Semi-Annual Progress Report for University Transportation Centers

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- **Program Director (PD) Name, Title, and Contact Information**
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  Semi-annual

- **Signature of Submitting Official (signature shall be submitted in accordance with agency- specific instructions)**

  L.R. Rilett, Director, Mid-America Transportation Center

1. ACCOMPLISHMENTS

What are the major goals of the program?

The major goals of the Mid-America Transportation Center (MATC), which were outlined in the MATC proposal, are indicated in the table below. Activities related to research, education, technology transfer, and USDOT requirements are well underway. Please refer to the table below for 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 Years 1-3
Call for Problem Statements	On Schedule	100%
Request for Proposals	On Schedule	100%
Final Proposal Ranking & Selection	On Schedule	100%
Data Management Plan (DMP) - Overarching Plan for MATC	On Schedule	100%
Collect DMPs from PIs for Individual Research Projects	On Schedule	100%
Collect ORCIDs from all MATC Researchers	On Schedule	100%
Submit Project Descriptions to TRB's RiP Database	On Schedule	100%
Submit Final Research Reports	On Schedule	100%
Collect & Store Final Data in UNL Data Repository	On Schedule	100%
Education and Outreach Activities:		
Grad/Undergrad MATC Course Development & Implementation	Forthcoming	0%
MATC Undergraduate Summer Internship Program	On Schedule	100%
MATC Scholars Program	On Schedule	100%
MATC/UTC Outstanding Student of the Year	On Schedule	100%
MATC Roads, Rails, and Race Cars After-School Program	On Schedule	100%
MATC/NCIA Sovereign Native Youth STEM Leadership Academy	On Schedule	100%
MATC Summer Institute	Forthcoming	0%
MATC Research Experience for Undergraduates (REU) Program	On Schedule	100%
MATC Joint Activities with Student Chapters	On Schedule	100%
Technology Transfer Activities:		
Technology Transfer Plan – Overarching Plan for MATC (Approved October 19, 2018)	On Schedule	100%
Collect Tech Transfer Plans from PIs for Individual Research Projects	On Schedule	23%

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Technology Transfer Tech Briefs, Webinars & Presentations on Research Results	On Schedule	100%
Roadside Safety Short Course (UNL)	On Schedule	100%
Roadside Safety Workshop (UNL)	On Schedule	100%
Traffic Safety Classes (KU)	On Schedule	100%
Structural Condition Assessment Short Course (MS&T)	Forthcoming	0%
LTAP Workshop	On Schedule	100%
USDOT OST-R Reporting Requirements:		
Federal Financial Reports	On Schedule	100%
Post Research Project Descriptions on MATC Website	On Schedule	100%
UTC Program Progress Performance Reports (Semi-annually)	On Schedule	100%
Annual Performance Indicators Reports	On Schedule	100%
Additional USDOT OST-R Requirements:		
Establish and Maintain Center Website	On Schedule	100%
Directory of Key Center Personnel	On Schedule	100%
Attendance at UTC Grantees' Meetings	On Schedule	100%

What was accomplished under these goals?

<u>**Research Activities:**</u>

Several research activities were accomplished during the reporting period of April 1, 2019 – September 30, 2019. Principal Investigators (PIs) completed Data Management Plans for their individual research projects, which are in accordance with USDOT requirements and the Center's overarching plan. In June, MATC sent out the call for year 3 research proposals. Sixteen proposals have already been submitted and sent to external reviewers for feedback. MATC expects to have the remainder of the proposals submitted by November 1, 2019 and approved by the end of the year.

Throughout the reporting period, PIs submitted quarterly reports detailing the progress, activities, and outcomes of their individual research projects. MATC staff maintained project records on the Transportation Research Board's Research in Progress (RiP) database and on MATC's online database at: http://matc.unl.edu/research/research_search.php. Links to the RiP records are provided on each project page in the MATC research database.

MATC projects are committed to having a sustained impact on the transportation system through technology transfer and workforce development efforts. MATC PIs are developing Technology Transfer Plans for their individual projects to ensure transferability of their research to other regions. For example, researchers from the University of Nebraska-Lincoln are developing a virtual barrier system, vehicle containment system, and improved criterion for bridge pier column resiliency that will all become national standards.

Additionally, MATC research projects provide students with hands-on experience in their area of interest. Due in part to his work on a MATC project at the University of Nebraska-Lincoln, one master's student received the prestigious SAE fellowship for promising young engineers. As a Latino student, he helps recruit new graduate students from groups traditionally underrepresented in the transportation

field. Another student at the University of Omaha was offered an information technology internship at Werner Enterprises, a national long-haul company, in relation to his work on a MATC project.

MATC's plans for sharing research activities through upcoming workshops can be found on p. 9.

Education and Outreach Activities:

MATC has implemented several educational outreach programs in support of USDOT's Strategic Plan and the center's mission to increase the number of students from underrepresented groups in STEM education and transportation-related careers. Descriptions of each educational program and the activities that took place during April 1, 2019 – September 30, 2019 are detailed below.

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

MATC's after-school program combines the talents of 4-12th grade teachers, engineering graduate and undergraduate college and university student mentors, and professional and industry partners to educate the diverse leaders of tomorrow about STEM principles. Each participating school offers the club for an hour every week. Mentors present on an engineering or transportation-related topic and lead students in an interactive activity that encompasses the concepts of the lesson. Examples of activities include constructing bridges and conducting strength tests, creating towers that can withstand simulated earthquakes, and building race cars powered by potential energy stored in a rubber band.

During the reporting period, RRRC was implemented at a total of 10 locations in 4 cities across Nebraska. Total attendance for the 2019 spring, summer, and fall programming of the MATC RRRC program was 721 students.

Spring 2019 Programming

The spring semester portion of RRRC was implemented at ten (10) sites from January to May 2019: Culler Middle School, Dawes Middle School, Goodrich Middle School, Lefler Middle School, Mickle Middle School, Park Middle School, and Maxey Elementary School. All of these sites are located in Lincoln, NE. Additionally, RRRC is implemented at three (3) sites outside of Lincoln: Omaha Nation Public School in Macy, NE; Santee Community School in Santee, NE; and Winnebago Public School, in Winnebago, NE. In the period from April 1, 2019 to May 22, 2019 there were a total of thirty-five (35) implementation dates with total attendance being 239 by 93 unique students. The curriculum included activities under the topics of civil engineering, mechanical engineering, simple machines, renewable energy, and physics.

Summer 2019 Programming

MATC was asked by Girls' Inc. of Lincoln to provide hands-on lessons to their participants during their summer program. Girls' Inc. shares a common mission with MATC to promote STEM subjects among middle school girls. The summer portion of RRRC was implemented at one (1) site in July: the University of Nebraska-Lincoln. A total of sixteen (16) implementation dates were offered during this period with total attendance being 403 by 51 unique students. The curriculum included activities under the topics of civil engineering, traffic and railway safety, simple machines, mechanical engineering, and renewable energy with a focus on solar power.

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<u>Fall 2019 Programming</u>

The fall semester portion of RRRC is being implemented at six (6) sites: Culler Middle School, Dawes Middle School, Goodrich Middle School, Lefler Middle School, Mickle Middle School, and Park Middle School. All of these sites are located in Lincoln, NE. As of September 30, there was a total of ten (10) implementation days with total attendance being 79 by 58 unique students. The curriculum included activities under the topics of structural engineering and civil engineering.

RRRC will also be implemented at the reservation schools in Macy, Winnebago, and Santee this fall. MATC is currently coordinating with the teachers to finalize the schedule.

For the 2019 spring, summer, and fall programming, RRRC employed: one (1) Education and Outreach Coordinator, ten (10) on-site teachers, and fourteen (14) undergraduate engineering student mentors. Additional RRRC tasks completed included developing new curriculum for both semesters, daily meetings with mentors to develop strategies and track progress of the lessons and activities, and communication with mentors, teachers, CLC staff, and MATC staff. Club promotion and recruitment also took place at Culler Middle School, Omaha Nation Public School, Santee Community School, and Winnebago Public School.

MATC Scholars Program

The MATC Scholars Program is a three-day conference designed to promote graduate study among underrepresented groups and women in STEM fields, which is accomplished through targeted seminars, workshops, and networking opportunities.

The seventh MATC Scholars Program is scheduled to take place on October 16-18, 2019. The program will focus on assisting Native American students with transitioning from 2-year to 4-year degree-granting institutions. Session topics include: (1) choosing a degree program and a 4-year institution that is right for you, (2) how to apply to a 4-year institution, (3) and strategies for success. Students will also participate in a writing skills workshop to prepare personal essays for scholarship applications. Ten Native American students and professionals will serve on panels to share their success stories and answer students' questions about what to expect at a 4-year institution. Keynote speakers include Ms. Judi gaiashkibos, Executive Director of the Nebraska Commission on Indian Affairs and member of the Ponca Tribe of Nebraska; Mr. Chris Howell, Executive Director of Native American Affairs in the Kansas Office of the Governor and citizen of Pawnee Nation of Oklahoma; and Ms. Tammy Eagle Bull, President of Encompass Architects and the first female Native American architect in North American history. Students from Little Priest Tribal College in Winnebago, NE and Nebraska Indian Community College in Santee and Macy, NE are registered to attend. Additional information including the 2019 MATC Scholars Program booklet can be found at: http://matc.unl.edu/education/scholars-program-home.php.

MATC will begin planning for the 2020 Scholars Program early next year.

MATC Intern Program

The MATC Intern Program partners with private companies, local government, and academia to provide undergraduate students with paid summer internship opportunities in the transportation and engineering fields. During this 12-week program, students gain hands-on experience in their area of interest under the mentorship of a professional. Students work 40 hrs/wk while experiencing the day-to-

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day tasks and responsibilities of their desired career. The program culminates in a written paper and presentation detailing the student's internship experience.

The 2019 MATC Intern Program took place May 20-August 9. Thirteen students participated in this year's program and gained experience at one of seven sponsoring organizations: City of Lincoln, City of Omaha, Nebraska Department of Transportation, Metropolitan Area Planning Agency, JEO Consulting Group, Iteris, and Felsburg Holt & Ullevig.

The 2019 program kicked off with an orientation and luncheon on May 17. The Assistant Director of Career Services at the University of Nebraska-Lincoln spoke to the interns about office etiquette, the importance of networking, and how to maximize their internship experience. A former MATC intern and current Traffic Engineer at the City of Omaha shared his advice and professional journey with attendees.

Halfway through the summer, the interns went on a daylong technical tour of four organizations in the public and private sector of transportation engineering to gain a sense of the differences and help interns narrow their focus. Highlights of the trip include seeing how big the traffic lights and signs are up close at City of Lincoln's Traffic and Utilities Department, learning about flood recovery assistance at JEO Consulting, riding newly installed e-bikes at Metropolitan Area Planning Agency, and hearing about recent and ongoing projects at Felsburg Holt & Ullevig such as the Omaha Zoo train expansion in the new Asian Highlands exhibit.

The program culminated in a closing ceremony on August 9. Interns gave PowerPoint presentations about what they accomplished and learned over the summer to supervisors and fellow interns. To view interns' report and PowerPoint slides, visit: http://matc.unl.edu/internship/internship_success.php. MATC will start connecting with sponsors and recruiting interns in December of 2019 for the 2020 summer program.

NCIA/MATC Sovereign Native Youth STEM Leadership Academy

The Sovereign Native Youth STEM Leadership Academy is a six-day summer camp that provides Native American high school students with the leadership skills to positively impact their tribal communities and shape their futures. The academy, held on the University of Nebraska-Lincoln campus, offers a broad range of interactive, hands-on activities that expose students to science, technology, engineering, and math (STEM) and transportation-related opportunities after high school. The curriculum is developed and implemented by Native American faculty, community leaders, students, and MATC staff.

The 2019 program took place June 2-7. Attendance increased to 33 Native American high school students from 18 the previous year. Participants attended sessions on public speaking and gave a presentation at the end of the academy on an important issue in their life or community. Hands-on activities included building a boat large enough to hold several students, learning basic bike maintenance skills, and calculating speed based on stopping distance on a bicycle. The students toured the Nebraska State Capitol and spoke with Senator Tom Brewer, the first Native American to serve in Nebraska's Unicameral. They explored STEM fields at the University of Nebraska Medical Center, the Strategic Air Command & Aerospace Museum, and the Biological Systems Engineering lab at the University of Nebraska-Lincoln. Native American professionals and graduate students served on panels to share their education and career experiences with students and answer questions.

MATC collaborates with the University of Nebraska-Lincoln's Bureau of Sociological Research to conduct pre- and post-surveys and focus groups to measure how participants are being impacted by their participation in the program and to determine areas for improvement. The 2019 evaluation indicated

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that 100% of the students were interested in attending college after participating in the Academy, and 65.5% stated they were interested in beginning a career in STEM. Compared to the pre-survey, 24.3% more students indicated being very interested in transportation in the post-survey.

To view the 2019 full agenda, visit: http://matc.unl.edu/education/SNY-Leadership/2019_Program.php.

MATC is in the process of selecting dates for next year's program.

MATC Research Experience for Undergraduates (REU)

MATC selected one Native American undergraduate civil engineering student to participate in the 2019 MATC REU program. Over the summer, the student completed a pedestrian traffic study in Macy, NE. She collected data on the average daily traffic and the speed of the vehicles on Highway 77 in front of Nebraska Indian Community College (NICC) as well as video data of pedestrians crossing the highway to access the school. This data was given to NICC administration, who passed it along to the Tribal leaders to encourage them to make a change to the highway and increase safety.

The REU intern also worked on transportation safety during extreme events or hazardous material spills in rural and tribal areas. The early stages of the project were completed this summer, including contacting community leaders and presenting the project to the Nebraska Commission on Indian Affairs and the Village Chairman of Walthill, NE.

The REU intern started working with MATC as a RRRC mentor, served as a leader for the 2018 and 2019 Academy, and will serve as a panelist for the 2019 Scholars Program. Her participation with MATC's education outreach programs greatly influenced her decision to pursue graduate school. She started a master's program in Civil Engineering at the University of Nebraska-Lincoln in the fall of 2019 and continues to work on the project she started as an REU. She plans to write her thesis on this research and how to help these communities become better prepared for an extreme event or hazardous material spill in their area.

How have the results been disseminated?

All MATC activities are in the planning or implementation phases. News of MATC's activities have primarily been shared on our social media and website. MATC is currently working on an annual report that will contain information on MATC's key personnel and Advisory Board as well as research, education, and technology transfer activities. For MATC research projects that ended during the reporting period, final reports were collected and posted on MATC's website and sent to the libraries, as required by the *Grant Deliverables and Reporting Requirements for 2016 and 2018 for University Transportation Centers.*

On April 16-17, the University of Nebraska-Lincoln hosted a Roadside Safety Workshop to discuss previous and ongoing problem statement activities and identify areas that the participating states would like addressed in the upcoming year. Over 60 participants from across the U.S. were in attendance.

Since the last reporting period, MATC hosted 5 webinars as part of the 2019 MATC Spring and Fall Webinar Series. On April 29, researchers from the University of Kansas Medical Center (KUMC) shared their ongoing MATC research project. Dr. Shelley Bhattacharya, an associate professor in the Division of Geriatric Medicine and Palliative Care, introduced the project and its overall process. Dr. Abiodun Akinwuntan, the Dean of the School of Health Professions and MATC's Associate Director for KUMC, overviewed the driving simulator, and the project coordinator Ms. Iarina Devos explained recruitment

efforts. Since truck driving is the second most common occupation with over 1.7 million long-haul truck drivers, their project aims to assess truck drivers' cognitive and visual fitness while giving them the tools to improve in order to increase safety on the roadways.

On June 14, Dr. Jamilla Teixeira, a professor of Civil Engineering from the Federal University of Espírito Santo-Brazil, discussed her research focused on infrastructure materials characterization and computational modeling of composite materials. Motivated by the 1.7 million kilometers of roadway in Brazil in which a mere 12% are paved, Dr. Teixeira and her students work to improve road conditions and develop uses for the discarded slag in asphalt mixture production.

MATC spotlighted another ongoing research project at the University of Iowa on August 30. Assistant Professor Dr. Ricardo Mantilla discussed flood forecasting research including tools under development for collecting flood data such as inundation maps. Dr. Mantilla gave a live demonstration of how to use the Iowa Flood Information System developed at the Iowa Flood Center, which helps researchers communicate findings with the public. With this system, state Departments of Transportation will be able to better predict and prepare for the impact of flooding on the transportation system in their area.

MATC participated in a joint webinar series at the invitation of Tran-SET, a fellow University Transportation Center. The event highlighted several university and state DOT research projects related to "Innovative Technology, Techniques, and Processes in Transportation Infrastructure Inspection." On September 26, MATC Principal Investigator Dr. Salam Rahmatalla from the University of Iowa shared his research on producing an interactive physical-computer model for structural health monitoring of highway bridges during extreme natural events. The model will predict changes in a bridge's loading capacity and assess the integrity of the structure.

Recordings from the webinar series were uploaded to the MATC YouTube channel and are available on the MATC website at: http://matc.unl.edu/webinarseries.php. Note that we are still in the process of adding captions to Dr. Rahmatalla's recording before adding it to the website.

MATC has three additional webinars scheduled for the fall series. On October 14, Dr. Anusha S.P. will discuss a paper that was recently awarded the 2019 American Society of Civil Engineering (ASCE) Arthur M. Wellington Prize. The research was conducted as part of the Indo-US Joint Centre on Intelligent Transportation Systems Technologies (IUJC-ITST) led by the Indian Institute of Technology-Madras and the University of Nebraska-Lincoln. Dr. Anusha S.P. is currently an assistant professor at APJ Abdul Kalam Technological University in India. MATC director Dr. Laurence Rilett is a co-author on the paper.

On October 25, 2019, Daniel Murray, Senior Vice President of the American Transportation Research Institute (ATRI) will discuss ATRI's latest research as well as critical issues in the trucking industry and the impacts on carriers and consumers. Mr. Murray has more than 26 years of experience in a broad range of transportation fields including trucking research and economics, transportation safety technologies, and autonomous vehicles. He currently serves on the MATC Advisory Board.

The Fall series will close with a MATC research spotlight from the Missouri University of Science and Technology. On December 13, MATC Principal Investigator Dr. Mohamed ElGawady will highlight his research for the Center on assessing the axial capacity for corroded H-piles.

MATC is currently reaching out to affiliated researchers to participate in the upcoming 2020 Spring Webinar Series. Partner institutions and interested community members will be able to participate live

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via Zoom with audio and video feed and ask the speakers' questions via chat. All of the presentations will be posted online via SlideShare. The speakers will be recorded and shared on MATC's YouTube channel and website.

What do you plan to do during the next reporting period to accomplish the goals?

Implementation of the activities outlined in Table 1 for all research, education, technology transfer, and USDOT requirements will continue toward completion on-schedule.

MATC has several research workshops planned to share ongoing projects and products under development with state personnel and interested parties from academia and the private sector. On October 23, MATC will be co-hosting a transportation workshop with the Nebraska American Council of Engineering Companies and the Nebraska Department of Transportation to highlight the center's research.

On November 25, MATC will be hosting a workshop at the University of Nebraska-Lincoln to provide a more in-depth demonstration on the flood prediction tools developed by MATC researchers at the University of Iowa following the August webinar. The workshop will assist public sector transportation professionals with updating Nebraska flood prediction and recovery methods. Members from the Nebraska Department of Environmental Quality, Nebraska Emergency Management Agency, and American Council of Engineering Companies will be in attendance.

MATC is planning another workshop to take place in the next three months that would bring together all MATC researchers working on infrastructure projects to provide guidance on each other's projects and to communicate their progress and anticipated impacts with the wider community.

2. PARTICIPANTS & COLLABORATING ORGANIZATIONS

What organizations have been involved as partners?

During the reporting period, the Mid-America Transportation Center worked with 56 unique 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.

MATC's education programs have an especially strong history of forming strong partnerships with professionals from a wide range of disciplines across the public and private sectors. Four of the 2019 Intern Program supervisors were former MATC interns and now established professionals at City of Omaha, City of Lincoln, Iteris, and Felsburg Holt & Ullevig. These supervisors served as a testament to the value of MATC's Intern Program in providing students with a network of transportation professionals. Two former interns are now working for the organization they initially interned for while they participated in MATC's program. The other two former interns were exposed to various organizations during their internship, which helped them build connections for future employment opportunities.

MATC's partnership with the Nebraska Commission on Indian Affairs (NCIA) and tribal schools across Nebraska has led to several expansions of the STEM Academy, RRRC, and Scholars Program. Initial collaboration with NCIA on the first MATC/NCIA STEM Academy led to MATC's introduction with

UmóᴺhoᴺNation Public School, Santee Community School, and Winnebago Public School. RRRC was implemented at each of these schools following the participation of STEM teachers in the Academy. A representative from Little Priest Tribal College also served on a panel during the 2019 Academy. MATC continued collaborating with Little Priest through recent recruitment efforts for the 2019 Scholars Program. This year will be the first time Little Priest students have participated in the program.

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
Intern Program	City of Lincoln Public Works	Lincoln	NE		X	X		
Intern Program	City of Omaha Public Works	Omaha	NE		X	X		
Intern Program	Metropolitan Area Planning Agency	Omaha	NE		X	X		
Intern Program	JEO Consulting Group Inc.	Lincoln	NE		X	X		
Intern Program	Nebraska Department of Transportation	Lincoln	NE	X	X	X		
Intern Program	Felsburg Holt & Ullevig	Omaha	NE		X	X		
Intern Program	Iteris, Inc.	Lincoln	NE		X	X		
Roads, Rails, and Race Cars Program (RRRC)	Culler Middle School	Lincoln	NE		X	X		
RRRC	Lefler Middle School	Lincoln	NE		X	X		
RRRC	Mickle Middle School	Lincoln	NE		X	X		
RRRC	Goodrich Middle School	Lincoln	NE		X	X		
RRRC	Dawes Middle School	Lincoln	NE		X	X		
RRRC	Park Middle School	Lincoln	NE		X	X		
RRRC	Maxey Elementary School	Lincoln	NE		X	X		
RRRC	Girls' Inc.	Lincoln	NE	X	X		X	
Academy; RRRC	UmóᴺhoᴺNation Public School	Macy	NE	X	X	X	X	

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Program	Organization	City	State					
Academy; RRRC	Winnebago Public School	Winnebago	NE	X	X	X	X	
Academy; RRRC	Santee Community School	Santee	NE	X	X	X	X	
RRRC	Community Learning Center	Lincoln	NE				X	
Academy; RRRC	Nebraska Indian Community College	Macy	NE	X			X	
Academy	Doane University	Lincoln	NE				X	
Academy	Nebraska Writers Collective	Omaha	NE				X	
Academy	Vision Maker Media	Lincoln	NE				X	
Academy	Legal Aid of Nebraska	Lincoln	NE				X	
Academy	Creighton University	Omaha	NE				X	
All Programs	University of Nebraska-Lincoln	Lincoln	NE	X	X	X	X	X
Academy	Nebraska Commission on Indian Affairs	Lincoln	NE				X	
Academy	Union Pacific	Omaha	NE	X				
Academy	Nebraska State Legislature	Lincoln	NE	X		X	X	
Academy	University of Nebraska Medical Center	Omaha	NE	X		X		
Academy	Strategic Air Command & Aerospace Museum	Ashland	NE			X		
Academy	Indianz.com	Winnebago	NE				X	
Academy	Baylor Evnen, LLP	Lincoln	NE				X	
Academy	National Park Service	Washington D.C.					X	
Academy	Little Priest Tribal College	Winnebago	NE				X	
Academy	Trinity College	Hartford	NE				X	
All Programs	Nebraska Transportation Center	Lincoln	NE		X	X	X	X
RRRC; Academy	Lincoln Public Schools	Lincoln	NE	X			X	
Academy	Claire M. Hubbard Foundation	Omaha	NE	X				
Academy	Lincoln Bike Kitchen	Lincoln	NE	X				

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Type	Organization	City	State					
Academy	National Science Foundation	Alexandria	VA	X				
Academy	National Institutes of Health (Worlds of Connections)	Lincoln	NE	X				
Research	KUMC Research Institute	Kansas City	KS	X				
Research	Durham Buses	Kansas City	KS		X			
Research	Missouri DOT	Jefferson City	MO	X	X		X	
Research	National Institute of Standards and Technology	Gaithersburg	MD				X	
Research	U.S. Geological Survey	Rolla	MO		X	X	X	
Research	National Weather Service	Springfield	MO		X	X	X	
Research	MicroSystem Inc.	Fort Walton Beach	FL				X	
Research	Iowa Flood Center	Iowa City	IA		X	X	X	
Research	United States Army Corps of Engineers	Washington, D.C.					X	
Research	Santa Catarina State University	Florianópolis	Brazil		X			
Research	Liquid Bulk and Tank, Inc.	Omaha	NE		X	X		
Research	Nebraska State Patrol	Lincoln	NE		X	X	X	
Tech Transfer	Florida Atlantic University	Boca Raton	FL			X		
Tech Transfer	Tran-SET at Louisiana State University	Baton Rouge	LA				X	

Have other collaborators or contacts been involved?

MATC Principal Investigator Dr. George Constantinescu discussed work related to riprap design formulas with Dr. Bruce Melville at the University of Auckland.

John Woolf and Senator Jim Scheer, both of Nebraska, contributed financial support to the 2019 STEM Leadership Academy.

3. OUTPUTS

In the center's overarching Technology Transfer Plan, MATC identified three performance measures and three corresponding goals related to the outputs, or products, resulting from research and development activities. Table 3 contains a description of each performance measure, the associated goal, and the center total for the reporting period.

Table 3: Performance Measures, Goals, and Totals for MATC Outputs

	Performance Measure	Description	Goal	Center Total for April 1, 2019-Sept. 30, 2019
Output 1	Products and Processes	Quantity of new or improved processes, practices, technologies, software, training aids, or other tangible products.	Thirty (30) new products and processes by the end of the grant period.	Zero (0) MATC is on schedule to develop new and improved processes, practices, technologies, and other products by the end of the grant cycle.
Output 2	Technical Communications	Number of technical communications (journal papers, conference papers, final reports, etc.)	Fifteen (15) technical communications each year of the grant period.	Sixteen (16) During the reporting period, 3 final reports and 5 peer reviewed journal papers and 8 conference papers were published.
Output 3	Outreach Activities	Number of outreach activities (webinars, social media, workshops, newsletters, and presentations, etc.)	Fifteen (15) outreach activities for each year of the grant period.	Twenty-five (25) During the reporting period, 13 presentations and 5 webinars occurred and 7 websites and social media platforms were utilized.

Publications, conference papers, and presentations:

Journal Publications
1. Dellanbaugh, L., Kong, X., Al-Salih, H., Collins, W., Bennett, C., Li, J., and Sutley, E. (2019). Development of Distortion-induced Fatigue Crack Characterization methodology using Digital Image Correlation. Yes, acknowledgement of Federal support.

2. Yuan, F., Yan, G., Honerkamp, R., Isaac, K., Zhao, M., & Mao, X. (2019). Numerical Simulation of Laboratory Tornado Simulator that can Produce Translating Tornadoes. Journal of Wind Engineering and Industrial Aerodynamics.

3. Li, Z., Honerkamp, R., Yan, G., & Feng, R. Influence of a community of buildings on tornadic wind fields. Journal of Wind and Structures.

4. Singh, G., Esmaeilpour, M., & Ratner, A. Investigation of Combustion Properties and Soot Deposits of Various US Crude Oils. Energies 2019. Yes, acknowledgement of Federal support.

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5. Singh, G., Esmaeilpour M., & Ratner, A. Effect of carbon-based nanoparticles on the ignition, combustion, and flame characteristics of crude oil droplets. Energy 2019. Yes, acknowledgement of Federal support.

Presentations

1. Kummetha, V.C., Kondyli, A., & Schrock, S.D. Incorporating Biobehavioral Architecture into Car-Following Models. Presented at the Roadway Safety & Simulation Conference, Iowa City, IA, October 2019.

2. Collins, W. Evaluation of Digital Image Correlation for Detecting Distortion-Induced Fatigue Cracks in Steel Bridge Girders. Presentation at AISC World Steel Bridge Symposium, St. Louis, MO, April 4, 2019.

3. Al-Salih, H. Exploring the Performance of Digital Image Correlation on Complex Loading and Test Geometries. Presentation at ASCE/SEI Structures Congress, Orlando, FL, April 26, 2019.

4. Klegseth, M., Bao, Y., Fan, L., & Chen, G. Distributed Strain Measurements in a Steel-Concrete Composite Floor Beam under Multi-Point Loading at Ambient Temperature. Presented at the 9th International Conference on Structural Health Monitoring of Intelligent Infrastructure, St. Louis, MO, August 4-7, 2019.

5. Yuan, X., & Chen, G. A New Methodology of Earthquake Classification and Structural Damage Evaluation Based on Artificial Neural Networks. Poster presentation at the 9th International Conference on Structural Health Monitoring of Intelligent Infrastructure, St. Louis, MO, August 4-7, 2019.

6. Li, T., Yan, G., Yuan, F., & Chen, G. Non-stationary Characteristics of Tornadoes and Induced Dynamic Impact on a Large-span Dome Structure. Presented at 2019 Structural Congress, Orlando, FL, April 24-28, 2019.

7. Li, Y., Md., A., Karim, M.M., & Qin, R. Clustering Analysis of Crash Report Data for Identifying and Characterizing Representative Scenarios of Vehicle Crashes. Abstract presentation at 2019 INFORMS Annual Meeting, Seattle, WA, October 20-23, 2019.

8. Singh, G., Esmaeilpour, M., & Ratner, A. Effect of carbon nanoparticles on the droplet evaporation characteristics of crude oil. Western States Combustion Institute Fall 2019 meeting, Albuquerque, NM, October 14-15, 2019.

9. Singh, G., Hentges, N., Johnson, D., & Ratner, A. Experimental investigation of combustion behavior of biodiesel-water emulsion. ASME International Mechanical Engineering Congress and Exposition, November 8-14, 2019.

10. Singh, G., Lopes, E., Hentges, N., & Ratner, A. Experimental investigation of water emulsion fuel stability. ASME International Mechanical Engineering Congress and Exposition, November 8-14, 2019.

11. Nalwala, M., Nsengiyumva, G., & Kim, Y. Testing and Modelling of Polymeric Materials for Resilient Infrastructures. Poster presentation at 2019 Spring Research Fair, Lincoln, NE.

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12. Nalwala, M., Nsengiyumva, G., & Kim, Y. Assessing Impact and Blast Resilience of Polymer Coated Cementitious Materials. Poster presentation at the UNL research fair, Lincoln, NE, 2019.

13. Collins, W. Examining the Use of Digital Image Correlation for Detecting Distortion-Induced Fatigue Cracks in Steel Bridges. Third International Conference on Structural Integrity, September 2, 2019, Funchal, Madeira, Portugal.

Conference Papers
1. Al-Salih, H., Juno, M., Collins, W., Bennett, C., Li, J., & Sutley, E. (2019). Evaluation of a Digital Image Correlation Bridge Inspection Methodology on Complex Distortion-Induced Fatigue Cracking. In proceedings of Structural Integrity, 17, 682-689. Yes, acknowledges Federal support.

2. Kummetha, V. C., & Kondyli, A. Investigating the Relationship between Workload, Situation Awareness, and Driving Performance as a Function of Task Demand: A Simulator-Based Study. Transportation Research board Annual Meeting, Washington, DC, August 2019.

3. Wiklund, T., Heim, M., Halberstadt, J., Duncan, M., Mittman, D., DeAgostino, T., & Depcik, C. Design and Development of a Cost-Effective Lidar System for Transportation. In proceedings of the ASME 2019 International Mechanical Engineering congress & Exposition Conference, Salt Lake City, UT, November 8-14, 2019.

4. Flood Evacuation Planning and Routing using Deep Learning Neural Networks, presented at University of Missouri System Research Summit, June 2019.

5. Kanwar, B., Corns, S.M., Shoberg, T., & Long, S. (2019) Flood Evacuation Planning and Routing using Deep Learning Neural Networks. In proceedings of the Institute of Industrial and Systems Engineering Annual Conference, Orlando, FL, May 2019.

6. Li, T., Yan, G., Yuan, F., & Chen, G. Non-stationary Characteristics of Tornadoes and induced Dynamic Impact on a Large-span Dome Structure. 2019 Structural Congress, April 24-28.

7. Moniruzzaman, M., Yin, Z., & Qin, R. Spatial Attention Mechanism for Weakly Supervised Fire and Traffic Accident Scene Classification. In proceedings of 2019 IEEE International Conference on Smart Computing, June 2019.

8. Klegseth, M., Bao, Y., Fan, L., & Chen, G. Distributed Strain Measurements in a Steel-Concrete Composite Floor Beam under Multi-Point Loading at Ambient Temperature. In proceedings of the 9th International Conference on Structural Health Monitoring of Intelligent Infrastructure, St. Louis, August 4-7, 2019.

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

MATC maintains five online sites that distribute information utilizing the internet. Links to each site as well as report period information can be found below.

MATC Website
By clicking the following link, http://matc.unl.edu, you will be directed to MATC's website. Below is highlighted information from Google Analytics about the website's traffic from April 1, 2019 –

September 30, 2019. By understanding and capitalizing this knowledge, we are able to make our homepage engaging, relevant, and resourceful to our viewers. Since our last progress report, the total number of page views increased by 6,945.

| Visits: 15,222 | Page views: 42,578 | Pages per visit: 2.48 | Average visit duration: 01:36 |

SlideShare

The top 5 countries that viewed our Slideshare presentations during the reporting period are: the United States, Germany, Netherlands, India, and Brazil. Below is a snapshot of MATC's SlideShare activity and the link to view the page: https://www.slideshare.net/matcRegion7UTC/presentations/. MATC's SlideShare views have increased by 3,953 since the last progress report.

| Total Views: 5,569 | New Uploads: 10 | Downloads: 5 | Favorites: 2 |

Facebook

Metrics for the MATC Facebook page can be viewed below, and the page can be accessed by clicking on the following link. MATC's reach increased by 3,855 since the last reporting period. https://www.facebook.com/pages/Mid-America-Transportation-Center-MATC/141238439284182.

| Views: 315 | Total Page Likes: 379 | Reach: 5,512 | Total Countries (of Followers): 37 | Total Languages (of Followers): 17 |

Twitter

MATC's Twitter handle is @MATCNews. The page can be viewed by clicking the following link: https://twitter.com/MATCNews. The highlighted numbers for MATC's Twitter activity can be seen below. The number of tweets MATC produced increased by 43 since the last reporting period. The number of profile visits increased by 660.

| New Followers: 3 | Tweet Impressions: 25,421 | Profile Visits: 859 | Tweets: 50 |

YouTube

MATC's YouTube feed can be viewed by clicking the following link: http://www.youtube.com/user/midamericatrans?feature=results_main. MATC uploaded 14 more videos compared to the last reporting period.

| New Videos: 18 | Views: 1,074 | Minutes Watched: 2,922 |

Additional Partner Websites

Several MATC Principal Investigators created websites to share information about their research projects. The links to these websites are provided in Table 4 along with the corresponding MATC project.

Table 4: Websites for Individual MATC Research Projects Created by Principal Investigators

Project Title	Principal Investigator	Website Link
Assessing and Improving the Cognitive and Visual Driving Fitness of CDL Drivers	Dr. Shelley Bhattacharya	http://www.kumc.edu/landon-center-on-aging/research/truck-safety-study.html

Transportation Planning for Floods	Dr. Ann Melissa Campbell	http://iihr-vl01.iihr.uiowa.edu/dev/pchen18/
LIDAR, Electric Bikes, and Transportation Safety	Dr. Christopher Depcik	http://depcik.faculty.ku.edu/ebike
Real-Time Flood Forecasting for River Crossings	Dr. Witold Krajewski	http://s-iihr50.iihr.uiowa.edu/smap/demo/

4. OUTCOMES

MATC identified three performance measures and three corresponding goals related to program outcomes in the center's Technology Transfer Plan. Table 5 contains a description of each performance measure, the associated goal, and the center total for the reporting period.

Table 5: Performance Measures, Goals, and Totals for MATC Outcomes

	Performance Measure	Description	Goal	Center Total for April 1, 2019 – Sept. 30, 2019
Outcome 1	Commercialized Products	Quantity of invention disclosures, patent disclosures, patents issued, cooperative research and/or user agreements, and new business entities created.	Ten (10) products that are commercialized or in the commercialization process by end of grant period.	Zero (0)

MATC is on schedule to develop commercialized products by the end of the grant period. This process is reflected in each PI's individual tech transfer plan. |
| Outcome 2 | Output Adoption | Number of changes made to the transportation system (including regulations, legislation, standard plans, technical guides, or policy) resulting from MATC research. | Ten (10) that have been adopted or in the process of adoption by the end of grant period. | Zero (0)

MATC is on schedule to implement changes to the transportation system by the end of the grant period. |
| Outcome 3 | Product Utilization | Number of MATC products utilized (including | Forty (40) by the end of the grant period. | One-hundred thirteen (113) |

| | | | | 5 Slideshare downloads occurred. On the MATC website, 97 unique downloads of MATC research reports occurred as well as 11 unique clicks on the links to final data. |
| | citations, references, views, report downloads, and report requests). | | | |

5. IMPACTS

MATC identified three performance measures and three corresponding goals related to program impacts in the center's Technology Transfer Plan. Table 6 contains a description of each performance measure, the associated goal, and the center total for the reporting period.

Table 6: Performance Measures, Goals, and Totals for MATC Impacts

	Performance Measure	Description	Goal	Center Total for April 1, 2019-Sept. 30, 2019
Impact 1	Public Stakeholder Participation	Number of public organizations serving as sponsors of research and T2 programs.	Five (5) public sector external partners providing support to MATC activities for each year of the grant period.	Forty-six (46) MATC partnered with 46 public organizations on research, education, and technology transfer activities. See Table 2 for the complete list.
Impact 2	Private Stakeholder Participation	Number of private organizations serving as sponsors of various research and T2 programs.	Five (5) private sector external partners providing support to MATC activities for each year of the grant period.	Ten (10) MATC partnered with 10 private organizations on research, education, and technology transfer activities. See Table 2 for the complete list.
Impact 3	Transportation Professional Participation	Number of transportation professionals who participate in MATC T2 activities.	One hundred (100) transportation professionals for each year of grant period.	One-Hundred Seventy-Nine (179) 179 transportation professionals participated in MATC activities during the reporting period.

What is the impact on the effectiveness of the transportation system?

Ongoing MATC research projects will have a wide variety of impacts on the effectiveness of the transportation system. In a project led at the University of Kansas, researchers are working on completing a model that considers human biobehavioral factors such as workload, situation awareness, and level of activation by capturing bodily changes such as pupil diameters, blink frequency, gaze fixations, and heart rate. This will provide a platform to refine existing car-following models and provide key insights to how behavior affects traffic and performance. Improving the prediction capabilities of car-following models can have a significant positive impact on traffic mitigation and planning strategies as prediction models can be refined to a greater accuracy. The research could be used as a starting guideline for car-following preferences in automation. Since the sample size of the study is relatively high, the data can be used to comment on gap preferences of various drivers. Insights on driver workload and its influence on following gaps/speeds can suggest preferred thresholds for SAE level 2 and 3 of automation, where the driver still plays a key role in the vehicle.

At the Missouri University of Science & Technology, researchers are working to understand bridge behavior during a fire and how they are left vulnerable following an incident. The capability to evaluate the condition of bridges in and after fire hazards can significantly improve the safety and reduce maintenance/repair costs associated with bridge fire accidents in highway operation. The knowledge of bridge behaviors and failure mechanisms in fire hazards can facilitate the designs of bridges with improved fire resistance. In addition, the assessment of post-fire condition of bridges will support more effective and efficient implementation of repair strategies.

At the University of Nebraska-Lincoln, researchers are developing a guidance reference system that will improve driver awareness functionality in "smart" vehicles that could be used as a foundational tool in future vehicle guidance applications. Current Advanced Driver-assistance Systems (ADAS) rely on the vehicle interpreting and understanding the environment. This project represents the first scientific attempt to evaluate an externally sourced guidance and/or trilateration system for ground transportation, the impact of which would increase safety and save countless lives.

Researchers at the University of Iowa are working on making transportation of highly inflammable crude oil by rail safer. This is expected to increase the effectiveness of the transportation system by preventing fires resulting from crude oil train derailments, which in the past have caused several fatalities and serious damage to property and infrastructure.

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?

There is nothing to report yet on the center's impact on the adoption of new practices or instances where research outcomes have led to the initiation of a start-up company. MATC PIs are required to develop a Technology Transfer Plan for their individual project in accordance with the center's overarching plan and USDOT requirements. The process of implementing each project's research outcomes is reflected in these plans.

What is the impact on the body of scientific knowledge?

MATC's current and ongoing transportation research will have a wide variety of safety-related impacts on the current body of scientific knowledge. In the University of Iowa crude oil project previously

mentioned in section one the impact on the transportation system, splashing and associated fluid behavior is expected to impact the science behind combustion and ignition of crude oil and other organic solvents. Modifying crude oil properties by additives to change viscosity and thereby drag is of great interest in the discipline of crude oil transportation by pipeline. Finding optimum concentrations of additives at which combustion and splashing substitutes are most stable would save costs during eventual industry technology implementation.

At the Missouri University of Science & Technology, researchers are working to produce a high-fidelity CFD model to obtain the wind pressure distribution on girder bridges induced by tornadoes. Additionally, a modified equation for calculating the design wind pressure towards tornado-resistance design for bridges will be developed. The obtained design tornadic wind loads can be used to evaluate the vulnerability of existing bridges, and to develop a reinforcing strategy for existing bridges to achieve a continuous load path. This research will eventually advance the design theory of highway or railroad bridges based on the in-depth understanding of tornadic wind effects. This research has informed the implementation of a new graduate course related to wind engineering that will be used to train structural engineering students to design tornado-resistant structures.

At the University of Nebraska-Lincoln, researchers are conducting a study to improve the resiliency and robustness of bridge pier columns in the event of intentional or accidental vehicle collision coupled with a possible event, such as an explosion. The overall purpose is to produce material properties of concrete subjected to blast and/or impact. The material properties can be used to evaluate the effects of polymeric materials for retrofitted concrete structures by conducting numerical model simulations and experimentally characterizing contribution of retrofitting techniques to impact and blast resilience of concrete. Using polymeric materials such as polyurea is an attractive option that can retrofit existing bridge piers to improve their impact and blast resilience. Experimental testing for adhesion, impact, and blast resistance in a controlled laboratory environment can produce materials properties to simulate behavior of larger structures such as bridge piers under collision and blast loads.

What is the impact on transportation workforce development?

MATC's research and education activities play a vital role in inspiring and preparing students to become future professionals of the transportation workforce. The MATC Scholars Program, STEM Academy, Intern Program, and After-School Program are designed to increase access and retain students from underrepresented groups in STEM and transportation-related degree granting programs and careers. MATC research projects provide graduate students with the opportunity to gain hands-on research experience in the field of transportation. The interdisciplinary projects completed during program activities bolstered students' conceptual and practical skills in STEM subjects. Students were encouraged to reconfigure their expectations of STEM subjects and perceived barriers and extend their interest beyond classroom experiences.

6. CHANGES/PROBLEMS

Nothing to report.

7. SPECIAL REPORTING REQUIREMENTS

Nothing to report.

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