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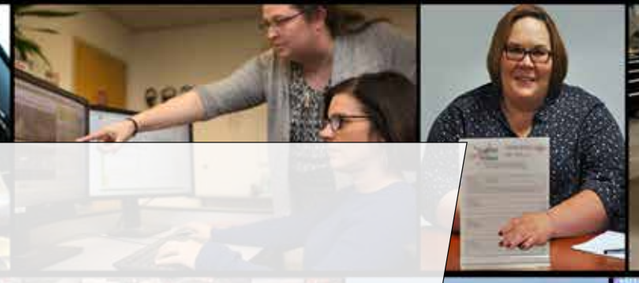
Smart
Road














Welcoming Remarks
Tom Dingus, Director, VTTI















Wednesday
THOMAS DINGUS
C-SPAN 2
Virginia Tech
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A MESSAGE FROM OUR DIRECTOR

Here at the Virginia Tech Transportation Institute (VTTI), we set the standard.

For 35 years, VTTI has advanced transportation through innovation. Created as the Center for Transportation Research in 1988, we trace our roots to a handful of faculty who leveraged the power of teamwork in pursuit of a future with safe and effective mobility. With successful programs and expansions through the ensuing years, this progressive structure led the university to establish VTTI as the first research institute of Virginia Tech, paving the way for the nation's premier academic transportation research organization.

Unquestionably, the key to our success is a team of individuals who dedicate their lives to saving lives. Core to our approach, we understand that transportation exists to serve humans and, if implemented appropriately, represents an opportunity to broadly improve the human condition. However, while transportation enables our modern lifestyles, it also creates some of our largest challenges. We find it unacceptable that people lose their lives or suffer debilitating injuries, find their time consumed by lengthy commutes, are unable to access affordable mobility, or feel stuck using a system that ranks among the largest contributors to degrading the earth's environment. For these reasons, every member of VTTI plays a critical role enabling or performing research which saves lives, time, money, and protects the environment.

Advancing vehicle and infrastructure systems begins with generating great ideas and finishes with physical technology in our communities. We pride ourselves on a whole-cloth ability to identify opportunities for improvement, ideate solutions, rapidly create prototypes, and evaluate performance in robust and realistic conditions. With teams dedicated to advanced hardware and software design, we are able create entirely new test methods in our labs, on our tracks, and out in the field.

Over two decades ago, we pioneered the naturalistic driving research method using tape-based video recorders choreographed by cutting-edge custom embedded electronics. Much like the invention of the microscope gave us the ability to see things we had never seen before, this technology-enabled approach to observe driving in the field gave us an unprecedented ability to investigate the underlying causes of crashes. Not only is this naturalistic method now used worldwide, but coupled with our advanced data analytics strategies, it remains one of our strongest tools for investigating current and future transportation systems.

As the original transportation research institute of Virginia Tech with a full-scale controlled testing environment, we leverage our strong relationships with the Commonwealth of Virginia and the Virginia Department of Transportation to operate the unparalleled Virginia Smart Roads. This facility enables precise research wherein we safely choreograph complex roadway scenarios using highly trained experimenters, test drivers, robotics, and other custom research apparatus to exercise future vehicle and infrastructure features.

We also boast unique laboratories which allow foundational research into crash biomechanics, lighting systems, driver interfaces, and roadway surfaces. We leverage truly 'big data' warehousing and computational resources from which we innovate modeling and simulation methods to rapidly investigate challenges and identify the optimal solutions - leveraging both digital and physical domains to accelerate the progression of research into reality.

OUR IDENTITY OVER THE YEARS

Virginia Tech
TRANSPORTATION INSTITUTE

CENTER FOR TRANSPORTATION RESEARCH

Virginia Tech TRANSPORTATION INSTITUTE
Driving Transportation with Technology

VirginiaTech TRANSPORTATION INSTITUTE

VirginiaTech Transportation Institute

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With disruptive technologies hitting the road every day–automated driving, connected applications, electrification, high performance materials, big data, alternative vehicles, and mobility as a service–the possibilities are endless. The 2020s may change transportation more than the prior half century combined and, with it, industry could be disrupted as long-held paradigms such as “people to goods” transforms to “goods to people”. We pursue opportunities to profoundly improve transportation in this age of smart mobility. Innovations will spill over into consumer vehicles, and before we know it, our daily commutes of tomorrow could be as foreign as driving a horse and carriage would feel today.

Despite advances, if we are to realize a future where safe and effective motility is universal, innovations must continue across all facets of product and operations development. Private and public organizations across the entire domain are facing and will continue to wrestle with hard problems, protracted timelines, and high expectations from the market. At VTTI, we are advancing core technologies in human factors design, new business models, support services, data-based decision making, policy, and (often neglected) matters of public acceptance all while working closely with many key partners.

Informed by the innovations of our past, I am thrilled to imagine our role toward realizing a better future. We are a close community at VTTI, brought together by our passion for improving the human condition through enhancing transportation. We scaled VTTI with intention - cultivating capabilities and experts to help overcome transportation challenges while establishing ourselves as a trusted partner. These are exciting times where the rapid pace of advancement provides us with an unparalleled opportunity to affect positive change. I am enthusiastic for the future of this wonderful institution as we leave these fantastic 35 years in our rear view and peer through the windscreen at the next evolution of VTTI.

Zac

This is our story.

OUR PAST

For 35 years, VTTI has been conducting research to save lives, time, and money, and protect the environment. While we have more in front of us than behind us, VTTI a leader in transportation research today because of our past successes.

SMART ROADS AND TEST BEDS

The Smart Roads play a critical role in the overall success of VTTI and its research mission. For many, the Virginia Smart Roads and the Virginia Tech Transportation Institute are synonymous with each other. Located at the VTTI campus in Blacksburg, Virginia, the Smart Roads are state-of-the-art, closed test-bed research facilities managed by VTTI in cooperation with the Virginia Department of Transportation (VDOT).

In close partnership with VDOT, VTTI opened the original Virginia Smart Road - the highway section - in 2000. This progressive construction project created one of the world's most advanced testing facilities for advanced transportation research. More than 36,000 hours of research have been conducted on the road since its opening. In November 2017, VTTI launched the Virginia Smart Roads initiative, a track expansion that enables advanced vehicle testing on an interconnected and comprehensive cross section of highway, surface, rural, and unimproved roadways.

Two of the new testbeds were completed in 2017. The Live Roadway Connector and the Surface Street expanded the capabilities of the Virginia Smart Roads and empowered us to push the boundaries of transportation research even further.

The Live Roadway Connector links the highway section directly to U.S. 460 in Blacksburg, Virginia. Equipped with traffic control devices and protocols, this connector allows VTTI to seamlessly route test vehicles between live roadways and closed test tracks, enabling studies of long duration which leverage a combination of field and controlled environments. For example, this connector allows researchers to safely study issues such as driver readiness to assume vehicular control in response to an unexpected event after long periods under automated driving on live roadways.

The Surface Street facilitates increasingly advanced and automated vehicle testing inconfigurable environments such as suburban neighborhoods and city intersections. This facility provides users with an unprecedented opportunity to precisely study challenging transportation situations such as pedestrian risk in urban environments thanks to a host of specialized test equipment (e.g., configurable signs, buildings, sidewalks, precise geolocation, robotic pedestrians). Research conducted on the Surface Street explores the safety and performance benefits of advanced-vehicle and infrastructure technologies by enabling researchers to choreograph reproducible studies which yield robust design guidance implemented by vehicle manufactures, infrastructure operators, and their associated technology supply chains.

Located adjacent to the Surface Street is the Automation Hub, which serves as home base for the InternHUB, an interdisciplinary advanced learning program focused on accelerating practical skill development for students. Virginia Tech students collaborate with faculty and industry partners work on advanced-transportation technology testing.

OUR PAST

The most recent expansion, completed in 2020, is the Rural Roadway. This expansion includes 2.5 miles of paved roads and 4.5 miles of unimproved roads that have been built to allow users to test advanced and automated vehicles in realistic rural settings. The facility includes hilly and flat winding roads with short sight distances, interfering terrain, natural foliage, small bridges, narrow sections, off-road segments, soft grass shoulders, and rural intersections. Vehicles can connect directly to the Rural Roadway from the

Highway section through realistic off-ramps and connecting roadways. The Rural Roadway supports the testing necessary to deploy automated vehicles safely and efficiently in challenging rural environments that represent the majority roadway miles throughout the U.S.

The composition of the Smart Road itself has been part of studies to characterize the performance of advanced materials. We have tested various asphalt mixtures coupled with hundreds of sensors to test stress, strain, moisture penetration, shifting and separation. Sections of the Smart Road have been used to research the impact of certain treatments and overlays to facilitate salt retention and delay the freezing point, which improves traction in adverse weather events. Tire noise and traction are also evaluated in various weather conditions.

With 7 miles of roadway providing nearly 14 total lane-miles of testing facility, these research facilities feature weather-making (rain, fog, and snow), adaptive lighting capabilities, advanced sensors, controlled intersections, and comprehensive communications, enabling VTTI to conduct safe and precisely controlled evaluations for our partners in a secure location. Collectively, the Virginia Smart Roads are an ideal facility for advanced vehicle infrastructure testing.

The Smart Roads are a Federal Aviation Administration (FAA) approved test facility for unmanned aerial vehicles (UAV). Historically, we were one of 2 sites in Blacksburg, and 7 in the nation, authorized by the FAA to conduct UAV testing. We are now part of a much larger FAA approved area to conduct various UAV testing and research.

Starting in 2006, VTTI joined the Cooperative Intersection Collision Avoidance System for Violations (CICAS-V) project. The CICAS-V project represented an exciting new collaboration with public and private partners - including automotive manufacturers, state and local departments of transportation, and other university transportation research centers. The goal of the project was to prevent crashes associated with stop-signs and signal-controlled intersections first through design, development, and testing of a prototype system utilizing the Smart Roads, and then system deployment in the real-world. VTTI researchers continue to collaborate with many of the same partners, working together to solve transportation safety challenges of the present and future.

In late 2014, VTTI and VDOT launched the Virginia Connected Corridor, comprised of the Virginia Smart Roads and the Northern Virginia Connected Vehicle Test Bed. The latter covers Interstates 66 and 495 and U.S. 29 and 50, widely considered to be among the most congested corridors in the U.S. The combined roadways and surrounding environment provide considerable transportation challenges that may be addressed and mitigated by advanced vehicle technologies.

The VCC currently includes 56 roadside units installed on freeways, arterials, and the Smart Roads. Thirty of these units interface directly with VDOT's existing signal controllers to support the broadcast of signal phase and timing (SPaT) and MAP messages, which will facilitate the roll out of higher-level automated vehicles. VDOT, VTTI, and partner organizations have used this facility to implement 30 connected vehicle applications that can be used by a wide range of vehicles (e.g., passenger, transit, emergency vehicles, motorcycles) to provide information to roadway users such as lane closure alerts, work zone alerts, incident management, and merge management.

The VCC infrastructure includes a developer friendly, cloud computing environment that supports the development and deployment of third-party applications; data exchange services; application program interfaces and reference applications for developers; support for the migration of applications from the Smart Roads to public roadways; and instrumentation and data acquisition systems for the post-deployment safety assessments.

NATURALISTIC DRIVING

VTTI is known as a pioneer in naturalistic driving research. The research award that started this all came in 2000 for the 100-Car Study, the first large-scale, naturalistic driving study undertaken globally. The Naturalistic Driving Data Collection System, the first fully digital video and parametric data collection system for large scale automotive data collection, was designed for the 100-Car in 2002. Soon after, installation of the instruments that would make it possible to observe real-world in situ driving began during January 2003, and the task was completed in June 2003.

The data collection technology at that time included up to five channels of digital video; multiple radar sensors; machine vision-based lane-tracking systems; GPS; accelerometers; glare sensors; radio frequency detectors; and connections to the auto manufacturers' in-vehicle networks to obtain factory vehicle sensor information.

VTTI naturalistic research did not stop at cars. Researchers embarked on a number of naturalistic truck driving studies, including one that used 34 trucks and 102 drivers to develop a drowsy driver warning system. These studies resulted in a naturalistic dataset from commercial vehicle drivers that ultimately captured more than 200 drivers and three million miles.

The results of the 100-Car Study and the truck studies served as a wake-up call to the dangers of distracted driving. The May 2006 news release from the 100-Car Study sponsor, the National Highway Traffic Safety Administration, announced that "driver distraction" - which included distraction from a specific source, a random glance away from the roadway, or drowsiness - was responsible for 80 percent of crashes and 65 percent of near crashes. According to results of the truck studies, tasks that significantly increased risk included texting, interacting with a dispatching device, and dialing a cell phone. Texting while driving increased the risk of safety-critical events by 23 times.

VTTI now has over 4,000 instrumented vehicles and has collected over 70 million miles of naturalistic driving data, including crash and near-crash events. VTTI researchers continue to lead increasingly large and complex naturalistic driving studies and explore opportunities for improving transportation systems and safety based on the research techniques invented at VTTI.

After successful work in light- and heavy-vehicle naturalistic driving research, VTTI expanded their research efforts to include more types of vehicles and different groups of drivers.

MOTORCYCLES

The number of motorcyclists killed and injured has increased while fatalities and injuries for other road users have decreased. Starting in 2007, VTTI founded the Motorcycle Research group with the objective of applying VTTI's multidisciplinary research capabilities to real-world motorcycle riding. With support from the VTTI-based National Surface Transportation Safety Center for Excellence (NSTSCE), VTTI demonstrated that motorcycles can be outfitted with equipment that will record rider and machine performance. This instrumentation led to the Motorcycle Safety Foundation (MSF) funding our research to conduct the largest naturalistic motorcycle study to date. VTTI has instrumented over 100 motorcycles in four states to collect data and develop strategies to mitigate crashes and enhance the training provided by the MSF.

OUR PAST

OLDER DRIVERS

VTTI expanded their research to include vulnerable road users. Sponsored by NSTSCE, VTTI researchers collected naturalistic driving data on older drivers. The study included instrumentation of 20 vehicles and resulted in the collection of more than 4,600 hours of driving data from more than 29,000 trips. The aim of this pilot effort was to collect the first substantive naturalistic driving database from a senior population to learn about their typical driving patterns and crash-related behaviors and situations. The project was also designed to correlate functional impairment profiles to driving behavior and risk. Results help with the development of fitness to drive models and influence the content of older-driver training programs, development of technological assistance devices, and licensing and restriction protocols.

LIGHTING

Lighting is critical to the safety of motorists, pedestrians, and bicyclists on roadways, parking lots, and garages. VTTI has conducted research in all these venues. From the start, the Smart Road highway included lighting equipment. Each light pole has three different kinds of luminaries capable of reproducing over 90 percent of the types of roadway lighting typically used on U.S. highways. VTTI lighting researchers have studied how best to light intersections on rural roads–which can have too little or abrupt lighting– and have collected data about cities awash in light (such as Washington, D.C. and Seattle) to recommend strategies and standards for improved lighting methods. The use of adaptive lighting technologies, an approach which allows the lighting system to be adjusted based on need, is a new method being studied by VTTI researchers. Additional studies have included the impact of headlight design on safety, wet night visibility, and other low-visibility conditions and road designs.

OTHER ROADWAY USERS

VTTI researchers continued to expand their research to enhance the visibility of cyclists and their bicycles. These studies involved monitoring cyclists in naturalistic settings such as public roads and assessing their visibility using various lighting and reflective methods.

MAJOR CONTRIBUTIONS TO TRANSPORTATION

During his 25 years as director of VTTI, Dr. Tom Dingus grew the inaugural group of 15 employees into what is now the second largest university-level transportation institute in the U.S. Along the way, he managed more than $800 million in research funding. These projects focused on enhancing transportation safety, improving the efficiency of transportation systems for all users, assessing driver performance and behavior, and ensuring the safe and efficient development and deployment of advanced vehicles.

While Tom admits that he did not initially envision a career in automotive safety research, he became intrigued with the idea after being exposed to the work being performed in the labs of Professor Walter Wierwille at Virginia Tech. Tom said: “While I never planned on studying automotive safety, it quickly became apparent that this field was at the center of injury prevention and risk management.”

After earning his master’s and doctoral degrees in industrial engineering and operations research (human factors option) from Virginia Tech, he took a teaching position at the University of Idaho that also gave him the opportunity to seek out and win grants from private industry and the federal government.

After his stint at Idaho, Tom moved to the University of Iowa to lead the safety research efforts for the National Advanced Driving Simulator as the associate director for the Center for Computer-Aided design. After three years, Tom was excited to return to Virginia Tech to take on a dual role as a professor in the Industrial and Systems Engineering Department and director of the University Center for Transportation Research (the name was changed to the Virginia Tech Transportation Institute in 2000).

Tom took over the reins as the director from Ray Pethtel in 1996, turning VTTI into the university’s largest research institute with annual external funding from more than 200 private and public sector sponsors equivalent to approximately 12-15% of all externally sponsored research conducted at Virginia Tech. He is responsible for pioneering the naturalistic driving study (NDS) method that has given VTTI a worldwide reputation.

Along the way, Tom built a dedicated and talented team that subscribed to his vision of saving lives through human factors engineering. He is quick to give credit for VTTI’s success and growth to the students and colleagues that he was able to bring on board to staff the research center. Tom has noted that each one has been instrumental in fostering the next generation of transportation researchers, demonstrably expanding the breadth of depth of research performed at VTTI today.

He has also gathered various honors for his accomplishments. A selection of particularly noteworthy honors include: named the Newport News Shipbuilding Professor for the Departments of Biomedical Engineering and Mechanics and Civil & Environmental Engineering from 2001- present; designated as a White House Champion of Change for Innovation in Transportation and an invited panel member at the White House in 2013; and induction into the Virginia Tech College of Engineering Academy of Alumni Excellence in 2020.

After stepping down as director of VTTI in August 2021, Tom was appointed Distinguished Technical Fellow with Virginia Tech’s Institute for Critical Technology and Applied Science. Zac Doerzaph, VTTI’s Executive Director, sums it up here:

> *“It is not possible to talk about VTTI without mentioning Tom’s leadership and accomplishments. His vision for what the Institute could become, along with his ability to cultivate the enabling talent, provided the roadbed for our achievements to this day.”*

OUR PRESENT

For 35 years, VTTI has been conducting research to save lives, time, and money and protect the environment. In our world-class facilities, we investigate, invent, design, develop, refine and test transportation systems of the future. As one of seven premier research institutes created by Virginia Tech to answer national challenges, VTTI is continually advancing transportation through innovation and has affected public policy on national and international levels.

VTTI is known for robust transportation studies, both with public partners, as well as with private partners, original equipment manufacturers, and suppliers on proprietary research. Established in 1988 as the University Center for Transportation Research, VTTI is now the second largest university-level transportation institute in the U.S. and is home to the largest group of driving safety researchers in the world.

- Division of Data & Analytics
- Division of Freight, Transit, & Heavy Vehicle Safety
- Division of Technology Development & Deployment
- Division of Technology Implementation
- Division of Vehicle, Driver, & System Safety
- Center for Injury Biomechanics
- Center for Sustainable & Resilient Infrastructure
- Center for Sustainable Mobility
- Global Center for Automotive Performance Simulations (affiliated company)

Our facilities provide a research friendly environment that government agencies, original equipment manufacturers, and suppliers can use to test and certify their systems, providing a path from test-track to real-world deployment.

- Virginia Smart Roads test tracks providing highway, urban, and rural roadway environments, weather-making and lighting configurations
- VTTI-designed data acquisition systems, capturing rich data from crash vehicle and infrastructure at scale
- Labs for driver interface development, data reduction, lighting research, crash analysis, pavement research, and traffic simulation
- Fleet of instrumented vehicles that can be tailored to project specifications
- High-performance computing and data warehousing to unleash the potential of data analytics using cutting edge data processing pipelines
- Engineering labs to rapidly prototype novel technologies for tests and evaluation
- GCAPS state of the art indoor tire test facility

OUR PRESENT

Currently, VTTI is expanding with over 350 faculty, staff, and students, and a research portfolio that approaches $50 million per year. The Institute is divided into nine units that all strive to achieve a vision of ubiquitously safe and effective mobility through our mission of conducting research which saves lives, time, money, and protects the environment.

DIVISION OF DATA & ANALYTICS

The Division of Data & Analytics (DDA) specializes in collaboration with industry, academic, and government partners to translate large-scale data collections into robust and timely guidance and decisions. The division focuses on challenging questions at the intersection of engineering, physics, computer science, statistics, behavior, performance, safety, and policy. DDA projects leverage innovative data fusion approaches, algorithmic labeling processes, and interactive visualizations to translate disparate and highly dimensional data into visible progress and understandable results. The division's goals are to provide domain expertise and state-of-the-art data and analytic methods to enable our partners to answer their questions quickly, cost effectively, and with accessible output that is ready to address their most pressing needs.

PROJECT HIGHLIGHT

ESTIMATING CRASH CONSEQUENCES FOR OCCUPANTLESS AUTOMATED VEHICLES

Occupantless vehicles (OVs) are a proposed application of automated vehicle technology that would deliver goods from merchants to consumers with neither a driver nor passengers on-board. The purpose of this research was to understand and estimate how the increased presence of OVs in the United States fleet may influence crash risk and associated injuries and fatalities. This is of particular interest as OVs may replace some subset of the trips taken by U.S. drivers. OVs have unique physical characteristics that may be expected to improve road safety, such as low mass, the absence of human occupants, and lower structural rigidity requirements, and they operate within specific operational design domains (ODDs), including low-speed environments and locations with reduced exposure to crossing traffic.

The approach used to estimate potential modifications in crash risk consequences was a counterfactual simulation, where real-world observations were modified as if alternate events had occurred. This analysis leveraged several U.S. national crash databases, along with the Second Strategic Highway Research Program (SHRP 2) NDS dataset.

The results of this investigation suggest that there is potential for OVs to reduce the number of fatalities and injured persons that occur on the nation's roadways. Most of that reduction will come from the removal of occupants who are simply making a trip to obtain goods that can be delivered by an OV. The results of this project are meant to support critical thinking into how innovative technologies such as OVs may offer benefits that transcend the typical approaches used in vehicle safety, including passive and active safety measures.

DIVISION OF FREIGHT, TRANSIT, & HEAVY VEHICLE SAFETY

The Division of Freight, Transit, & Heavy Vehicle Safety (DHVY) solves complex and meaningful heavy-vehicle problems through deployment, testing, analysis, education, and outreach. With a focus on addressing real-world challenges, this Division follows a research-to-practice philosophy by translating research findings into actionable countermeasures - most recently with a strong focus on cutting-edge driver assistance and automated truck and bus technologies. With a long history of establishing key partnerships across a variety of industry and government stakeholders, DHVY has conducted innovative research-based initiatives that support the safety, health, and well-being of truck and bus drivers and all who share the roads with them.

PROJECT HIGHLIGHT

TRUCKING FLEET CONCEPT OF OPERATIONS

VTTI is currently working on a robust study of issues concerning the deployment of automated driving systems (ADS) to highlight important aspects of how motor carriers can incorporate ADS-equipped vehicles into their operations. The DHVY team is leveraging an ADS developed by our industry partners. DHVY is collaborating with several motor carriers to create a trucking fleet concept of operations for the deployment of ADS-equipped trucks to safely, efficiently, and cost-effectively move freight.

The study comprises three phases: (1) partial automation; (2) conditional automation; and (3) full automation. This project will navigate through each phase based on the ADS's ability to pass the imposed safety metrics created for each step. The VTTI team, in conjunction with the Commercial Vehicle Safety Alliance, will develop and demonstrate ADS inspection procedures and depict how these data can be used by motor carrier companies and roadside inspectors. Our industry partners are sharing techniques to keep operators alert through the utilization of a driver monitor and an alertness management system.

The Federal Motor Carrier Safety Administration (FMCSA) is the sponsor for this effort. VTTI is refining safety metrics for ADS vehicles. In addition, there will be opportunities to visualize the project through ADS demonstrations, a driverless cross-country highway demonstration, ADS port queuing demonstrations, and an exit-to-exit use case operation. VTTI will host several ADS Roadshow events across the country at national and international industry conferences, trade shows, and trucking events. Roadshows will feature interactive static and dynamic ADS demonstrations and collect feedback from roadshow attendees that may contribute to future ADS development and knowledge.

To complement this effort, our research partner, the Texas A&M Transportation Institute, is working with state departments of transportation across the country to create a system that DOT's can use to assess roadway readiness and safety for ADS-equipped vehicles. VTTI is also developing data security and transfer protocols so that the data collected can be stored in the FMCSA's dataverse housed at VTTI. Our partners are developing a cybersecurity best practice guide for motor carriers. DHVY researchers attended the 2022 TMC Annual Meeting in Orlando, Florida, to showcase the project and educate attendees on ADS technology in heavy vehicles

OUR PRESENT

DIVISION OF TECHNOLOGY DEVELOPMENT & DEPLOYMENT

The Division of Technology Development and Deployment specializes in developing, manufacturing, implementing, and maintaining innovative systems for transportation research. The division collaborates with other research programs and groups within VTTI to provide innovative research support. For example, it is continuously developing advanced systems for data collection with the goal of collecting a range of detailed data while remaining unobtrusive to participant drivers.

The division's responsibilities include: a) developing highly integrated DAS to accelerate research, b) maintaining the reliability of VTTI's DAS as vehicle electrical systems become more complex, and increasing capabilities to keep pace with new technologies and research demands, c) capturing, storing and processing large volumes of data in a secure research computing environment, d) designing, developing and testing ADs, including higher levels of automation, e) maintaining and expanding the capabilities of VTTI and the Virginia Smart Roads.

RESEARCHER SPOTLIGHT: JON HANKEY

When Dr. Jonathan Hankey joined VTTI, then the University Center for Transportation Research (CTR), in 1998, he did not envision that he would be spending the next 25 years working at the Institute. After earning his master's degree from the University of Idaho and his doctorate from the University of Iowa studying under Tom Dingus, he began his professional career working as a lead human factors engineer for Boeing Commercial Airplane Group in Everett, WA. When given the opportunity to work with Tom and Walter Wierwille at CTR, he moved across the country and accepted the position of research scientist.

In the intervening years, Jon has served in various roles, including group leader, research center director, associate VTTI director, interim director of VTTI (during Dingus' sabbatical), and director for research and development. In 2020 he was named senior transportation fellow. During the past two and half decades, in addition to leading a myriad of research projects, Jon developed and maintained strong affiliations between VTTI and public and private entities such as the Federal Highway Administration, National Academies of Science and General Motors.

Jon has served as the principal investigator (PI) or co-PI on more than $100M of contract research, which includes SHRP2 NDS, the largest naturalistic driving study NDS to date, and the subsequent project to store and facilitate use of that data, the InSight Data Access Portal. Currently, he is conducting a major NDS of advanced vehicles which will lead to more opportunities for future research. Jon continues to direct NSTSCE, which is guided and funded by stakeholders, including General Motors, VDOT, the Virginia Center for Transportation Research, the FMCSA, and VTTI. This group shares a vision of improving safety for all road users, locally and nationally, and guides the research portfolio to address key surface transportation issues.

Of his former student and longtime colleague, Tom has this to say: "Jon Hankey deserves as much credit as anyone for the tremendous success of VTTI. When I was able to recruit him in 1998, he said he would only stay for two years to help me get programs rolling. Twenty-five years later, with major leadership roles in all of the major initiatives and decisions, Jon continues to be a stabilizing force as he has been through good times and not-so-good times. The rest is history."

Jon summed up his VTTI experience in this way: "I work with some of the best, smartest people I've ever met. Not many people can say that about their job. On a personal level, it is rewarding for me to see the results of our work being used in vehicles, infrastructure, and policy. I have always been an applied guy, so my greatest joy is seeing our work being used."

DIVISION OF TECHNOLOGY IMPLEMENTATION

The Division of Technology Implementation (DTI) participates in the investigation of requirements, selection of vendor solutions, development of hardware and software solution components, systems integration, data collection, data analysis, performance analysis, and cost/benefit estimation. DTI leads outreach activities that join partners into consortia to collaboratively resolve the legal, policy, operational, and technical issues required to conduct an effective implementation. DTI has developed and maintained connected vehicle test bed environments including a cloud computing environment, roadside communications and localization equipment, dashboard applications for performance monitoring, and mobile reference applications. DTI has deployed these capabilities on closed test tracks and live operational environments on public roads. DTI also specializes in the development of customized web and mobile applications that are used for a variety of transportation research purposes.

PROJECT HIGHLIGHT

WORK ZONE SAFETY INITIATIVE

DTI is leading an effort to develop a Smart Work Zone system that will include a wearable Smart Vest that accurately localizes, monitors, and predicts potential collisions between work zone workers and passing motorists. The set-up includes a mobile base station which provides an edge computing environment to support the broadcast of work zone information to connected vehicles, and smart channelizing devices that can automatically define work zone boundaries and improve communication reliability between workers and the base station.

DTI is also leading a consortium consisting of VTTI, VDOT, and industry partners to design and build an automated truck-mounted attenuator system with the goal of removing the human driver from the dangerous position within the mobile crash cushion vehicle.

OUR PRESENT

DIVISION OF VEHICLE, DRIVER, & SYSTEM SAFETY

The Division of Vehicle, Driver, & System Safety (DVDSS) applies cutting-edge scientific methods to design, develop, refine, and evaluate solutions to complex transportation challenges, focusing on applications to improve the safety and effectiveness of transportation systems for the broad range of users. DVDSS supports the development and evaluation of advanced technologies and operations using VTTI's laboratories, numerical models, test-tracks, field studies, and analysis toolchains. The applied nature of their work is intended to support original equipment manufacturers, automotive suppliers, policy makers, and infrastructure owner operators in designing and improving the effectiveness of systems by quantifying performance benefits, resilience, unintended consequences, and potential misuse while also characterizing user acceptance, reliance, comprehension, and understanding of advanced vehicle and infrastructure systems.

PROJECT HIGHLIGHT

ASSESSMENT AND COMPARISON OF ADVANCED DRIVER ASSISTANCE SYSTEM SAFETY TESTING PROCEDURES

Vehicle safety testing programs such as the NHTSA's New Car Assessment Program (NCAP), the Insurance Institute for Highway Safety, the Euro NCAP, and many other regional NCAPs, have been established to elevate vehicle safety standards, raise consumer awareness, and encourage a market for safer vehicles on our roads. Historically, the focus was on the passive safety performance of a vehicle by assigning safety ratings to vehicles based on how well the vehicle performs in a series of crash tests (e.g., frontal and side impacts). Advanced driver assistance systems (ADAS), however, increase road safety by helping the driver to either avoid potential collisions or, in the event of a collision, by mitigating the severity of the crash. Currently, there is no existing single standard when it comes to ADAS and crash avoidance testing procedures, which means each testing program that assesses and rates advanced safety systems may have its own testing and rating process. As such, the goal of this project was to examine differences between ADAS test procedures conducted by test programs across the globe.

The review of all test organizations revealed a healthy coverage of ADAS technologies currently included in vehicle assessments, along with revisions and additions planned for upcoming years. General differences were observed at the organizational level and were seen to be consistent across protocols available from each testing organization–most notably, the scoring assessments and how those were communicated. Ultimately, the analysis provides a comprehensive snapshot of the current ADAS test procedure landscape across vehicle assessment programs with differences highlighting the varying approaches employed.

GLOBAL CENTER FOR AUTOMOTIVE PERFORMANCE SIMULATION

The Global Center for Automotive Performance Simulation (GCAPS) is an affiliated company of Virginia Tech that is revolutionizing the automotive industry. GCAPS provides advanced tire research, vehicle simulation, and mathematical modeling for virtual vehicle technology development. The Center specializes in independent simulation, testing, research, and assessments to complement or supplement activities performed by global vehicle manufacturers, tire manufacturers, suppliers, and motorsports teams.

GCAPS provides and utilizes accurate models to support virtual development for the transportation industry. Their simulation group, which has significant experience ranging from mathematical model development to graphic design to tire mechanics, is an important aspect of the successful model creation. These models–including tire models, vehicle models, and environments–are created from both customer data sources and physical testing performed in their own advanced testing facilities, which feature the world's most capable indoor flat-belt tire test machine.

GCAPS' physical testing expertise has led to research and new modeling methods for improved products delivered to their customers. Clients use the models and testing services to elevate their performance in vehicle handling, automated vehicle technology, and many other aspects of transportation simulation. Collectively, the vast experience in controls development, vehicle simulation, model creation, and physical data interpretation helps many companies in the transportation industry excel.

PROJECT HIGHLIGHT

SENSOR DEGRADATION DETECTION ALGORITHM FOR AUTOMATED DRIVING SYSTEMS

The Global Center for Automotive Performance Simulation (GCAPS) is currently working on creating a sensor degradation detection algorithm through simulation established by physical testing and naturalistic data. The Commonwealth Cyber Initiative (CCI) provided the funding for this project. The purpose of this algorithm is to enhance the reliability of the performance of automated driving systems by outlining possible sensor data that has broken down due to malfunction, environment, or offensive cyber-attacks. The project uses the Virginia Smart Roads for sensor testing and naturalistic driving data for events used in the simulation. GCAPS is collaborating with VTTI and Old Dominion University on these efforts.

OUR PRESENT

CENTER FOR INJURY BIOMECHANICS

The Center for Injury Biomechanics (CIB) is an interdisciplinary research center that is a partnership between the Virginia Tech College of Engineering, VTTI, and the Wake Forest University School of Medicine. The CIB is part of the Virginia Tech - Wake Forest School of Biomedical Engineering and Sciences joint graduate program.

The center investigates injury mechanisms following trauma to develop a greater understanding of human tolerance to injury, to engineer enhanced safety countermeasures, and to mitigate the occurrence of serious injury in society. Applications of this research are significant to transportation safety. Most of the work performed at CIB is proprietary.

CENTER FOR SUSTAINABLE & RESILIENT INFRASTRUCTURE

The Center for Sustainable & Resilient Infrastructure (CSRI) is a partnership between VTTI and the Transportation Infrastructure and Systems Engineering Program in Virginia Tech's Via Department of Civil and Environmental Engineering. The mission of CSRI is to envision, develop and deploy innovative, safe, sustainable, and resilient infrastructure solutions. We re-imagine and manage our infrastructure facilities, networks, and systems. We aim to educate the next generation of transportation professionals with a solid academic foundation, teaching them to be creative and resourceful, and to appreciate the societal, economic, and environmental impacts of our profession.

PROJECT HIGHLIGHT

IMPLEMENTATION OF NETWORK LEVEL PAVEMENT STRUCTURAL TESTING INTO VIRGINIA PAVEMENT MANAGEMENT

This recently completed project for VDOT included structural testing with a Traffic Speed Deflectometer (TSD) on 1,500 miles of interstate roads and 2,520 miles of primary roads in Virginia. The two main objectives of the project were to 1) determine the levels of pavement structural response that define structurally good, fair, and poor pavements, and 2) determine the impact of including the structural information on VDOT's network-level pavement maintenance and rehabilitation decision-making process. Specific major tasks include:

- TSD data collection and processing (4,020 total miles)
- Ground penetrating radar data collection on primary roads to support pavement structural evaluation (2,520 miles)
- Evaluate the different structural parameters or indexes that can be used to characterize the pavement structural condition and recommend the most appropriate one(s)
- Demonstrate that the pavement structural condition has an impact surface deterioration and develop pavement surface deterioration curves that incorporate the impact of the structural condition

Findings from this project were crucial in VDOT's decision to: 1) replace the outdated structural information in its pavement management system obtained from Falling Weight Deflectometer testing with the newly collected structural information obtained from the TSD, and 2) develop webinar and training material on how to use and interpret TSD data for VDOT district level engineers.

CENTER FOR SUSTAINABLE MOBILITY

The Center for Sustainable Mobility (CSM) conducts research relevant to society's transportation mobility, energy, environmental, and safety needs. The center translates the results of research into realistic and workable applications, creates and provides tools needed to apply developed knowledge and processes, and educates qualified engineers to meet today's transportation demands and tomorrow's transportation challenges. CSM research focus on the following areas: transportation network control; large-scale transportation system modeling; traffic state prediction using large data and artificial intelligence techniques; transit bus real-time routing and scheduling; vehicle energy and environmental modeling; connected and automated vehicle control; and eco-transportation applications.

PROJECT HIGHLIGHT

DEVELOPING AN ECO-COOPERATIVE AUTOMATED CONTROL SYSTEM (ECO-CAV)

Transportation is responsible for 69% of the petroleum consumption in the United States and 33% of the country's CO2 emissions. Any decrease in the energy used by transportation will have notable environmental benefits. Rapidly emerging technologies such as vehicle-to-vehicle, vehicle-to-infrastructure, battery-only electric vehicles (BEVs), and hybrid electric vehicles (HEVs) have the ability to immensely improve the efficiency and longevity of the transportation system.

The main objective of the Center for Sustainable Mobility's Eco CAC project is to significantly reduce vehicle energy consumption. Eco-CAC uses computer algorithms to calculate vehicle routes and speeds that optimize energy use based on the current and predicted traffic conditions. That information is relayed to connected automated vehicles (CAVs), which adjust their route and speed accordingly. Specifically, the Eco-CAC is a novel integrated control system that: (1) routes vehicles in a fuel/energy-efficient manner for internal combustion engine vehicles (ICEVs), BEVs, and HEVs; (2) selects vehicle speeds based on anticipated traffic network evolution; (3) minimizes vehicle fuel/energy consumption near signalized intersections; and (4) intelligently modulates the longitudinal motion of vehicles within a cooperative platoon to minimize its fuel/energy consumption.

VTTI researchers tested the Eco-CAC system considering the current and future vehicle compositions in a simulation environment on the Los Angeles downtown network. The current vehicle composition, which includes 86.8% ICEVs, 7.7% BEVs, and 5.5% HEVs, was constructed based on 2019 vehicle sales data in California. Researchers used a future vehicle composition of 50% ICEVs, 30% BEVs, and 20% HEVs. The study found that the Eco-CAC system effectively reduced fuel and energy consumption, travel time, total delay, and stopped delay in heavily congested conditions for both vehicle compositions. It was further found that different vehicle compositions produced different results. In particular, the maximum energy consumption savings for BEVs (36.9% savings) for the current vehicle composition was observed at a 10% CAV market penetration rate in mild congestion, while the maximum savings for the future vehicle composition (35.5%) was observed at a 50% CAV market penetration rate in no congestion.

OUR PRESENT

RESEARCHER SPOTLIGHT: ANDY PETERSEN

As VTTI's Chief Engineer, Andy Petersen advises the executive director on the strategic direction of the institute's advanced technology program and guides technology development and initiatives that are heavily technical in nature, including the design and implementation of research equipment hardware and software.

Andy joined VTTI's precursor, the CTR, in 1996 as one of the original 15 employees. Having worked with Tom Dingus at the Center for Computer-Aided Design at the University of Iowa, Andy was eager to continue their collaboration when given the opportunity to come on board at CTR.

Since 1991, he has invented and designed many hardware and software products. He has supervised over 40 engineers responsible for inventing and implementing hardware and software systems for data collection in all types of vehicles and from many types of roadside sensors. Andy led the creative development teams behind VTTI's naturalistic driving instrumentation, which directly contributed to the success of the National Academy of Sciences' Transportation Research Board SHRP2 NDS, the largest research program ever funded by the Academy. The data that resulted from the study has been used by more than 700 separate research teams worldwide to answer a multitude of safety and mobility research questions.

Currently, Andy leads critical hardware and software development projects and coordinates the development and execution of VTTI's technology roadmaps. He also manages the technical development on two high-performance ADS demonstration reference vehicles: a light vehicle and a Class 8 heavy truck. His expertise in the installation of covert video surveillance, data collection hardware, and in-vehicle displays has been instrumental to the growth of VTTI, leading and working with hundreds of researchers in a wide range of disciplines. The research tools he has created enabled us to conduct research valued in excess of $500 million over the course of his career.

Senior research associate Carl Cospel, who leads VTTI's electronic Systems & Technology Innovation group, has this to say: "All of the data acquisition hardware and software used by VTTI have roots that can be traced back to the original systems Andy developed. More importantly, our cohesive work culture, focus on exceptional quality, and high ethical standards all stem from Andy's leadership. His contributions are felt by every employee throughout VTTI."

STUDENTS AT VTTI

Since our humble beginnings in 1988, students have played an integral role in the growth and success of the institute. VTTI supports approximately 100 undergraduate and graduate students per year, and is proud to contribute to Virginia Tech's land-grant education mission by providing students with a world-class opportunity to obtain hands-on experience in various fields.

The InternHUB is just part of the student impact at VTTI. This program gives select Virginia Tech undergraduate students the opportunity to work alongside leading automakers on projects that address some of the industry's most pressing transportation challenges. Under the guidance of faculty mentors, interns work on high-tech automotive projects that match their current interests and future career aspirations. With internships spanning the traditional academic and summer semesters, InternHUB students can make substantial contributions to the future of transportation while developing the real-world skills demanded by high-tech employers. Graduates of the program are equipped with the skills and knowledge to become the next generation of leaders in the transportation industry and often receive offers of employment from their sponsoring industry partners.

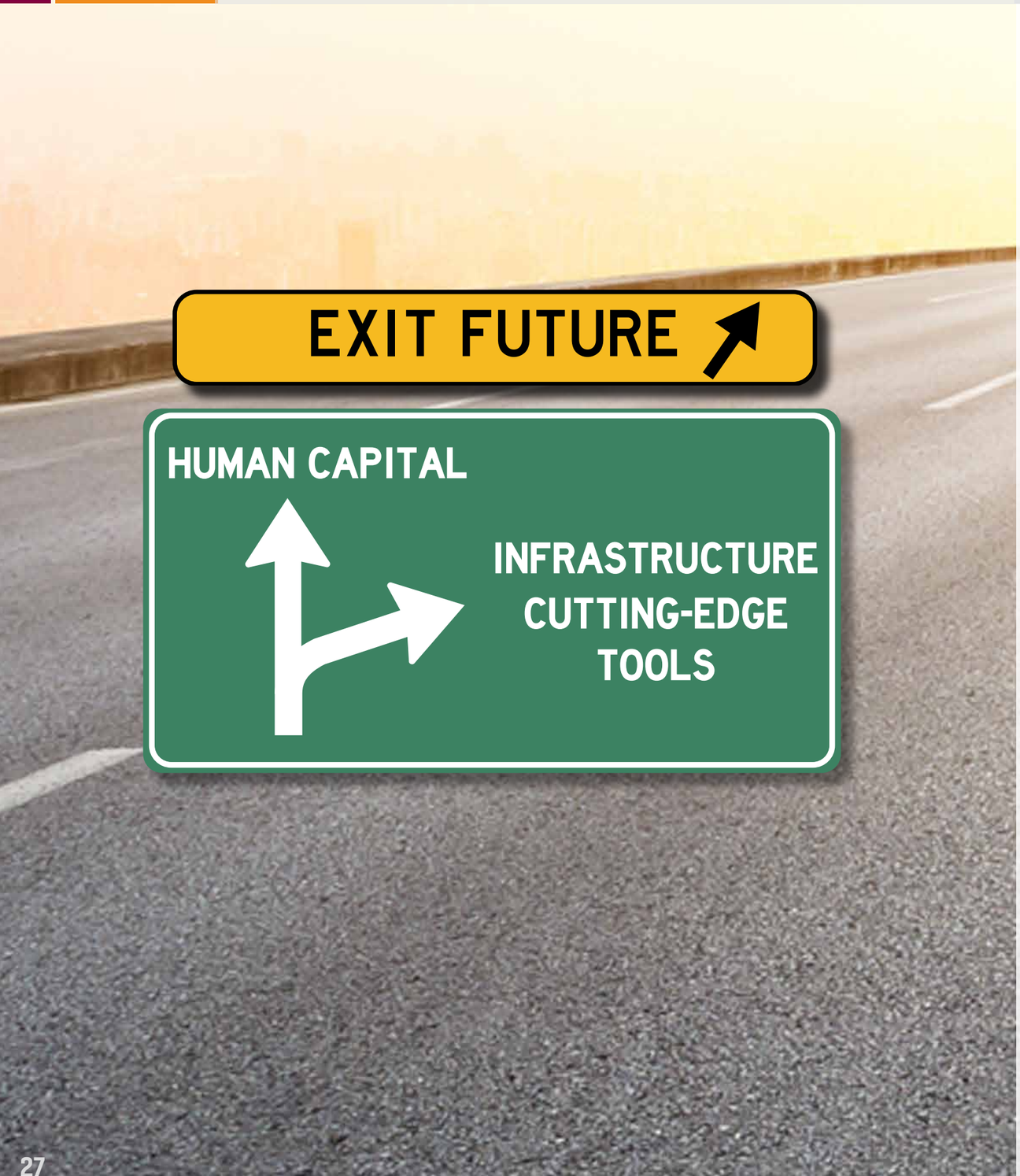
Many graduate students conduct research at VTTI with faculty who also serve as professors at Virginia Tech. Many of these students have gone on to receive special recognition and honors such as the Dwight Eisenhower Fellowship, student of the year awards, winners of the Student Safety Technology Design Competition at the Conference on Enhanced Safety of Vehicles, and many more. These students represent the next generation of transportation safety researchers and engineers and the institute is proud to be able to support them.

PROJECT HIGHLIGHT

STUDENTS WIN THE STUDENT SAFETY TECHNOLOGY DESIGN COMPETITION AT THE INTERNATIONAL TECHNICAL CONFERENCE ON THE ENHANCED SAFETY OF VEHICLES

What began as a class project on vehicle safety led to international recognition for a group of Virginia Tech engineering students. In October 2018, seven graduate students in the Advanced Vehicle Safety Systems and Development course invented a safety feature as part of a class assignment. The safety feature aimed to reduce injuries for occupants during a rear-end collision. Six months later, the students won the NHTSA's Student Safety Technology Design Competition, and in June 2019 they won the Student Safety Technology Design Competition at the International Technical Conference on the Enhanced Safety of Vehicles. The students continued to refine their project, which culminated with the recent publishing their findings in the *International Journal of Intelligent Transportation Systems Research* in November 2022. For many of the students, this was their first research project in transportation safety. Several have recently graduated and are pursuing academic and/or research positions related to transportation safety.

VTTI is pleased to sponsor several student chapters of professional organizations at Virginia Tech, including the Women's Transportation Seminar (WTS) International and the Society of Automotive Engineers (SAE). Participation in WTS and SAE gives Virginia Tech students hands on experience, as well as access to leaders in the transportation sector for mentorship and networking opportunities. VTTI faculty and staff provide leadership to both student organizations.



OUR FUTURE

Technology and connectivity are changing the way we think about transportation. At VTTI, we are working on the technology of tomorrow, today. Technology is progressing rapidly - you can see it daily when driving alongside increasingly automated vehicles on roadways, and there is even more happening behind the scenes.

VTTI has established itself as a leading research institution, with a staff that combines human factors expertise with strong engineering support to bring real-world answers to a variety of research questions. We have the tools to research challenging human factors topics for future deployment of advanced driving assistance and automated driving systems. Notably, we have road safe vehicles designed to answer tough questions about Level 3+ automated vehicle interfaces. One of our research vehicles has a full-time rear-seated safety driver with front seat by-wire controls and a fully programable LCD screen for an instrument panel cluster, which allows us to evaluate the human-vehicle interactions in increasingly automated vehicles. VTTI has a private test track with a range of safe “targets” for vehicles to interact with - from vulnerable road user placement targets to foam cars. VTTI is also using smart intersection technologies and connected vehicles-to-everything (C-V2X) technologies, now deployed on the Smart Road and on the Virginia Tech campus and soon to be deployed in Northern Virginia. We have been designing and deploying data acquisition systems (DAS) for over 25 years - the most recent evolution of this work is the MicroDAS, designed to be small, cost effective, and easy to install in a wide variety of vehicles. Our researchers and engineers can prototype and build out specialized software and hardware to address specific research needs. We continue to expand our Smart Roads, along with lighting and weather capabilities, leading to more precision in our research variables. Our researchers are currently proofing systems that can push the limits of research technology and instrumentation, expanding our capabilities even further.

VTTI is equipped with the tools, vehicles, and infrastructure to maintain and grow our leadership role in the field of transportation research. We are a team of problem-solvers who will continue to explore the increasingly complex transportation challenges of the future.

Our greatest strengths are our people and our adaptability.

For the past 35 years, VTTI has been conducting research to save lives, time, and money and protect the environment. But we have more in front of us than behind us. Making the world a safer place is not an easy task and takes a lot of time, resources, and collaboration; that is why we work with partners from around the globe with the shared mission of advancing transportation technology and safety. We will continue to hire, train, educate, and partner with the best and brightest in the transportation and technology fields to maintain our reputation as the premier transportation institute in the world.

OUR PEOPLE

VTTI is a world-class facility with world-class talent. Each division, center and department within VTTI is vital to our success. While each group specializes in a certain area, they overlap and work together in ways that make the whole greater than the sum of its parts. With more than 300 employees, it is difficult to name each one here, but we deeply appreciate every single person who works here and makes a difference at VTTI. We could not thrive without the contributions of all employees, from those who have been with VTTI since its start to those who have recently joined our team.

Every group depends upon **Christine Absher**, Chief Finance Officer, and her Pre-Award team (led by **Mary Beth Lombardo**), Post-Award team (**Ryan Naff**), and Contract Agreements support (**Catherine Strickland**). Their employees coordinate the submission of proposals, the fund management of awarded task orders, and contract compliance. Christine also serves as the treasurer for VTT, LLC, the affiliated company that manages the Global Center for Automotive Performance Simulation. Personnel in the finance group work closely with sponsors and departments at Virginia Tech to keep the financials in order and comply with the myriad requirements needed on both ends.

Chief of Staff **Andy Schaudt**, who also serves on the faculty of Virginia Tech's Management Department, leads a large, eclectic team, including volunteer coordination, program and business management, human research protection, safety, human resources, technical writing/editing, and facilities. **Christine Link-Owens**, **Liz White**, **Julie Cook**, **Elliott Laratonda**, **Lisa Eichelberger**, **Laura Hamm**, and **Keith Johnson** serve as supervisors in those areas. Their employees affect everything that happens at VTTI: finding and screening the volunteer participants for each study; managing the projects as they progress; ensuring that we comply with all protocols related to human study participants and safety procedures; hiring faculty, staff, and students to keep the institute growing and thriving, managing the proposal efforts that keep funding coming in and providing editing services to all VTTI employees; and keeping the VTTI facilities in order.

Zeb Bowden directs VTTI's largest group, the Division of Technology Development & Deployment (DTDD). Zeb also serves as an adjunct professor within Virginia Tech's Pamplin College of Business. Within DTDD, **Calvin Winkowski** leads the Research Computing, Development and Operations program along with **Phil Lambert**, **Brian Daily**, **Neal Feierabend**, and **Kenny Strickler**. **Carl Cospel** manages the Electronic Systems & Technology Innovation programs; these include: Instrumentation (led by **Julie Rutledge**), Software Development (**John Yankowski**), Automated Systems Development (**Bill Freeman**), and Electronic Systems Development (**Joshua Quesenberry**). **Jared Bryson** leads the Virginia Smart Roads and Mechanical Systems programs, with the support of supervisors **Leonore Nadler** (Operations & Safety), and **Mario Jones** (Mechanical Design). **Carri Edmiston** oversees program management activities for DTDD. Zeb and his team provide the computing and mechanical backbones for VTTI's studies. These employees provide high-performance computing services for securing, storing, and processing VTTI's great wealth of research data, continually develop ever more sophisticated data acquisition systems, oversee the activities on the Virginia Smart Roads, and manage VTTI's fleet of vehicles.

The Division of Data & Analytics (DDA) is led by Director **Kevin Kefauver**. DDA employs sophisticated algorithms, statistical methods, and visualization techniques to advance transportation. **Feng Guo**, VTTI's Lead Data Scientist, directs the Statistical Methods & Analysis program; Feng also serves as an assistant professor in Virginia Tech's Department of Statistics. **Tammy Trimble** leads DDA's Policy & Qualitative Data Analysis program, and **Andy Schaudt** serves as interim leader of the Motion & Context Analytics program. **Miguel Perez** manages the Data Engineering program, oversees the experiential learning program and the InternHUB, and is an associate professor in Virginia Tech's Department of Biomedical Engineering and Mechanics. **Julie McClafferty** leads the Data Annotation program and co-leads the Technology Road Map program with **Andy Petersen**, VTTI's Chief Engineer. **Matthew Casadonte** oversees program management activities for DDA. The division's impact can be seen in the areas of industry best practices, naturalistic data analysis, industry partnerships, and consumer outreach.

OUR PEOPLE

Luke Neurauter directs the Division of Vehicle, Driver, & System Safety (DVDSS) and also serves as the lead for the division's Advanced Vehicle Systems & Interfaces program along with **Naomi Dunn** and **Marty Miller**. Other DVDSS programs and leaders are: Dynamics, Electronics, & Perception Systems (managed by **Loren Stowe)**, Training Systems (**Sheila "Charlie" Klauer**), Advanced Product Test & Evaluation (**Eddy Llaneras**), and Vulnerable Road Users (**Jon Antin** along with **Justin Owens**). **Ammie Carter** oversees program management activities for DVDSS. The division's researchers apply cutting-edge scientific methods to design, develop, refine, and evaluate solutions to complex transportation challenges with a goal of increasing safety for all users.

Myra Blanco leads the Advancement, Partnerships, & Outreach group (APO) to promote and advance VTTI's efforts, collaborations, and fundraising activities. Myra also serves as a Senior Faculty Fellow for the Office of Research and Innovation. Within APO, **Eric Holbrook** leads the Marketing & Communications group, and **Carl Mitchell** leads Advancement. Carl also serves as Associate Director for Business Development at Virginia Tech's Link + License + Launch. The APO group develops relationships with potential partners and communicates VTTI's accomplishments via publications, social media, and the website in addition to providing pathways for supporters' contributions. **April Gray** is the VTTI webmaster. **Pam Stiff** oversees events coordination, ensuring that VTTI guests are well taken care of during their visits.

Mike Mollenhauer directs the Division of Technology Implementation (DTI) which addresses infrastructure solutions and leads industry and government partners through early-stage pilot implementations and evaluations of transportation and smart cities technologies. **Ron Gibbons** heads up the Infrastructure-Based Safety Systems program with the assistance of **Brian Williams**, which researches the effects of lighting on roadway safety, **Dean Iverson** leads Application Development for DTI, and the division's Implementation Research program is led by **Jean Paul Talledo Vilela**. DTI program management is led by **Jordan Erisman**.

The Division of Freight, Transit, & Heavy Vehicle Safety (DHVY) is led by **Rich Hanowski** and assisted by program leads **Andrew Krum** and **Mark Golusky** (Human Factors & Advanced System Testing), **Abhijit Sarkar** (Advanced Analytics in Behavior Perception & Safety), **Andrew Miller** (Fleet Focus & Industry Applications), **Andy Alden** (Demonstration & Deployment Research), **Matt Camden** (Research-to-Practice & Outreach), and Senior Research Associate **Rebecca Hammond** (Division Support). As the division and program names illustrate, all aspects of heavy-vehicle research are studied by the DHVY team.

Hesham Rakha heads up the Center for Sustainable Mobility (CSM), which tackles complex projects relevant to energy, the environment, safety, and mobility. In addition, Hesham is the Samuel Reynolds Pritchard Professor of Engineering in the Charles E. Via, Jr. Department of Civil and Environmental Engineering at Virginia Tech. CSM researchers, including research scientists **Ihab El-Shawarby** and **Kyoungho Ahn**, focus on innovative research, education, gathering and sharing critical information to move society toward more sustainable transportation systems, and translating research results into workable applications.

The Center for Sustainable & Resilient Infrastructure (CSRI) is led by **Gerardo Flintsch**, who also serves as the Dan Pletta Professor in the Charles E. Via, Jr. Department of Civil and Environmental Engineering at Virginia Tech. CSRI envisions, develops, and deploys innovative, safe, efficient, sustainable, and resilient infrastructure solutions. CSRI research scientists **Edgar de Leon Izeppi** and **Samer Katicha** and Technical Support Services Lead **Billy Hobbs** collaborate to deliver work products that result in innovative approaches and industry best practices, and the center maintains a strong commitment to outreach and education.

Warren Hardy directs the Center for Injury Biomechanics (CIB), which is a partnership between the Virginia Tech College of Engineering and the Wake Forest University School of Medicine. CIB's mission is to reduce injury, disability, death, and the associated societal costs. **Andrew Kemper** (Laboratory Manager) and principal investigators **Devon Albert**, **Stefan Duma**, **Luke Riexinger**, **Steve Rowson**, **Costin Untaroiu**, and **Pamela VandeVord** work with Warren to solve real-world biomechanics problems related to transportation, the military, and recreational sports. Select CIB programs include Impact and Injury Response and Tolerance; Injury Risk Formulation; Restraint System & Protective Equipment Evaluation; and Crash Avoidance & Driver Assistance.

The Global Center for Automotive Performance Simulation (GCAPS), an affiliated company of Virginia Tech, is led by Executive Director **Frank Della Pia** with the assistance of Operations Director **Jonathan Darab**. GCAPS provides advanced tire research, vehicle simulation, and mathematical modeling for virtual vehicle technology development. The center is located in Alton, VA near the Virginia International Raceway and the Virginia Motorsports Technology Park.

MAKE YOUR IMPACT

You can help shape the future of transportation safety by supporting our mission of saving lives, time, money and protecting the environment.

BECOME a part of the team

that supports cutting-edge transportation research. VTTI has nine divisions and centers researching a wide range of transportation solutions. Your money will fund diverse topics that can have an immediate global impact and help to:

- Conduct and advance vital transportation-related research
- Provide advanced training that produces highly skilled and effective transportation researchers and professionals
- Award student scholarships to ensure promising pplicants can conduct research without incurring overwhelming debt
- Incorporate state-of-the-art facilities and equipment to nsure ubiquitous transportation research solutions
- Recruit, maintain, and support world-class faculty and researchers

Many lives are lost each day in roadway collisions. The research being conducted at VTTI is striving to reduce the number of lives lost and create a safer environment for all road users. Please support us as we advance transportation through innovation.

WHEN YOU MAKE A GIFT

you join other individuals, corporations, and associations in supporting an indispensable resource for advancing transportation safety. With a gift of any amount, you can contribute to:

VTTI Annual Fund

Gifts to this fund will be used to advance the mission of transportation research, from operational support to funding projects to providing students with meaningful academic and work experience.

VTTI Pedestrian & Cyclist Research Fund

Gifts to this fund will be used to advance pedestrian and cyclist safety research, ranging from operational support to funding projects that provide students with meaningful academic and work experience.

THANK YOU for your interest

in being a part of our future at the Virginia Tech Transportation Institute

Thank you for your interest in supporting the mission of VTTI through your generous gift of cash, property, assets, or a planned gift. Your gift will help fulfill our mission to save lives, time, money, and protect the environment.

VTTI's Advancement, Partnerships, & Outreach group, (APO), is dedicated to connecting our community members to the institute and helping them make their desired impact through philanthropic support. If you would like to speak about making a gift please contact me:

Carl E. Mitchell, MS, Associate Director of VTTI Advancement & LINK @ Virginia Tech

540-231-1548 ■ 540-231-1555 ■ cmitchell@vtti.vt.edu

VIRGINIA TECH TRANSPORTATION INSTITUTE
VIRGINIA TECH

Virginia Tech Transportation Institute
3500 Transportation Research Plaza
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INNOVATION AND PARTNERSHIPS
VIRGINIA TECH

LINK: CENTER FOR ADVANCING PARTNERS

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to make a difference today

THIRTY-FIVE YEARS *and counting!*

1988

The University Center for Transportation Research (CTR), which will later be known as Virginia Tech Transportation Institute (VTTI) is established.

1989 - 1990

The planning for a "smart road" begins. The Virginia Smart Road is included in Virginia's six-year transportation plan. The road is described as an "electronically monitored highway of the future."

1993

VTTI continues to advance its research and education mission with research projects focusing on truck safety, passenger information systems, adaptive cruise control, incident detection and management, and a traffic diversion deployment system.

1997

Groundbreaking occurs for the first 1.7-mile part of the Smart Road.

1999

VTTI researchers lead a naturalistic driving study that informs the 2003 Federal Motor Carrier Safety Administration hours-of-service rule that provides a special exemption for local short-haul operators.

2000

The Center for Transportation Research officially becomes VTTI. The Smart Road officially opens in co-sponsorship with VDOT.

2002

VTTI begins to conduct the 100-Car Naturalistic Driving Study, the first instrumented vehicle study ever undertaken with the primary purpose of collecting large amounts of driving data under real-world conditions, using a data collection system developed in-house.

2003

VTTI research makes important contributions to teen driving safety recommendations after observing that teens engage longer with cell phones and lack situational awareness as compared to experienced adult drivers, suggestions included cell phones while driving be discouraged or outlawed.

2005 - 2006

VTTI is designated as a Center for Excellence in the 2005 Safe, Accountable, Flexible Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) transportation bill, and a National Surface Transportation Safety Center for Excellence from the Federal Highway Administration.

2009

The VTTI Center for Injury Biomechanics opens the crash sled laboratory, which is used to study transportation-related trauma and helps researchers better understand the mechanisms of injuries.

2011

The Global Center for Automotive Performance Simulation (GCAPS) is launched, developing a state-of-the-art tire development and testing system, to be located in the Virginia International Raceway Motorsports Technology Park in Alton, Va.

2008 - 2010

VTTI has become the leading expert in the collection of real-world transportation data and maintains the largest repository for naturalistic driving data.

2012

After over two years in development, the newest iteration of the VTTI-developed DAS is unveiled: the MiniDAS. The MiniDAS expands the capabilities of VTTI data collection to include motorcycles and support onboard monitoring and driver feedback for traditional and non-traditional vehicles.

2014

VTTI partners with VDOT to establish the Virginia Connected Corridors (VCC) connected vehicle test bed in Northern VA.

2016

VTTI is selected to lead a U.S. Department of Transportation National University Transportation Center focused on four key themes surrounding the potential of disruptive technologies to improve transportation safety.

2017

VTTI launches the Automated Mobility Partnership program, which brings industry leaders together to promote the development of tools, techniques, and data resources to support the rapid advancement of automated driving systems.

2018

VTTI launches the InternHUB program, which provides Virginia Tech students with the opportunity to work alongside leading automakers on projects that address the industry's most pressing transportation challenges.

2019

VTTI receives two U.S. Department of Transportation grants totaling $15 million to advance research on the safe integration of automation into U.S. roadways.

2020

In partnership with VDOT, VTTI completes the final of four major enhancements to Virginia Smart Roads: 1) the surface street facility, 2) the Automation Hub, 3) the live roadway connector, and 4) the rural roadway facility.

2022

VTTI enters its 35th year dedicated to transportation safety and mobility.

Virginia Tech Transportation Institute
3500 Transportation Research Plaza,
Blacksburg, VA 24061

There's more in front of us than behind us.