Chris Cherry, UTK, is Chair of SAE's Powered Micromobility Committee, served on Bird's Global Safety Advisory Board, and is co-chair of TRB's Emerging Vehicles for Low Speed Transportation joint subcommittee.
- David Ragland, UCB, participated in development of a California Master Plan for Aging, mandated by the Governor, and is meant as a blueprint for the State to meet the needs of the rapidly growing population of seniors in related to younger cohorts. The Master Plan, while not yet completed, includes extensive sections addressing mobility and safety for the senior population.
- The Strategic Highway Safety Plan SHSP is required under the Federal Transportation Bill to be updated every five years. In the period from April 2020 to the present (and in several months before) members of SafeTREC participated in development of this Plan. The Plan includes focus on 15 areas of road safety, including Impaired Driving, Speeding, Younger Drivers, Road Departure, etc. This is the 3rd SHSP round that SafeTREC has helped develop. While limitations due to COVID have impacted the process, the SHSP should be completed before the end of the year.
- Harmon collaborated with the Carolina Center for Health Informatics to update the e-scooter injury case definition available in NC DETECT, the syndromic surveillance system used by health department personnel statewide.

5.4 Impact on transportation workforce development

CSCRS's continuing workforce development activities have been bringing people together who have not traditionally worked together, breaking down siloes and recognizing roles that technology, land-use planning, and other disciplines play in safe transportation. CSCRS's continuing work with the NCDOT Center of Excellence in Advanced Transportation Technology, in collaboration with other NC UTCs and state universities, leverages multi-disciplinary skills and knowledge towards a long-term view and cutting-edge approaches in transportation research and implementation, creating opportunities for new projects, partnerships and work focused on Safe Systems approaches to transportation safety. In a related effort, management of the 2020 NCDOT Research & Innovation Summit contributes to workforce development and brings together different stakeholders to discuss innovative research, technologies, and other issues. We will continue our outreach via webinars, virtual events, and other campus-specific seminars.

6. Changes/Problems

6.1 Changes in approach and reasons for change

While the COVID-19 pandemic continued to impact CSCRS transportation research and engagement activities due to social distancing, travel restrictions, and other factors, CSCRS continued adapting to these changes throughout this reporting period. CSCRS pursued opportunities and partnerships related to COVID research. For example, UNC-HSRC launched a new NC [COVID-19 Mobility and Health Impacts Study](#), a partnership with UNC's Gillings School of Global Public Health, Cecil G. Sheps Center for Health Services Research, Odum Institute for Research in Social Science, and the NC State University Department of Statistics. Researchers at UNC, UC-B, and UT-K examined

crash data trends, compared information, and began efforts to seek additional resources to match or complement CSCRS research to investigate COVID-19 related research needs.

Noreen McDonald, UNC-DCRP, spoke in a [podcast](#) about why cities have had such ranging experiences with COVID. Tab Combs, UNC DCRP, gained wide recognition for her work on cities' efforts to adapt streets to accommodate increased demand for safe spaces to walk and bicycle during the COVID-19 pandemic.

Many activities were quickly moved to online formats, such as the NCDOT Research & Innovation Summit and NaTMEC, and other new online learning opportunities, such as the CSCRS webinar series, were launched.

6.2 Actual or anticipated problems or delays

Key examples of COVID-19 related disruptions that occurred during this reporting period include:

- Cancellation or postponement of in-person training, conferences, and workshops.
- Issues related to in-person data collection (see section 6.4).
- International student recruitments have been affected partly due to the closure of U.S. missions abroad. This is envisioned to be offset by greater efforts for recruitment of domestic students.
- Delays in CSCRS communications and processing of final reports due to staff limitations or reduced staff/student hours due to COVID-19 related family or health needs.
- Cancellation or postponement of STEM projects due to school closures.
- Delay or cancellation of state or local match-funded projects.

6.3 Changes that have a significant impact on expenditures

Costs associated with rescheduling and reformatting the NaTMEC conference to a virtual event in June 2021.

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

The pandemic caused temporary freezes on data collection requiring close contact with human subjects, such as simulator-based research and intercept-survey studies, and university requirements for IRB application resubmission/reapproval. In addition, there have been temporary freezes on data collection requiring close contact with research team members, such as in-vehicle experiments and automated vehicle testing. School-based STEM activities and other community-based events have been rescheduled or put on hold as schools were closed or operate virtually and communities continue social distancing efforts.

7. Special Reporting Requirements

Nothing to report. This entire report is available on the [CSCRS website](#).