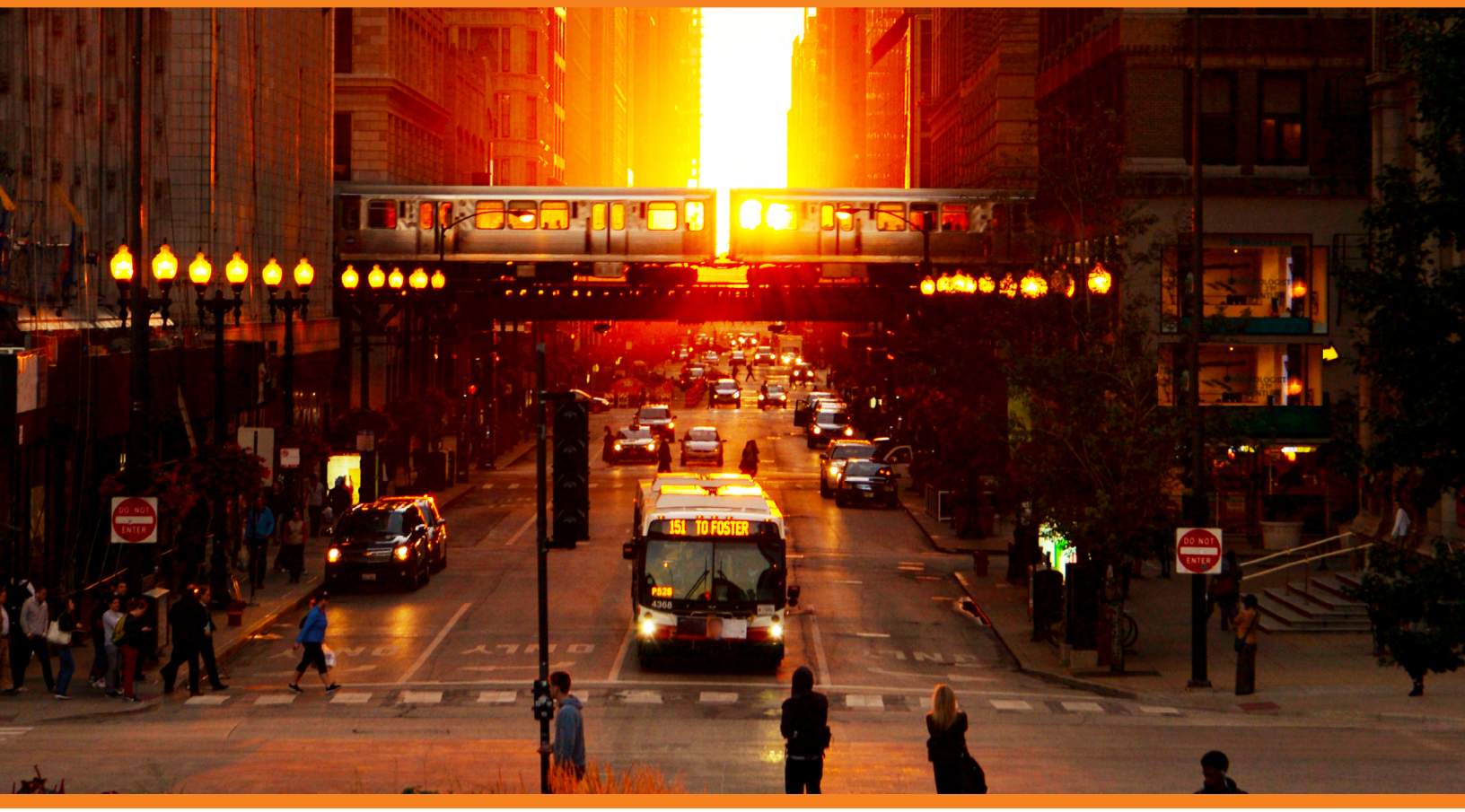
VISION FOR A SAFER ROAD SYSTEM



Collaborative Sciences Center for
ROAD SAFETY

A SIX-YEAR REVIEW

LETTER FROM THE DIRECTOR

Roadway fatalities and injuries in the United States have reached a 10-year high. In the last decade, the number of people dying in motor vehicle crashes increased by 20 percent. Pedestrian deaths alone skyrocketed by a shocking 46 percent. Traditional safety measures have not worked to stem this tide.

"It's time for a fresh approach." That's been the mantra of the Collaborative Sciences Center for Road Safety (CSCRS) since day one, when CSCRS was funded as a University Transportation Center by the U.S. Department of Transportation (USDOT) in 2016. The fresh approach we have taken is to apply public health principles and systems science in our work to equip current and future transportation professionals and communities with more effective tools to solve complex safety challenges. This multidisciplinary work advances Safe System concepts—such as accounting for human vulnerabilities and human behavior to proactively limit the chance of fatal injury—through research, education, workforce development, and technology transfer.

CSCRS's mission is to create and exchange knowledge to advance transportation safety through a multidisciplinary, systems-based approach. Led by the University of North Carolina (UNC) Highway Safety Research Center (HSRC) in collaboration with the UNC Department of City and Regional Planning (UNC DCRP) and the UNC Injury Prevention Research Center (UNC IPRC), CSCRS unites leading transportation research, planning, public health, data science and engineering programs at Duke University, Florida Atlantic University (FAU), University of California, Berkeley (UCB), and University of Tennessee, Knoxville (UTK). Linked data systems, new technology, evaluation of safety disparities, and improved research methods are key elements of our holistic exploration of the relationship between the built roadway environment, traveler behaviors, crash events, and injury and health outcomes.

We have aligned our activities toward these three goals:

- Safe System principles and approaches are shared, understood, and adopted by traffic safety professionals and stakeholders.
- Cutting-edge research, tools, data, and resources compatible with a Safe System approach are developed and utilized by professionals and the public at large to better understand and address existing and emerging road safety issues.
- A growing body of students and future leaders are engaged and well trained in road safety principles and Safe System approaches and methods.

I'm happy to present this report, which provides an overview of CSCRS's work since 2016, demonstrating the breadth of our research and outreach activities all designed to help shape a Safe System for U.S. roadways. It highlights the talented team we've united from a variety of diverse backgrounds to do this work. And it also reflects on the work left to be done around safety, and more critically, around the people who use our roadways.

Over the last six years we have seen incredible progress – the Safe System approach is no longer such a novel concept in the U.S. It has even been codified into state and national legislation and policy. USDOT has said that it "invests in the future of transportation through its [UTC] Program." At CSCRS, we believe the future of safe and equitable transportation will require a Safe System approach, and we're proud to help provide the "why" and "how" this vision for a safer road system for all can become a reality in the U.S.

Collaborative Sciences Center for ROAD SAFETY

Laura Sandt

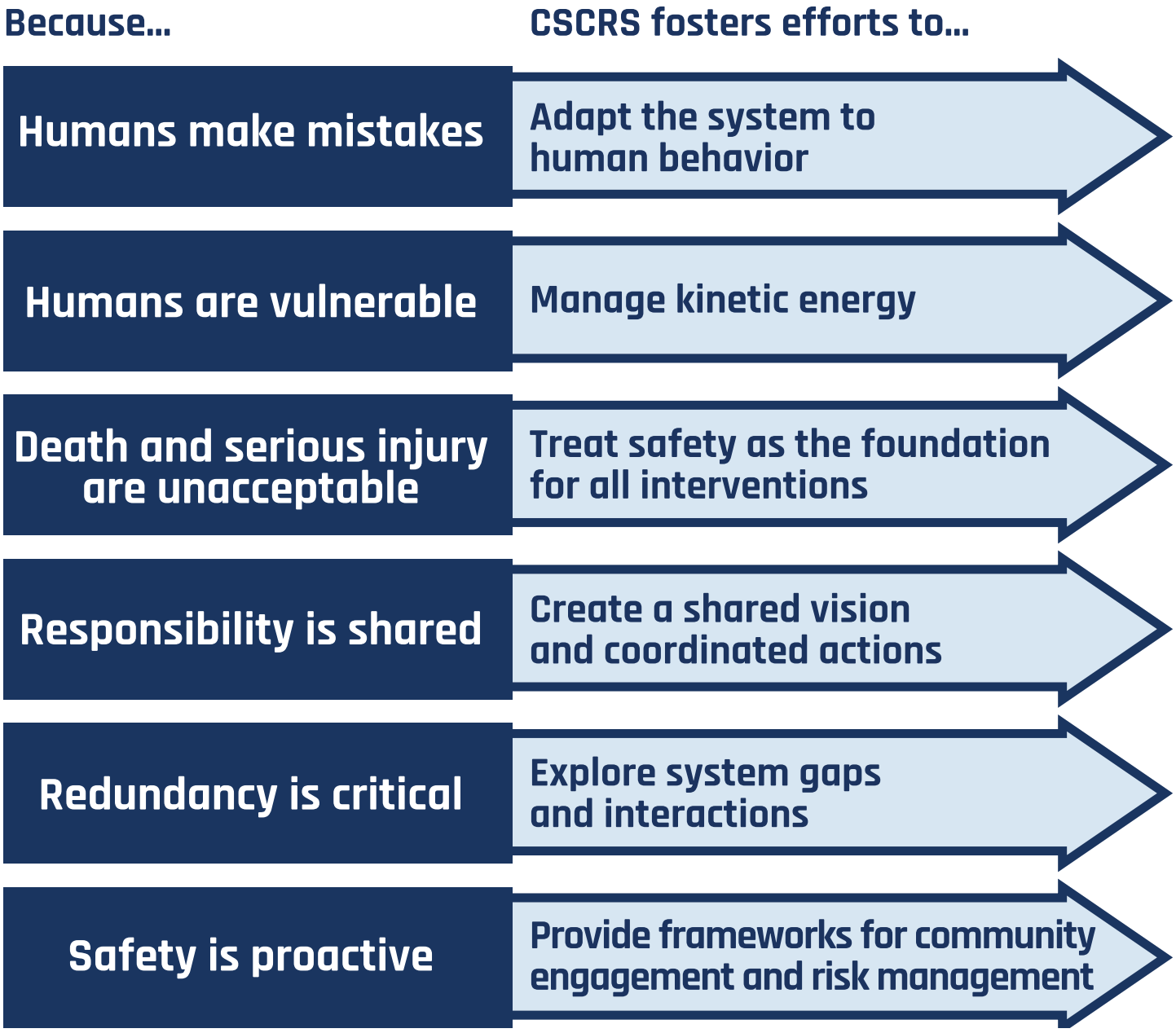
LAURA SANDT, CSCRS DIRECTOR, HSRC

Table of Contents

Picturing the Safe System concept

This diagram is inspired by the USDOT Federal Highway Administration's (FHWA's) depiction of how a Safe System works. On the left are six key principles around which a Safe System approach is built, and the right shows the work CSCRS has done to address the principles.

Within this framework, CSCRS's cross-cutting research and tech transfer activities cover the areas of Vision Zero, mobility justice, public health, technology, data, pedestrian and bicyclist safety, micromobility, behavior, and implementation.



This diagram will be used throughout the report to demonstrate how CSCRS's work factors into a complete Safe System.

Collaboration is everything

Multidisciplinary collaboration is the bedrock of creating a Safe System and is the foundation of CSCRS's work. Leveraging existing partnerships and expertise, plus building new connections, strengthens the work we do.

Our Executive Committee/Associate Director team covers the gamut of Safe System elements:

LAURA SANDT, HSRC, is active in a variety of Safe System research areas, including the development and evaluation of community-involved health and injury prevention programs and studies focusing on pedestrian and bicycle safety, mobility, and access.

ERIC DUMBAUGH, FAU, specializes in urban transportation research, with particular focus on planning, policy, engineering, and design.

OFFER GREMBEK, UCB, focuses his research on injury risk in multimodal environments, pedestrian safety, speed management policy, and in-vehicle injury protection systems.

ASAD KHATTAK, UTK, is an expert in intelligent transportation systems, transportation safety, and sustainable transportation.

STEPHEN MARSHALL, UNC IPRC, contributes a public health perspective, with specific expertise in injury prevention.

NOREEN MCDONALD, UNC DCRP, researches how infrastructure investments and technology changes influence travel and road safety, public health, energy demand, and city form.

MIROSLAV PAJIC, DUKE, specializes in cyber-physical systems with autonomy and human interaction, as well as embedded systems, artificial intelligence, robotics, and more.

In addition, CSCRS has worked with hundreds of people and partners to further its mission:

- **221** unique researchers representing **52** different organizations
- More than **220** students
- Almost **70** outside partner organizations

Our Advisory Board is an esteemed team of seasoned professionals whose guidance has been invaluable to further CSCRS's goals:

NADIA ANDERSON
DIRECTOR, FEDERAL AFFAIRS, INRIX

LINDA BAILEY
VISION ZERO DIRECTOR, DISTRICT DEPT. OF TRANSPORTATION

CHARLES T. BROWN
FOUNDER AND CEO, EQUITABLE CITIES

JASON GAINEY
MANAGER, PASSIVE SAFETY AND ACCIDENT RESEARCH, VOLKSWAGEN GROUP OF AMERICA

DIA GAINOR
EXECUTIVE DIRECTOR, NATIONAL ASSOCIATION OF STATE EMS OFFICIALS

KING GEE
DIR., SAFETY & MOBILITY, AMERICAN ASSOC. OF STATE HIGHWAY & TRANSPORTATION OFFICIALS

JACQUELINE GILLAN
PRESIDENT EMERITUS, ADVOCATES FOR HIGHWAY AND AUTO SAFETY

DANA MAGLIOLA
STATEWIDE PROGRAM MANAGER, FREIGHT + LOGISTICS, NORTH CAROLINA DEPT. OF TRANSPORTATION

DAN MAGRI
DEPUTY ASST. SECRETARY, OFFICE OF PLANNING, LOUISIANA DEPT. OF TRANSPORTATION & DEV.

JEFF PANIATI
CEO AND EXECUTIVE DIRECTOR, INSTITUTE OF TRANSPORTATION ENGINEERS

LEAH SHAHUM
DIRECTOR, VISION ZERO NETWORK

JANE TERRY
SENIOR DIRECTOR, GOVERNMENT AFFAIRS, NATIONAL SAFETY COUNCIL

DAVID YANG
EXECUTIVE DIRECTOR, AAA FOUNDATION FOR TRAFFIC SAFETY

Last but not least is our staff at HSRC, who keep all engines running:

CHRIS GOMOLA
EMBEDDED RESEARCH LIBRARIAN

NANCY LEFLER
BUSINESS MANAGER

KRISTA NORDBACK
RESEARCH PROGRAM MANAGER

JENNIFER PALCHER-SILLIMAN
PROFESSIONAL DEVELOPMENT / OUTREACH PROGRAM MANAGER

Snapshot of key successes

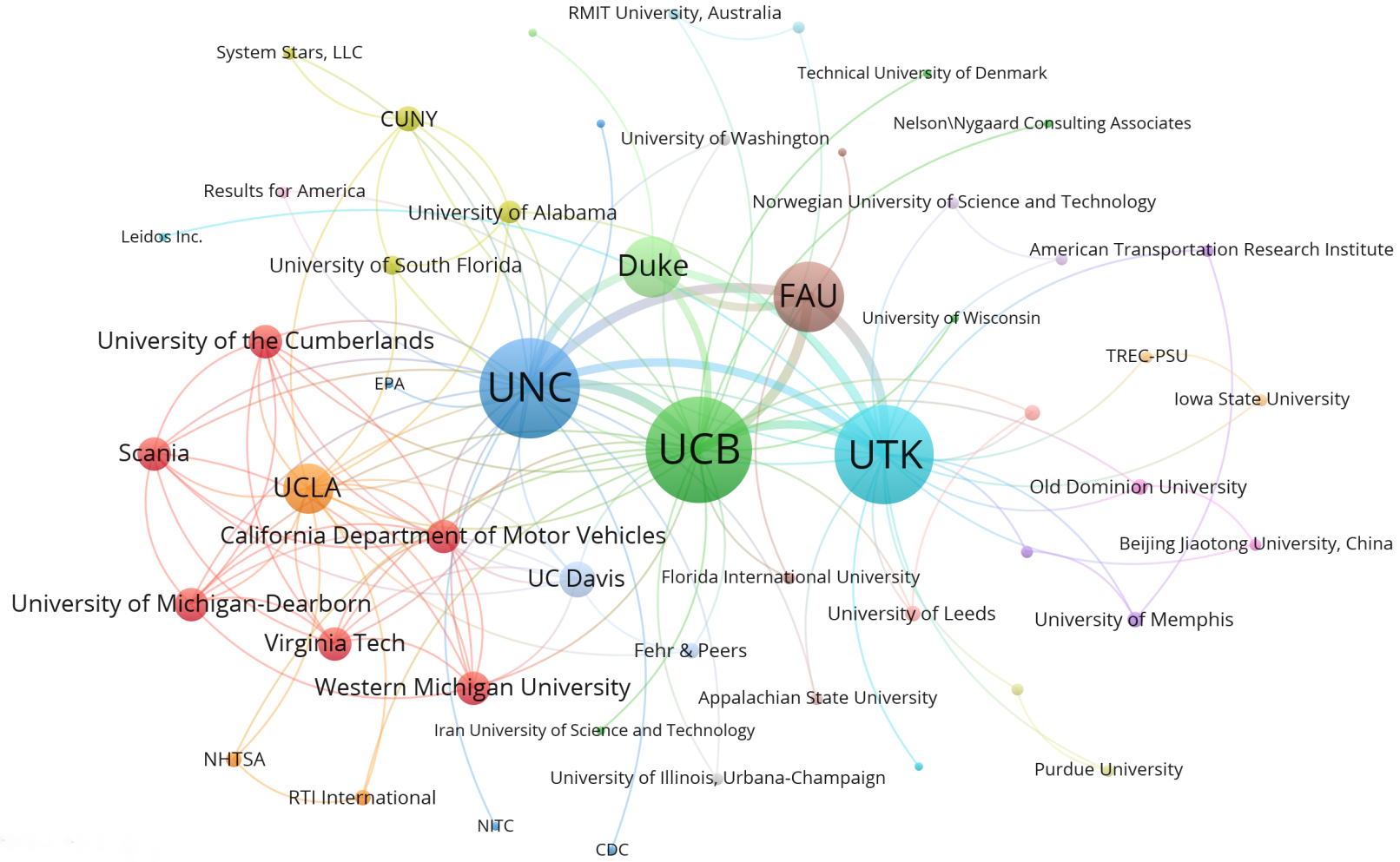
Over the last six years CSCRS has measured impressive accomplishments, including:

- **5** consortium campuses
- **45** research projects
- **161** journal papers, conference papers, book chapters, reports, websites, and thesis papers
- **2** national conferences
- **5** students of the year

Of course, sheer numbers don't tell the whole story. Here are other noteworthy CSCRS successes:

- In April 2019, CSCRS and the North Carolina Governor's Highway Safety Program hosted the Safe Systems Summit: Redefining Transportation Safety, a two-day conference held in Durham, N.C. More than 340 participants gathered to develop a stronger understanding of Safe System and systems science.
- In October 2019, FAU researchers coordinated with local partners in South Florida to hold the Cardboard Challenge, an activity for elementary school kids focused around creative play, street safety, and environmental stewardship.
- From 2019-2021, CSCRS researchers at HSRC and UTK coordinated the development of new injury case definition codes for e-scooters and e-bikes to enable more consistent injury data collection for U.S. healthcare professionals.
- In 2020, a UNC DCRP researcher initiated the "Shifting Streets COVID-19 Mobility Dataset," a widely used, crowd-sourced resource tracking responses to changing demands on public space during the COVID-19 pandemic.
- Mary "Missy" Cummings of Duke spearheaded CSCRS research projects focused on the safety of autonomous vehicles, jumpstarting a national conversation (and sometimes controversy) on this important safety topic for researchers and policymakers.
- The inaugural NC Vision Zero Leadership Team Institute, co-managed by UNC IPRC in June 2021, hosted eight invited teams of Vision Zero communities for a deep dive into systems-thinking.
- In February 2022, a video produced by UTK researchers highlighting their CSCRS work related to artificial intelligence was featured in the first USDOT UTC "Research, Development, and Technology Forum on AI in Transportation."
- CSCRS researchers at UCB worked with California state officials to help develop the California 2020-2024 Strategic Highway Safety Plan, which incorporates the Safe System approach.

CSCRS TEAM



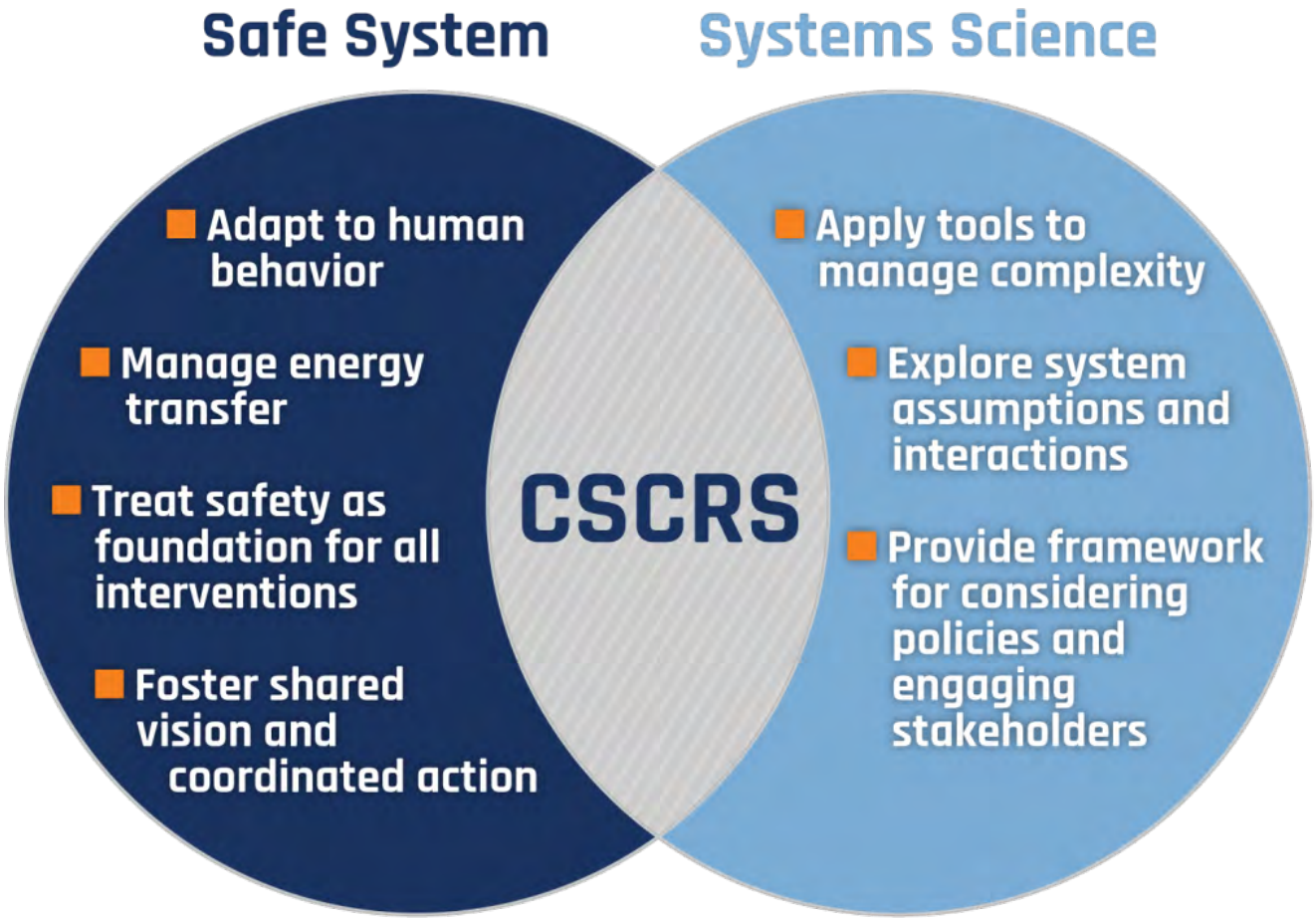
CSCRS co-authorships show a wide and diverse network of US and international organizations.

In a recent survey, attendees at CSCRS Safe System educational events were asked "To what extent do you believe that the content covered in the sessions can be applied to your work?" Approximately 90 percent of respondents said that CSCRS's Safe System education could be applied, ranging from a moderate amount to a great deal. These respondents represented 27 U.S. states and territories.

The ultimate attestation to our work: Safe System concepts have been codified into legislation and policies on the national level. The bipartisan Infrastructure Investment and Jobs Act that became law in November 2021 contains many provisions that CSCRS and its partners and advisory board members have been providing information for and conducting research around for years.

Other developments include the release of USDOT's National Roadway Safety Strategy, which promotes the Safe System approach. The document's opening letter from Secretary Pete Buttigieg states:

"At the core of this strategy is a Department-wide adoption of the Safe System Approach, which focuses on five key objectives: safer people, safer roads, safer vehicles, safer speeds, and post-crash care. We will launch new programs, coordinate and improve existing programs, and adopt a foundational set of principles to guide this strategy."



Diagramming a safe roadway system

During CSCRS's April 2019 Safe Systems Summit in Durham, multiple speakers outlined the success of the Safe System approach around the world. Peter Furth, Professor, Civil and Environmental Engineering, Northeastern University, posed the question "What is the systematic safety approach as it's been applied in the Netherlands, and as an American, I look at, what can it mean for us?" He went on to say, "In 1972, they had the same traffic fatality rate that we did," and since then, "the U.S. got better, but the Netherlands got A LOT better." Also, during his keynote address, Roderick McClure, Dean, Faculty of Medicine and Health, University of New England (Australia), offered perspective on Australia's version of the Safe System.

SAFE SYSTEMS SUMMIT

EXAMPLES OF KEY CSCRS ACTIVITIES RELATED TO FRAMING A SAFE SYSTEM:

- Nine research projects and related resource development
- Hosting of the 2019 Safe Systems Summit: Redefining Transportation Safety conference
- Creation of the Creating Safer Systems and Healthier Communities: Resource Hub
- Leadership in systems-thinking coalitions

THIS WORK HELPS TO:

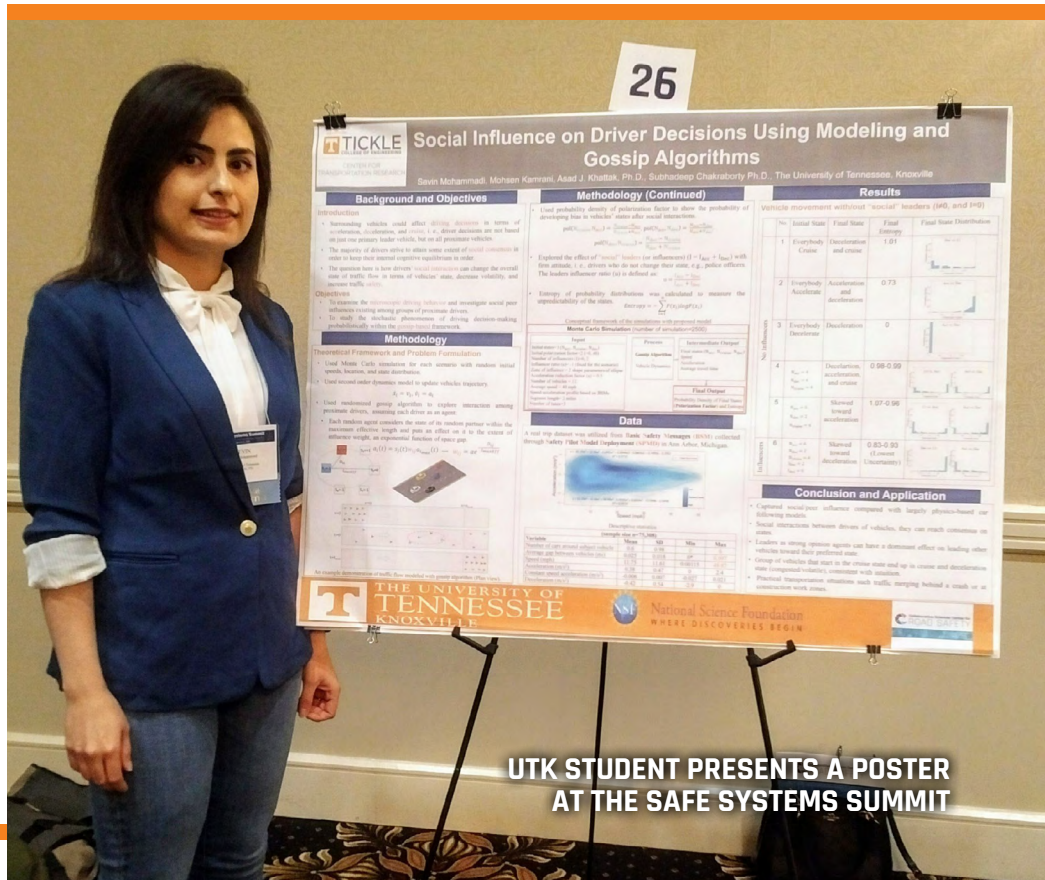
- ADAPT THE SYSTEM TO HUMAN BEHAVIOR
- MANAGE KINETIC ENERGY
- TREAT SAFETY AS THE FOUNDATION FOR ALL INTERVENTIONS
- CREATE A SHARED VISION AND COORDINATED ACTIONS
- EXPLORE SYSTEM GAPS AND INTERACTIONS
- PROVIDE FRAMEWORKS FOR COMMUNITY ENGAGEMENT AND RISK MANAGEMENT

Luxembourg, New Zealand, Sweden, and the United Kingdom also adopted the Safe System approach. These countries fought long and hard to envision and establish their Safe Systems. Now the U.S. is going through the same process.

What would a U.S. Safe System even look like? There are varying definitions of the concept, but they all hew closely to the USDOT's FHWA definition: "The Safe System approach aims to eliminate fatal and serious injuries for all road users. It does so through a holistic view of the road system that first anticipates human mistakes and second keeps impact energy on the human body at tolerable levels."

How do you take a concept like this – proven successful in other countries with different safety cultures – and implement it in the U.S.? That is the "million dollar" question CSCRS has been working to answer through efforts like the 2019 Summit, which brought together more than 340 participants to develop a stronger understanding of Safe System and systems science.

Recent developments like the inclusion of Safe System principles in state and U.S. national policies and laws seem to show we're headed in the right direction. Case in point: CSCRS researchers at UCB worked with California state officials to help develop the California 2020-2024 Strategic Highway Safety Plan, which incorporates the Safe System approach. There's a lot of work to do to catch up with countries like the Netherlands and Australia, and CSCRS will continue connecting its research to policy to help make the Safe System approach a reality at home.



UTK STUDENT PRESENTS A POSTER AT THE SAFE SYSTEMS SUMMIT

The goal of zero

The CSCRS project "Strengthening Existing and Facilitating New Vision Zero Plans," led by Kelly Evenson, Professor of Epidemiology, UNC Gillings School of Global Public Health, discovered that the U.S. cities of Hoboken, Monterey, Richmond, and Houston all have something forward-thinking in common: They adopted Vision Zero initiatives. Vision Zero initiatives establish ambitious goals demonstrating a commitment to eliminate all traffic-related injuries and deaths. As part of this effort, Evenson and her team created a map providing links to Vision Zero plans all over the U.S., demonstrating that the Vision Zero concept is being embraced coast-to-coast.

Vision Zero and the Safe System approach are interconnected, though the degrees to which they each can be implemented vary widely. The Vision Zero Network defines Vision Zero as a "strategy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all." Reaching a Vision Zero goal starts with a Safe System, identifying safety risks before injuries happen and considering entire populations of road users when working to enhance equitable and safe access for the most vulnerable.

CSCRS Safe System work has always been conducted with an eye toward how it can inform the implementation of Vision Zero programs. For example, Evenson's project produced the Vision Zero Plan Library, an inventory of existing U.S. Vision Zero plans including those for the cities listed above. The project team conducted an analysis of these plans, identifying common features of high-quality plans. The findings motivated the development of a Guide to Developing a Vision Zero Plan, which offers evidence-based recommendations. In addition, the NC Vision Zero Leadership Team Training Institute, co-managed by IPRC in June 2021, trained multidisciplinary teams from eight North Carolina Vision Zero cities on core equity and public health principles and coalition building best practices.

The concept of Vision Zero has also been codified into legislation and policies on the national level, such as in the bipartisan Infrastructure Investment and Jobs Act that became law in November 2021. Also, the Fiscal Year 2022-2026 U.S. Department of Transportation Strategic Plan includes this strategic goal: "Advance a future without transportation-related serious injuries and fatalities." CSCRS work could not be more timely for helping to strengthen community-led coalitions rooted in safety and equity practices.

EXAMPLES OF KEY CSCRS ACTIVITIES RELATED TO VISION ZERO:

- Four research projects
- Creation of web resources including:
  - CSCRS map of Vision Zero Plans by State
  - CSCRS Vision Zero Plan Library
- Hosting the NC Vision Zero Leadership Team Training Institute
- Partnerships with organizations such as the Vision Zero Network and the Road to Zero Coalition

THIS WORK HELPS TO:

TREAT SAFETY AS THE FOUNDATION FOR ALL INTERVENTIONS

PROVIDE FRAMEWORKS FOR COMMUNITY ENGAGEMENT AND RISK MANAGEMENT

APRIL 2022 NC SCIENCE FESTIVAL

Safety through the lens of equity and mobility justice

In the conclusion of their final graduate school research paper "The Racial Equity Implications of Road Safety Enforcement in Oakland, CA," Alejo Alvarado, MCRP, UCB Safe Transportation Research and Education Center, said, "In conducting this research, I found that road safety enforcement has largely inequitable outcomes in Oakland. Black people in particular are over-policed, while communities of concern are burdened by high injury and collision rates. Future exploration of road safety outcomes should consider a model that allows for community-based accountability, while ensuring an overall reduction in traffic violations and collisions."

Projects like Alvarado's aim to explore fundamental aspects of transportation safety and equity that sometimes get overlooked. What do we really mean when we talk about road safety? Safety from what and for whom? How do we measure it and how do we know when we've gotten there?

At CSCRS we incorporate a holistic focus on equity and have learned that bidirectional learning with community partners produces better results. For example, during our 2021 Summer Learning Series, we engaged with several new partners to discuss the supports needed to make the Safe System approach meet equity needs.

Supporting more authentic public engagement, harnessing the power of community, and providing support for interventions with local impact will lead to expanding access and mobility, and shared understandings of safety. Continuing to engage with diverse perspectives to reflect on the broader system in which our work unfolds makes us better researchers.

EXAMPLES OF KEY CSCRS ACTIVITIES RELATED TO MOBILITY JUSTICE:

- Four research projects
- Producing the 2021 Safe Systems Summer Learning Series
- Delivering inclusive STEM engagement opportunities including the Miami Cardboard Challenge

THIS WORK HELPS TO:

EXPLORE SYSTEM GAPS AND INTERACTIONS

CREATE A SHARED VISION AND COORDINATED ACTIONS

Viewing road safety as a public health concern

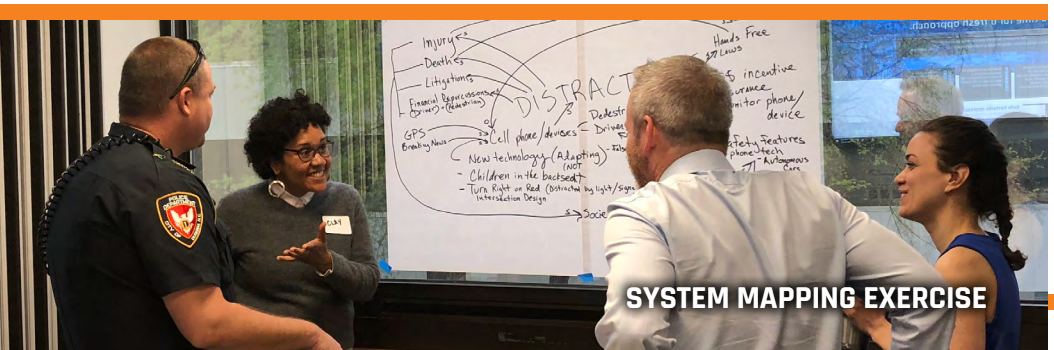
The U.S. roadway fatality rate is three times that of Ireland, Israel, Japan, Netherlands, and Spain; and four to five times that of the United Kingdom, Sweden, Singapore, and Norway. The National Highway Traffic Safety Administration (NHTSA) estimates that an estimated 42,915 people died in motor vehicle traffic crashes in 2021, more than 10 percent more than in 2020.

Transportation-related deaths – be they the loss of life of pedestrians and bicyclists or drivers and passengers involved in vehicle crashes – have created a public health crisis in the U.S. And they comprise the reason why CSCRS has incorporated the public health point of view from the inception of the UTC's research mission, projects, and activities.

Road safety has much to learn from public health. Epidemiologists and public health practitioners were early adopters of systems science and population-level approaches to proactively reduce health and injury risks, working with communities to address local needs and health disparities. CSCRS's researchers with public health backgrounds have led the way on projects related to Vision Zero, linking healthcare and crash data, and new mobility healthcare codes, and evaluating the linkages between health and transportation injury outcomes. Our public health researchers introduced us to systems mapping tools to help visualize the connections and leverage points across healthcare and transportation systems and take a more holistic view of injury prevention opportunities.

Plus, safe mobility is connected to health in myriad ways. To illustrate this point during a CSCRS Coffee & Conversation seminar in 2018, CSCRS Director Laura Sandt, HSRC, listed several ways in which transportation systems affect health, such as providing opportunities for physical activity, access to critical services and destinations, spaces for civic engagement, and protection from injury or other risk exposure.

A key objective in USDOT's 2022-2026 Strategic Plan is to "Protect urban and rural communities and travelers, including vulnerable populations, from health and safety risks." With the ultimate goal of a Safe System being to save lives, working closely with the public health community to implement and evaluate Safe System approaches is crucial to meeting USDOT's goal.



SYSTEM MAPPING EXERCISE

EXAMPLES OF KEY CSCRS ACTIVITIES RELATED TO THE PUBLIC HEALTH PERSPECTIVE:

- Two research projects and related resource development
- Development and delivery of public health-focused college courses related to transportation safety
- Virtual learning opportunities such as the December 2018 webinar "Systems Thinking for Injury and Violence Prevention Practice"
- Contributing to the creation of International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes for micromobility-related injury surveillance

THIS WORK HELPS TO:

- ADAPT THE SYSTEM TO HUMAN BEHAVIOR
- CREATE A SHARED VISION AND COORDINATED ACTIONS
- TREAT SAFETY AS THE FOUNDATION FOR ALL INTERVENTIONS

In questions of safety, is technology the answer?

In 2019, CSCRS recorded a series of casual conversations with a wide variety of "everyday" people, asking what they think about the future of autonomous vehicles. We recorded some of the eye-opening responses:

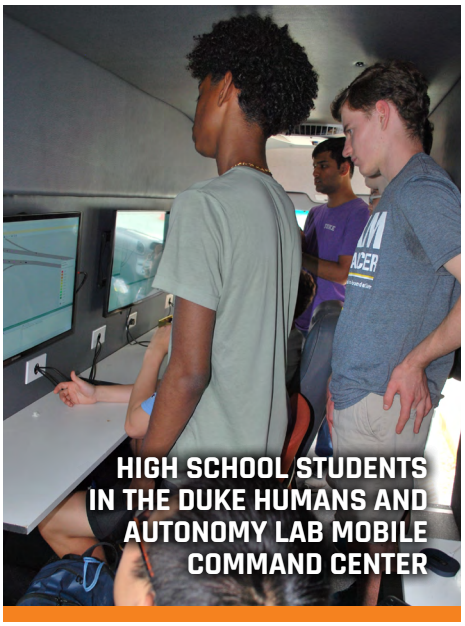
- "I can't believe that they've actually thought of such an amazing idea for new cars …. Like, auto-drive cars – it's a crazy idea!"
- "At this point I'm a little skeptical."
- "I cannot see a driverless car as something that's safe."
- "Initially, it might be a thrill to sit in something that's not being driven by a human being…"

The promise of problem-solving technology can be very alluring. But is autonomous technology the panacea everyone hopes it will be? Who's right, the skeptics or the optimists?

CSCRS research and outreach has delved into many different topics related to rapidly advancing road safety technologies including connected and autonomous vehicles, pedestrian crash prevention systems, machine learning concepts, artificial intelligence, and more. A highlight of these efforts: In February 2022, a video produced by UTK researchers showcasing their CSCRS work related to artificial intelligence was featured in the first USDOT UTC "Research, Development, and Technology Forum on AI in Transportation."

We've learned that modern technology offers hope for a future with crash-free roads. But innovative technology can also introduce risks that are hard to predict during early development, creating challenges for policymakers concerned with public safety.

After spearheading CSCRS research projects focused on the safety of autonomous vehicles, Mary "Missy" Cummings from Duke was appointed to be a senior advisor for NHTSA. As Cummings said during a 2021 interview with Fortune magazine, "We still cannot figure out how to make cars see the world around them to be able to make the right decisions." The future of road safety technology holds promise, but it will take sound research to get there.



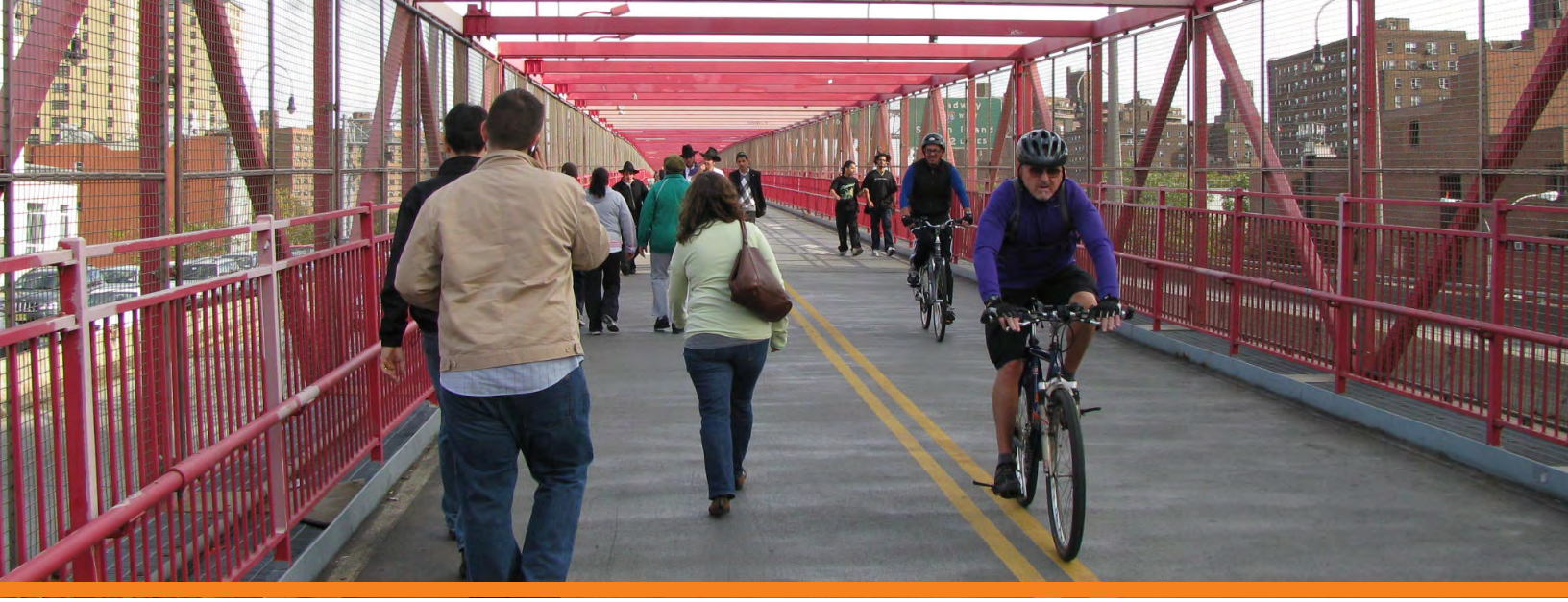
HIGH SCHOOL STUDENTS IN THE DUKE HUMANS AND AUTONOMY LAB MOBILE COMMAND CENTER

THIS WORK HELPS TO:

- EXPLORE SYSTEM GAPS AND INTERACTIONS
- PROVIDE FRAMEWORKS FOR COMMUNITY ENGAGEMENT AND RISK MANAGEMENT

EXAMPLES OF KEY CSCRS ACTIVITIES RELATED TO TECHNOLOGY:

- Eight research projects and related resource development
- Educational resources such as UTK's Southeastern Transportation Center Seatbelt Convincer and the Duke Humans and Autonomy Lab (HAL) mobile command center
- UNC's Coffee & Conversation 2.0 in 2018 with seven sessions devoted to AV topics
- Presentations at technology-related conferences such as the Automated Vehicles Symposium



Using data to complete the picture of traffic safety

Debuting in 2019, the CSCRS-funded National Pedestrian and Bicycle Safety Data Clearinghouse did something sorely needed: It provided a centralized data clearinghouse for bicycle and pedestrian safety-related data as a national resource for safety researchers and practitioners. This resource serves as a model for practitioners who want to see how other states or cities have developed data sets.

Data are central to connecting the dots needed to understand complicated issues, and in the transportation safety world, there are many gaps. A comprehensive transportation safety data system should have a number of data sets, including not only crash data, but also roadway and traffic data, vehicle, driver, citation, and hospital/emergency medical service data, among others. USDOT reiterated the importance of data in its 2022-2026 Strategic Plan: Making the system safer and stronger "will require collaboration across the public and private sectors to foster an innovation ecosystem based on open data, honest dialogue, and shared insights."

Yet, historically these datasets have been kept in siloed data repositories across a number of agencies. While transportation agencies are increasingly seeing the benefits of merging data for more robust safety analyses, integrating these disparate systems remains a challenge.

CSCRS has worked on a variety of activities promoting enhanced and integrated data systems. Projects have zeroed in on what data are needed, what needs to be connected, and how to do the connecting. This work is helping build a foundation of knowledge upon which to build a Safe System.

EXAMPLES OF KEY CSCRS ACTIVITIES RELATED TO DATA:

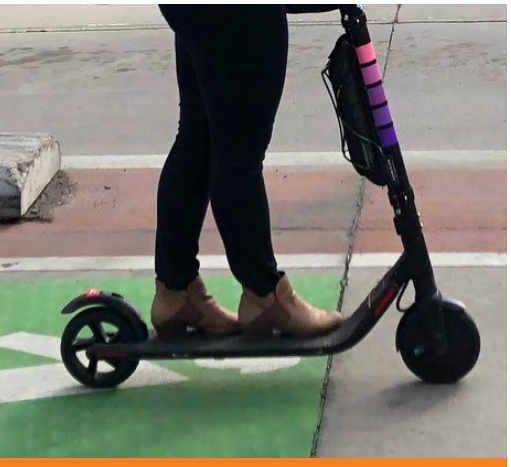
- Ten research projects and related resource development
- National Pedestrian and Bicycle Safety Data Clearinghouse
- Management of the 2021 National Travel Monitoring Exposition and Conference (NaTMEC) for 400 attendees
- Creation of the E-Scooter Fatality Dashboard

THIS WORK HELPS TO:

- CREATE A SHARED VISION AND COORDINATED ACTIONS
- EXPLORE SYSTEM GAPS AND INTERACTIONS
- PROVIDE FRAMEWORKS FOR COMMUNITY ENGAGEMENT AND RISK MANAGEMENT

THIS WORK HELPS TO:

- ADAPT THE SYSTEM TO HUMAN BEHAVIOR
- MANAGE KINETIC ENERGY
- CREATE A SHARED VISION AND COORDINATED ACTIONS



Transportation is more than cars

In March of 2020, the world shut down due to the COVID-19 pandemic. Curious about how communities were adjusting, CSCRS researcher Tabitha Combs, UNC DCRP, created the Shifting Streets Dataset, a crowd-sourced resource that tracked how cities and towns addressed changes in travel demand and the need for social distancing. Examples included converting traffic lanes to pedestrian spaces, making bus rides fare-free, and even determining that walking and biking were "essential activities." The now widely used dataset continues to be updated with new data, including some changes that eventually went away and those that were incorporated into permanent infrastructure.

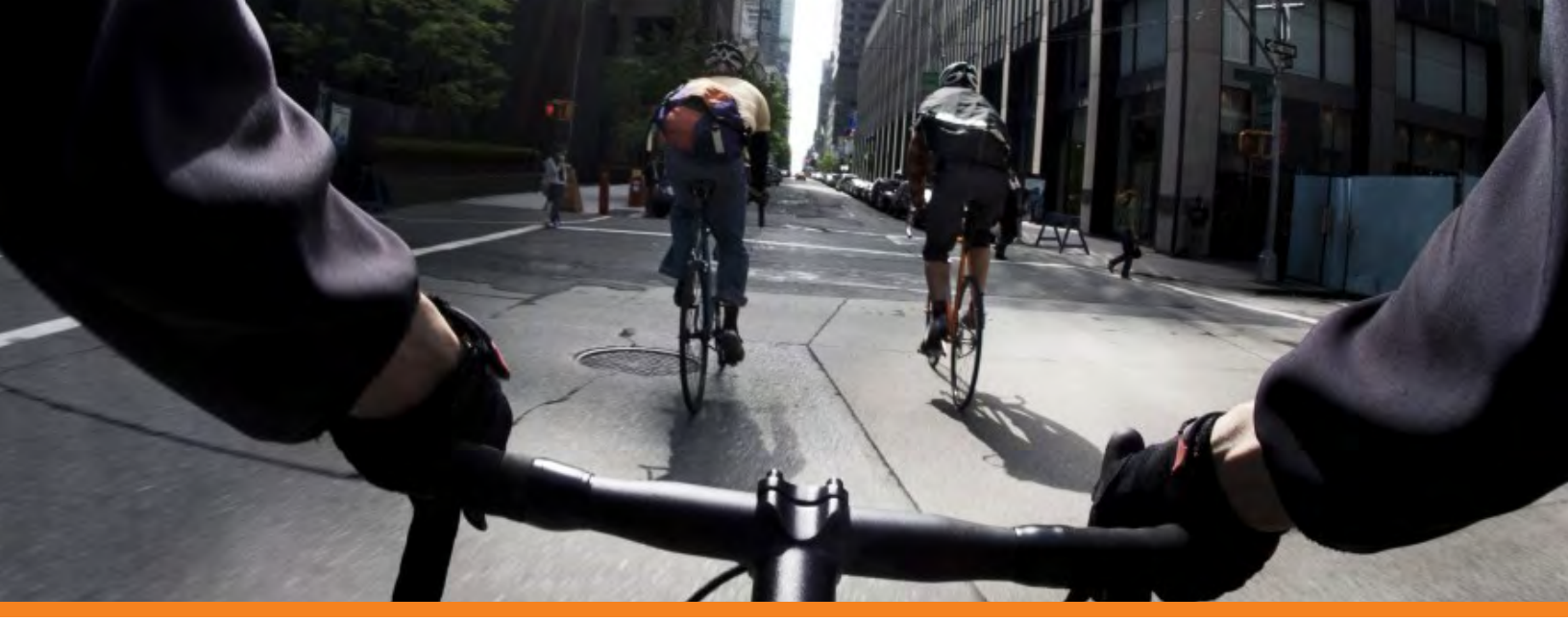
It's no secret that the U.S. roadway system is built for cars, which often positions other road users as little more than afterthoughts. Combs's dataset was an exercise in looking at what happens when that dynamic shifts, when a road is reconfigured to place people who walk, bike, and use micromobility, transit, and assistive devices as the focus. People who travel by active modes or nonmotorized means almost always have to share the road with cars at some point during the journey and are at a disadvantage without the same level of protection as occupants inside the vehicle. This creates an unfair playing field for safety.

A large volume of CSCRS work has been focused on those who get from point A to point B without the use of cars. In addition to research on safety for bicyclists and pedestrians, CSCRS has delved into safety for motorcyclists, transit, ridesharing, and emerging mobility modes. From 2019-2021, CSCRS researchers at HSRC and UTK coordinated the development of new injury case definition codes for e-scooters and e-bikes to enable more consistent injury data collection for U.S. healthcare professionals.

The ideal is exemplified by the concept of Complete Streets, defined by USDOT as "streets designed and operated to enable safe use and support mobility for all users." Until all modes of travel are safe, we will never realize a Safe System.

EXAMPLES OF KEY CSCRS ACTIVITIES RELATED TO ROAD USERS WITHOUT CARS:

- Sixteen research projects
- Shifting Streets Dataset
- Professional development like the NC mobile workshop "Flipping the Script" held in April 2022
- Participation in the April 2022 NC Science Festival with STEM activity encouraging kids to envision a safe route to school



Adding (human) behavior to the road safety equation

What motivates a person to choose one mode of transportation over another? Why would someone choose to ride an e-scooter on a sidewalk instead of a shared traffic lane? How can parents be involved in helping teens learn to drive?

Probing the complexities of traveler choices and behavior covers a key segment of the Safe System approach. Asad Khattak, UTK, has worked on two CSCRS research projects in this area: one project involved developing a taxonomy for human errors in crashes, and the other used volatility analysis to explore driver impairment. Another UTK project headed by Chris Cherry looks at micromobility safety behavior.

No doubt, addressing road user behavior is a key part of building a safe roadway system. CSCRS research focuses on trying to document the nature of human errors that precipitate traffic crashes and develop holistic interventions to help reduce the likelihood of deadly errors. Another CSCRS project by Arthur Goodwin, HSRC, explored a comprehensive program to support parents of new drivers in North Carolina, providing guidance to parents at various points in the licensing process when this guidance is most needed.

But CSCRS work also makes clear that behavior is just part of the safety mix and that it's important to place behavior in the context of the overall system. Impaired drivers, young/novice and older drivers, and pedestrians and bicyclists perceived as not using facilities properly should not become scapegoats for systemic traffic problems.

At CSCRS, we strive to be a part of shifting the perspective away from the "blame game" toward envisioning a system that keeps all road users safe and alive, no matter the behavior.

EXAMPLES OF KEY CSCRS ACTIVITIES RELATED TO ROAD USER BEHAVIOR:

- Four research projects
- UNC's 2019 Coffee & Conversation III series sessions devoted to distracted driving, young drivers, and elderly drivers

THIS WORK HELPS TO:

- ADAPT THE SYSTEM TO HUMAN BEHAVIOR
- MANAGE KINETIC ENERGY
- CREATE A SHARED VISION AND COORDINATED ACTIONS

The road to implementation

In October 2019, school-aged children from Miami's Little Havana came together to use imaginations to build their idea of a "perfect city." For this Cardboard Challenge, the children and their families used recyclable materials for creative placemaking to construct their ideas of safe communities.


CARDBOARD CHALLENGE

This event was conducted as part of the CSCRS project "Applying Civic Innovation Methods to Advance Safety Education: A Pilot Program." Eric Dumbaugh, FAU, coordinated with local partners in South Florida to put on the event, which exemplified the benefits of involving communities in improving road safety and embracing environmental stewardship. It was an exercise in helping communities envision their neighborhoods as complete spaces made for people, supporting the idea of Complete Streets.

It's endeavors like these that aim to answer questions like: How do you build buy-in for the holistic approach of a Safe System to a population accustomed to the status quo, that sadly seems to have accepted the rate of road deaths as the cost of doing business? How can the needs of multiple partners with often conflicting priorities be engaged in a meaningful way?

There are many challenges. One area that CSCRS has focused on is how the media frames traffic crashes. For example, a media story that frames a road injury as causing traffic delays appeals to values for control over one's time and use of road space. Activating people's values for control can suppress their concern for the welfare of others. On the other hand, the "human interest" or "victim narrative" story appeals to yet a separate set of values.

"I think we can't talk about shared responsibility without acknowledging power dynamics, without acknowledging … the way our built environment currently is and what that prioritizes and who it prioritizes," said Tamika Butler, founder and principal, Tamika L. Butler Consulting, during the session "Redistributing Responsibility for Safety" as part of CSCRS's Safe Systems Summer Learning Series in 2021. "As long as we acknowledge that we're not all starting from the same place in that system of shared responsibility."

When pondering these issues, events like the Miami Cardboard Challenge provide an answer: Start by engaging the power of the communities being served.

EXAMPLES OF KEY CSCRS ACTIVITIES RELATED TO IMPLEMENTATION:

- Four research projects
- Creation of UCB's Road Safety Video Series
- FAU's presentation on the Safe System concept to the Florida Department of Transportation

THIS WORK HELPS TO:

- TREAT SAFETY AS THE FOUNDATION FOR ALL INTERVENTIONS
- CREATE A SHARED VISION AND COORDINATED ACTIONS
- EXPLORE SYSTEM GAPS AND INTERACTIONS
- PROVIDE FRAMEWORKS FOR COMMUNITY ENGAGEMENT AND RISK MANAGEMENT

STUDENTS FROM NC A&T'S SUMMER HIGH SCHOOL TRANSPORTATION INSTITUTE VISIT DUKE

Now it's time to accelerate our work

CSCRS has made great strides in foundational research that furthers the Safe System approach. And there is still work to do. It's time to accelerate our progress in implementing a Safe System to transform the transportation network. Here are key areas of opportunity for CSCRS to expand Safe System research:

- **EXPANDING WORK ON DIVERSITY, EQUITY, AND INCLUSION:** A deeper dive into racial- and income-equity aspects of Safe System work is needed. Safe System work needs to continue reorienting direction to encompass more diverse experiences and center the perspectives of those who are the furthest from safety.
- **DEVELOPING PARTNERSHIPS TO PROMOTE IMPLEMENTATION:** We must work closely with agencies, organizations, and communities to further the adoption of Safe System principles and implement systems structures.
- **PROVIDING TRAINING OPPORTUNITIES:** Research-to-practice professional development is integral to promoting implementation.
- **BUILDING STEM PROGRAMS:** Inspiring the next generation of traffic safety professionals is a key part of building a future for a Safe System, so more programs for K-12 students must be created.
- **ENHANCING DATA AND EVALUATION TECHNIQUES:** We must create next generation data tools and standards that provide a fuller safety picture.
- **MEASURING KEY TRENDS AND OUTCOMES:** The Safe System approach requires new ways to measure how Safe System strategies are implemented and how effective they are.
- **GROWING RESEARCH IN KEY AREAS:** CSCRS researchers have opportunities to complement research by engaging in more efforts related to speed and kinetic energy, post-crash care and after care, and technology development, as well as cross-disciplinary approaches involving sectors beyond transportation, such as housing, environmental preservation, and healthcare.

Thanks to USDOT, the CSCRS team, our Advisory Board, and our extended network of partners for a great six years of shared accomplishments. We look forward to working together moving forward to advance transportation safety through a multidisciplinary, systems-based approach.

Learn more about our work

Visit these sites for more information about CSCRS's work and resources.

RESEARCH-RELATED

- Research projects
- CSCRS Dataverse
- Highlighted project deliverables:

  VISION ZERO
  - Guide to Developing a Vision Zero Plan
  - Vision Zero Plan Library
  - Map of Vision Zero Plans by State

  DATA
  - National Pedestrian and Bicycle Safety Data Clearinghouse

  TECHNOLOGY
  - Videos of tests evaluating the safety of Tesla Model 3s

  BEYOND CARS
  - Micromodes.org, a resource that tracks fatalities involving micromobility devices
  - Micromobility Coding Poster
  - Model interface: A systems approach to pedestrian safety: Examining congestion pricing policies

PROFESSIONAL DEVELOPMENT/EDUCATION

- 2019 Safe Systems Summit: Redefining Transportation Safety
- 2021 Safe Systems Summer Learning Series
- 2021 National Travel Monitoring Exposition and Conference (NaTMEC)
- Research to Practice Bytes
- Students of the Year

CSCRS RESOURCES

- What is a Safe Systems approach?
- What is systems science?
- Creating Safer Systems and Healthier Communities: Resource Hub
- "Shifting Streets" COVID-19 Mobility Dataset
- Newsletter archive

SOCIAL MEDIA

- Twitter
- Facebook
- YouTube

Research projects

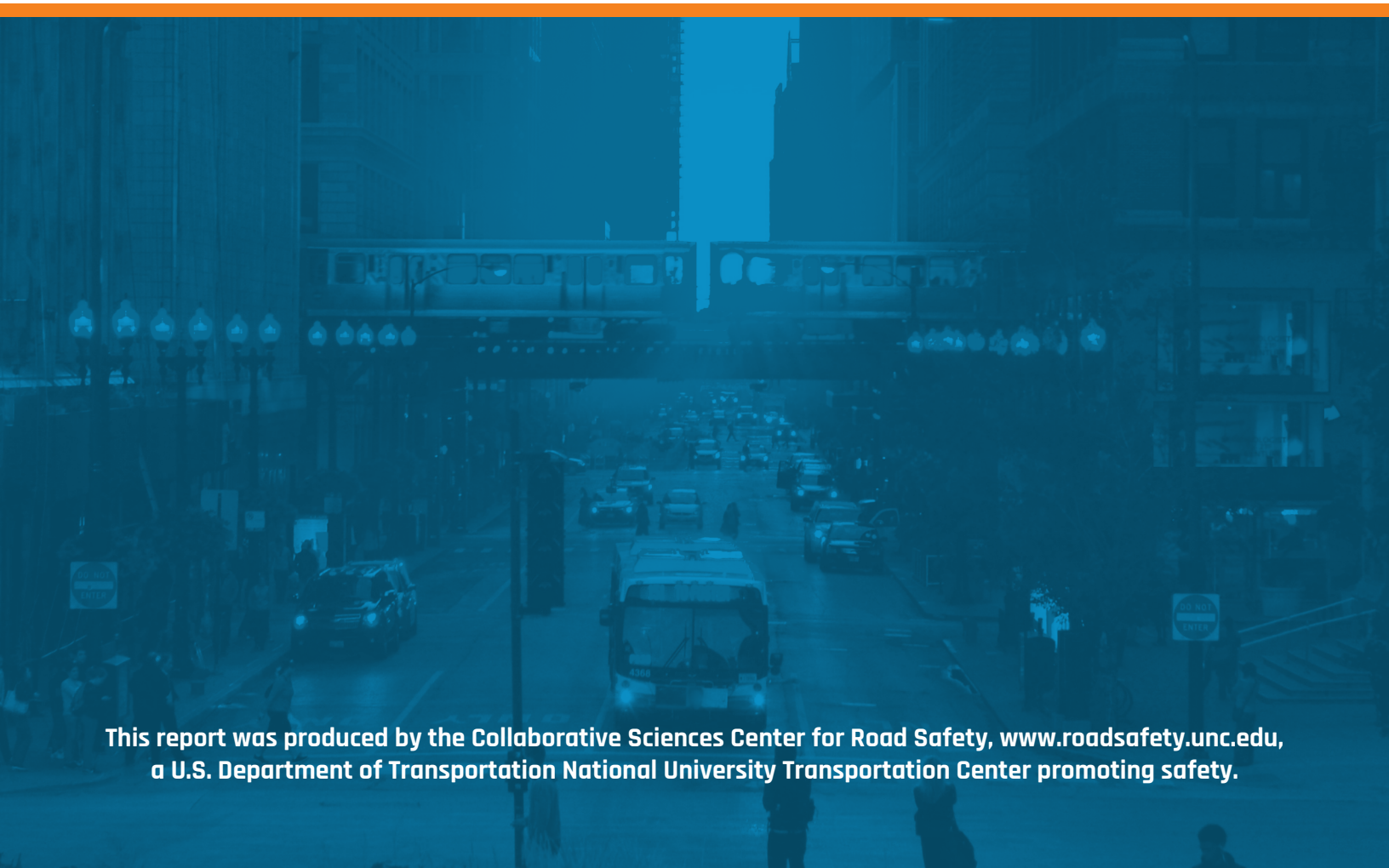
To learn more about the projects below, visit our **Research Projects** page.

TITLE	PI	PI AFFILIATION
Structures of Stakeholder Relationships in Making Road Safety Decisions	Seth LaJeunesse	UNC-HSRC
An Enhanced Systemic Approach to Safety	Offer Grembek	UCB
Implementing Safe Systems in the United States: Guiding principles and lessons from international practice	Eric Dumbaugh	FAU
Completing the picture of traffic injuries: Understanding data needs and opportunities for road safety	Christopher Cherry	UTK
Traffic safety practices in U.S. cities: Survey and focus group results	Eric Dumbaugh	FAU
Using advanced analytics to frame vulnerable road user scenarios with autonomous vehicles	Noreen McDonald	UNC-DCRP
Development and Evaluation of Vehicle to Pedestrian (V2P) Safety Interventions	Missy Cummings	Duke
Development of Resources to Guide Parents in Helping Teens Learn to Drive	Arthur Goodwin	UNC-HSRC
Concept of Operations for an Autonomous Vehicle Dispatch Center	Missy Cummings	Duke
Machine Learning Tools for Informing Transportation Technology Design	Missy Cummings	Duke
The influence of the built environment on crash risk in lower-income and higher-income communities	Yanmei Li	FAU
Emergency Medical Services (EMS) and the California EMS Information System (CEMSIS) Working Paper	David R. Ragland	UCB
Shared Mobility Services and Their Connection to Roadway Fatalities	Noreen McDonald	UNC-DCRP
Creating a CSCRS Clearinghouse for Bicyclist and Pedestrian Safety-Related Data, Phase I: Inventory & Framework	Krista Nordback	UNC-HSRC
Integrating Spatial Safety Data into Transportation Planning Processes	Christopher Cherry	UTK
Opioids at the Health and Transportation Safety Nexus	Christopher Cherry	UTK
Strengthening Existing and Facilitating New Vision Zero Plans	Kelly Evenson	UNC-IPRC
Examining the Traffic Safety Effects of Urban Rail Transit: A Review of the National Transit Database and a Before-After Analysis of the Orlando SunRail and Charlotte Lynx Systems	Eric Dumbaugh	FAU
Developing a Taxonomy of Human Errors and Violations that Lead to Crashes	Asad J. Khattak	UTK
Investigating the Vulnerability of Motorcyclists to Crashes and Injury	Asad J. Khattak	UTK
A Systems Approach to Pedestrian Safety, Phase II: Examining Congestion Pricing Policies	Becky Naumann	UNC-IPRC
Using Integrated Data to Examine Characteristics Related to Pedestrian and Bicyclist Injuries	Katherine Harmon	UNC-HSRC
Driver Impairment Detection and Safety Enhancement through Comprehensive Volatility Analysis	Asad J. Khattak	UTK

TITLE	PI	PI AFFILIATION
Developing a Framework to Combine the Different Protective Features of a Safe System	Offer Grembek	UCB
Advancing Accident Investigation with Connected and Automated Vehicle Data	Asad J. Khattak	UTK
Understanding Micromobility Safety Behavior and Standardizing Safety Metrics for Transportation System Integration	Christopher Cherry	UTK
Advancing accelerated testing protocols for safe and reliable deployment of connected and automated vehicles through iterative deployment in physical and digital worlds	Subhadeep Chakraborty	UTK
Strategies for Reducing Motorcyclist Injuries: Engaging Stakeholders to Apply Evidence-Based Countermeasures that Work	Jerry Everett	UTK
Factors and Frames that Shape Public Discourse around Road User Safety	Seth LaJeunesse	UNC-HSRC
Urban Freight and Road Safety: Trends and Innovative Strategies	Noreen McDonald	UNC-DCRP
Crash Risk for Low-income and Minority Populations: An examination of At-risk Population Segments and Underlying Risk Factors	Diana Mitsova	FAU
Applying Civic Innovation Methods to Advance Safety Education: A Pilot Program	Eric Dumbaugh	FAU
Explaining the Rise in Pedestrian Fatalities: A Safe Systems Approach	Laura Sandt	UNC-HSRC
US Vision Zero Implementation *(separate but related projects)*	Kelly Evenson	UNC-IPRC
US Regional Vision Zero Implementation	Kelly Evenson	UNC-IPRC
COVID-19 streets: Mobility justice and the rapid rollout of pedestrian and bicyclist improvements	Tab Combs	UNC-DCRP
Using Safe Systems approach to assess traffic impact and land development	Tab Combs	UNC-DCRP
Laying the Groundwork for a National Pedestrian Injury Surveillance System	Katherine Harmon	UNC-HSRC
Applying AcciMap to e-Scooter Crashes: A safe systems approach to analyzing micromobility	Katherine Harmon	UNC-HSRC
Assessing how private beliefs conflict with public action on Safe Systems	Seth LaJeunesse	UNC-HSRC
Integrating systems thinking tools into Vision Zero and Safe Systems approaches	Becky Naumann	UNC-IPRC
A Safe Systems approach to motorcycle safety	Eric Dumbaugh	FAU
Advancing crash investigation with connected and automated vehicle data – Phase 2	Asad J. Khattak	UNC-HSRC
Applying AI to data sources to improve driver-pedestrian interactions at intersections	Subhadeep Chakraborty	UTK
Safety enhancement by detecting driver impairment through analysis of real-time volatilities	Asad J. Khattak	UTK

Collaborative Sciences Center for
ROAD SAFETY

ROADSAFETY.UNC.EDU



This report was produced by the Collaborative Sciences Center for Road Safety, www.roadsafety.unc.edu,
a U.S. Department of Transportation National University Transportation Center promoting safety.