Semi-Annual Progress Report for University Transportation Centers

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- **Program Director (PD) Name, Title, and Contact Information**
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- **Signature of Submitting Official (signature shall be submitted in accordance with agency- specific instructions)**

  Aemal Khattak, MATC Director

1. ACCOMPLISHMENTS

What are the major goals of the program?

The original goals of the Mid-America Transportation Center (MATC) were modified considering the various Executive Orders (EOs) and directives from the USDOT. MATC will focus on new USDOT priorities and RD&T strategic goals when they are made available. The modified activities related to research, education, technology transfer, and USDOT requirements are well underway. Table 1 presents an update on the status of each activity.

Table 1: Status of MATC's Research, Educational, and Technology Transfer Activities and Reporting Requirements

Research Activities	**Status**	**Percent Completed for Year 1-2-3**
Data Management Plan (DMP) - Overarching Plan for MATC	Complete	100%
Collect DMPs from PIs for Individual Research Projects	In Process	60%
Collect ORCIDs from all MATC Researchers	In Process	100%
Submit Project Descriptions to TRB's Rip Database	Complete	100%
Education and Workforce Development Activities		
MATC Seminar Series	In Process	0%
MATC/UTC Outstanding Student of the Year	Complete	100%
MATC Roads, Rails, and Race Cars After-School Program	In Process	100%
MATC STEM Leadership Academy	In Process	100%
Technology Transfer Activities		
Technology Transfer Tech Briefs, Webinars & Presentations	In Process	60%
USDOT OST-R Reporting Requirements:		
Federal Financial Reports	In Process	100%
Post Research Project Descriptions on MATC Website	In Process	100%
Semi-Annual UTC Program Progress Performance Report	In Process	100%
Annual Performance Indicators Report	In Process	100%
Additional USDOT OST-R Requirements:		
Annual Progress Meetings	In Process	100%
UTC Director's Meetings	In Process	100%
Participation in UTC Symposiums	In Process	100%
Maintain Website (personnel directory, research pages and reports)	In Process	100%

What was accomplished under these goals?

Research Activities

The Mid-America Transportation Center (MATC) for USDOT Region 7 focuses on the statutory research priority area of Promoting Safety. During the reporting periods MATC has changed focus to comply with the various EOs and directives from the USDOT. MATC will focus on USDOT new priorities and RD&T strategic goals when they are made available by the USDOT. The MATC consortium consists of the

University of Nebraska-Lincoln (UNL; lead institution), the Nebraska Indian Community College (NICC), the Missouri University of Science and Technology (MS&T), the University of Iowa (UI), the University of Kansas (KU), and the University of Missouri-St. Louis (UMSL).

As of this reporting period, UNL has ten (10) ongoing USDOT-funded projects, supported by nineteen (19) PI's and Co-PI's. The University of Iowa (UI) has eleven (11) ongoing USDOT-funded projects, supported by eight (8) PI's and Co-PI's. The University of Kansas (KU) has ten (10) ongoing USDOT-funded projects, supported by twelve (12) PI's and Co-PI's. The Missouri University of Science & Technology (MS&T) has nine (9) ongoing USDOT-funded projects, supported by five (5) PI's and Co-PI's. The University of Missouri-St. Louis (UMSL) has ten (10) ongoing USDOT-funded projects, supported by seven (7) PI's and Co-PI's. The Nebraska Indian Community College (NICC) currently has one (1) ongoing USDOT-funded project, supported by one (1) PI and two (2) Co-PI's.

Throughout the reporting period, individual project PIs from Nebraska, Iowa, Kansas, and Missouri submitted quarterly reports detailing the progress, activities, and outcomes of their individual research projects. Some of the accomplishments reported by PIs are outlined below.

Specific Research Objectives, Significant Results, and Key Outcomes

In addition to ongoing extensive literature and case study reviews, experiment development, and data acquisition, MATC Researchers reported the following project objectives, results, and key outcomes for this reporting period.

In the research project Analyzing the Accessibility to Safe and Connected Bicycling Infrastructure Facilities at the University of Nebraska-Lincoln, Dr. Yongping Liang and his team are completing their analysis. Their findings carry significant implications for planning and policy and advance the project's core objective—promoting access to safe bicycling facilities. GIS analysis reveals detailed patterns of varying access levels, while a focus group captures cyclists' lived experiences, offering insights not available through quantitative data alone. Together, these analyses align with agency priorities by emphasizing safety based on actual usage.

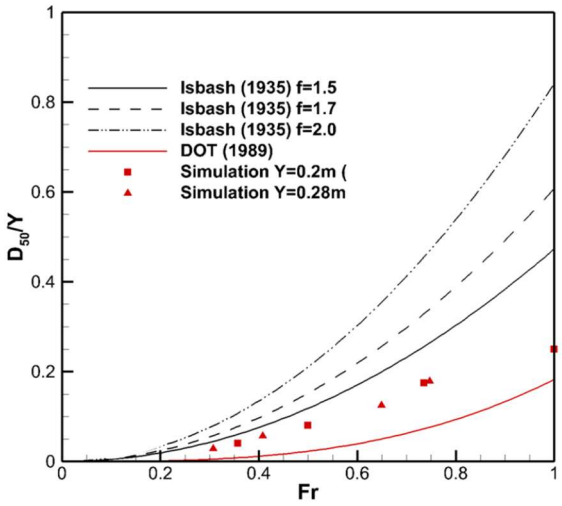
Liang concludes that although high-demand and low-income or no-vehicle households often receive greater lane density, communities with large non-working populations or lower educational attainment remain underserved. Importantly, anomaly density when normalized by area or lane length, shows consistently higher tracts with greater proportions of residents in poverty populations, with overlapping disadvantages intensifying deterioration. Focus-group findings highlight concerns about intersection safety, inconsistent lane design, and obstructed or poorly marked facilities.

The study offers a transferable, practice-oriented framework that strengthens access assessment by jointly examining infrastructure provision and performance. It shows that several determinants of inadequate bicycling infrastructure availability to the population. Policy implications include condition-based reinvestment, improved intersection treatments, clearer and more consistent traffic-sign visibility, and maintenance prioritization. The framework provides a scalable path for agencies seeking evidence-based methods to embed bicycling access into asset management and active-transportation planning.

At the University of Iowa, Dr. George Constantinescu completed project Development of New Design Guidelines for Protection Against Erosion at Bridge Piers and Estimating Effects of Pressurized Flow on Erosion Potential. During this reporting period, the main activity was to conduct simulations for circular

pier cases where the free surface elevation is situated above the bridge deck and to postprocess data from the simulations conducted with various values of the riprap diameters, D50, and incoming flow depths, y0. The main objective for this ending quarter was to determine the critical value of the bed shear stress for riprap collars at circular bridge piers as a function of the median diameter of the riprap stone based on numerical simulations and to understand how this dependency changes once the upstream flow depth is sufficiently large for the flow to become pressurized at the bridge deck. Work also began on generating meshes for rectangular pier simulations.

Figure 3



Several series of simulations were conducted for y0 = 0.2 m (unsubmerged bridge deck) and 0.28 m (fully submerged bridge deck) with different values of the median diameters of the riprap stone. A sample converged result for D_{50} = 50 shows a sample converged result for D_{50} = 50 mm with a correction constant of 0.8, which results in good agreement with experimental data for circular bridge piers. Figure 3 summarizes results of the series of simulations performed with circular bridge piers.

The sample converged result for D50=50 mm also shows that the D50/y0 curve predicted by the circular pier simulations in the open channel flow regime is consistent with design curves proposed in the literature. The most important finding is that, as opposed to bridge abutments in compound channels, the variation of D50/y0 with the critical Froude number for riprap stone entrainment, Fr, is about the same for the open channel and pressurized flow regimes. This is probably due to the relatively small blockage ratio in the section where the pier is situated compared to the case of an abutment. This effect is still to be confirmed. The future rectangular pier simulations will hopefully clarify this effect for piers.

Turning to geotechnical investigations, Dr. Chung Song at the University of Nebraska-Lincoln led his research team to conduct laboratory tests and data analyses for evaluating strength reduction in soils. Through the project Enhancing the Reliability of Transportation Structures by Quantifying Strength Reduction Magnitude of Soils in Midwestern States, they found that clear strength reduction was observed from most specimens. A site (US-75) that has soils brought in from outside did not show the strength reduction. This test result confirmed that the widespread strength behavior for Nebraska soils is due to their unique geological history.

The next project focused on regional differences in work zone crashes. The objectives of the Regional Disparities in Work Zone Crashes: Understanding Factors and Predictive Modeling for Targeted Safety Measures project, led by Dr. Islam El-Adaway at Missouri University of Science & Technology, are focused on the ML model development, hyper-tuning and verification, and the synthesis of policy insights and recommendations. Recently, their team finalized ML predictive models, refined spatial autocorrelation and negative binomial count-regression statistical models, and generated insights and recommendations based on the data analytics. From these analyses, they found in addition to the US South being the region with the highest fatalities per vehicle miles traveled (VMT), U.S. DOT Regions 6, 9, and 7 also had the

highest fatalities per VMT. At a more detailed county level, only Regions 4, 6, and 9 had higher fatality rates than Region 7.

Further analysis revealed that the top associated factors identified through chi-square analysis included alcohol presence, manner of collision, motorcycle involvement, dark lighting, and nighttime operations. Together, these results support identifying the top work zone accident-causing factors and the comparison of Region 7 fatalities with those of other regions.

Also, at UNL, Dr. Wissam Kontar led the MATC Year 3 project, Safety and Mobility Risk Index for Region VII Transportation Networks, and the research team held biweekly meetings. Meetings focused on establishing the project framework, conducting a literature review, and identifying data requirements. A graduate student led the literature review and helped refine the methodological framework. The primary objective accomplished the January-March 2026 quarter was establishing a data-driven methodological framework for the Safety and Mobility Risk Index (SMRI), organized into three sub-indices: Operations, Safety, and Socioeconomic. A systematic inventory of available GIS datasets was completed, and component data collection began using the City of Lincoln Open Data Portal and federal/state GIS repositories. A multi-layer GIS environment for Lincoln, NE was initiated in ArcGIS Pro. Fourteen datasets were identified and catalogued from the Lincoln Open Data Portal. Key data gaps were identified, including multi-year crash records and segment-level AADT, which are being pursued through NDOT and city data requests. The project established a clear, data-driven framework for the SMRI grounded in literature review and available local datasets.

In another MATC Year 3 research project titled Reliable Drone Corridor Planning for Rural Transportation Systems, Dr. Shakiba Enayati and the team at University of Missouri-St. Louis focused on initiating Task 1, in the proposal. The research team conducted an initial literature review on drone corridor planning, including prior work on command-and-control (C2) connectivity, weather-driven operability, system reliability, and risk-aware routing in rural environments. This effort was aimed at identifying relevant data sources, modeling approaches, and key variables required for corridor network construction. The literature review confirmed the need for integrated approaches that jointly consider C2 connectivity, weather variability, and safety-related risk factors in corridor planning, highlighting gaps in existing transportation planning tools. The key outcome of this reporting period is the successful initiation of the project and establishment of a clear direction for developing safe and reliable drone corridor planning tools for rural transportation systems.

Dr. Jie Han and her research team began their Year 3 project at the University of Kansas. During this reporting period, they focused on reviewing existing literature on modeling geosynthetic-stabilized rigid pavement systems and determining the modulus of subgrade reaction. Experimental data were gathered from previous and ongoing projects, and two- and three-dimensional numerical models were developed to simulate system behavior. These models are being calibrated with the collected data to ensure accurate load-displacement responses for evaluating the modulus of subgrade reaction. The overall objective is to develop guidelines for estimating the modulus of subgrade reaction of geosynthetic-stabilized aggregate subbases over subgrade. Key findings include:

(1) Various approaches have been used to model geogrids in three-dimensional analyses. Structural geogrid elements captured settlement reductions of about 10%, but for multiaxial geogrids—reported to reduce settlement by up to 40%—conventional modeling was insufficient because soil-geogrid interlocking is not explicitly represented.

(2) The developed two-dimensional models were validated against Burmister's two-layer elastic solutions.
(3) While correction factors for small plate loading tests are generally applicable to homogeneous soils, their direct use in layered pavement systems may require modification.
(4) Burmister-based analysis showed that the modulus of subgrade reaction increases with subbase thickness and with greater modulus contrast between subbase and subgrade.

The research team also examined Bayesian methods for predicting freight rates through the project Decision Support for Dynamic Risks: Predicting Transportation Costs. The team evaluated dynamic Bayesian networks, Kalman filtering, and Hidden Markov Models (HMMs), focusing on initial state priors using expert-informed, uniform, empirical, Dirichlet, and logistic-normal approaches. They assessed performance using model fit and cross-validation and explored hierarchical Bayesian methods and logistic-normal priors for context-sensitive modeling. Simulations evaluated how prior-specification strategies affect performance in Viterbi decoding, forward-backward inference, and Baum-Welch estimation.

During the reporting period, this study provided new insights into geosynthetic-stabilized pavement behavior, identified limitations in current numerical modeling, and established validated tools that underscore the need for more accurate determination of the modulus of subgrade reaction.

Dr. Jian Li from the University of Kansas reported major activities in his project titled Enhancing Structural Safety in Infrastructure Maintenance through Human-Centered Bridge Inspection Empowered by Artificial Intelligence and Augmented Reality. Development during this reporting period focused on improving the inference projection method and expanding database and temporal-analysis functionality. The team explored Unity URP decal projections as an alternative to standard Unity projectors for more consistent inference anchorage on infrastructure surfaces. Decal projectors were implemented and tested, but they offered no clear advantage and were not well suited for Augmented Reality headsets such as Magic Leap 2. Despite these limitations, they were integrated into the inspection pipeline for further evaluation.

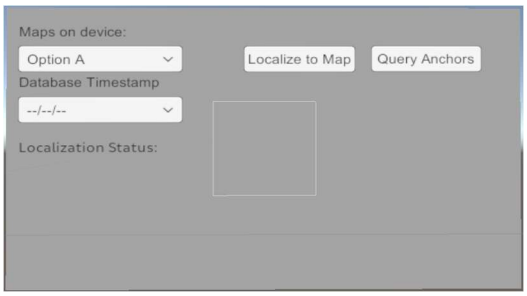


Figure 5. Development also progressed on the temporal-analysis feature using the existing SQLite database, enabling inspectors to filter and view results by date through a graphical interface. The feature is nearing completion and is being validated on the Magic Leap headset.

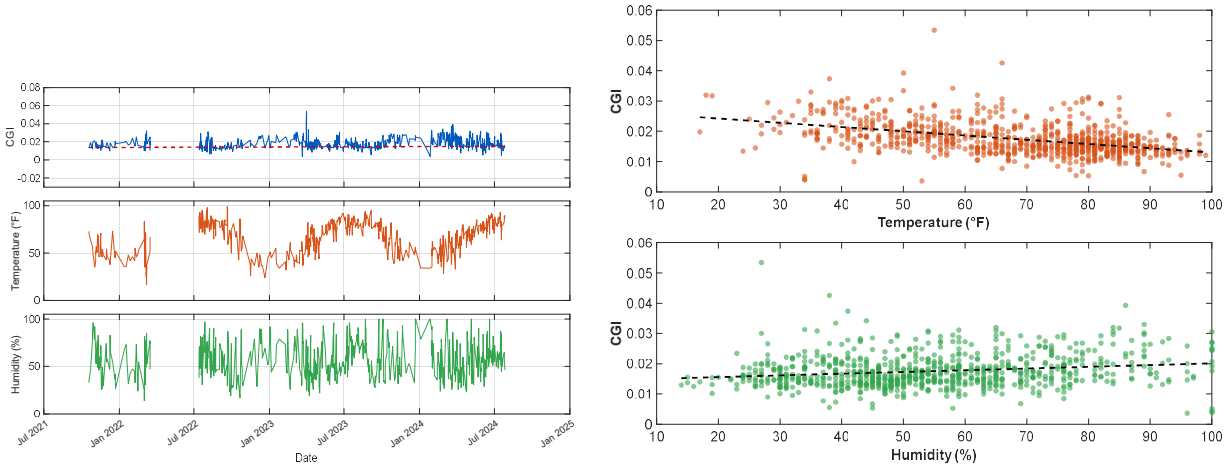
In their Year project Impact of and Compensation for Environmental Factors in Long-Term Fatigue Crack Monitoring of Steel Bridges Using Wireless Large-Area Strain Sensors, the team retrieved sensors from the bridge and collected the full monitoring dataset, including SEC and strain-gauge measurements. Python was used to collect temperature and humidity data from the nearest weather station, and MATLAB was used to synchronize these environmental records with the sensing datasets. The synchronized data was used to evaluate the crack growth index (CGI) against environmental factors. Development of the finite element model began by defining geometry, material properties, and boundary conditions to investigate temperature effects on strain behavior.

Objectives related to data collection, environmental data, and dataset synchronization were completed, and initial development of the Abaqus finite element model was initiated. Figure 2 shows the long-term

evolution of CGI with temperature and humidity. CGI remained generally stable, while temperature showed a strong seasonal trend and humidity short-term variability.

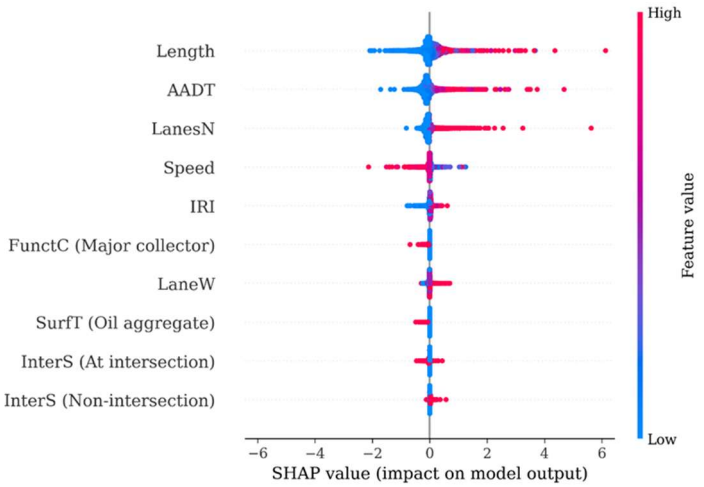
To evaluate environmental influence on SEC response, temperature and humidity were plotted against CGI, and Pearson correlation analysis was performed. Temperature showed a moderate negative correlation with CGI, while humidity showed a weak positive correlation. Preliminary development of the Abaqus model of the skewed bridge superstructure also began, including creation of girders and cross-frame members, application of boundary conditions, and girder meshing.

Overall, key outcomes included successful retrieval and analysis of wireless sensors, development of automated weather-data collection, identification of temperature as the dominant environmental influence on CGI, and initial construction of the finite element model to support future simulations of temperature-induced strain.



Dr. Jenny Liu at the University of Missouri Science & Technology leads a project titled Correlating Pavement Conditions and Traffic Accidents through AI-based Date Mining. The research team conducted Shapley Additive Explanations (SHAP)-based interpretation and analysis of the FT-Transformer (FTT) results at the statewide, all-roadway scale and further examined the SHAP outputs to understand how significant variables influence traffic crash frequency. In addition, the draft report is currently being prepared.

The work focuses on two objectives: compiling a comprehensive integrated dataset containing crash data and pavement conditions, particularly for the Midwest region, and developing machine learning algorithms for data mining and identifying correlations between traffic crashes and their key contributing factors. Figure 1 represents the SHAP summary plot of the top 10 most influential variables. Variables on the y-axis are ranked from top to bottom by overall importance. The x-axis shows the SHAP value, which represents the direction and magnitude of each variable's contribution to the model output. A positive SHAP value indicates that the variable pushes the prediction higher, whereas a negative SHAP value indicates that it lowers the prediction. Each point represents one sample, and the color denotes the feature value, with red indicating high values and blue indicating low values.



Among all variables, Length, AADT, and LanesN have the greatest influence on the model output. Higher values of these variables are generally associated with positive SHAP values, indicating that longer roadway segments, higher traffic volumes, and more lanes tend to increase predicted crash frequency. Speed also shows a strong effect but in the opposite direction: higher values are more often linked to negative SHAP values, likely reflecting differences in roadway environment rather than an isolated speed effect. IRI shows a moderate positive influence, with higher values tending to increase predicted crash frequency, indicating an association between poorer pavement conditions and traffic safety outcomes.

The remaining variables have smaller effects. LaneW shows a slight positive contribution, while FunctC (Major collector), SurfT (Oil aggregate), and InterS (At intersection) show slight negative contributions. InterS (Non-intersection) shows a weak positive effect. Overall, the results indicate that roadway scale and traffic exposure variables are the dominant predictors, with pavement condition (IRI) also having a measurable impact on crash-frequency prediction.

Education and Outreach Activities

Since 2023 MATC has implemented educational outreach programs in support of USDOT's objectives and the center's mission to increase the number of students in STEM education and transportation-related careers. During 2025, MATC programs were changed in response to directives from USDOT to comply with the various EOs. The Scholars program in its previous format has been discontinued while the format of the previous STEM summer academy (SNYLA) has been changed. The program, now called the MATC STEM Academy, is open to all students and in compliance with USDOT/EO directives. As a result of the changes, any savings are being invested in ongoing outreach efforts. Descriptions of each educational program funded by the MATC UTC program are detailed below.

MATC After-School Program - Road, Rails, and Race Cars (RRRC)

MATC's after-school program brings together the expertise of local middle school teachers, UNL undergraduate mentors, and the MATC Education and Outreach Program Manager to engage diverse young leaders in STEM learning. Designed for students in grades 6 through 8, each participating school hosts a weekly one-hour club where teachers and mentors introduce an engineering or transportation-related concept and guide students through an interactive, hands-on activity. During the reporting period, ten Lincoln (NE) middle schools (Park, Culler, Mickle, Lefler, Goodrich, Scott, Schoo, Dawes, Irving, and Pound) implemented weekly RRRC programming with support from MATC staff and materials. Across all sites, 205 students participated in 159 sessions, generating a combined 1,056 total attendees. Sixth graders represented the largest group (106 students, 51.7%), followed by seventh graders

(78 students, 38%) and eighth graders (21 students, 10.2%). Gender distribution was nearly even, with 51% female and 49% male participants. Attendance per school ranged from 43 to 205, with a median school attendance of 87.

Students were engaged in a wide range of hands-on STEM and engineering activities designed to foster creativity, collaboration, and critical thinking. These included constructing bridges and conducting strength tests (Suspension Bridges, Eureka Bridge, Popsicle Stick Bridge); creating towers to withstand simulated earthquakes (Straw Tower, Tallest Paper Tower, Wood-and-Adhesive Tower, Space Needle Tower, Noodle and Marshmallow Towers, Spaghetti Tower Challenge, Solar Updraft Tower, and Seismograph/Earthquake); building a racetrack (Road Cant); constructing levees to protect cities; designing cranes for lifting; and developing animal fencing. Students also explored motion and energy through Fan Cars, Rubber Band Cars, Balloon Cars, Edible Cars, Rockets, Helicopters, Wind Turbines, Kites, and Gliders (O-Wing, Styrofoam, and paper), as well as Craft Stick Launchers.

Creative and design-focused activities included arts and engineering, foil sculptures, balance and mobile structures, magnetic scenes, finger skateboards, paper windmills, pinwheels, and roller coasters. Additional STEM-focused activities introduced students to concepts such as time, speed, velocity, and acceleration; catapults; parachutes (including tissue-paper versions); egg drops; straw-based design; mechanical hands; articulated grabbers; sleighs and ramps; traffic maps; gears; spectroscopes; and the Bernoulli principle.

MATC STEM Academy

The MATC STEM Academy is a multi-day summer program held on the University of Nebraska-Lincoln campus. Its mission is to provide extended learning opportunities in science, technology, engineering, and math (STEM) and to help students explore postsecondary education and career options. Through mentorship from faculty, university students, and professionals, participants gain exposure to real-world STEM pathways and build connections with guest speakers who share their educational and career experiences. Hands-on activities help students identify their interests and potential career directions. Being on the UNL campus also familiarizes them with university life by allowing visits to facilities and highlighting the value of higher education. The program brings together a diverse group of high school students from across Nebraska, giving them opportunities to meet peers, share experiences, and discuss future plans. In addition to STEM learning, students develop leadership and soft skills such as teamwork, communication, public speaking, problem-solving, and decision-making.

Planning for the 2026 MATC STEM Academy started in January 2026. This involves setting up the activities for each day of the program, reservation of housing, catering plans, transportation plans, and changes to participant rules based on issues encountered during the previous STEM Academy. It also involves hiring teachers and mentors (usually undergraduate or graduate students) that help supervise the participating high school students, advertising the program in high schools and setting up the MATC Website to receive participant applications. The MATC 2026 STEM Academy is planned at the University of Nebraska-Lincoln campus from Sunday, June 7th through Thursday, June 11th , 2026. Program requirements, policies, and procedures can be found at 2026 Academy | Mid-America Transportation Center | Nebraska

The program is currently reviewing applications from high school students across Nebraska and plans to admit 30-35 participants. The program has reached out to high schools across the state to encourage more students to apply. The application process closed on April 21, 2026, and 76 students have already

applied. Established standards and selection criteria will be used to choose the final group of 30-35 students.

Activities for the 2026 STEM Academy include Civil Engineering lab activities, a visit to the Spring Creek Prairie Audubon Center, Nebraska Innovation Center activities, activities at the UNL Love Library, and a tour of the Omaha Zoo. During the program, each student will complete a pre- and post-survey to provide feedback and help with planning future STEM Academy events.

MATC Research Experience for Undergraduates (REU)
MATC continues to support academic year undergraduate research assistantships and graduate research projects. While the REU program is not offered this year, future summer research opportunities are under consideration.

How have the results been disseminated?

The MATC Program Coordinator continues to maintain individual project records in the Transportation Research Board's Research in Progress (RiP) database, the Transportation Research Information Database (TRID), and MATC's online research database at https://matc-data.unl.edu/research-database.

Across MATC projects, dissemination efforts have been robust and multi-layered, reflecting a strong commitment to technology transfer, workforce development, and sustained impact on the transportation system. All research proposals included technology transfer plans, and project teams have actively engaged in both internal and external dissemination throughout the reporting period.

Years 3 projects remain in the early stages of literature review and evidence synthesis; however, results-to-date have been regularly shared through:

- Weekly internal research meetings
- Ongoing progress discussions with research staff
- Weekly reporting to principal investigators

These structured interactions ensure continuous monitoring, collaborative problem solving, and early-stage knowledge exchange. At the University of Kansas and the University of Missouri-St. Louis, faculty integrated emerging findings into graduate courses such as Advanced Foundation Engineering, Ground Improvement, and Design with Geosynthetics, exposing students—including those not directly involved in the projects—to current MATC research.

Several Year 2 projects are nearing completion and have generated substantial dissemination activities. Dr. Song (UNL) and his team met with the project sponsor to discuss the results and agreed to continue the research to mitigate the destructive characteristics of the soils under study. This direct engagement with the sponsor reflects an important form of dissemination and collaborative decision making that supports ongoing project development.
Year 2 teams have also shared findings through national and international venues, includes:

- **ASCE Transportation Conferences** – Abstract accepted by Dr. Liang (UNL), with a journal manuscript in preparation.
- **2026 TRB Annual Meeting** – Presentation by Dr. Trilce Encarnacion (UMSL).
- **67th International Meeting of the Transportation Research Forum (2026)** – Dr. Akenroye's team (UMSL) will present their validated ISM framework.
- **2025 INFORMS Annual Meeting** – Dr. Hupman (UMSL) presented work on decision modeling with asymmetric costs.

- **2026 TRB Annual Winter Meeting** – MATC-related results presented by Dr. Kondyli (KU).

These activities demonstrate strong national visibility and engagement with the broader transportation research community.

Multiple teams from UMSL advanced dissemination through peer-reviewed publications and manuscript development:

- Haitao Li submitted and revised the paper "Quantum Bridge Analytics: A QUBO Approach to the Uncapacitated Facility Location Problem," co-authored with Kochenberger, Glover, and Henig. The paper has since been accepted by the Annals of Operations Research.
- Enayati's group prepared a manuscript based on focus group data for submission to a health policy journal and is revising another manuscript under review at the American Journal of Public Health. Graduate students contributed to data preparation and writing, supporting workforce development.

Industry and cross-sector dissemination engaged industry partners and interdisciplinary audiences:

- Li delivered an invited talk at Siemens in Saskatoon on semiconductor supply chain optimization and discussed quantum optimization collaborations with the University of Saskatchewan.
- Li also participated in the IBM Quantum Developers Conference, engaging with industry and academic experts on large-scale quantum optimization.

These interactions extend MATC's reach beyond academia into industry and applied research environments.

Enayati's team is preparing to disseminate survey-based findings through:

- Future conference presentations
- Peer-reviewed journal submissions
- A comprehensive synthesis report for public health officials, rural healthcare providers, MU Extension, and regional partners.
- Policy briefs, summary materials, and invited presentations targeting practitioners and policymakers

These efforts will ensure that findings on rural healthcare access and telehealth implementation reach decision makers and community stakeholders across Missouri.

MATC Research Webinars

No USDOT funded research webinars were hosted by MATC during this reporting period. Previously hosted webinars are uploaded to the MATC YouTube channel (https://www.youtube.com/user/MidAmericaTrans/videos) with full research briefs and presenter bios available on the MATC website (http://matc.unl.edu/webinarseries.php). Planning for future (2026) webinars is underway.

2. PARTICIPANTS & COLLABORATING ORGANIZATIONS

What organizations have been involved as partners?

During the reporting period, MATC worked with twenty-nine (29) organizations to develop and implement research, education, and technology transfer activities. Each organization and its location are listed in Table 2 along with information describing the specific area or capacity in which the respective organization is committed to supporting the center.

Table 2: MATC Partners and Type of Collaboration

MATC Program Affiliation	Organization Name	City	State	Financial	In-Kind Support	Contribution Facilities	Collaborative Research	Personnel Exchanges
All Programs	University of Nebraska-Lincoln	Lincoln	NE	X	X	X	X	X
Research	University of Missouri	Columbia	MO				X	
Research	The St. Louis Regional Freightway	St. Louis	MO				X	
Research	University of Wisconsin-Eau Claire	Eau Claire	WI				X	
Research	University of Southern California	Los Angeles	CA				X	
Research	CEMATRIX Inc.	CANADA			X		X	
Research	Tensar International Corp.	Alpharetta	GA		X		X	
Research	UMSL Bridge Program	St. Louis	MO		X			
Research	University of Missouri Extension	St. Louis	MO				X	
Research	Entanglement, Inc.	Miami	FL		X			
Research	University of Colorado-Denver	Denver	CO		X			
Research	Kansas Department of Transportation	Topeka	KS		X		X	
Research	Seatbelts Are For Everyone (SAFE)		KS				X	
Research	University of Kansas Medical Center	Kansas City	KS		X		X	
Research	University of Ulsan	SOUTH KOREA					X	
Research	IBM		NY		X		X	X
Research	Entanglement Inc.,	Denver	Co		X		X	
Research	Institution for Data Science and Informatics at UMC		MO				X	
Research	University of Saskatchewan	Canadian					X	
Research	Global Foundries	Malta	NY				X	
Research	University of Calgary	Calgary	Canada				x	
Research	Salem Senior High	Salem	MO		X		X	
Research	Grace Community Church	Salem	MO		X		X	

3. OUTPUTS

Publications, conference papers, and presentations

Journal Publications

1. Li, H., G. Kochenberger, F. Glover, R. Hennig (2026), Quantum Bridge Analytics: A QUBO Approach to the Uncapacitated Facility Location Problem, Annals of Operations Research, forthcoming.
2. Li, H. (2025), Data-Driven Optimization for Modern Urban Logistics and Transportation: Modeling Framework and Applications, Urban Lifeline, forthcoming.

3. Li, H. (2025), Integrating Simulation, Optimization and Reinforcement Learning for Large-Scale Stochastic Scheduling Problems, in Handbook of AI-Driven Scheduling and Planning: Advances, Challenges, and Industrial Applications, edited by M. Fathi, A. Dolgui, P. Pardalos and M. Khakifirooz, Springer Nature.
4. Nie, D. and Li, H. (2026), Optimizing Agri-food Supply Chain Configuration for Mitigating both Supply- and Demand-Side Risks, Agriculture and Food Security, https://rdcu.be/e8S9c
5. Gosh, K. and Li, H (2026), Quantum Optimization for the Facility Layout Problem, submitted to Scientific Reports.
6. Liang, Y., Zhang, Y., Ho, C., Min, E., Ren, K. (2026), From Access to Usage: Socio-Spatial Variation in the Provision and Condition of Urban Bicycle Infrastructure, Journal of Transport Geography, under review

Books or other non-periodical Publications

Conference Papers

1. Li, J. (2025-2026), Two research papers have been accepted by IABMAS 2026 conference.
2. Chen, H., Han, J., Parsons, R.L. (2026). Numerical Analysis of Stability of Geosynthetic-Reinforced Embankments over Aggregate Columns-Improved Soft Ground under Undrained Conditions. Abstract submitted for the 13th International Conference on Geosynthetics, Montreal, Canada, Sept. 13–17, 2026.
3. Chen, H., Han, J., Parsons, R.L. (2026). Stabilization of Slopes Subjected to Storm Surge and Rapid Drawdown with Geosynthetics and Plastic Pins. Abstract submitted for the 51st Annual Conference on Deep Foundations, Orlando, Florida, Nov. 2-5, 2026.
4. Chen, H., Han, J., and Parsons (2026). Assessment of Analytical and Numerical Methods for Stability of Embankments over Deep Mixed Columns-Improved Soft Ground under Undrained Conditions. Submitted for GeoCongress 2026, accepted.
5. Chen, H., Han, J., Parsons, R.L. (2027). Mitigation of Rainfall-Induced Surficial Slope Failure Using Geosynthetic Reinforcement. Abstract submitted for the ASCE 2027, Philadelphia, Pennsylvania, March 1-5, 2027.
6. Han, J., Chen, H., and Parsons (2026). Numerical Analysis of Stability of Embankments over Aggregate Columns-Improved Soft Ground under Linked, Undrained and Drained Conditions. Submitted for International Conference on Soil Mechanics and Geotechnical Engineering, Vienna, Austria, June 14 to 19, 2026. accepted.
7. Chen, H., Han, J., Parsons, R.L. (2026). Numerical Analysis of Stability of Geosynthetic-Reinforced Embankments over Aggregate Columns-Improved Soft Ground under Undrained Conditions. Accepted for the 13th International Conference on Geosynthetics, Montreal, Canada, Sept. 13–17, 2026. Accepted.

Seminars and Workshops

1. Han, J. gave an MyIGS Webinar Geosynthetic Solutions for Improving Road Resilience and Sustainability, International Geosynthetics Society Malaysia Chapter, January 16, 2026.
2. NICC, (2026), a poster for inclusion in the MATC display at the 2026 National Safety Summit of U.S. DOT University Transportation Center
3. The MCTI Freight Infrastructure Workshop, held on February 27, 2026 at the UMSL Entrepreneurship and Innovation Center, convened stakeholders from academia, industry, and public agencies to discuss challenges and opportunities in freight infrastructure. The workshop featured presentations

and panels on multimodal freight systems, including rail, trucking, and air cargo, with participation from MoDOT and regional industry leaders. Discussions focused on infrastructure performance, bottlenecks, and strategies to enhance system efficiency, resilience, and safety. The event facilitated cross-sector dialogue and helped strengthen partnerships aimed at advancing data-driven freight planning and investment in the St. Louis region.

Presentations

1. Li, H., (2025), Optimizing Semiconductor Supply Chain Configuration", Siemens, Saskatoon, Canada, Dec.
2. Jaramillo-Rios, J. & Encarnacion, T. (2026, January). Stakeholder perspectives on the challenges and opportunities in U.S. inland waterway transport. Paper presented at the Transportation Research Board (TRB) Annual Meeting, Washington, D.C., United States. Status: Presented. Acknowledgment of Federal support: Yes.
3. Abualshar, B., Song, C.R. (2025), ASCE-EMI: Coupled Effects of Hydrodynamic Parameters on Sediment Transport under University of Nebraska Lincoln Erosion Testing Bed Conditions.
4. Abualshar, B., Al-Nimri, B., Song, C. (2025), GeoOmaha: Bridging Hydrodynamics and Sediment Transport: Modeling Challenges in Turbulent Conditions
5. Al-Nimri, B., Abualshar, B., Song, C., Silvey, and Glenniee (2025), Evaluation of Critical Shear Strength of Soils Based on Revised CPT, 5th ICITG, 2024
6. Song, C. R., Pandy, D. R., Suh, E. L., Silvy, and Glennie (2026), Nano-Level Evaluation of Moisture Dependent Strength Degradation of Montmorillonite based on Nano-Indentation and Nano-Scratch Tests, EMI-ASCE, Boulder, Colorado, 2026
7. Song, C. R., Al-Nimri, B., Abualshar, B., Pandy, Eun, and Kim (2026), Strength Reduction and Geotechnical/Geological Condition in Nebraska and Midwestern States, EMI-ASCE, Boulder, Colorado, 2026
8. Liang, Y., (2025), Safe biking for all - A data-driven analysis considering infrastructure asset quantity and quality, ASCE Transportation Conferences, Detroit, MI, June 28-July 1

Patent Applications

Technologies or Techniques

1. Akenroye, T., ISM hierarchy diagram - Visual representation of the six-level causal structure showing relationships among thirteen factors contributing to the truck driver shortage. The diagram illustrates how regulatory barriers (Level 6) cascade through operational factors and working conditions to influence workforce outcomes (Level 1).
2. Song, C. R., The method used in this research is an innovative one that was developed throughout this research. The method is similar to a conventional CPT(Cone Penetration Testing) method, but the researchers embedded a water injection mechanism to a desired depth so that the field soils could be nearly saturated within 2 to 3 hours. After saturation, the equipment was switched back to the conventional CPT and the test was conducted obtaining the wet-drained-fully saturated strength. With this method, the field testing to obtain the "wet-drained-fully softened-strength (WDFSS)" became reliable and easier than ever. With the developed method in this research, many parties (DOT's, Academia, Research Institute, Practicing Engineers) may obtain this critical strength quickly and economically, eventually the method will contribute to building a resilient society.
3. Nam, Y., The project has developed and tested several methodological components: Semantic segmentation methods, including SegFormer-B0 and B5 pre-trained on Cityscapes, were tested to extract streetscape features from Google Street View imagery and identify built-environment factors

linked to pedestrian crash risk. An automated workflow collected GSV images from four directions at each crash location to improve completeness and support large-scale analysis. A geospatial database was then created in ArcGIS Pro by integrating pedestrian crash data, street network data, and the extracted streetscape features.

Website(s) or other Internet site(s):
The MATC website was changed to comply with the various EOs 14148, 14153, and 14154 as outlined in the program guidance issued on by USDOT on March 25, 2025. The list of changes was submitted to the USDOT. MATC intends to continue maintenance of five online sites that distribute information utilizing the internet. Metrics for the period 10/1/2025-3/31/2026 can be found below.

MATC Website
By clicking the following link, http://matc.unl.edu, you will be directed to MATC's website.

SlideShare
https://www.slideshare.net/matcRegion7UTC/presentations/.

Total Views: 436	New Uploads: 0	Downloads: 0	Favorites: 0

Facebook
https://www.facebook.com/pages/Mid-America-Transportation-Center-MATC/141238439284182.

Total Page Followers: 467	Reach: 3,915	Content Interactions: 87

X.com (Twitter)
MATC's Twitter handle is @MATCNews. The page can be viewed by clicking the following link: https://x.com/MATCNews

Total Followers: 536	Posts: 7

YouTube
MATC's YouTube feed can be viewed by clicking the following link: http://www.youtube.com/user/midamericatrans?feature=results_main.

New Videos: 0	Views: 658	Hours Watched: 23.2	New Subscribers: 4

Additional Partner Websites
MATC partners institutions were requested to ensure compliance with EOs 14148, 14153, and 14154 as outlined in the program guidance issued on March 25, 2025, by USDOT. Several MATC Principal Investigators created websites to share information about their research projects. The links to these websites are provided in Table 3 along with the corresponding MATC project.

Table 3: Websites for Individual MATC Research Projects Created by Principal Investigators

Project Title	Principal Investigator	Website Link

Development of a Real-Time Flood Forecasting System for Railroad Crossings in the Midwest	Witold Krajewski Nicolas Velasquez	https://github.com/nicolas998/network_conditioning https://github.com/nicolas998/asynch/tree/distv2
Understanding Moving/Damage Mechanism of Vehicles under Tornadoes for Enhancing Vehicle/Driver Safety	Grace Yan	http://hmcr.mst.edu/ https://sites.google.com/a/mst.edu/wham/home

4. OUTCOMES

During this reporting period, several outcomes were identified through MATC projects. At NICC, efforts focused on technology transfer, with the first three students now prepared to test for their CDL licenses. Program development and operational planning advanced expanded driver training. The team began planning new training opportunities, including driver's education courses, and research on a suitable driving range for CDL instruction. A maintenance schedule was established, and the fleet was adjusted by operating two semi-trucks with different DEF requirements. Three students from earlier instruction obtained their CDL permits, making them eligible for CDL testing. Efforts will support these students as they prepare for and complete their CDL licensing exams, further strengthening the regional transportation workforce.

Across the reporting period, the KU research team advanced transportation research, education, and workforce development. Kondyli expanded the pool of trained transportation professionals by engaging engineering students. Year 3 work improved understanding of how driver heterogeneity can be incorporated into Level 2 automated vehicle control logic. The development of a driver mental model framework and the identification of high and low-sensitivity driver groups support personalized CT/ACC models and enhance modeling techniques for automated vehicle behavior and control transitions.

In geotechnical engineering, Han conducted numerical studies providing insights into embankment stability. The parametric analysis showed that stone columns, deep mixed columns, and rigid inclusions with large size and small spacing can effectively increase the factor of safety and prevent deep-seated failure, while current design methods tend to overestimate safety. Rainfall simulation results demonstrated that effective soil strength is more suitable for surficial stability analysis, with uniform soil strength producing more realistic critical slip surfaces than Gibson soil strength. Scenarios with a groundwater table showed low safety factors, but mitigation strategies such as geosynthetic reinforcement and slope flattening proved effective. Design charts were developed for practical use. Collectively, these findings expand the body of knowledge and provide technical guidance for preventing deep-seated and surficial failures of embankments over soft clays. In Year 3, Han advanced understanding of geosynthetic-stabilized rigid pavement systems by clarifying system behavior related to modulus of subgrade reaction and layered response. The work identified limitations in current numerical modeling approaches—particularly in capturing soil-geogrid interlocking—and validated models against theoretical solutions, strengthening confidence in their use.

In transportation safety and education, Gunda analyzed Kansas teen driving skills, behaviors, and crash patterns, identifying opportunities to enhance teen driver safety and strengthen SAFE program effectiveness. The recommendations emphasized a comprehensive, multi-layered approach integrating education, behavioral interventions, enforcement, vehicle safety, and environmental strategies. In Year

3, Gunda contributed to student development and engagement. The project expanded student awareness of transportation career pathways and strengthened professional networking with industry, academic, and public-sector partners. Collaboration with the Kansas Department of Transportation increased visibility of KU research and created opportunities for partnerships and implementation of innovations.

The UMSL team made substantial progress across multiple research areas, advancing methodological development, student training, and regional engagement. Haitao Li continued computational research on large uncapacitated facility location problem (UFLP) benchmark instances using Gurobi's QUBO solver, D-Wave's hybrid quantum annealer, and the project's tabu search (TS) algorithm. Across instances with up to 250 facilities and 250 customers, the TS algorithm outperformed the other approaches in solution quality and efficiency. Year 3 experiments extended the analysis to the largest benchmark set with 500 facilities and 500 customers, where TS again produced higher-quality solutions, indicating strong potential for future hybrid TS-quantum algorithm development.

Enayati oversaw field-based research that strengthened graduate student skills in survey administration, informed consent, and engagement with rural communities. Students gained experience in data quality assurance, respondent communication, and adapting survey methods to different literacy and technology access levels. Their work produced a high-quality dataset supporting future analysis. The project also advanced methodological capabilities by integrating behavioral data with transportation and system design models. Graduate assistants gained experience formulating optimization models incorporating demand heterogeneity, spatial factors, and access constraints, contributing to new approaches for addressing healthcare access challenges in rural transportation systems. In Year 3, Enayati's team focused on foundational knowledge for integrating drone operations into rural transportation systems. A literature review clarified challenges involving command-and-control connectivity, weather variability, and safety considerations, informing upcoming modeling efforts. Training a graduate research assistant further expanded technical capacity in transportation analytics and initial modeling.

Hupman reported that project outputs will inform predictive models for decision-support tools aimed at improving transportation network cost efficiency, aligning with Year 3 progress. In workforce policy research, Akenroye completed a manuscript reframing turnover as a dependent rather than root cause, offering actionable insights for fleet managers and regulators. Finally, Encarnacion advanced dissemination and stakeholder engagement by presenting research at the 2026 Transportation Research Board Annual Meeting and hosting the MCTI Freight Infrastructure Workshop. These activities strengthened regional partnerships and supported dialogue on freight infrastructure, inland waterway resilience, and multimodal system design.

At Missouri Science & Technology, El-Adaway and Zhang jointly contributed to outcomes that strengthened understanding of work zone safety across multiple dimensions. Their work increased awareness of the top factors influencing work zone crash severity and highlighted disparities in work zone fatalities across regions, states, and Region 7 counties. These findings provided a clearer picture of the policies and actions needed to reduce severe work zone accidents and added to the body of knowledge through a comprehensive examination of accident patterns. The team also advanced the adoption of an AI-based system capable of predicting accident severity and mitigating contributing factors, while generating statistical insights that explain how accident characteristics differ across states. Collectively, these efforts support more informed decision-making and improved safety strategies for work zones.

At the University of Nebraska-Lincoln, several projects advanced workforce development, methodological innovation, and transportation safety research during this reporting period. Song oversaw fieldwork that provided graduate students with experiential learning. Through in-person survey administration, students gained hands-on experience obtaining informed consent, communicating with rural community members, and adapting procedures to literacy and technology access levels. These activities strengthened skills in data quality assurance, ethical research practices, and respondent engagement, giving students a deeper understanding of real-world data collection challenges and inclusive research design. Their efforts produced a high-quality dataset supporting subsequent analysis, and the research team plans to apply this method to transportation system design and publish findings at the 2027 TRB Annual Meeting.

Building on student development, Yuping Liang contributed to the body of knowledge by identifying gaps in literature and expanding the pool of trained transportation professionals through a graduate student. These efforts support research advancement and workforce preparation. Turning to transportation safety research, Brandon Perry reported outcomes. The literature review heightened awareness of gaps in roadside safety criteria, particularly regarding the needs of females and other underrepresented occupant groups. By identifying biomechanical, anatomical, and historical gaps in crash test protocols, the project added to the growing body of knowledge on sex-specific vulnerabilities and occupant protection. The integration of findings from historical sources—such as military ejection seat tests—alongside recent studies represents a contribution. Additionally, simulation plans and occupant configurations are advancing finite element modeling to evaluate safety criteria more inclusively. These techniques are expected to improve safety assessments across populations and inform best practices.

Finally, Kontar's Year 3 project expanded the team's understanding of available transportation datasets and their suitability for constructing composite safety indices. The literature review deepened knowledge of data-driven safety index methodologies, while the project continued to build on pavement condition data collection and processing techniques developed by the research team. This reporting period demonstrated the feasibility and repeatability of these methods, reinforcing their potential for broader application in safety analysis.

5. IMPACTS

What is the impact on the effectiveness of the transportation system?
Across the consortium, research in Years 2 and 3 collectively strengthened transportation safety, reliability, and operational performance. At KU, Kondyli advanced automated-vehicle behavior through control-transition-enabled car-following algorithms; Han improved pavement and geotechnical engineering via refined subgrade-reaction evaluation and rainfall-induced slope-stability mitigation; Li enhanced structural-health monitoring with wireless smart-sensor systems enabling earlier fatigue-crack detection. Workforce-focused efforts by Gunda and Tran expanded the SAFE program, supported targeted crash-reduction interventions, and advanced construction-zone fatality-reduction strategies.

At MS&T, Chen improved automated long-span bridge inspection, while Year 2 work by El-Adaway, Zhang, Liu, and Yan advanced work-zone safety through crash-factor identification, severity-prediction modeling, and improved pavement-management and geometric-design decision-making. Yan's tornado-vehicle safety research supported better vehicle design, emergency-system integration, and safer traffic management during extreme weather. MS&T's rural omnichannel healthcare project, led by Enayati, established empirical foundations for understanding healthcare-related travel demand and optimizing telehealth-kiosk siting.

UMSL projects strengthened economic competitiveness, safety, and supply-chain resilience. Hupman developed models addressing uncertain transportation costs; Haitao Li improved warehouse placement and demonstrated quantum-inspired optimization advantages for large-scale network design; Guo quantified benefits of improved backhaul utilization; Enayati advanced early-stage planning for rural drone freight corridors; and Encarnacion provided data-driven insights for inland-waterway infrastructure investment and policy. At UNL, Year 2 research by Liang, Perry, Song, and Zhu advanced equity analysis, acoustic bridge scanning, roadside-safety criteria, soil-strength evaluation, and inland-waterway optimization. Year 3 work by Kontar and Naveed expanded regional safety and cybersecurity capabilities through the Region VII Safety and Mobility Risk Index and analysis of highway-rail grade-crossing vulnerabilities. NICC's Safe Drivers Academy increased the number of trained and licensed drivers in rural and Tribal communities, improving roadway safety, mobility, and workforce capacity.

What is the impact on the adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company?

Across the consortium, projects demonstrate strong potential to advance safety, efficiency, equity, and data-driven decision-making in transportation systems. At UNL, research led by Liang, Perry, Song, Zhu, Kontar, and Naveed spans analysis of bicycling infrastructure, roadside-safety innovation with anticipated patent activity, development of new testing methods, direct technology transfer through a regional risk-analysis web portal, and cybersecurity frameworks for highway-rail grade crossings. These efforts support adoption of improved engineering, safety, and cybersecurity practices, with several projects laying groundwork for future commercialization or transfer to industry and government partners.

At MS&T, projects led by El-Adaway, Zhang, Liu, Chen, and Yan developed machine-learning models for improved work-zone planning, analysis tools for highway safety and pavement management, real-time detection and alert systems to enhance work-zone traffic flow, and their research may lead to weather-resilient vehicle designs and warning systems. These outcomes provide actionable tools and insights that state DOTs, emergency agencies, and manufacturers can adopt to strengthen safety and operational performance.

At UMSL, research by Hupman, Haitao Li, Guo, Encarnacion, and Enayati advances decision-support modeling for transportation planning, next-generation optimization algorithms with strong IP potential, and data-driven frameworks for integrating healthcare access into rural transportation design. These tools support more informed planning across public agencies, healthcare providers, and industry stakeholders. NICC is building foundational program capacity through staffing, curriculum development, and evaluation tools to support long-term delivery of safe-driver and CDL training programs.

At KU, projects led by Tran, Gunda, Han, Kondyli, and Jian Li provide recommended safety strategies for highway construction zones that can reduce fatalities, lower liability risks, and strengthen workforce sustainability. Additional KU research offers guidance for selecting ground-improvement and slope-stabilization methods to prevent embankment failures, promoting safe and economical use of these technologies in highway and railway systems.

What is the impact on the body of scientific knowledge?

Consortium research in Years 2 and 3 advanced scientific understanding across automated-vehicle behavior, geotechnical and pavement engineering, structural health monitoring, transportation safety, cybersecurity, and multimodal data analysis. At KU, Tran (Year 2) and Gunda (Year 2/3) strengthened behavioral and safety science through studies on construction-zone fatality reduction and teen driver risk.

Other contributions include Kondyli (Year 2) advancing Level-2 automated-vehicle modeling; Han (Year 2/3) expanding geotechnical and pavement engineering knowledge; Jian Li (Year 3) improving understanding of environmental effects on fatigue-crack indicators in steel bridges; Kontar (Year 3) at UNL advancing multimodal data-analysis methods; and Naveed (Year 3) establishing foundational cybersecurity knowledge for highway-rail grade-crossing systems. At MS&T, El-Adaway and Chen (Year 3) expanded scientific understanding of bridge-failure mechanisms and automated inspection practices.

UMSL's Year 3 research advanced operations research and logistics through the work of Hupman, Haitao Li, and Guo, who contributed predictive modeling, facility-location and safety-stock optimization, and improved understanding of backhaul integration in hub-and-spoke networks. Enayati (Year 3) established a foundational framework for drone-based rural transportation by integrating safety, reliability, communication, and environmental considerations. Collectively, these Year 2 and Year 3 efforts produced new models, empirical insights, and analytical frameworks that broaden the scientific base supporting safer, more resilient, and more efficient transportation systems.

What is the impact on transportation workforce development?
Across the consortium, Year 2 and Year 3 projects strengthened transportation workforce development by engaging students at multiple levels, integrating research into coursework, and supporting skill-building. At KU, Gunda (Year 2/3) expanded the workforce pipeline through the SAFE program and student research engagement, while Han (Year 2/3) incorporated geotechnical and pavement findings into instruction. Jian Li (Year 2/3) advanced tools to improve inspector efficiency and structural-health monitoring, and Tran (Year 2) emphasized how improved safety training and protective technologies support a more stable transportation workforce. Kondyli (Year 3) trained students in automated-vehicle safety, driver-behavior analysis, and control-transition modeling. At MS&T, El-Adaway (Year 2) advanced work-zone safety awareness, Zhang (Year 2) improved chip-seal quality-control, Liu (Year 2) trained students in data-driven pavement modeling, and Chen (Year 3) prepared MoDOT staff for automated inspection technologies, broadening participation through recruitment of underrepresented researchers.

UNL and UMSL further expanded the workforce pipeline through hands-on research, interdisciplinary training, and practitioner engagement. At UNL, Liang (Year 2) supported STEM participation through student-focused learning materials; Zhu (Year 2) trained a graduate student in infrastructure inspection and sensing; Perry (Year 2) advanced workforce understanding of roadside-safety criteria; Song (Year 2) disseminated geotechnical insights to practicing engineers; and Naveed (Year 3) trained graduate researchers in cybersecurity for transportation systems. At UMSL, Hupman (Year 2/3) trained graduate assistants in transportation systems and Bayesian modeling; Haitao Li (Year 2/3) engaged master's and PhD students and integrated research into supply-chain modeling courses; Encarnacion (Year 2) delivered a PDH-accredited freight-infrastructure workshop and trained a graduate assistant in optimization and GIS; Guo (Year 3) developed logistics optimization tools for future training; and Enayati (Year 2/3) provided interdisciplinary experience in drone-enabled transportation and rural mobility planning. Collectively, these efforts enhanced technical competencies, expanded exposure to real-world challenges, and prepared a capable transportation workforce.

6. CHANGES/PROBLEMS
Initial delay in recruiting Graduate Research Assistants for multiple projects. We are seeing some resolution with the start of several new students working on various projects during the reporting period.

7. SPECIAL REPORTING REQUIREMENTS
Nothing to report.