

Semi-Annual Progress Report for University Transportation Centers



- **Federal Agency and Organization Element to which Report is Submitted**
United States Department of Transportation, Office of the Assistant Secretary for Research and Technology
- **Federal Grant or Other Identifying Number Assigned by Agency**
69A3551747107
- **Project Title**
University Transportation Centers Open Competition 2016
- **Program Director (PD) Name, Title, and Contact Information**
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- **Submission Date**
April 30, 2020
- **DUNS and EIN Numbers**
DUNS: 55-545-6995
EIN: 47-0049123
- **Recipient Organization**
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- **Recipient Identifying Number or Account Number**
25-1121-0005-001
- **Project/Grant Period**
December 5, 2016 – September 30, 2022
- **Reporting Period End Date**
March 31, 2020
- **Report Term or Frequency (annual, semi-annual, quarterly, other)**
Semi-annual
- **Signature of Submitting Official (signature shall be submitted in accordance with agency- specific instructions)**

A handwritten signature in black ink, appearing to read "L.R. Rilett", is written over a horizontal line.

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	74%
Collect ORCIDs from all MATC Researchers	On Schedule	100%
Submit Project Descriptions to TRB's RiP Database	On Schedule	88%
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	20%
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	30%

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)	On Schedule	20%
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?

Research Activities:

Although hindered as of late by the COVID-19 Pandemic, all research activities have continued and the following research activities were accomplished during the reporting period of October 1, 2019 – March 31, 2020.

Principal Investigators (PIs) either submitted or are in the process of completing Data Management Plans for their individual research projects, which are in accordance with USDOT requirements and the Center’s overarching plan.

In December, MATC sent out the call for internal research proposals. Four (4) UNL MATC research projects were reviewed by an External Review Committee and approved. These projects are in addition to the sixteen (16) projects approved the by the MATC Executive Committee in June 2019.

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, recent Technology Transfer plans include projects focusing on infrastructure inspections during and after unexpected events, and protecting critical civil infrastructure against impact from commercial vehicles.

MATC's plans for sharing research activities through upcoming workshops can be found on p. 7.

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 October 1, 2019 – March 31, 2020 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 9 locations in 4 cities across Nebraska. Total attendance for Fall 2019 and Spring 2020 was 732 by 216 unique students.

Fall 2019 Programming

The fall semester portion of RRRC was implemented at six (6) sites in Lincoln, NE: Culler Middle School, Dawes Middle School, Goodrich Middle School, Lefler Middle School, Mickle Middle School, and Park Middle School. Between October 1, 2019 and December 19, 2019, there were a total of sixty-five (65) implementation days with total attendance being 379 by 106 unique students. The curriculum included activities under the topics of structural engineering, civil engineering, and mechanical engineering.

RRRC was also implemented at reservation schools in Macy and Winnebago, NE during Fall 2019. In the period reported, RRRC was offered at Omaha Nation Public School in Macy a total of five (5) implementation days with total attendance being 36 by 20 unique students. At Winnebago Public School in Winnebago, there were a total of three (3) implementation days with total attendance being 9 by 6 students. The curriculum included activities under the topics of structural engineering, civil engineering, and mechanical engineering.

For the Fall 2019 programming, RRRC employed: one (1) Education and Outreach Coordinator, eight (8) on-site teachers, and nine (9) undergraduate engineering student mentors. Additional RRRC tasks completed included developing new curriculum, 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.

Spring 2020 Programming

The spring semester portion of RRRC was implemented at five (5) sites in Lincoln, NE: Culler Middle School, Goodrich Middle School, Lefler Middle School, Mickle Middle School, and Park Middle School. From January 7 to March 6, 2020, there were a total of twenty-seven (27) implementation days with total attendance being 218 by 51 unique students. The curriculum included activities under the topics of

mechanical engineering, civil engineering, and aeronautical engineering. On March 10, 2020, Lincoln Public Schools announced a closure of after-school activities in response to the Covid-19 pandemic.

RRRC was also implemented at the reservation schools in Macy, Winnebago, and Santee this spring. In the period reported, RRRC was offered at Omaha Nation Public School in Macy a total of ten (10) implementation days with total attendance being 73 by 21 unique students. At Winnebago Public School in Winnebago, there were a total of five (5) implementation days with total attendance being 12 by 7 unique students. At Santee Community School there was a total of one (1) implementation dates, with total attendance being 5 by 5 unique students. The curriculum included activities under the topics of structural engineering, civil engineering, and mechanical engineering. During the week of March 9 - 13, 2020, it each school announced a closure of after-school activities in response to the Covid-19 pandemic.

For the Spring 2020 programming, RRRC employed: one (1) Education and Outreach Coordinator, eight (8) on-site teachers, and ten (10) undergraduate engineering student mentors. Additional RRRC tasks completed included developing new curriculum, updating the MATC online curriculum database, 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.

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 was held October 16-18, 2019. The program focused on assisting Native American students with transitioning from 2-year to 4-year degree-granting institutions. Session topics included: (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 participated in a writing skills workshop to prepare personal essays for scholarship applications. Ten Native American students and professionals served on panels to share their success stories and answer students' questions about what to expect at a 4-year institution. Keynote speakers included 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 attended. Additional information including the 2019 MATC Scholars Program booklet can be found at: <http://matc.unl.edu/education/scholars-program-home.php>.

MATC began planning for two (2) 2020 Scholars Programs. One (1) Scholars Program is being planned to focus on Historically Black Colleges and Universities (HBCU); date to be determined. Additionally, the 8th Annual Native American Scholars Program in October 2020 is being planned.

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

MATC began connecting with sponsors and recruiting interns in December of 2019 for the 2020 summer program. UNL received nine (9) student applications. Initially, UNL received five (5) external sponsor applications to host Summer 2020 Interns however, due to the COVID-19 pandemic, all external sponsors have withdrawn their ability to host interns. Discussions are currently underway between MATC UNL Faculty to determine if the university will be able to support the qualifying student applicants.

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.

MATC was planning to hold the 2020 academy for the period May 31, 2020 – June 5, 2020. Due to the COVID-19 pandemic, MATC Faculty and the MATC Education and Outreach Coordinator are discussing virtual academy options for Summer 2020.

MATC Research Experience for Undergraduates (REU)

MATC is reviewing undergraduate options to support a Summer 2020 MATC REU student.

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. 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*.

Since the last reporting period, MATC hosted three (3) webinars. On October 14, 2019, Dr. Anusha S.P. discussed 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) discussed 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 closed with a MATC research spotlight from the Missouri University of Science and Technology. On December 13, 2019, MATC Principal Investigator Dr. Mohamed ElGawady highlighted his research for the Center on assessing the axial capacity for corroded H-piles.

MATC also hosted two (2) research workshops to share ongoing projects and products under development with state personnel and interested parties from academia and the private sector.

On October 23, 2019, MATC co-hosted 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, 2019, MATC hosted a workshop at the University of Nebraska-Lincoln to provide an in-depth demonstration on the flood prediction tools developed by MATC researchers at the University of Iowa. The workshop allowed public sector transportation professionals to update attendees on Nebraska flood prediction and recovery methods. Members from the Nebraska Department of Environmental Quality, Nebraska Emergency Management Agency, and American Council of Engineering Companies were in attendance.

On February 21, 2020, MATC hosted an Infrastructure workshop to provide to provide an in-depth demonstration of three key areas of Infrastructure-related research being conducted by MATC researchers at UNL, MS&T, University of Iowa, and the University of Kansas. Session I of the workshop focused on Infrastructure Design, Inspection, and Maintenance & Repair; Session II focused on New Technologies and; Session III focused on Infrastructure Inspection & Design for Various Loading Conditions. Members from the Nebraska Department of Transportation, Virginia Department of Transportation, Utah Department of Transportation, and the Ontario Good Roads Association were in attendance, either virtually or in person.

Recordings from the webinar and workshop series were uploaded to the MATC YouTube channel and are available on the MATC website at: <http://matc.unl.edu/webinarseries.php>.

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.

On April 24, 2020, MATC is planning to host a webinar with the U.S. Army Engineer Research and Development Center (ERSC). Dr. Catherine Stephens will discuss the development of the Barrier Damage Assessment Module which aims to predict the effects of a VBIED on common protective barriers including precast concrete and soil-filled barriers. Mr. Bowen Woodson will discuss research being done to develop and demonstrate friction-based, expedient vehicle barriers to resist the penetration of large vehicles in urban environments.

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

The Covid-19 pandemic has curtailed on campus-activities at all MATC consortium schools. Research continued remotely at all universities. Approximately six of our projects, that required laboratory work, were delayed by the Covid-19 pandemic. However, researchers were able to continue data analyses remotely. Our summer outreach programs, including the MATC Summer Institute, the NCIA/MATC Sovereign Native Youth STEM Leadership Academy, and the MATC Intern Program will be held remotely. A decision on whether to postpone the MATC Scholars Program from fall 2020 to Spring 2021 will be made shortly.

2. PARTICIPANTS & COLLABORATING ORGANIZATIONS

What organizations have been involved as partners?

During the reporting period, the Mid-America Transportation Center worked with 42 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. 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 Umo^Nho^N Nation 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 recruitment efforts for the 2019 Scholars Program. This year will be the first time Little Priest students 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
All Programs	University of Nebraska-Lincoln	Lincoln	NE	X	X	X	X	X
All Programs	Nebraska Transportation Center	Lincoln	NE		X	X	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	Umó ^N ho ^N Nation Public School	Macy	NE	X	X	X	X	
RRRC	Community Learning Center	Lincoln	NE				X	
RRRC; Academy	Lincoln Public Schools	Lincoln	NE	X			X	
RRRC; Academy	Winnebago Public School	Winnebago	NE	X	X	X	X	
RRRC; Academy	Santee Community School	Santee	NE	X	X	X	X	
RRRC; Academy	Nebraska Indian Community College	Macy	NE	X			X	
Academy	Union Pacific	Omaha	NE	X				
Academy	University of Nebraska Medical Center	Omaha	NE	X		X		
Academy	Little Priest Tribal College	Winnebago	NE				X	
Academy	Claire M. Hubbard Foundation	Omaha	NE	X				
Academy	Lincoln Bike Kitchen	Lincoln	NE	X				
Academy	National Institutes of Health (Worlds of Connections)	Lincoln	NE	X				
Academy; Scholars	Nebraska Commission on Indian Affairs	Lincoln	NE				X	
Scholars	Encompas Architects, P.C.	Lincoln	NE				X	
Scholars	Kansas Office of the Governor	Topeka	KS			X		
Intern Program	City of Lincoln Public Works	Lincoln	NE		X	X		
Intern Program	City of Omaha Public Works	Omaha	NE		X	X		
Intern Program	Nebraska Department of Transportation	Lincoln	NE	X	X	X		
Intern Program	Felsburg Holt & Ullevig	Omaha	NE		X	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	Marshall University	Marshalltown	WV		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. Shelley Bhattacharya of KUMC continues to partner with the Kansas Department of Transportation and Kansas Department of Health and Environment to work with trucking companies to recruit subjects. Subsequently, KUMC partners with a KUMC affiliated facility, State Avenue University of Kansas location, where CDL drivers are seen for their DOT physicals. Additional funding received from the KUMC Research Institute enabled the group to increase participant support payments from \$25 to \$50 per visit. In an effort to continue to increase visibility of the MATC-KUMC study, Dr. Bhattacharya has learned that the Kansas City and Iowa DOTs would like to collaborate. Collaborative discussions have been initiated.

MATC Principal Investigator Dr. Christopher Depcik of KU began discussions with a faculty member from Wichita State University for a potential collaboration on the next generation of the 3-D lidar system and will be investigating what it will take to properly post-process the point cloud data.

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 October 1, 2019-March 31, 2020
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.	Twenty-two (22) During the reporting period, 10 final reports and 9 peer reviewed journal papers and 3 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.	Eighteen (18) During the reporting period, 6 presentations, 3 webinars, and 2 workshops occurred; 7 websites and social media platforms were utilized.

Publications, conference papers, and presentations:

Journal Publications

1. Fang, C., Yosef, T.Y., Linzell, D.G, Rasmussen, J.D., “Computational Modeling and Simulation of Isolated Highway Bridge Columns Subjected to Vehicle Collision and Air Blast”, Ready for submission.
2. Fang, C., Yosef, T.Y., Linzell, D.G, Rasmussen, J.D., “Performance of Isolated Highway Bridge Columns Subjected to Vehicle Collision and Air Blast”, Manuscript in preparation.
3. Fang, C., Yosef, T.Y., Linzell, D.G., Rasmussen, J.D., (2019 draft produced). “Residual Axial Capacity Estimates for Bridge Columns Subjected to Vehicle Collision and Air Blast”. Manuscript in preparation.
4. Fang, C., Yosef, T.Y., Rasmussen, J.D., Linzell, D.G., (2019 draft produced). “Numerical Investigation of FRP-Coating Effectiveness for RC Bridge Column under Vehicle Collision and Air Blast”. Manuscript in preparation.

5. Kummetha, V. C., A. Kondyli, E. G. Chryssikou, and S. D. Schrock. "Gaze-based Safety Analysis of Work Zone Configurations with respect to Driver Characteristics – A Driving Simulator Study." *Accident Analysis & Prevention*, January 2020.
6. Kummetha, V. C. and A. Kondyli. "Evaluating Driver Comprehension in Complex Environments by Using Fixation Duration and Probe-Questions" *Frontiers in Psychology*, February 2020.
7. Singh G, Esmaeilpour M, Ratner A. Effect of carbon-based nanoparticles on the ignition, combustion and flame characteristics of crude oil droplets. *Energy*, 2019. Elsevier (in press).
8. Singh G, Esmaeilpour M, Ratner A. Effect of polymeric additives on ignition, combustion and flame characteristics and soot deposits of crude oil droplets. *Fuel*, 2019. Elsevier (under review).
9. Wu, H., Zen, J. and Constantinescu, G. (2020). A multiparameter design formula for riprap size selection at wing-wall abutments, *Journal Hydraulic Research*, under review.

Presentations

1. Fang, C., Linzell, D.G., Kim, Y.R., Rasmussen, J.D., (2020). "Numerical Simulation of Isolated Highway Bridge Columns Subjected to Vehicle Collision and Air Blast". Presented at the TRB 99th Annual Conference (2020), Roadside Safety Design Computational Mechanics Subcommittee (AFB20(1)), Washington, D.C., January 2020.
2. Fang, C., Linzell, D.G., Kim, Y.R., Rasmussen, J.D., (2019). "Protecting Critical Civil Infrastructure Against Impact from Commercial Vehicles". Presented at the ASCE Nebraska & Nebraska Department of Transportation Partnership Conference, Lincoln, Nebraska, October 2019.
3. Fang, C., Linzell, D.G., (2018). "Numerical Simulation of RC Bridge Columns under Combined Vehicle Impact and Blast". Presented at Structures Congress 2018, Fort Worth, Texas, April 2018.
4. Singh G, Hentges N, Johnson D, Ratner A. Experimental investigation of combustion behavior of biodiesel-water emulsion. ASME. ASME International Mechanical Engineering Congress and Exposition. November 8 – 14, 2019.
5. Singh G, Lopes E, Hentges N, Ratner A. Experimental investigation of water emulsion fuel stability. ASME. ASME International Mechanical Engineering Congress and Exposition. November 8 – 14, 2019.
6. Theodore Wiklund, Mark Heim, Jaret Halberstadt, Michael Duncan, Deven Mittman, Thomas, DeAgostino, and Christopher Depcik; Design and Implementation of a Cost-Effective Lidar System for Transportation; IMECE2019-11279; Presented at IMECE in November. Doi: 10.1115/IMECE2019-11279.

Conference Papers

1. N. Akula, J. Urrutia, H. Khatri¹, M. Anusha, J. Grothe, S. Medcalf, A. Yoder, D. Ghersi, C. Achuthan, A. Fruhling, University of Nebraska at Omaha, University of Nebraska Medical Center, Lessons Learned from Designing a Health Monitoring System to Improve First Responders Safety User Interface, Poster Presentation, UNO annual Student Activity and Research Fair, March 6, 2020.
2. Fang, C., Linzell, D.G., Rasmussen, J.D., Tewodros, Y.Y., (2020). "Resiliency of Reinforced Concrete Bridge Frame Piers Subjected to Combined Vehicle Collision and Air Blast". Proceeding of 6th International Conference on Protective Structures (ICPS6), 10 – 13 May 2020, Auburn University.
3. Medcalf, S., Hale, ML, Achutan, C., Yoder, AM, Shearer, S., Fruhling, A. Requirements Gathering through Focus Groups for A Real-Time Emergency Communication System for Hazmat Incidents (Reach), Transportation Research Board (TRB) 99th Annual Meeting. Poster presentation.

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 October 1, 2019 – March 31, 2020. 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 site visits decreased by 2,520.

Visits: 12,702	Page views: 24,751	Pages per visit: 1.95	Average visit duration: 01:01
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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 decreased by 2,987 since the last progress report.

Total Views: 2,582	New Uploads: 16	Downloads: 0	Favorites: 0
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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 decreased by 3,185 since the last reporting period. <https://www.facebook.com/pages/Mid-America-Transportation-Center-MATC/141238439284182>.

Views: 573	Total Page Likes: 385	Reach: 2,327	Total Countries (of Followers): 37	Total Languages (of Followers): 15
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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 decreased by 34 since the last reporting period. The number of profile visits decreased by 660.

New Followers: 4	Tweet Impressions: 15,630	Profile Visits: 199	Tweets: 16
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YouTube

MATC’s YouTube feed can be viewed by clicking the following link: http://www.youtube.com/user/midamericatrans?feature=results_main. MATC uploaded 3 more videos compared to the last reporting period.

New Videos: 21	Views: 1,280	Minutes Watched: 3,834
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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://ihr-vl01.ihr.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-ihr50.ihr.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 October 1, 2019 – March 31, 2020
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 citations, references, views, report downloads, and report requests).	Forty (40) by the end of the grant period.	One-hundred thirteen (113) Including unique downloads of MATC research reports and unique clicks on the links to final data.
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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 October 1, 2019 – March 31, 2020
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.	Thirty-two (32) MATC partnered with 32 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 Sixty-Nine (169) 169 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, the 2-D lidar device could be a reliable way to detect unnoticed vehicles that can reduce the number of collisions. The third generation system has enough computing power that it could effectively give information in a timely manner and for a reasonable cost. It could be implemented on more than just bicycles, any vehicle with large blind spots (e.g., semi-trucks) could benefit from lidar to identify if an obstacle exists and how far away it is. The 3-D lidar system has the potential to map and keep track of road defects or structural damage on bridges and elevated roads. This information can be used to identify problem areas and decide when repairs are necessary before the roads become unsafe. With faster processing power, the system could potentially be mounted onto a mobile vehicle to map large sections of road at a time or monitor traffic.

At the Missouri University of Science & Technology, the proposed project will result in a series of tools and protocols based on deep learning methods. These materials will promote safety and economic viability of the surface roadways by providing real-time processes for flood control and driver rerouting schemas. These processes are data driven and use geospatial data and information to fully model areas categorized as high risk for flooding.

At the University of Nebraska-Lincoln, the biggest impact will be the tank-trailer model that will be used further for simulation in LS-DYNA, which will help to design a new roadside containment barrier for tractor-tank trailer vehicles. Upon successful completion, the new barrier could be used to mitigate the effects of hazardous crash events from tank trailers carrying hazardous materials. The tank model could also be used by other transportation agencies to study other topics related to tank trailer vehicles.

Researchers at the University of Iowa, this research will result in 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 Kansas, 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 (classes of 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 driver still plays a key role in the vehicle).

At the Missouri University of Science & Technology, this project will help understand how this new autonomous driving technology will perform, interact and impact the general transportation systems.

At the University of Nebraska-Lincoln, all existing ADAS systems rely on the vehicle interpreting and understanding the environment. No existing ADAS systems reference external markers nor obtain guidance or road profile data from external databases. Thus, this project represents the first scientific attempt to evaluate an externally-source guidance and/or trilateration system for ground transportation.

At the University of Iowa, we will work with the Transportation Research Board (TRB) committees related to bridges (e.g., TRB-AFB60) and FHWA such that the main findings and the improved formulas will be published as a Technical Brief of HEC-23. Once adopted by state and federal agencies in charge of maintaining operational our bridges, the present research will increase the efficiency of scour protection measures at two main types of abutments used especially for small bridges in the US. It will also decrease the costs associated with maintaining such bridges operational after flooding events (e.g., if the flood protection measure is not effective part of the abutment can be washed away during the flood and needs to be reconstructed, a procedure that involves large costs). The present procedure based on 3D simulations can be extended to other types of abutments and also to bridge piers of complex shape, or to cases when erosion at the abutment is due to more than one factor (e.g., there is a component associated with channel curvature in the vicinity of the abutment, or pressure scour effects are important if the bridge deck becomes submerged during the flood event). Such cases are not covered by existing design formulas which are mostly based on experiments conducted in straight channels. In the long term, the present procedure to estimate potential for erosion can provide a reliable approach to generate data needed to calibrate riprap design formulas which will complement and partially replace expensive scaled model studies conducted in the laboratory. Given that detailed information on the flow fields, turbulence and their effects on the bed shear stress distributions are available from these simulations, the present approach can lead to incorporating more physics into existing design formulas and proposing new design formulas for protection against local scour at hydraulic structures. More reliable design formulas for protection of bridges abutments against erosion will result in significant reduction of costs to maintain roads operational during and after flood events. It will also avoid structural failure of some of the bridges and thus reduce risk for hazard associated with bridge failure during floods

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

The Covid-19 has impacted negatively the operations of all MATC institutions. Essentially all universities are closed except for essential services. Consequently, all MATC research and outreach activities are being conducted remotely.

With respect to research approximately six of our projects, that required laboratory work, were delayed by the Covid-19 pandemic. It is anticipated that the laboratories will reopen within the next month. MATC researchers will continue their work remotely, as appropriate.

Our summer outreach programs, including the MATC Summer Institute, the NCIA/MATC Sovereign Native Youth STEM Leadership Academy, and the MATC Intern Program will be held remotely. However, this will impact negatively the efficacy of these programs. At this time it is unclear what the overall effect on attendance/participation will be although we are expecting a significant drop in participation. A decision on whether to postpone the MATC Scholars Program from Fall 2020 to Spring 2021 will be made in the coming months.

7. SPECIAL REPORTING REQUIREMENTS

Nothing to report.