Program Progress Performance Report for University Transportation Centers

- **Federal Agency and Organization Element to which Report is Submitted**
  United States Department of Transportation, Research and Innovative Technology Administration

- **Federal Grant or Other Identifying Number Assigned by Agency**
  DTRT12-G-UTC07

- **Project Title**:
  Mid-America Transportation Center: Region 7 UTC

- **Program Director (PD) Name, Title, and Contact Information**
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- **Recipient Organization**
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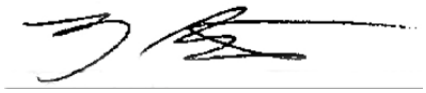
- **Report Term or Frequency (annual, semi-annual, quarterly, other)**
  Other (first six months of grant period)

- **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 and objectives of the program?

The following is a list of the major goals and objectives that were outlined in the MATC Proposal and highlighted at the US DOT RITA site visit on April 12th, 2012.

Research Program		Status	% Complete
	Call for Problem Statements	Complete	100%
	Request for Proposals	Complete	100%
	Proposals under External Review (US DOT Reviewer, SHRP II Coordination, US DOT Thematic Goal Alignment)	Complete	100%
	Review Budgets and for Duplication with Region 5 & 6 UTC Research Programs	Complete	100%
	Final Proposal Ranking & Selection	Complete	100%
	Research Projects under Contract	On Schedule	95%
	Technology Transfer Tech Briefs, Webinars, & Presentations on Research Results	On Schedule	5%
	Applicable Slides, Handouts, Videos, Podcasts, etc. Posted/Linked on MATC Website & US DOT RITA Research Hub	On Schedule	5%
	Final Reports Due & All Research Projects Complete	Forthcoming	0%
Leadership Activities			
	Coordination with Region 7 UTC Directors	Complete	100%
	Regional Successes & Lessons Learned Workshop	On Schedule	15%
Educational Activities			
	Grad/Undergrad MATC Course Development & Implementation	On Schedule	25%
	MATC Supported Certificate Programs in Transportation	On Schedule	25%
	MATC Undergraduate Summer Internship Program (Summers 2012 & 2013)	On Schedule	70 % YR 1
	MATC Transportation Scholars Program: Graduate Seminar Course	On Schedule	25%
	MATC Transportation Scholars Conference	On Schedule	15%
	MATC/CUTC Student of the Year Program - Annually @ TRB	Forthcoming	0%
	MATC Summer Institute (Summers 2012 & 2013)	On Schedule	70% YR 1
	MATC After School Program (Summers 2012 & 2013)	On Schedule	33% YR 1
	MATC Support of "GO/Vamos!" Online K-12 Publication	On Schedule	25%
	MATC Transportation Student Chapter (ITE/ASCE/Etc.) related activities	On Schedule	25%
	Underrepresented Student MATC Summer Intern Program (Summers 2012 & 2013)	On Schedule	55%
	MATC Scholars Program for Underrepresented Students (October 2012)	On Schedule	33%
Technology Transfer Activities			
	MATC Supported Specialty Conferences, Workshops, and Short Courses	On Schedule	25%
	Mid-Continent Research Symposium 2013	On Schedule	15%
	LTAP Regional Meeting - MATC Workshop: September 2012 & 2013	On Schedule	25%
	MATC Website Information Dissemination	On Schedule	33%
	MATC Social Media Sites Information Dissemination	On Schedule	33%
US DOT RITA: Reporting			
	Posting Directory of Key Center Personnel	Complete	100%
	Posting Research Project Descriptions	Complete	100%
	UTC Program Progress Performance Reports (Quarterly)	On Schedule	15%
	Federal Financial Reports (Quarterly)	On Schedule	15%
	Annual Performance Indicators Report	Forthcoming	0%

What was accomplished under these goals?

Currently, all MATC-planned activities are underway, in progress, or are currently in the planning stages. Please see the *percent complete* and *status* columns shown above for established progress on these activities.

What opportunities for training and professional development has the program provided?

As indicated in the table above, there are multiple opportunities for training and professional development within the planning and development phases.

Opportunities for contact hours with participants during the period of January 1st – June 30th included the **Summer Institute** for Math and Science Teachers; the Roads, Rails, and Racecars **After-School Program**; and the MATC **Intern Program**. Summaries of these activities are provided below.

Summer Institute: On June 12th-14th, 2012, three middle school and three high school teachers from the state of Nebraska participated in the UNL 2012 Professional Development Science and Math Summer Technology Institute. This institute was also sponsored by the UNL Nebraska Transportation Center. During this training program, teachers were educated in areas related to transportation safety and distracted driving, as well as green transportation, with the mission of preserving the future by saving lives and protecting the environment. To accomplish this mission, teachers were given the task of creating lesson plans and activities that were centered around the aforementioned topics, highlighting STEM and transportation constructs and using a science-as-inquiry methodology. Approximately 20 lesson plans are anticipated as a result of the summer institute.

Presenters selected to educate our teachers came from a diverse range of fields and industries within the transportation safety and green transportation technology sectors, including: the Nebraska Department of Roads; the Nebraska State Patrol; C.A.R. Alliance for Safer Teen Driving; Operation Life Saver; Nebraska Transportation Center - Midwest Roadside Safety; Kansas City Regional Clean Cities Coalition; and EV World. Presenters also included UNL Civil Engineering graduate students who specialized in Transportation Systems and Roadside Safety. This wide array of presenters from both the public and private sectors provided our teachers with knowledge on where to find data and how to implement these topics in their classrooms, while also providing teaching material. Ultimately, one of the main roles of these presenters was to answer any questions teachers had about incorporating these topics into their lesson plans. Graduate student mentors were on hand to assist in bridging the gap between transportation concepts and real-world applications, enabling students to grasp the concepts they were learning by relating the concepts to scenarios they encounter in their everyday lives.

At the conclusion of the Institute, teachers were directed to develop two transportation safety and distracted driving lesson plans and two sustainable and green transportation lesson plans. These lessons were then presented to their peers, as well as to the NTC and MATC director, Dr. Laurence Rilett, for feedback and suggestions. These lesson plans will be piloted to approximately 50 students on July 18th and 19th, 2012. Based on student feedback and additional peer input, the lesson plans will be revised and implemented in classrooms during the fall and spring semesters. MATC plans to visit the classrooms to obtain photos and video of the teachers implementing the lesson plans. Over 1,200 students in Lincoln and Omaha, Nebraska, will be exposed to these lessons. We will be posting the lesson plans online and distributing them to teachers nation-wide through math and science teacher associations and other avenues.

Road Rails and Race Cars (RRRC): RRRC is an after-school program that was developed in collaboration with the U.S. Department of Transportation; Lincoln Public Schools (LPS); Lincoln Community Learning Centers; the Nebraska Department of Education; and the Mid-America and the Nebraska Transportation Centers (MATC and NTC). The program educates, engages, and provides firsthand exposure for youth of Lincoln, Nebraska, to the field and related concepts of Transportation Engineering. This program emphasizes STEM concepts and hands-on lessons and activities, while utilizing a science-as-inquiry methodology. RRRC began during the 2010-2011 academic year at Culler Middle School with one teacher and two MATC graduate students. Since, the program has expanded to include one elementary school (Maxey Elementary), three middle schools (Culler, Lefler, and Mickle Middle Schools), and one high school (North Star High School), all of Lincoln, Nebraska, with seven teachers, fourteen graduate and undergraduate student mentors, one media relations specialist, and one program coordinator all currently participating. This program was also funded by the US DOT Garrett Morgan Transportation and Technology Education Program.

Multiple outside speakers assisted in educating RRRC students. Speakers included John Huber, Omaha Public School teacher and past Summer Institute participant; Wally Mason, Lincoln High School teacher and past Summer Institute participant; Christina Argo, Omaha Public School teacher and past Summer Institute participant; Amy Starr, Nebraska Department of Roads materials and research engineer and RRRC advisory board member; Tim Foss, Nebraska Department of Roads engineer; John Swanson, Swanson Trucking employee; and Terry Webb, Nebraska Safety Council member. Each of these outside speakers provided detailed information about themselves and their profession, STEM and transportation-related lessons and activities, and/or community information about STEM and transportation-related concepts.

The overall structure of a typical RRRC session is to begin each club day with a “hook” question that grabs students’ attention and engages them from the outset—a learning strategy based upon the educational principles founded in science as inquiry. Engineering mentors then present a brief lesson on the day’s topic. During this lesson time, facilitators attempt to break down abstract and detailed Transportation Engineering concepts and apply them to real-life situations that the students can understand and relate to. The remainder of club time is spent on hands-on activities that highlight the day’s main lesson and allow the students to solve interesting and fascinating Transportation Engineering problems. On occasion, community members (described above) come to the classroom sites to supplement the day’s lesson. As previously mentioned, these professionals provide detailed information about themselves and their professions, including career-related details, educational backgrounds and/or requirements, and salary information, among other aspects that realistically illustrate the diverse array of career opportunities within the Transportation field.

A goal of the RRRC program is to expose students to multiple topics and sub-fields within Transportation Engineering. Some examples of the topics covered in Period One include lessons and activities providing an introduction to Transportation Engineering and its related fields (e.g., Defining Transportation, Defining Geotechnical Engineering, and Types of Transportation); lessons involving transportation modes and systems design (e.g., Create Your Own Mode of Transportation and its Infrastructure; Road Construction; Tunnels; Traffic Flow; Traffic Barriers; Edible Cars; Connected Vehicles; Glider Airplanes; and Walk-Along Gliders); lessons centering on transportation communication (e.g., Railroad Signals; Navigation; Radio Frequency Identification; and Global Positioning Systems and Geographic Information Systems); lessons on the effects of speed, safety, and driving behaviors (e.g., Understanding Speed; Motion and Speed; Motion and Barriers; and Texting and Driving); lessons on physics and chemistry as they relate to Transportation Engineering (e.g., Friction; Pressure; and Acid Rain/Road Erosion); and lessons relating to student interest in and exploration of the field of Transportation Engineering (e.g., Transportation Careers Exploration and Create Your Own Transportation Design PowerPoint). Additionally, we were fortunate enough to obtain applied presentations and activities from the Nebraska Trucking Association (semi-truck exploration activity) and the Nebraska Safety Council (SIDNE Experience distracted driving go-kart simulator) for multiple RRRC sites throughout period one.

From January through March (Quarter three of the LPS academic year), RRRC was implemented in each of the five previously mentioned sites. The program was offered once a week at all sites, with the exception of Culler Middle School, which offered the program twice a week due to its popularity with students. During the months of March through May (Quarter four of the LPS academic year), RRRC was again offered at all sites (excluding Maxey, which implements after-school clubs in Quarter three only). Combined, a total of 86 club days were completed at the aforementioned sites during the period of January through May. The total attendance for each of the 86 club days for Period One for all Lincoln Public School sites was 812; the total number of student attendees who attended the program at least one time over this period was 209. Curriculum modules were developed for the January-March and April-June time periods. MATC anticipates posting these curriculum materials online and marketing them to schools nationwide.

Not only were we able to implement RRRC during the regular academic year, but we also were fortunate enough to be invited back to Culler Middle School for their summer school program. Two teachers, six graduate and undergraduate engineering student mentors, one media relations specialist, and one program coordinator participated in the program. RRRC was conducted once a week for four weeks in two identical sections on Wednesday afternoons (Group A: 1p-2p and Group B: 2p-3p; both groups were given the same lesson and activity). The total attendance for the four summer school program club days was 272; the total number student participants who attended the program at least once out of the four program days was 99. Topics covered during the summer school RRRC program were very similar to those offered during the academic year, including Introduction to Transportation Engineering and Bridge Building; Global Positioning Systems and Geographic Information Systems; Edible Race Cars; and a field trip to the Nebraska Transportation Center. During the field trip, students rotated through four stations led by engineering graduate students. At each of these stations, hands-on labs were conducted pertaining to Geographic Information Systems, Information Technology Systems, and Speed Guns, respectively, ending with an introduction to Civil Engineering so that students could see firsthand how each of the labs apply to Transportation Engineering careers.

MATC Intern Program: There were ten undergraduate students competitively selected for MATC Internships for the 2012 summer program at UNL. The program began on May 10th with a luncheon, during which sponsors could be introduced their respective interns. The organizations involved in this year's intern program included three consulting companies: Iteris, Inc., Olsson Associates, and the Schemmer Associates, Inc. Our municipal intern sponsor was the City of Lincoln: Materials and Research division. The University of Nebraska-Lincoln departments that sponsored MATC interns included the Civil Engineering department and the Durham School of Architectural Engineering and Construction. The interns are working full-time for their respective organizations from May 10th through August 10th, 2012. On August 10th a luncheon is to be held where each intern will be showing a 3-5 minute video highlighting their internship experience. The videos will be hosted on MATC's YouTube channel and used to recruit students for the 2013 intern program. The students are also expected to develop a two-page report on their experience that will be posted on the MATC website along with their profile.

How have the results been disseminated?

Currently, all MATC activities are primarily in the planning and implementation phases. To enhance public awareness, the Summer Institute was featured on the local news. The news story can be found online at
http://www.1011now.com/home/headlines/Math_and_Science_Concepts_Teach_Driving_Safety_158958635.html
We anticipate that the media will also be covering the students test driving the lesson plans on July 18th and 19th. Video of teachers describing and implementing their lesson plans is also currently being developed for the MATC YouTube Channel.

MATC has connected with all local TV and radio organizations located in all eight partner institution main campus city locations, and will be collaborating with them to feature the respective research projects at each location. The goal is to establish a strong, reliable connection with each news agency to allow the activities in which MATC is engaged to be visible and accurately represented to the public.

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

There will be no change in the agency-approved application for this effort. Implementation of the activities outlined in the table above for all research, education, workforce development, and technology transfer projects will continue toward completion on-schedule.

2. PRODUCTS:

Publications, conference papers, and presentations:

At the CUTC National Workforce Development Summit in Washington, DC on April 24th -26th, 2012, four MATC papers were selected. They can be accessed online at: http://cutcworkforce.com/

Authors	Affiliation	Paper Title
Laurence Rilett, Gina Kunz, and Gwen Nugent	Mid-America Transportation Center, University of Nebraska-Lincoln	Professional Development Summer Institute: Transportation Curriculum Development Using Technology Application and Student Experiences in STEM
Laurence Rilett, Gina Kunz, Gwen Nugent, and Cynthia Baker	Mid-America Transportation Center, University of Nebraska-Lincoln	Next Generation Inspiration Program for Careers in Transportation: An After-School Program Dedicated to Transportation and STEM Interest Development
Laurence Rilett, Karen Schurr, Mustaque Hossain, Steven Schrock, and Genda Chen	Mid-America Transportation Center, University of Nebraska-Lincoln, Kansas State University, University of Kansas, and Missouri University of Science & Technology	The MATC Intern Program: Ensuring a Successful Transition from Student to Transportation Professional
Laurence Rilett, Judy Perkins, and Erick Jones	Mid-America Transportation Center, University of Nebraska-Lincoln and Prairie View A&M University	The MATC Scholars Program Graduate Conference: Building the Bridge to Higher Education

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

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

1) **MATC Website:** By clicking on the link matc.unl.edu you will be directed to the MATC website. Select information from Google Analytics pertaining the website's traffic from January 2012-June 2012 is provided below. By interpreting and capitalizing upon this knowledge, we are able to make our homepage engaging, relevant, and resourceful for our viewers.
Visits: ***12,923,*** *Pages per visit:* ***5.08,*** *Average visit duration:* ***4:58*** *minutes*

2) **SlideShare:** Mid-America Transportation Center was selected to have two presentations featured on SlideShare's homepage: "20 Minutes in May…The Joplin Tornado" received 1,230 views. "Summer Institute 2012: Traffic Incident Management" received 712. MATC's SlideShare pace can be found at http://www.slideshare.net/matcRegion7UTC/presentations/
Total Views: ***7,563,*** *Downloads:* ***30,*** *Tweets:* ***8***

3) **Vimeo:** Mid-America Transportation Ctr is the page title for the Vimeo account. Below you will find the hyperlink to access the account as well as related activity. http://vimeo.com/matc
Videos: ***44*** *Total Loads:* ***5,161,*** *Total Downloads:****558***

4) **Facebook**: The Mid-America Transportation Center (MATC) page generated the following statistics, and can be viewed by clicking on the following link: https://www.facebook.com/pages/Mid-America-Transportation-Center-MATC/141238439284182 Views: **298,** Likes: **48**

5) **Twitter:** @MATCNews is the Mid-America Transportation Center's twitter handle. The page can be viewed by clicking the following link - http://twitter.ie/MATCNews, and highlighted numbers for MATC's Twitter activity featured:
Followers ***46,*** *Following* ***219,*** *Tweeted* ***76*** *times*

6) **You Tube:** MATC's you tube feed can be viewed by clicking the link below. Next quarter this site will feature one participating Region 7 University per month. http://www.youtube.com/user/midamericatrans?feature=results_main We are working with faculty and students to gather additional videos from their research to be posted online and shared with the US DOT Research Hub.
Videos, ***13*** *Views* ***409***

7) **LinkedIn:** The newly-created Mid-America Transportation Center LinkedIn group can be found at http://www.linkedin.com/groups/MidAmerica-Transportation-Center-4484370?trk=myg_ugrp_ovr . We have compiled a list of individuals to invite. Our goal is to post valuable and relevant information that fits the group's interests. We will also be posting our research, tech transfer and educational information, and other MATC updates within other transportation-related LinkedIn groups.

Overall, across the 7 sites we have gathered over 26,000 views. Currently, marketing and media plans are being established to further advance and grow each site's exposure and content, based upon the programs established. In particular, MATC's Linked-In Group and YouTube channel will be strongly enhanced over the next reporting period.

Technologies or techniques:

Nothing to report, all current research and workforce development activities are under implementation.

Inventions, patent applications, and/or licenses:

Nothing to report, all current research and workforce development activities are under implementation.

Other products:

As the research selection process is complete, the following research projects listed by university have been selected for funding.

University of Nebraska- Lincoln MATC Research Projects

Optimizing Concrete Deck Removal in Concrete I-Girder Bridges

PI: George Morcous, Ph.D., Associate Professor, Architectural Engineering and Construction

Current concrete bridge I-girders, such as NU girders, have unique characteristics compared to the standard AASHTO I-girders. These girders have a wide and thin top flange to improve lateral stability of long span girders during erection, provide adequate platforms for workers, shorten deck span, and reduce girder weight. However, these features made the top flange more susceptible to damage during deck removal operations, which will be inevitably encountered soon as several bridges will require re-decking for structural and functional reasons in the near future. Therefore, there is an urgent need nationwide to determine the optimal deck removal method(s) with respect to their impact on girder top flange and shear connectors. These methods also need to be evaluated considering cost, time, noise, safety, and environmental criteria to ensure rapid construction, sustainability, optimal use of federal funds, and safety of workers and the traveling public. The main objective of this project is to identify the deck removal method that is optimal for use in precast/prestressed concrete I-girder bridges, which represent over 50% of the bridges constructed in the last few decades.

These methods include, but are not limited to: saw cutting, jackhammering, hydro-blasting, and combinations. The Eastbound of Camp Creek Bridge in Lancaster County, Nebraska, is scheduled for demolition in the fall of 2012. The planned deck removal methods will be applied to this bridge. After deck removal, several girders will be inspected for damage, repaired, re-decked, and tested at the structural laboratory to evaluate their residual flexural and shear capacities.

Alternative Funding Mechanisms for State Transportation Systems in Predominantly Rural States

PI & CoPI: John Anderson, Ph.D., Professor, Economics; and Eric Thompson, Ph.D., Associate Professor and Director, Economics and Bureau of Business Research

The Transportation Research Board of the National Academies has identified a number of research needs related to alternative transportation finance systems. Alternatives are needed because motor fuels taxes are proving to be insufficient to fund operation and maintenance costs of the transportation system. The long-term trend is likely to be continuing use of motor fuel taxes, supplemented by or transitioning to use-based fees. Current research in progress in this area is focused on designing variable fees that will internalize congestion externalities in urban areas. These approaches are particularly well suited to highly urbanized areas but other approaches may be required for predominantly rural states. One possible approach is to implement an optimal two-part tariff which incorporates a flat fee with a variable charge. Such a two-part tariff is an efficient solution in markets with increasing returns to scale and falling long-run average cost curves. Efficiency requires pricing at the marginal cost of travel, and given low marginal costs in rural areas (with limited congestion), a flat fee is needed in combination with the variable charge in order to make the financing mechanism sustainable. The current transportation funding system already includes flat fees (licensing and registration fees) and variable fees (gasoline and diesel taxes). Our approach is to consider alternative configurations of these two existing mechanisms, which in combination may be capable of mimicking an optimal two-part tariff. The research will be carried out utilizing data from the state of Nebraska on licensing and registration fees and taxes by type of vehicle, motor fuels tax revenues by source, and data on average annual daily travel (AADT) as well as engineering estimates of road maintenance costs associated with automobile and truck travel.

Development of a Guide for Prioritization of Railway Bridges for Repair and Replacement

PI : Andrzej S. Nowak, Ph.D., P.E., Professor, Civil Engineering

The objective of this study is to develop a guide for evaluation and prioritization of repair, rehabilitation and replacement for existing railway bridges. The research project will involve review and analysis of the major factors that influence structural performance, e.g. degree of corrosion, loss of material (section loss, holes), cracking and spalling of concrete, bearing problems, loose connections, traffic volume (number of cars/trains and tonnage), and bridge importance for the railroad network. However, these factors are random in nature; therefore, it is convenient to consider reliability as a measure of performance. The relationship between various conditions and ability to perform the required function (i.e. carry the freight trains) will be established in form of limit state function(s). The statistical parameters will be determined for each factor using the available data, by Monte Carlo simulations and if needed also by the so called Delphi process. The reliability as a measure of structural performance will be expressed in terms of a reliability index. Reliability indices will be calculated for selected representative railway bridges, and based on the results, a target reliability index will be selected. The sensitivity analysis will be performed to establish the relationship between the load and resistance factors and reliability to be presented in the form of graphs and tables. The results will serve as a basis for the development of a decision making spread sheet. The final report will document research and provide a tool for bridge owners for prioritization of structures for repair/rehabilitation or replacement.

Development of a Vacuum-Filtration-Based Method for Rapid Measurement of Total Suspended Solids in Stormwater Runoff from Construction and Development Sites

PI & CoPI: Tian Zhang, Ph.D., Professor and Associate Chair, Civil Engineering; and John Stansbury, Ph.D., P.E., Associate Professor, Civil Engineering

Stormwater discharges from construction and dewatering sites can carry large sediment loads resulting in highly turbid water. The US EPA established a NPDES permit for construction-related runoff (i.e., turbidity < 280 NTU) in 2009. However, this limit has subsequently been removed pending further review. On the other hand, many states have issued NPDES permits with TSS limits (e.g., Nebraska requires TSS ≤ 90 mg/L). Since standard TSS measurement requires a time-consuming laboratory procedure, it is imperative to develop a method for rapid, cost-effective, and reliable measurement of TSS in the field.
The goal of this research is to develop a vacuum-filtration based method for rapid measurement of TSS in stormwater runoff from construction and dewatering sites. The specific objectives (& tasks) are to:

1) Make a vacuum-filtration system for rapid TSS measurement. The system will consist of:
   a. a pipette tip filled with a layer of glass fiber to retain suspended solids (particles > 2 μm) but allow dissolved solids (particles < 2 μm) and water to pass through.
   b. An electronic repeating pipette. It can produce a repeatable vacuum so that the sample volume passing through the glass filter will only depend on the properties of the sample (e.g., TSS).

2) Test the system for artificial and real stormwater runoff to establish the method. Artificial runoff will be made up of silt, clays, and sand of different combinations. Real stormwater will be sampled from several construction sites. We will establish calibration curves of TSS vs. the passed water for different runoff mixtures. The performance, statistics, and cost effectiveness of the method will be evaluated.

The research is a significant, initial step in tracking TSS in the field. The method should be rapid, cost-effective, reliable and easily commercialized.

Development of Shaker Test as a Standardized Test Protocol for Deicing Chemicals Evaluation

PI: Christopher Y. Tuan, Ph.D., Professor, Civil Engineering

During a research project previously funded by MATC, a simple and economical test using a martini shaker for ice melting capacity evaluation showed good potential in becoming a standardized test. The development of the shaker test was prompted by the inconsistent results from the SHRP ice melting capacity test. Further, there is a general interest within the winter maintenance community (e.g., Clear Roads and TRB Committee AHD65) to further develop the shaker test into a deicing chemicals test protocol. A number of parameters of the testing procedure need to be precisely specified to ensure repeatability and consistency, and then expanded to cover common weather and roadway conditions.

The automated vehicle location (AVL) and the Maintenance Decision Support System (MDSS) systems installed on some of the plow trucks by the Nebraska Department of Roads (NDOR) worked very well the first time in winter 2010 at recording vehicle locations and weather data. However, some essential data regarding the deicer type, application rate of deicer, and dispensing equipment used during an event were incomplete.

The MDSS information and field data are crucial for correlation analyses with shaker test data. The information gathered from winters 2010 through 2012 from this project will provide an adequate database with statistical significance for correlation studies. The findings will be used to develop guidelines for efficient winter roadways maintenance operations involving the use of deicing chemicals. Guidelines for best practices under various weather and roadway conditions will improve snow removal operations and to provide adequate level of service and safety to the general public on the U.S. surface transportation system.

Dilemma Zone Protection on High-Speed Arterials

PI: Justice Appiah, Ph.D., Post-Doctoral Research Associate, Nebraska Transportation Center

Driver behavior within the dilemma zone can be a major safety concern at high-speed signalized intersections, especially for heavy trucks. The Nebraska Department of Roads (NDOR) has developed and implemented an actuated advance warning dilemma zone protection system. The system continually monitors traffic at an upstream detector as well as at stop line detectors to predict the onset of the yellow indication and provides information to drivers (via flashing signal heads and a warning sign) regarding whether they should be prepared to stop as they approach a traffic signal.

The system has been documented as being effective at improving traffic safety at isolated signalized intersections where the controller operates in the fully actuated mode. NDOR is currently considering the feasibility of deploying these devices on its coordinated arterials.

One objective of this research is to develop a traffic microsimulation procedure for testing the feasibility of deploying the NDOR actuated advance warning system on coordinated arterials. The calibrated traffic microsimulation model will be used to test potential locations of the upstream detector, durations of the lead flash (amount of advance warning time provided to drivers before the green ends), and the maximum allowable headway at the upstream detector location. This will help establish the sets of design parameters for which the system will be beneficial on coordinated arterials. The findings will be used to develop guidelines for the application of the actuated advance warning system so that NDOR can make more informed decisions about where to deploy the system.

Distracted Highway Users at Highway-Rail Grade Crossings

PI: Aemal Khattak, Ph.D., Associate Professor, Civil Engineering

The objective of this research is to assess the incidences of distracted drivers, pedestrians, and bicyclists at highway-rail grade crossings using data collected in the field and provide guidance on countermeasure strategies. Distractions for highway users have increased over the past decade due to the widespread availability of electronic gadgets that allow owners to listen to music, talk, text, and use the Internet while on the road. Significant research emphasis has been on distracted drivers; however, pedestrians and bicyclists are also susceptible, especially at highway-rail grade crossings where mistakes could easily result in fatalities.

A total of 2,397 highway-rail grade crossing collisions were reported in 2008, resulting in 286 deaths and more than 900 injuries. The Federal Railroad Administration (FRA) statistics show that in 78 of these vehicle-train collisions, the cause was listed as “highway user inattentiveness,” resulting in 14 deaths and 117 injuries. Other FRA statistics show that in 488 grade crossing crashes, vehicles ran into trains already present at the crossings. Of those crashes, more than 60% were at crossings equipped with either gates or flashing lights, while just over 33% occurred at crossings with either stop or crossbuck signs. Although these crashes may have multiple causes, distracted driving appears to be a contributing factor.

A highway-rail crossing located in Fremont, NE will be studied for distracted drivers, pedestrians, and bicyclists by using observers in the field and a video recording system. Additional data will be gathered by surveying a sample of the grade crossing users. This location already has the needed electric power while a new camera and digital video recorder will be installed. Collected data will be analyzed for instances of distracted usage of the crossing by drivers, pedestrians, and bicyclists. The results will provide information for the development of an informed strategy on reducing distracted usage of grade crossings.

Investigation, Dynamic Testing, and Evaluation of Guardrail Posts for Use in Transitions between Temporary Concrete Barrier and Guardrail

PI & CoPIs: Karla A. Lechtenberg, M.S.M.E., Research Associate Engineer, Midwest Roadside Safety Facility; John D. Reid, Ph.D., Professor, Mechanical & Materials Engineering Department; and Ronald K. Faller, Ph.D., P.E., Assistant Director and Research Assistant Professor, Midwest Roadside Safety Facility

Temporary concrete barriers (TCBs) are connected and transitioned to many types of barriers. Unfortunately, the only transitions previously developed have been between TCBs and safety shaped concrete barriers and TCBs and permanent concrete median barriers. Transitions between TCBs and other common barrier types, such as guardrail, have typically not been full-scale crash tested and may pose a serious hazard to motorists during an impact.

The Midwest Roadside Safety Facility (MwRSF) has an existing project that consists of developing a transition between TCBs and the Midwest Guardrail System (MGS). That project has funding to identify and quantify the most pressing TCB to guardrail transition needs and for concept development with LS-DYNA computer simulation. However, further research is needed to evaluate the performance of typical post types and sizes that could potentially be utilized during the concept development. Therefore, this project seeks to supplement the concept development and simulation of transitions between TCBs and the MGS through dynamic post testing.

Safety Performance Evaluation of Posts for Use in a New Short Radius Guardrail for Intersecting Roadways

PI & CoPIs: John D. Reid, Ph.D., Professor, Mechanical & Materials Engineering; Karla A. Lechtenberg, M.S.M.E., Research Associate Engineer, Midwest Roadside Safety Facility; and Ronald K. Faller, Ph.D., P.E., Assistant Director and Research Assistant Professor, Midwest Roadside Safety Facility

Guardrail systems used along roadways are intended to redirect impacting vehicle or in the case of short-radius guardrail, capture the vehicle at certain impact points. Kinetic energy is dissipated during any impact event through the deformation of the rail and posts and post rotation through the soil. This dissipated energy reduces the risk of injury to the vehicle’s occupants.

Previous development of a short radius system has shown significant improvement over the existing NCHRP 230-compliant system. Unfortunately, the system length and backside space requirements made the system impractical to use in most real-world applications. In addition, any necessary improvements to help the system meet the current safety performance criteria would only further increase the system length. Therefore, a need exists to develop a new barrier system that can be used near intersecting roadways, driveways, and streets that would meet the MASH TL-3 safety performance criteria.

The current project of developing an impact attenuation system (short radius system) for intersection roadways has funding to conduct background research on previous short-radius designs and for concept development. However, further research is needed to evaluate different post sizes and types that could potentially be utilized during concept development. Therefore, this project seeks to supplement the concept development of a new short-radius system for intersecting roadways.

Smart City Lincoln: Safe Intersections and Intelligent Enforcement

PI: Anuj Sharma, Ph.D., Assistant Professor, Civil Engineering

Red light running and resulting crashes levies a significant cost on the general public. In 2006, there were 171,000 crashes, 144,000 injuries and 887 fatalities attributed to red light running in the United States (Source: the Insurance Institute for Highway Safety). The total social cost of these crashes exceeds $ 14 billion per year.

“Research suggests that intentional red-light runners, who account for a significant percentage of red-light runners, are most affected by enforcement countermeasures” (Source: FHWA Intersection Safety Issue Briefs, 2004). Currently crash data and public complaints are used to select the enforcement locations. These approaches are very simplistic and lack enough resolution to identify the target location along with the time of deployment. This research will develop a systematic approach using the available data resources, like crash history and complaint logs, which can be augmented with the data obtained from existing video based stop bar sensors at several city intersections. Based on our discussions with the Lincoln Public Works Department (Scott Opfer, Virendra Singh) and the Lincoln Police Department (Capt. Joy Cita), such an approach will be very useful in maximizing the societal benefits achieved under constrained enforcement resources. This research will also study the impact of one other counter measure like confirmation light on a few selected intersections.

This project is part of a collaborative effort from multiple universities and a unified final report will be submitted at the end of this project. Additional PI’s include: Sunanda Dissanayake, Ph.D., Associate Professor, Civil Engineering, Kansas State University; Steven Schrock, Ph.D., P.E., Assistant Professor, Civil, Environmental, and Architectural Engineering, University of Kansas; Thomas E. Mulinazzi, Ph.D., P.E., L.S., Professor and Interim Chair, Civil, Environmental, and Architectural Engineering, University of Kansas; Eric Fitzsimmons, Ph.D., Post Doctoral Researcher, Transportation Research Institute, University of Kansas

Study of a Distributed Wireless Multi-Sensory Train Approach Detection and Warning System for Improving the Safety of Railroad Workers

PI & CoPI: Hamid Sharif, Ph.D., Charles J. Vranek Professor, Computer and Electronics Engineering; and Michael Hempel, Ph.D., Computer and Electronics Engineering

The Federal Railroad Administration strongly promotes safer railroad operations throughout the nation's railroad industry. One area of concern is the safety of railroad workers who are often required to work on active mainline tracks or in their close proximity. To prevent accidents, workers have to be aware of approaching trains with enough time to move equipment and personnel to a safe distance from the track.

Currently, railroads require their workers to act as lookouts for oncoming trains. This tedious task is prone to failure due to human nature and our tendency to relax attention. Consequently, the number of fatalities among track workers is on the rise. Some devices attempt to address this concern, but based on feedback from Union Pacific Railroads none of these are acceptable in terms of sensitivity, warning time, and fail-safe operations.

To address this vital need, Union Pacific and the Advanced Telecommunications Engineering Laboratory have teamed up to investigate a solution. Currently, no commercially available system can detect trains reliably in all environments including hills, tunnels, etc. Existing solutions use only single sensors such as track circuit detectors, vibration, etc. An integrated system utilizing multiple techniques jointly to offset individual shortcomings may provide the detection accuracy and reliability needed.

Therefore, this project will research key aspects of a vital multi-sensory train detection approach—a distributed system that collaboratively processes data and shares its findings to accommodate detection on all tracks in the area for all environments. We envision a system that is rechargeable, communicates wirelessly, and will be able to interface with the Positive Train Control infrastructure for future-proof operation and integration with other safety aspects like in-cab alerting. Union Pacific is committed to providing $300,000 support through railroad equipment access, track and yard availability for field data collection, analysis, and testing.

University of Iowa MATC Research Projects

Mobility and Accessibility of Hispanics in Small Town and Rural Areas

PI: Miwa Matsuo, Ph.D., Assistant Professor, Urban and Regional Planning

The Hispanic population is rapidly increasing in the U.S., particularly in nonmetropolitan counties in the Midwest and South, including Iowa (Kandel and Cromatie, 2004). The status of non-metropolitan Hispanics raises concerns about their accessibility because of the low-density built environment and socioeconomic factors that may reduce their mobility. Hispanic people in rural areas generally have lower income than non-Hispanic whites, and they also face language barriers in receiving public assistance.

This project examines mobility and accessibility difficulties that Hispanic population in small town and rural area are facing, using several manufacturing areas in Iowa as examples. Specifically, the researcher will conduct mail-in surveys and telephone follow-up interviews on Hispanic population around four towns in Iowa: Marshalltown, Columbus Junction, West Liberty, and Carroll. The survey will examine who in the Hispanic community suffers from mobility limitation and how much informal mobility support is provided within the community.

The survey will also investigate barriers the Hispanic population faces in using public transit service or public fund for transportation. After the survey, I will follow up with telephone interviews to identify more detailed travel diary data to specify the needs for transportation services. All of the processes will be planned and conducted with a Spanish-speaking research assistant hired using grant funds.

From literature and preliminary interviews, it is expected that Hispanic families have difficulty in getting access to goods and services for their daily needs. Since the proportion of senior citizens is small in these Hispanic communities, the main source of troubles would likely be scheduling vehicle usage between commuting and discretionary trips, particularly related to children. The final product of this project will be a quantitative analysis of the survey result to illustrate mobility and accessibility of rural Hispanics, and a qualitative analysis of their barriers in using public transportation services.

Integration of Human-in-the-Loop Driving Simulator with Microscopic Traffic Simulation

PI & CoPI: Yefei He, Ph.D., Associate Research Scientist, National Advanced Driving Simulator; and Haowei Hsieh, Ph.D., Assistant Professor, School of Library and Information Science

Driving simulator and microscopic traffic simulation are two important tools in transportation research. The former is used to study individual driver behaviors by placing human subjects in a realistic driving environment. The latter is used for traffic analysis by modeling individual vehicles and their interaction. Micro-simulation models provide realistic traffic patterns in terms of density and headway, which is something that the driving simulator lacks in its virtual environment. At the same time, micro-simulation models lack the human-in-the-loop aspect which a driving simulator could provide. We will integrate the widely used VISSIM micro-simulation software into the equally popular NADS MiniSim™ driving simulator to create a human-in-the-loop driving environment with realistic traffic patterns. The two systems are intrinsically compatible since both use agent-based modeling to simulate individual vehicles. This project will be carried out in coordination with Iowa State University, whose study on work zone and vehicle emission modeling will use the integrated MiniSim-VISSIM system, and who will provide design input from the aspect of expert users of microscopic traffic simulation models. The output of this research will be improved traffic scenarios in the MiniSim software which will benefit all users of this system, including MATC members University of Iowa and Iowa State University. Future applications of this capability include conducting human factors studies on impact of fuel economy displays on throttle usage and then using that behavioral data to conduct micro-simulations in VISSIM to assess impacts on vehicle emission and air quality.

Investigation of Synergistic Effects of Warm Mix Asphalt and High Fractionated Reclaimed Asphalt Pavement for Safe, Environmentally Sustainable Highway

PI: Hosin “David” Lee, Ph.D., P.E., Professor, Civil and Environmental Engineering and Public Policy Center

Increasingly, warm mix asphalt (WMA) pavements are being constructed with reclaimed asphalt pavement (RAP) contents. Currently, 10-20% of RAP materials are commonly used for WMA. In the future, it is anticipated that more highway pavements will be constructed using WMA with high fractionated reclaimed asphalt pavement contents (WMA-HiFrap). However, there is no comprehensive research done to identify the synergistic effects between WMA and high fractionated RAP; therefore, it is critical to determine the relationships between the fundamental characteristics of WMA-HiFrap materials as a function of the increasing FRAP content up to 100%. In the project, WMA with varying HiFrap contents will be evaluated with respect to their fractionation methods, WMA-HiFrap mix design procedures, dynamic moduli and flow number and rutting characteristics. As a result of this research, the synergistic effects between WMA and RAP will be identified to help pavement engineers build a safe and environmentally sustainable U.S. surface transportation system with an improved state of good repair.

Developing and Refining Sustainability Tools for Winter Maintenance Operations

PI: Wilfrid Nixon, Ph.D., Professor, Civil and Environmental Engineering

Sustainability in transportation requires that the three “pillars” of societal needs, environmental protection and economic costs and benefits, should be balanced. Yet, the tools currently available deal only peripherally with transportation operations and maintenance, and with winter maintenance in particular. It is planned to further develop a checklist tool that exists in preliminary form by working with winter maintenance professionals from states, cities and counties to determine how best to refine the existing tool in a variety of areas. The deliverables of this project will be a refined winter maintenance sustainability checklist tool, and the final report detailing the findings of the study.

Towards Autonomous Vehicles

PI & Co-PI: Chris Schwarz, Ph.D., Senior Research Engineer, National Advanced Driving Simulator; and Geb Thomas, Ph.D., Associate Professor, Mechanical and Industrial Engineering

From the self-driving Google car to plain old cruise control, automation in vehicles is an important issue. The aim of this project is to document the state-of-the-art autonomous vehicles for use in the United States transportation sector, specifically on U.S. roads and highways. A literature survey will be conducted that spans several intersecting fields, including artificial intelligence, robotics, mechatronics, military unmanned vehicles, intelligent transportation systems, and human factors.

Many factors influence the adoption of autonomous transportation systems, including the pace of evolving technology, trust in automation, infrastructure demands, and the regulatory landscape. These themes will be woven into the report as they are critical pieces of the story of automation. Of particular interest is the cycle of innovation, development, government/military deployment, technology transfer, commercialization, and regulation that iteratively advance the state of the art in a field such as automation.

One such example of a cycle of automation advancement started with a call for innovation from DARPA in the form of a Grand Challenge, and later an Urban Grand Challenge for the development of unmanned autonomous ground vehicles (Urmson et al 2008, Montemerlo et al, 2008). This resulted in a flurry of innovation and technology for the military. It has also borne technology transfer fruit leading directly to the development of the Google car. This cycle is continuing with the creation of a new office in the US DOT on automation and cybersecurity that may result in regulations for autonomous vehicles even as it spawns new topics of research.

The researchers plan to lay out the trajectories of component technologies and other contributing factors in the development and adoption of automated transportation systems. A desired outcome of this research is that the final report may be used as a guide to select future research topics in the short-, mid-, and long-term on this important topic.

Improving Freight Fire Safety: Modifying Droplet Behavior to Minimize Ignition

PI: Albert Ratner, Ph.D., Associate Professor and Director of the Combustion and High Speed Fluid Mechanics Lab, Mechanical and Industrial Engineering

Recent analysis of Iowa DOT truck crash data shows that fatalities are ten times more likely to occur during a crash if there is a fire present. This highlights the need for technology that can mitigate or eliminate these crash fires. One such methodology is to add a polymer additive to the fuel to modify its splashing and misting characteristics. Reduction of fuel splashing and misting greatly reduces the likelihood of a fire. Three years of MATC-DOT support has led to the development of a computer modeling method that can predict droplet splashing and mist formation. The goal of this project would bring that work to fruition by computationally testing all of the crash conditions of interest and then transferring the results to industry and academia where the appropriate polymers could be developed.

One of the recent issues for the state of Iowa is the increased number of pure ethanol shipments between producers and blending facilities, greatly increasing the accident risk and precipitating a warning from the US DOT on vehicle-related ethanol fires. The methods planned for this project would reduce this risk.

Iowa State University MATC Research Projects

Methods for Removing Concrete Decks from Bridge Girders

PI & CoPI: Brent M. Phares, Ph.D., Associate Director for Bridges and Structures and Assistant Professor, Civil, Construction, and Environmental Engineering; and Jennifer Shane, Ph.D., Assistant Professor, Civil, Construction, and Environmental Engineering

With ever tightening budgets, states are looking for cost-effective methods of extending the duration from initial bridge construction to complete replacement. One common technique that serves this purpose is to replace the deck after the end of its useful service life has been reached while keeping the original superstructure and substructure. That is, assuming that the superstructure and substructure still have adequate strength and remaining life. For this approach to be successfully accomplished, it is critical that the deck is removed without damaging the superstructure elements. Moreover, as the deck is often removed in large pieces, it is important to prevent concrete from falling below the bridge, especially where a roadway passes beneath. The objective of the work is to determine the most, and/or develop new, cost-effective and efficient deck removal techniques for steel and concrete superstructure bridges. The following criteria will be considered as part of the evaluation: Impact on the future performance of the superstructure, cost, time, safety, and noise. Further, the work will include guidance on assessing and repairing girders that are damaged during removal of a deck.

Evaluation of Thermal Integrity Profiling for Deep Foundations

PI: Jeramy C. Ashlock, Ph.D, Assistant Professor, Civil, Construction, and Environmental Engineering

Assessing the structural integrity of bridge foundations is critical to ensuring the safety of the traveling public. However, nondestructive methods currently used in practice to determine the quality of drilled shaft foundations are severely limited by their inability to provide full coverage of the foundation cross-section, particularly in the critically important region outside of the rebar cage. The goal of the project is to evaluate the accuracy of a new Thermal Integrity Profiling (TIP) technique for quality assurance of deep foundations. The TIP method utilizes infra-red thermal probes lowered into access pipes which are cast into the foundation to measure the heat of hydration of curing concrete. Previous studies demonstrated that the technique can detect loss of concrete cover outside the rebar cage as well as internal flaws such as cracking or voids. However, the studies did not assess the accuracy of the technique for indicating the specific location and extent of flaws.

The research project is a collaborative effort between ISU and the Iowa DOT to evaluate the accuracy of the TIP method. A full-scale test shaft will be constructed with voids at predetermined locations. Measurements of shaft integrity will be compared for the new TIP method and the cross-hole sonic logging (CSL) method, which is currently the most commonly used quality assurance tool for drilled shafts.
The ability and accuracy of the two techniques to detect the specific locations, size and general shape of the known shaft defects will then be assessed. It is anticipated that thermal integrity profiling will provide cost savings to state Departments of Transportation as a more economical alternative to CSL testing, or as a screening tool to identify which shafts should be further analyzed by CSL specialists.

Safety and Mobility Impacts of Winter Weather –Phase 3

PI & CoPIs: Zachary Hans, Research Engineer, Institute for Transportation; and Neal Hawkins, Director, Center for Transportation Research and Education

Highway agencies spend millions of dollars to ensure safe and efficient winter travel. However, the effectiveness of winter weather maintenance practices on safety and mobility are somewhat difficult to quantify. Safety and Mobility Impacts of Winter Weather – Phase 1 investigated opportunities for improving traffic safety on state-maintained roads in Iowa during winter weather conditions. The primary objective was to develop several preliminary means for the Iowa Department of Transportation (DOT) to identify locations of possible interest systematically with respect to winter weather-related safety performance based on crash history. Specifically, four metrics were developed to assist in identifying possible habitual, winter weather-related crash sites on state-maintained rural highways in Iowa. In addition, the current state of practice, for both domestic and international highway agency practices, regarding integration of traffic safety- and mobility-related data in winter maintenance activities and performance measures were investigated. This investigation also included previous research efforts.

In Phase 2, a combination of the Phase 1 results, and Iowa DOT Maintenance Field staff input, were then employed to evaluate three Iowa DOT high priority sites. Winter weather crash mitigation analysis procedures were developed and applied for
these three sites. Realistic maintenance and operations mitigation strategies were also identified.
The primary objectives of Phase 3 of this project are to: 1) develop a systematic site prioritization protocol, 2) analyze winter weather and crash history at the prioritized sites, 3) identify possible mitigation strategies, and 4) develop a prediction model of crash risk as a function of winter weather-related variables and traffic-related variables.

Statewide Heavy Truck Crash Assessment

PI & CoPI: Zachary Hans, Research Engineer, Institute for Transportation; and Konstantina (Nadia) Gkritza, Ph.D., Assistant Professor, Civil, Construction, and Environmental Engineering

In 2009, heavy trucks represented approximately 15% of the vehicle miles traveled (VMT) in Iowa (1), compared to 10% at the national level (2). Between 2006 and 2010 in Iowa, heavy trucks were involved in crashes resulting in, on average, 74 fatalities annually (3). Fifteen percent of these fatalities were large truck occupants (3). In other words, the vast majority of the resulting fatalities were non-large truck occupants, demonstrating the serious nature of these crashes when involving the general traveling public. While several national studies have investigated heavy truck crashes, e.g. "Large Truck Crash Causation Study", no rigorous analyses have been conducted in Iowa.

The objective of this project is to investigate the causes, locations and other factors related to heavy truck crashes in Iowa. Through efforts related to this study, the research team will provide results that may be used by decision makers and law enforcement, particularly Iowa DOT Motor Vehicle Enforcement (MVE), in establishing priorities and allocating limited resources to promote safety and reduce crashes.

Sustainable Asphalt Pavements Using Bio-Binders from Bio-Fuel Waste

PI & CoPI: R. Chris Williams, Ph.D., Associate Professor, Civil, Construction, and Environmental Engineering, Iowa State University; and Ken Klabunde, Ph.D., University Distinguished Professor of Chemistry, Chemistry, Kansas State University

The vast majority of asphalt materials used in highway construction are currently derived from the distillation of crude petroleum. The increasing demand for products derived from crude petroleum coupled with constrained supply has led to substantial price increases in crude petroleum products including asphalt. To further meet the increased demand for transportation fuels, many refineries have installed coking facilities which remove asphalt from the marketplace further impacting the pricing of asphalt. The evolution of the biorefineries producing transportation fuels, specialty chemical products and food products has created opportunities for using derived co-products in the asphalt industry. These co-products may be used to either partially or fully replace crude petroleum-derived asphalt or be used as beneficial additives for mitigating moisture damage as an example. Assessment and characterization of these materials including chemical compatibility, rheological testing and formulation for use in asphalt paving is needed. This project is a collaborative one involving Kansas State University's expertise in analytical chemistry and asphalt mixture characterization with Iowa State University's expertise in using bio-based materials in asphalt materials and rheological characterization. This project addresses the US DOT's strategic goals associated with state of good repair, sustainability, and economic competitiveness.

Validation of Traffic Simulation Model Output for Work Zone and Mobile Source Emissions Modeling and Integration with Human-in-the-Loop Driving Simulators

PI: Shauna Hallmark, Ph.D., Transportation Engineer and Associate Professor, Institute for Transportation

Collection of project level work zone performance measures, (i.e. queue length, travel speed) in the field is difficult because setting up data collection equipment within the work zone can be disruptive and the lack of right-of-way can force data collectors to be situated in unsafe locations. Additionally, the most recent emission model (USEPA's MOVES), requires second-by-second vehicle activity which may require methods such as instrumented vehicles. Consequently, data needs for both types of analyses are resource intensive.

The objective of the research is to demonstrate the utility of linking micro- simulation output with work zone and emission models. The project will collect data for several work zone and operational scenarios and develop models with the micro- simulation model, VISSIM. Work zone model scenario output (i.e. queue length, travel speed) will be compared to field data and drawbacks in use for analysis of work zone performance measures identified. The utility of using micro-simulation model output for work zone analysis will be documented.

VISSIM output from operational scenarios (speed/acceleration) will be compared to field data to assess the accuracy of micro-simulation models in providing realistic estimates of vehicle activity as input to MOVES. Results will be summarized to demonstrate the applicability of linking micro-simulated vehicle activity data with emissions models to better estimate the emission impacts of different transportation strategies. The requested MATC funds will be matched to a project which will be funded by a SWZDI, "Work zone Traffic Performance Measures."

Kansas State University MATC Research Projects

Evaluation of Bonding Agent Application on Concrete Patch Performance

PI: Kyle Riding, Ph.D., P.E., Assistant Professor, Civil Engineering

Concrete patching is a commonly used infrastructure preservation and repair technique. Patches are used frequently in the U.S. Midwest to repair areas of concrete freezing and thawing joint distress. The repair patches usually fail first at the interface between old and new concrete. Bonding agents such as cementitious grout or epoxy are often specified to enhance the bond. There is concern that these bonding agents may be more sensitive to environmental and construction practices than previously thought and that these bonding agents may actually give poor performance in the field. This project will establish the sensitivity of bonding agent performance to environmental and construction practices, and provides recommendations for achieving optimum performance. This will be accomplished by testing the repair bond to concrete for cementitious and epoxy bonding agents subject to different drying times. The repair will be also cycled through five temperature cycles before testing the bond using the guillotine test. Field trials will also be used to confirm the material sensitivity determined through the laboratory testing.

Evaluation of Low-Cost Intersection Countermeasures to Reduce Red Light Running Violations

PI & CoPIs: Sunanda Dissanayake, Ph.D., Associate Professor, Civil Engineering

Red light running (RLR) crashes are a serious safety concern at signalized intersections. In 2009 it was reported that 676 fatalities (FHWA, 2011) and 130,000 injuries were due to red light running crashes in the United States (IIHS, 2011). The Insurance Institute for Highway Safety (IIHS) reported that in 2007 over half of the red lights running fatalities were passengers of the violating vehicle, both passengers and the driver of the vehicle that was collided into, or pedestrians within the intersection (IIHS, 2007). Many communities have installed automated enforcement as a way to enforce red light violations at high-crash intersections. In 2011, it was estimated that over 538 communities had installed automated enforcement (IIHS, 2011).

However, automated enforcement may not be practical for an intersection or cannot be implemented due to state legislation. Many communities have implemented low-cost countermeasures at intersections (e.g. confirmation lights, reflective back plates, advance beacons, or enhanced signage) to alert the driver or aid law enforcement officials in capturing violators.

Limited research currently exists on evaluating low-cost red light running countermeasures beyond naïve before and after crash analysis in response to community pressure. To fully evaluate a countermeasure, typically 3 to 6 years of before and after crash data are required, and this may not always be feasible. For this analysis, a before and after reduction or increase in red light running violations will be used as a surrogate measure to crash data to evaluate red light running countermeasures and the spillover effect at select intersections in Kansas. The results of this research study is expected to have an immediate impact in the State of Kansas with legislation preventing automated enforcement to be installed and communities seeking low-cost ways to reduce red light running at signalized intersections.

Research is conducted in partnership with Steven Schrock, Ph.D., P.E., Assistant Professor, Civil, Environmental, and Architectural Engineering, University of Kansas; Thomas E. Mulinazzi, Ph.D., P.E., L.S., Professor and Interim Chair, Civil, Environmental, and Architectural Engineering, University of Kansas; Eric Fitzsimmons, Ph.D., Post Doctoral Researcher, Transportation Research Institute, University of Kansas; and Anuj Sharma , Ph.D., Assistant Professor, Civil Engineering, University of Nebraska-Lincoln.

Sustainable Asphalt Pavements Using Bio-Binders from Bio-Fuel Waste

PI & Co-PI(s): Ken Klabunde, Ph.D., University Distinguished Professor of Chemistry, Chemistry,

Asphaltic binders that are used for asphalt pavements have been traditionally obtained either from fossil fuels or from natural sources. However, due to growing interest in sustainability, search has been initiated for a non-petroleum binder that could be used for asphalt pavements. The objective of this study is to develop a modified asphalt binder from bio-refinery by-products and wastes that can be used as a replacement of bituminous adhesives/binders derived from fossil fuels for asphalt pavements. The internal chemical structures of the residue from fossil fuel processing and biofuel processing are similar.

Thus, necessary chemical changes would be minimal to produce the appropriate viscosity and aging index for use in asphalt mixtures. The bio binder properties will be modified using bio-polymers resulting in a better binder that will have enhanced wetability and coating (adhesion) and resistance to aging (loss of volatiles) properties. This research will be conducted with R. Chris Williams, Ph.D., Associate Professor, Civil, Construction, and Environmental Engineering, at Iowa State University.

University of Kansas MATC Research Projects

Evaluation of Low-Cost Intersection Countermeasures to Reduce Red Light Running Violations

PI: Steven Schrock, Ph.D., P.E., Assistant Professor, Civil, Environmental, and Architectural Engineering Thomas E. Mulinazzi, Ph.D., P.E., L.S., Professor and Interim Chair, Civil, Environmental, and Architectural Engineering, University of Kansas; Eric Fitzsimmons, Ph.D., Post Doctoral Researcher, Transportation Research Institute,

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This research is being conducted jointly with Sunanda Dissanayake, Ph.D., Associate Professor, Civil Engineering , Kansas State University and Anuj Sharma , Ph.D., Assistant Professor, Civil Engineering, University of Nebraska-Lincoln.

Geosynthetic Reinforcement to Protect Underground Pipes against Damage from Construction and Traffic

PI & CoPI: Jie Han, Ph.D., P.E., Professor, Civil, Environmental, and Architectural Engineering; and Robert L. Parsons, Ph.D., P.E., Professor, Civil, Environmental, and Architectural Engineering

More than 5,000 significant pipe incidents happened in the United States from 1999 to 2009 that resulted in fatalities, injuries, and significant property damage and loss. Of those serious incidents 25 percent were caused by excavation damage. Therefore, protection of underground pipes against damage from construction and traffic are important and necessary. Unfortunately, no effective method is available so far. This research project will develop a technology using geosynthetic reinforcement to protect underground pipes (either existing or new pipes) against damage from construction or traffic. The geosynthetic reinforcement is laid across the trench between the surface and the top of the pipe.

The objective of this research is to determine the level of protection provided to a flexible pipe by a geosynthetic layer. The hypotheses are: the geosynthetic reinforcement over a buried pipe will reduce the stresses and strains in a flexible pipe, caused by a penetrating (simulating excavation during construction) or dynamic surface load (simulating traffic). This research objective will be pursued at the CEAE Department at the University of Kansas using the large-scale geotechnical test box (3 m long x 2 m wide x 2 m high).

In this research, the following factors will be investigated: (1) type of backfill in trench (sand and gravel), (2) type of surface cover (sand and gravel); (3) mechanical properties of geosynthetic, (4) depth of geosynthetic, and (5) type of loading (penetrating and cyclic loading). Earth pressure cells, displacement transducers, and strain gauges will be installed around or on the pipe and the geosynthetic to investigate the effects of the above influence factors.

The successful completion of this research can advance the technology of using geosynthetic reinforcement to protect underground pipes, and potentially help engineers develop a system that can avoid catastrophes.

Properties of Fouled Recycled Ballast (Phase II)

PI & CoPI(s): Robert L. Parsons, Ph.D., P.E., Professor, Civil, Environmental, and Architectural Engineering; Jie Han, Ph.D., P.E., Professor, Civil, Environmental, and Architectural Engineering; and Thomas E. Glavinich, D.E., P.E., Associate Professor, Civil, Environmental, and Architectural Engineering

A thorough understanding of railroad ballast drainage and strength properties is required for developing ballast specifications. While the properties of new ballast meeting AREMA specifications have been investigated, as much as 70 percent of the ballast applied to track during maintenance activities is recycled ballast. This ballast and a great deal of ballast currently in service under track has experienced degradation due to particle breakdown and rounding. The properties of recycled or degraded ballast have not been thoroughly examined; however it is believed that this ballast will not perform as well as new ballast, particularly when fouled.

Furthermore, non-invasive detection of fouled ballast is often difficult in the field. The family of geophysical technologies has promise for enabling such detection. Electrical conductivity is one of these technologies that has not been thoroughly explored for this function. The change in electrical conductivity of ballast as it becomes fouled will be investigated.

It is hypothesized that the properties of recycled ballast from 3-5 sources be characterized with regard to their degree of degradation. The initial work on the first source of ballast was undertaken as a part of Phase 1. Strength, permeability, and electrical conductivity tests will be conducted on clean and fouled samples with the goal of relating the degree of fouling to reductions in the strength, drainage, and conductive properties of recycled ballast. The anticipated outcome is relationships

Repair of Floorbeam-to-Stringer Connections Affected by Distortion-Induced Fatigue

PI & CoPI(s): Caroline Bennett, Ph.D., Assistant Professor, Civil, Environmental, and Architectural Engineering; Adolfo B. Matamoros, Ph.D., Associate Professor, Civil, Environmental, and Architectural Engineering; and Stan Rolfe, Ph.D., P.E., Albert P. Learned Distinguished Professor, Civil, Environmental, and Architectural Engineering

Distortion-induced fatigue is a serious and costly problem facing the Nation's steel bridge infrastructure. Inexpensive, practical, and effective retrofit techniques are desperately needed for the repair of existing structures. One structural system that has repeatedly shown susceptibility to distortion-induced fatigue is the stringer-floorbeam system of bridge construction, wherein cracking is commonly encountered at the connection between floorbeams and stringers.

Little research has been performed aimed at developing inexpensive, practical, and effective retrofit techniques for floorbeam-stringer connections. This project contains a roadmap for accomplishing exactly that. Therefore, the research directly addresses the following US Strategic Goals: (1) Enhancing safety, (2) Improving the state of good repair, and (3) Improving environmental sustainability of the U.S. surface transportation system.

The research project includes selection of details for study based upon feedback from regional DOTs. Two physical floorbeam-stringer specimens will be tested in distortion-induced fatigue, and various retrofit techniques developed through complimenting finite element analyses will be evaluated on the physical specimens. From prior experience, it is anticipated that multiple tests will be obtainable from a single specimen. Recommendations will be provided regarding the various retrofits developed.

Missouri University of Science and Technology MATC Research Projects

Evaluation of Pile Load Tests for Use in Missouri LRFD Guidelines

PI: Ronaldo Luna, PE, PhD, F.ASCE, Professor and Assistant Chair, Civil Engineering

The current MoDOT Engineering Policy Guide (EPG) 751.36 for Driven Piles includes resistance factors to be used in the Load and Resistance Factor Design (LRFD). These resistance factors were adopted from the current AASHTO LRFD Bridge Manual (2010). These resistance factors at the national level tend to be in the conservative side and closely tied to the level of effort and engineering conducted during the installation of the foundation elements (static pile load and dynamic method tests). A series of load tests (3) will be conducted at three construction bridge sites along the Missouri highway system. The results will be used to adjust the resistance factors that have been developed previously based on high strain dynamic methods only.

Longitudinal Useful Life Analysis and Replacement Strategies for LED Traffic Indicators

PI & CoPIs: Suzanna Long, Ph.D., Assistant Professor, Engineering Management and Systems Engineering; Mariesa Crow, Ph.D., P.E., Professor, Electrical and Computer Engineering; Abhijit Gosavi, Ph.D., Assistant Professor, Engineering Management; Ruwen Qin, Ph.D., Assistant Professor, Engineering Management and Systems Engineering; and C.H. Wu, PH.D., Professor, Electrical and Computer Engineering

The project develops a robust, longitudinal methodology for LED traffic indicator useful life assessment and replacement. This project extends a previous study completed by the research team. Collecting data from the same LED traffic indicators over a several year period of time will provide more reliable results to perform regression analysis and increase the level of confidence the analyst would have in the predictions made for replacement strategies. This project is focused on three tasks. The team will develop a test matrix that will evaluate the impact of the following variables: manufacturer, color, directional view, daylight conditions on the gradation of LED traffic signals. These results will be analyzed using the methodology developed as part of the previous study.

Nondestructive Evaluation of Mechanically Stabilized Earth Walls with Frequency-Modulated Continuous-Wave (FM-CW) Radar

PI & CoPI: Genda Chen, Ph.D., P.E., F. ASCE, Professor, Civil Engineering; and Reza Zoughi, PH.D, Professor, Electrical and Computer Engineering

Effective techniques for a nondestructive evaluation of mechanically stabilized earth (MSE) walls during normal operation or immediately after an earthquake event are yet to be developed. The main objectives of this project are a) to quantify the laboratory performance and ability of an existing wide-band portable frequency-modulated continuous-wave (FM-CW) radar system for detection of defects behind MSE walls, and b) demonstrate the field applicability and performance of the existing radar system in MSE wall inspections. FM-CW radars offer a significant amount of information about the presence of void location and size behind an MSE wall and other anomalies such as excess moisture and its location.

Splice Performance Evaluation of Enamel-Coated Rebar for Structural Safety

PI: Genda Chen, Ph.D., P.E., F. ASCE, Professor, Civil Engineering

This project is aimed at further understanding of the splice mechanism and capacity of enamel-coated rebar in concrete beams. The objective is achieved by further analyzing the test data collected under the recently-completed MTI/MoDOT Collaborative Structures Research Program and testing additional 12 reinforced concrete beams for comparison. Additional documentation on the splice performance of enamel-coated rebar from this study will allow the PI to make a strong case for potential deployment of the enamel coating technology in various state departments of transportation.

Work Zone Safety: Physical and Behavioral Barriers in Accident Prevention

PI & CoPI: Suzanna Long, Ph.D., Assistant Professor, Engineering Management and Systems Engineering; Carlos Sun, Ph.D., Associate Professor, Civil Engineering, University of Missouri

Despite an overall decrease in fatalities on Missouri roads, work zones have not seen a corresponding decrease in fatalities and serious accidents (MoDOT Research Forum, 2011, 2012). This research conducts a risk and hazard analysis that includes a safety culture assessment in order to develop asset management processes to minimize risk by flaggers and other work zone personnel. An improved asset management process will save MoDOT and other agencies money by reducing the number and severity of claims from work zone personnel. A safety culture assessment investigates stakeholder values, attitude and behavior towards safety in the work place and links these attitudes to issues in the work zone. The research design for the study will use a mixed methods approach as part of the safety culture assessment (Creswell, 2003; Tashakkori and Teddlie, 2003). For quantitative analysis, the research design uses a formative analysis i.e. perception based quantitative data. The qualitative analysis used an in vivo analysis (e.g., Morse and Richards, 2002) of stakeholder responses to reflective questions regarding work zone safety. Stakeholders are defined for the research as work zone personnel, the general public (GP), and law enforcement agency (LE) representatives. Separate surveys are developed for each group. The risk and hazard analysis identifies and examines the appropriateness and sufficiency of physical safety barriers to prevent accident, whereas the safety culture assessment identifies the cognitive factors that contribute to work zone personnel behaviors that contribute to accidents. Training protocols will be developed in conjunction with LTAP and disseminated to state DOTs and local agencies to facilitate more proactive work zone safety measures.

A Quadcopter with Heterogeneous Sensors for Autonomous Bridge Inspection

PI: Zhaozheng Yin, Ph.D., Assistant Professor, Computer Science

Continuously monitoring a bridge's health by sensor technologies has been widely used to maintain the operation of a roadwork while protecting public users' safety. However, monitoring and inspecting numerous bridges in a state is a labor-intense and costly task. A recent survey (Gastineau et al. 2009) shows that among 25 sensors used in 38 companies, there is no autonomous system capable of inspecting bridges. We will advance the bridge monitoring technology a step further by developing a quadcopter with heterogeneous sensors, which aims to enable the autonomous bridge inspection.

University of Missouri MATC Research Projects

Best Practices in Work Zone Risk Management

PI & CoPI: Carlos Sun, Ph.D., Associate Professor, Civil and Environmental Engineering; and Praveen Edara, Ph.D., Assistant Professor, Civil and Environmental Engineering

Public transportation agencies own, operate and maintain an enormous number of infrastructure and properties that need to be kept in good condition. The prevalence of work zones means that many accidents occur at those locations; unfortunately leading to requests for compensation and litigation. This project seeks to examine all aspects of a transportation agency's practices that relate to work zones and to identify best practices that will improve overall risk management

Effectiveness of Work Zone Intelligent Transportation Systems

PI & CoPI: Praveen Edara, Ph.D., Assistant Professor, Civil and Environmental Engineering; and Carlos Sun, Ph.D., Associate Professor, Civil and Environmental Engineering

In the last decade, Intelligent Transportation System (ITS) technologies have been deployed in work zones by state departments of transportation (DOTs) to improve traffic operations and safety. Also known as Smart Work Zone Systems (SWZS) these deployments provide real-time information to travelers, monitor traffic conditions, and manage incidents. Although, there have been numerous ITS deployments in work zones to date, the evaluation of the effectiveness of these deployments has not been well documented. To justify the continuous development and implementation of work zone ITS, there is a need to determine the ITS effectiveness for specific work zone projects in terms of traffic diversion rate, delay, crash rate, queue, and speed management. This project aims to develop a framework for evaluating the effectiveness of SWZS and illustrate it on an actual work zone deployment in Missouri. The MATC portion of the effort is focused on technology transfer activities in terms of disseminating the results of the developed framework to a broader audience.

Evaluation of Alternative Geometric Designs on Highway Corridors – Case Study of J-Turns
PI & CoPI: Praveen Edara, Ph.D., Assistant Professor, Civil and Environmental Engineering; and Carlos Sun, Ph.D., Associate Professor, Civil and Environmental Engineering

Alternative geometric designs such as J-turns, double crossover interchanges and continuous flow intersections have the potential to improve safety and traffic flow on freeways and arterials. The evaluation of such designs will provide information on their effectiveness and guidance for their proper deployment.
J-turn intersection designs have been in operation in Maryland and North Carolina for years. They serve as an alternative to a two-way stop controlled intersection on high-speed roadways. By forcing the through and left turn movements from the minor street to turn right and make a U-turn at a downstream location, the J-turn design is safer due to fewer conflict points and less severe conflict types. Missouri DOT has recently started using J-turn design as a corridor safety treatment on rural high-speed roads. As their first corridor deployment, MoDOT is constructing J-turns on an 8.5-mile stretch of U.S. 54 south of Jefferson City. In this project, we will evaluate the safety and operational benefits of this J-turn deployment. The analysis will focus on several safety and operational performance measures, including conflicts, actual crash statistics, driver confusion measures, heavy vehicle maneuverability, gap acceptance, and travel time measures. The study findings assist Missouri and other Midwest states with new knowledge on the benefits of J-turn design and guidance on when to consider deploying J-turns as a corridor level safety treatment.

Evaluation of Work Zone (Wz) Software Programs: Phase 2 – Validation Using Field Data
PI & CoPI: Praveen Edara, Ph.D., Assistant Professor, Civil and Environmental Engineering; and Carlos Sun, Ph.D., Associate Professor, Civil and Environmental Engineering

In 2008, the University of Missouri evaluated several software programs for work zone traffic impact analysis and identified appropriate analytical tools for assessing traffic impacts at different types of work zones. This research was funded by the Missouri Department of Transportation (MoDOT). Three software programs – QuickZone, VISSIM, and CA4PRS were evaluated, and a customized spreadsheet for Missouri conditions, WZ Spreadsheet, was developed. WZ Spreadsheet produces queue length and delay estimates with minimum amount of input data. The current project is aimed at calibrating and validating the software programs using real world data. Performance measures such as queue length and delay obtained from the programs will be compared with the values observed in the field. The accuracy of results produced by each program will be quantified so that the users can attribute a level of confidence to the program's outputs. Thus the software programs will be calibrated to provide reliable and documented results so as to improve traffic operations and safety in work zones.

Highway Safety Manual Applied in States: Calibration and Training
PI & CoPI: Carlos Sun, Ph.D., Associate Professor, Civil and Environmental Engineering; and Praveen Edara, Ph.D., Assistant Professor, Civil and Environmental Engineering

This project involves two major steps for applying the national Highway Safety Manual (HSM) in states. The first step is the calibration of HSM to local conditions using historical safety, geometric and demand data. The focus of the calibration will be on Missouri although other MATC states could also benefit from the results. The second step is the development of training and technology transfer for a wide range of organizations including MoDOT, metropolitan planning organizations, regional planning commissions and local communities.

Nondestructive Evaluation Tools to Improve the Inspection, Fabrication and Repair of Bridges
PI & CoPI: Glenn Washer, Ph.D., Associate Professor, Civil and Environmental Engineering; and Charles Nemmers, P.E., Director of the Transportation Infrastructure Center, Civil and Environmental Engineering

The goal of this research program in Nondestructive Evaluation (NDE) is to improve the safety and reliability of bridges. The results of this research will enhance the safety of the transportation infrastructure by providing better tools for the safety condition assessment of bridges during fabrication, inspection and repair. The research will also enhance the state of good repair by developing technologies for detecting deterioration in its embryonic stages, when maintenance and preservation strategies can be implemented to ensure the state of good repair. The benefit is better, safer and longer lasting steel and concrete bridges and related structures. Three promising areas will be the focus of this research:

1) Vehicle-mounted Infrared Thermography for Bridge Condition Assessment
Develop a flexible, portable platform for infrared thermography that enables the technology to be vehicle-mounted for scanning bridge decks, bridge soffits and tunnels at close to normal traffic speeds.

2) Develop Phase Array Ultrasonic Testing for Steel Fabrication
Improve the quality control process for steel fabrication to improve the reliability, safety and quality of welded constructions.

3) Ultrasonic Measurement of In-Situ Stress Levels in Gusset Plates

Measure the actual the actual in-situ stress levels in the gusset plates to ensure structural safety. This experimental research will explore that application of these technologies for practical applications for bridge condition assessment. The research will also make a strong contribution to the education and training of students in the important arena of inspection and condition assessment of the civil infrastructure, where current curriculum is lacking. These technologies can make significant improvements in the ability of engineers and inspectors to assess the condition of bridges to improve highway safety and ensure the state of good repair.

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS:

What individuals have worked on the program?

The Mid-America Transportation Center respectfully requests exemption from this reporting requirement. Please see email for additional information concerning this request.

What other organizations have been involved as partners?

During the current reporting period, the Mid-America Transportation Center has worked with 57 unique organizations across the United States and around the world to develop the research, education, workforce development, and technology transfer activities that are currently underway at the center. Each organization and its location is listed below, along with information describing the specific area or capacity through which the respective organization has committed to supporting the center. For more detailed information on how each organization is working with the center, please email the MATC program coordinator, Valerie Lefler, at vlefler2@unl.edu.

Organization Name	City	State	CO	Financial Support	In-Kind Support	Facilities	Collaborative Research	Personnel Exchanges
Bryan Middle School, Omaha Public Schools	Omaha	NE	USA					X
CISL Research Project			Israel				X	
City of Lincoln Public Works & Utilities	Lincoln	NE	USA				X	
City of Lincoln: Materials Division	Lincoln	NE	USA			X		X
Culler Middle School, Lincoln Public Schools	Lincoln	NE	USA			X		X
Faubel Financial Services Inc.	Lincoln	NE	USA					X
Flatbed Express Inc.	Lincoln	NE	USA					X
Iowa Department of Transportation	Ames	IA	USA	X	X		X	
ISU Civil Engineering	Ames	IA	USA	X	X		X	
Iteris, Inc.	Lincoln	NE	USA		X	X		X
JPID Consulting	Batton-Rouge	LA	USA					X
Kansas Department of Transportation	Topeka	KS	USA	X	X		X	
Korea Institute of Construction Technology	Goyang-Si Gyeonggi-Do		Korea	X	X		X	
K-TRAN (Kansas Transportation Research and New-Developments)	Topeka	KS	USA	X	X		X	
KU Civil Engineering	Lawrence	KS	USA	X	X		X	
Kumho Petrochemical, Ltd	Seoul		Korea	X	X		X	
Lefler Middle School, Lincoln Public Schools	Lincoln	NE	USA			X		X
Lincoln Community Learning Centers	Lincoln	NE	USA					X
Lincoln High School, Lincoln Public Schools	Lincoln	NE	USA					X
Lincoln University	Jefferson City	MO	USA			X		X
Lockheed Martin	Bethesda	MD	USA	X			X	
Maxey Elementary School, Lincoln Public Schools	Lincoln	NE	USA			X		X
McMillian Middle School, Omaha Public Schools	Omaha	NE	USA			X		X
Mickle Middle School, Lincoln Public Schools	Lincoln	NE	USA			X		X
Missouri Department of Transportation	Jefferson City	MO	USA	X	X		X	
MS&T Dept of Civil Architectural & Environmental Engineering	Rolla	MO	USA	X	X		X	
MU Dept of Civil & Environmental Engineering	Columbia	MO	USA	X	X		X	
Nebraska Children and Families Foundation	Lincoln	NE	USA					X
Nebraska Department of Roads	Lincoln	NE	USA	X	X		X	
Nebraska Safety Council	Lincoln	NE	USA					X
Nebraska Trucking Association	Lincoln	NE	USA					X
North Star High School, Lincoln Public Schools	Lincoln	NE	USA			X		X
Olsson Associates, Inc	Omaha	NE	USA		X	X		X
Olsson Associates, Inc	Lincoln	NE	USA		X	X		X
Prairie View A&M	College Station	TX	USA					X
PTV America, Inc	Portland	OR	USA				X	
Schemmer Associates	Lincoln	NE	USA		X	X		X
Smart Work Zone Development Initiative	Ames	IA	USA	X	X		X	
Southern University and A & M College	Baton-Rouge	LA	USA					X
Swanson Trucking Inc.	Lincoln	NE	USA			X		X
Tencate Geosynthetics	Olathe	KS	USA		X		X	
Tennessee State University	Nashville	TN	USA					X
UI Dept of Civil & Environmental Engineering	Iowa City	IA	USA	X	X		X	
UI Dept of Mechanical and Industrial Engineering	Iowa City	IA	USA	X	X		X	
UI National Advanced Driving Simulator	Iowa City	IA	USA	X	X		X	
UI School of Library and Information Sciences	Iowa City	IA	USA				X	
UI School of Urban & Regional Planning	Iowa City	IA	USA	X	X		X	
Union Pacific Railroad	Omaha	NE	USA	X	X		X	X
University of Maryland-Eastern Shore	Princess Anne	MD	USA					X
University of Nebraska-Durham School of Architectural Engineering and Construction	Omaha	NE	USA	X	X	X		X
University of Texas-Arlington	Arlington	TX	USA					X
UNL Bureau of Business Research	Lincoln	NE	USA	X	X		X	
UNL Center for Children Youth Families and Schools	Lincoln	NE	USA					X
UNL Dept of Civil Engineering	Lincoln	NE	USA	X	X		X	
UNL Nebraska Transportation Center	Lincoln	NE	USA	X	X	X		X

Have other collaborators or contacts been involved?

The Mid-America Transportation Center works with numerous individuals at each of the organizations listed above. For collaborators or contacts at each of the organizations, please email vlefler2@unl.edu. MATC's research activities are highly multi-disciplinary, featuring faculty from disciplines including, but not limited to, chemistry, economics, civil engineering, mechanical engineering, computer science, and electrical engineering. The Principle and Investigators (PIS) and Co-Principle Investigators (Co-PIs) for MATC's research portfolio are listed below:

First Name	Last Name	Title	University	Department
John	Anderson	Professor	University of Nebraska-Lincoln	Economics
Justice	Appiah	Post-Doctoral Research Associate	University of Nebraska-Lincoln	Civil Engineering
Jeramy	Ashlock	Assistant Professor	Iowa State University	Institute for Transportation
Caroline	Bennett	Assistant Professor	University of Kansas	Civil, Environmental, & Architectural Engineering
Genda	Chen	Professor	Missouri University of Science & Technology	Civil, Architectural, & Environmental Engineering
Sun&a	Dissanayake	Associate Professor	Kansas State University	Civil Engineering
Praveen	Edara	Assistant Professor	University of Missouri	Civil & Environmental Engineering
Ronald	Faller	Assistant Director & Research Assistant Professor	University of Nebraska-Lincoln	Nebraska Transportation Center, Midwest Roadside Safety Facility
Konstantina (Nadia)	Gkritza	Assistant Professor	Iowa State University	Civil Engineering, Institute for Transportation
Thomas	Glavinich	Associate Professor	University of Kansas	Civil, Environmental, & Architectural Engineering
Shauna	Hallmark	Transportation Engineer & Professor	Iowa State University	Institute for Transportation
Jie	Han	Professor	University of Kansas	Civil, Environmental, & Architectural Engineering
Zachary	Hans	Research Engineer	Iowa State University	Institute for Transportation
Neal	Hawkins	Director, Center for Transportation Research & Education (CTRE)	Iowa State University	Institute for Transportation
Yefei	He	Associate Research Scientist/Engineer	University of Iowa	National Advanced Driving Simulator
Haowei	Hsieh	Assistant Professor	University of Iowa	School of Library & Information Science
Aemal	Khattak	Associate Professor	University of Nebraska-Lincoln	Civil Engineering
Kenneth	Klabunde	Professor of Chemistry	Kansas State University	Chemistry
Karla	Lechtenberg	Research Associate Engineer	University of Nebraska-Lincoln	Nebraska Transportation Center, Midwest Roadside Safety Facility
Hosin	Lee	Professor	University of Iowa	Public Policy Center & Civil & Environmental Engineering
Suzanna	Long	Assistant Professor	Missouri University of Science & Technology	Engineering Management & Systems Engineering
Ronaldo	Luna	Professor	Missouri University of Science & Technology	Civil Engineering
Adolfo	Matamoros	Associate Professor	University of Kansas	Civil, Environmental, & Architectural Engineering
Miwa	Matsuo	Assistant Professor	University of Iowa	Urban & Regional Planning
George	Morcous	Associate Professor	University of Nebraska-Lincoln	Durham School of Architectural Engineering & Construction
Charles	Nemmers	Program Director of Transportation Infrastructure Center & Research	University of Missouri	Civil & Environmental Engineering
Wilfrid	Nixon	Professor	University of Iowa	Civil & Environmental Engineering
Andrzej	Nowak	Professor of Engineering	University of Nebraska-Lincoln	Civil Engineering
Robert	Parsons	Professor	University of Kansas	Civil, Environmental, & Architectural Engineering
Brent	Phares	Associate Director, Bridge Engineering Center	Iowa State University	Institute for Transportation
Albert	Ratner	Assistant Professor	University of Iowa	Mechanical & Industrial Engineering
John	Reid	Professor	University of Nebraska-Lincoln	Mechanical & Materials Engineering Department
Kyle	Riding	Assistant Professor	Kansas State University	Civil Engineering
Stan	Rolfe	Distinguished Professor	University of Kansas	Civil, Environmental, & Architectural Engineering
Steven	Schrock	Assistant Professor	University of Kansas	Civil, Environmental, & Architectural Engineering
Chris	Schwarz	Associate Research Engineer	University of Iowa	National Advanced Driving Simulator
Jennifer	Shane	Director for the Construction, Materials, & Technology Center	Iowa State University	Institute for Transportation (InTrans)
Hamid	Sharif	Professor	University of Nebraska-Lincoln	Computer & Electronics Engineering
Anuj	Sharma	Assistant Professor	University of Nebraska-Lincoln	Civil Engineering
John	Stansbury	Associate Professor	University of Nebraska-Lincoln	Civil Engineering
Carlos	Sun	Associate Professor	University of Missouri	Civil & Environmental Engineering
Geb	Thomas	Associate Professor	University of Iowa	Mechanical & Industrial Engineering
Eric	Thompson	Associate Professor & Director	University of Nebraska-Lincoln	Economics & Bureau of Business Research
Christopher	Tuan	Professor	University of Nebraska-Lincoln	Civil Engineering
Glenn	Washer	Associate Professor	University of Missouri	Civil & Environmental Engineering
Chris	Williams	Professor	Iowa State University	Civil, Construction & Environmental Engineering
Zhaozheng	Yin	Assistant Professor	Missouri University of Science & Technology	Computer Science
Tian	Zhang	Professor	University of Nebraska-Lincoln	Civil Engineering
Reza	Zoughi	Professor	Missouri University of Science & Technology	Electrical & Computer Engineering

4. IMPACT:

What is the impact on the development of the principal discipline(s) of the program?

Activities conducted during the current reporting period are expected to have an impact upon the transportation engineering discipline in the future. The results from a number of research projects have been developed into courses for the public that will shape future knowledge of specific transportation-related technologies. Two examples of highlighted activities include: (a) instructional courses developed by researchers at Kansas State University involving Superpave mixture materials and thin surface treatments; (b) a short course and webinar in development by Missouri University of Science and Technology faculty members pertaining to the development of non-destructive evaluation and structural health monitoring technologies. This dissemination highlights just two of the numerous areas that will impact transportation-related fields by further refining existing knowledge and techniques discovered through the research process.

What is the impact on other disciplines?

Many of MATC's educational activity outputs offer an interdisciplinary experience. For example, the Transportation Scholar's Program pools undergraduate and graduate students from many transportation-related disciplines for seminars, the Transportation Scholar's Conference, and various other student activities. These experiences create an interdisciplinary atmosphere in which students, faculty, and staff from various institutions may interact, but also provides opportunities for professional networking with transportation sector leaders. These activities increase channels of communication between participants in the workforce and individuals from many fields of academics, and facilitate a more interconnected body of future transportation professionals. These outcomes are intended to create a highly responsive next generation of transportation professionals.

What is the impact on the development of transportation workforce development?

A number of educational and technology transfer activities utilize MATC-sponsored research to develop the transportation workforce:

- Exposure to transportation subjects for K-12 students promotes an early passion:
    - MATC has continued its successful Roads, Rails and Racecars After-School Program in area elementary, middle, and high schools. This program utilizes a mentor system, and personal interaction between students, undergraduate and graduate "teachers," and classroom staff, to foster interest and provide an applied, hands-on learning experience through transportation-related lessons. Altogether, a total of 86 club days were completed at the sites during the period of January through May. The total attendance for each of the 86 club days for Period One for all of the Lincoln Public School sites was 812. The total number of student participants that attended the program at least once over this period was 209. Curriculum modules were developed for the January – March and April – June academic periods. MATC anticipates posting these curriculum materials online and marketing them to schools nationwide. The Nevada Department of Transportation has been in contact with MATC regarding the process of implementing the after school program in their state. To determine the full scalability of the program, additional funding is currently pending for regional expansion of the program to Iowa, and national expansion to Wisconsin.
        - Not only were we able to implement RRRC during the regular academic year, but for their summer school program. Two teachers, six graduate and undergraduate engineering student mentors, one media relations specialist, and one program coordinator participated in the program. The total attendance for the four summer school program club days was 272; the total number student participants who attended the program at least once out of the four program days was 99.
    - MATC also supports *Go!*, a free online magazine geared toward adolescents. In 2011, *Go!* garnered 50,000 online visitors from over 100 countries. In 2012, the magazine's organizers have been developing spotlight articles highlighting the activities and transportation programs within the MATC consortium. This educational tool seeks to build a more informed and inspired youth population to create a more vibrant future transportation workforce.
    - MATC is developing K-12 activities and visits to MU, with the proposed outcome of expanding transportation awareness in minority schools in St. Louis and Kansas City, with the eventual potential impact of fostering a more culturally representative transportation workforce.
    - The transportation-focused MATC Summer Institute lesson plans will be piloted to 50 students on July 18th and 19th, 2012. Based upon student feedback and additional peer input, teachers will be revising the lesson plans and implementing them in their classrooms in the fall and spring semesters. MATC plans to visit the classrooms and obtain photos and video of teachers implementing the lesson plans. Over 1,200 7th – 12th grade students in Lincoln and Omaha, Nebraska will be participating in these lessons. MATC will be posting the lesson plans online and distributing them to teachers nation-wide through math and science teach associations and other avenues.
- A focus on undergraduate and graduate education through opportunities and scholarships ensures an experienced transportation workforce:
    - All of the more than three-dozen MATC research projects launched thus far will have significant have involvement from student researchers, with the expected outcome of providing firsthand experience and knowledge pertinent to careers in the transportation field.
    - The Transportation Scholar's Program allows students to focus on transportation-oriented preparation through exposure to real world, high-level transportation careers and challenges.
    - Academic year internships, summer internships, a transportation engineering certificate program, and joint courses in specialties such as railway engineering with other institutions provide students with enhanced exposure to transportation knowledge and practices.
    - The Transportation Seminar Series that will feature nationally recognized speakers, in order to expand the horizons for participating graduate students in transportation.
    - Various MATC partners support their students by increasing student access to conferences, seminars, and engineering organizations:

- MATC offers funding for students to attend regional and national conferences, and also supports transportation related local chapters of regional and national engineering associations. Graduate students also are awarded travel scholarships to the Transportation Research Board's Annual Meeting, with the expected outcome of creating a more informed and connected workforce.

- Other opportunities aid the spread of research results to the workforce:
  - In three years of symposia, the Mid-Continent Transportation Research Symposium (MCTRS) has attracted the attention of over 300 participants from 15 states. This opportunity facilitates the dissemination of knowledge through networking and interpersonal connection, which will impact future practice in the field.
  - Overall, across the MATC website and social media platforms we have received over 26,000 views, of which many members of the audience include members of the transportation workforce.

What is the impact on physical, institutional, and information resources at the university or other partner institutions?

Nothing to Report.

What is the impact on technology transfer?

MATC research projects at all campuses will be disseminated in the form of instructional courses and direct implementation. Additionally, researchers are currently cultivating partnerships that will enable successful technology transfer in the future. For example, researchers at KSU, MS&T, and MU have been transforming results into practical, hands-on courses and educational materials. At KSU, Superpave mixing materials courses have helped to train paving and inspection crews using techniques developed through MATC research projects. Faculty have also been developing a two-day workshop on thin surface treatments for pavement in the Kansas City area, serving both Missouri and Kansas transportation workers. MS&T faculty are creating a short course and webinar regarding the development and application of nondestructive evaluation (NDE) and structural health monitoring (SHM) technologies, marking the implementation stage of the research that developed these technologies. Finally, MU is utilizing various modes of communication to better disseminate research results: faculty and staff are exploring webinars, newsletters, and websites as technology transfer outputs. Overall, these products will improve the body of transportation knowledge and increase awareness of the research process.

In addition, efforts at MU have included the delivery of research results directly to public entities that could benefit from their implementation. In research associated with the Highway Safety Manual Calibration, outputs will center upon implementation within the state. The Missouri Department of Transportation is already fully participating. Future technology transfer initiatives will focus upon local governments. Such activity in the community could also incorporate graduate students into the development of training activities and presentations. These efforts could foster a positive linkage between academics and community and commercial entities, creating a healthier chain of communication and more responsive industries in the future.

MATC researchers are currently partnering with their state departments of transportation (DOTs) throughout the research project process. These relationships involve:

- Data sharing (e.g., the Nebraska Department of Roads on the project "Development of Shaker Test as a Standardized Test Protocol for Deicing Chemicals Evaluation" and the Iowa DOT on "Improving Freight Fire Safety: Modifying Droplet Behavior to Minimize Ignition")
- Technical reviewing (e.g., the Iowa DOT on "Evaluation of Thermal Integrity Profiling for Deep Foundations" and Missouri DOT)
- Maintenance crew involvement (e.g., the Iowa DOT on "Safety and Mobility Impacts of Winter Weather – Phase 3" and the Kansas DOT and other regional DOTs on "Repair of Floorbeam-to-Stringer Connections Affected by Distortion-Induced Fatigue")

Ties such as these will foster a more connected transportation community, and will positively impact the field of transportation research by creating a more efficient system for the implementation of research results.

What is the impact on society beyond science and technology?

Outside of workforce development and enhanced technology transfer, MATC's activities are also impacting society by influencing behavior, attitudes, and policies within the general population. For instance, MATC's supports ISU's online magazine *Go!* is introducing youth to transportation knowledge and related careers by utilizing a modern platform. This type of educational product—along with the consortium's various K-12, undergraduate, and graduate programs—strives for outcomes such as improved attitudes regarding the transportation workforce and increased knowledge about transportation careers. Beyond inspiring a future generation of transportation workers, these activities could have the future impact of improving the public's appreciation and discourse of transportation.

Other initiatives will also impact society, whether on macroscopic or microscopic levels. For example, at KSU, researchers are seeking to improve the social climate by participating in the KSU Sustainability Program's outreach activities. Participants will explore ways to promote bicycling and walking around campus and throughout the city of Manhattan, Kansas. This type of activity seeks to enhance citizen awareness and positively influence behavior, ultimately impacting the overall health and safety of infrastructure users.

5. CHANGES/PROBLEMS:

Nothing to Report.

6. SPECIAL REPORTING REQUIREMENTS:

Nothing to Report.