Program Progress Performance Report

To US DOT/OST-R, University Transportation Centers

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MIDWEST TRANSPORTATION CENTER MTC

Contents

1. Accomplishments

What are the major goals and objectives of the program?

Through a strategically focused program that is synergistic with U.S. DOT priorities and MAP-21 goals, the Midwest Transportation Center (MTC) addresses regional issues related to its theme of Data Driven Performance Measures for Enhanced Infrastructure Condition, Safety, and Project Delivery, focusing on the overall goal of State of Good Repair.

Under this theme, the MTC's objectives are to:

- Serve as a focal point regionally and nationally for research that develops data performance measures for infrastructure condition, safety, and project delivery.
- Ensure efficient use of funds by building on existing programs, avoiding duplication, leveraging existing resources, and developing creative cooperative activities with industry.
- Develop products that are useful and relevant to stakeholders including national, regional, state, and local transportation agencies as well as industry and other researchers.
- Provide leadership in the next generation of technology transfer, beginning with the research itself—involving the user, innovative outreach, and new communications technology.
- Develop the next generation of transportation professionals and provide opportunities for current professionals.
- Provide leadership opportunities for students and young professionals.
- Recruit and retain a diverse workforce.

What was accomplished under these goals?

The MTC accomplishes the above-listed goals by focusing on the following five activities:

A. Research (goals 1, 2, 3)
B. Outreach/technology transfer (goals 3, 4)
C. Education (goals 6, 7)
D. Workforce development (goals 5, 6)
E. Center management (all goals)

The following sections summarize MTC accomplishments under each of these activities during the reporting period. Highlights include the following:

- Mid-Continent Transportation Research Symposium (page 7)
- Study abroad in Istanbul (page 8)
- Workforce development workshop (page 10)
- Visits to MTC partner institutions (page 14)
- First meeting of the MTC advisory board (page 15)

A. Research

The MTC's lead organization Iowa State University (ISU) is working with partners Wichita State University and Creighton University to help them develop transportation-focused research programs; partner organizations University of Missouri–Columbia (UMC) and the University of Missouri–St. Louis (UMSL) are working with partner Harris-Stowe State University.

The total number of projects funded under this grant to date is 69, with 39 being led by ISU and 30 being led by partner or other institutions. All MTC–funded research projects, completed and in progress, are listed at intrans.iastate.edu/mtc/index.cfm/research/.

Completed Research

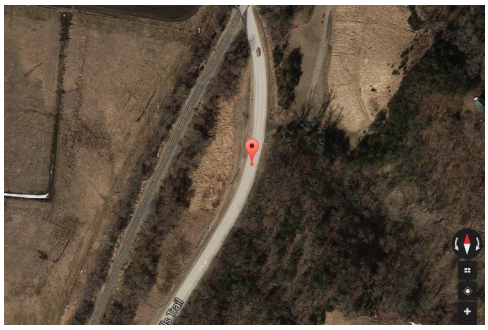
During this reporting period, three final reports were submitted for research projects funded under this UTC grant, bringing the total to five final reports to date ("Products" on page 16).

Current Projects

Following are highlights of a few current projects representing the work of all the partner institutions during this reporting period:

High Friction Surface Treatment for High Crash Locations
PI: Zach Hans, ISU

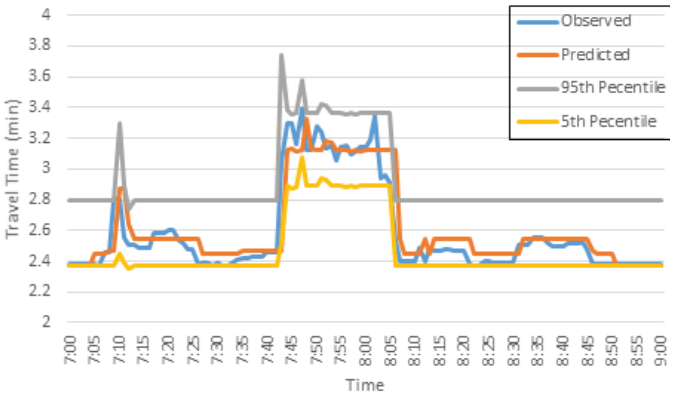
The Iowa DOT Office of Traffic and Safety is participating in an FHWA Every Day Counts initiative to advance the rapid deployment of high friction surface treatment (HFST) as a crash mitigation strategy. The Iowa DOT has allocated $1,000,000 to HFTS installation on selected two-lane primary and paved secondary horizontal curves in Iowa. A critical element of this initiative is identifying curves that are good candidates for HFST. To identify candidate sites, the research team has developed site selection criteria, taking into consideration various factors such as crash experience (evaluated from several different perspectives), traffic volume, roadway and roadside characteristics, and pavement condition. In a two-phase process, an initial set of more than 6,000 horizontal curves was refined into a set of 48 and then 22 candidate sites. The research team and the Iowa DOT's Office of Traffic and Safety are now working with the appropriate Iowa DOT district and county engineers to obtain additional feedback regarding candidate site characteristics and any recent or planned construction and rehabilitation. It is anticipated that final sites will be let for construction next calendar year.



Satellite image of a curve site identified for HFST (Map data ©2015 Google)

Assessing Segment and Corridor-based Travel Time Reliability on Urban Freeways
PI: Jing Dong, ISU

Precise and reliable predictions of travel time is a key component for many advanced traveler information and traffic management systems. Although numerous travel time prediction methods have been developed in the past few decades, only recently have researchers begun attempting to incorporate weather information into travel time prediction models. In order to capture different states from travel time distributions, some researchers have proposed a multi-state model to fit travel time distribution. In addition, several studies have found that the mean and standard deviation of distance-normalized travel times have a strong linear relation. Based on these previous studies, the research team is classifying the probe vehicle travel time data according to weather conditions and has developed algorithms to predict travel time reliability, considering traffic measurements and weather forecast.



Travel time reliability prediction of January 16, 2015

Visualization and Communication in Pavement Performance
PIs: Nalini Govindarajulu and Cindy Corritore, Creighton University

This research project is developing visualization techniques and methods that display pavement performance data and information in a communication-friendly format for a variety of end users. Several possible scenarios of end users and possible questions that might be answered using visual analyses are envisioned. The two primary end users are (a) engineers working with the datasets and (b) county office administrators examining the status of roads in their counties and the state. Accordingly, several visualizations are presented that would be useful for each of these end user groups. Each visualization includes a short description along with a sample question that the visuals could be used to answer.

The data used to generate these interactive visuals is being provided by the Iowa DOT; the data outline numerous indicators of pavement performance for the year 2013. The visual analysis is interactive and is designed to provide a dashboard at the county level. It can be modified to display information and visuals at other levels of county groupings.

Evaluation of Temporary Rumble Strips
PI: Neal Hawkins, ISU

The objective of this research is to quantify the impact of using temporary rumble strips on one-lane, flagger-operated traffic work zones. The temporary rumble strips are placed within the advanced warning section of a work zone to evaluate both safety and operational aspects, including driver braking, change in speed, and changes in lane placement (crossover or going around the rumbles). The Iowa DOT has developed a standard for placement of the temporary rumble strips, and the research team is evaluating safety and operations with and without the treatment. This research will support state DOTs, local agencies, and contractors in preventing work zone intrusions and rear-end crashes. In addition, this effort supports the MAP-21 emphasis area on safety within the work zone.

Temporary rumble strips installed in advance warning area

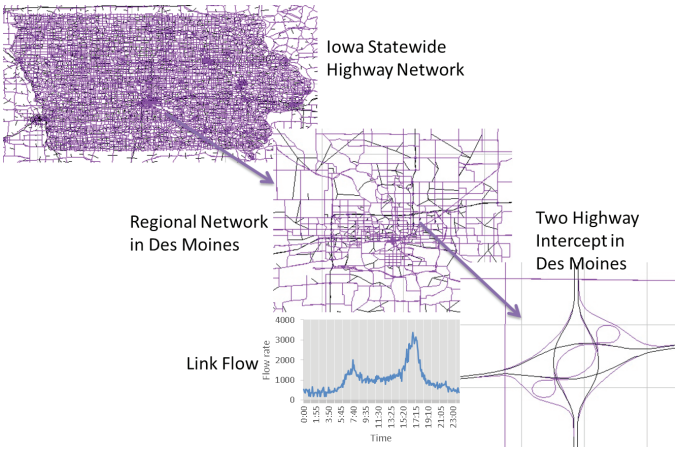
Airport Drop-off and Pick-up Charges for Private Autos
PI: Ray Mundy, UMSL

Through its Center for Transportation Studies, the MTC's partner organization UMSL is researching the growing practice in the United Kingdom of charging private as well as commercial vehicles for using an area at or near the airport entrance as a passenger drop-off or pick-up area. This practice offers a new source of revenue and is a mechanism for controlling peak time traffic at the nation's busiest airports. Its growing popularity suggests that dropping off and picking up passengers for free at airports may someday become a thing of the past. Researchers are examining if and how U.S. airports may adopt a similar scheme to generate significant airport roadway funding. By charging private vehicles the same fee now charged only to taxi services, the revenues would become very substantial.

Data Driven Highway Infrastructure Resilience Assessment
PI: Guiping Hu, ISU

A transportation network can encounter various sources of threat, ranging from natural disasters, accidents, and degradation of infrastructure. To confront threats, a transportation network should have the ability to recover from disruptions. This MTC project is developing a robust optimization model

to assess network resilience and perform a resilient network design. The resilience assessment focuses on the worst system performance. It identifies the worst case of disruption for a transportation network and conducts a network flow analysis. A bilevel programming model identifies the worst case, and an efficient algorithm is developed to solve the problem. Network expansion is conducted based on resilience assessment. A trilevel model will be formulated to find the most resilient network design. This project will continue in Phase II.



Flow of resiliency assessment/optimization model

Improving Striping Operations through System Optimization

PI: Ronald McGarvey, UMC

Each year, the Missouri DOT paints stripes (edge/lane lines) on over 30,000 miles of its road network. The Missouri DOT would like to reduce deadhead miles, or the distance that road striping crew vehicles must travel while not actively striping roads, which would reduce the cost of striping operations and improve the utilization of its striping equipment. This project has developed a decision support tool to optimize road striping operations. This tool is particularly useful for responding to schedule disruptions (e.g., chip seal operations not being completed on scheduled date) and facilitating "what-if" analyses (e.g., examining the impact of changing resource levels for striping operations).

Economic Sustainability of Inner City Streets: A Collaborative Transportation and Safety Model (Ph II)

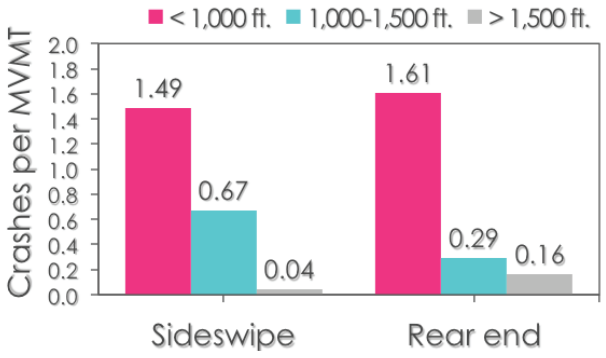
PI: Fara Zakery, Harris-Stowe State University

Building on Phase I and continuing to collaborate with other research institutions, the research team is identifying additional community groups to expand the streets project, including priority groups identified by the MTC, collaborative meetings, and the St. Louis metropolitan community. This initiative highlights safety in an urban area and applies social and economic variables within the community. The target area identified in Phase I is being used in Phase II. It includes a 45-block, St. Louis inner city area. The area has been divided into six sections, and identified observational variables are being evaluated and photographed by the team. This project continues to provide outreach activities engaging various constituents: MoDOT, local government officials, aldermen, businesses, families, and additional stakeholders identified by the project. It is expected that additional representatives from government, community, and real estate organizations will participate in the study.

System-wide Safety Treatments and Design Guidance for J-Turns

PI: Praveen Edara, UMC

The Missouri DOT has implemented system-wide safety treatments across the state over the past decade, which has resulted in significant decreases in traffic fatalities and injuries. For example, the number of traffic fatalities decreased from 1,257 in 2005 to 786 in 2011. This research project supports the Missouri DOT's goal of reducing annual traffic fatalities to 700 by 2016 and the long-term goal towards zero fatalities. The project is first synthesizing the literature and state of practice on system-wide safety treatments and documenting their effectiveness. The synthesis will assist Missouri DOT in selecting system-wide treatments for future deployments. Second, this project is developing guidance on design criteria for the spacing of U-turns in a J-turn design on high-speed rural multilane highways. The J-turns are a low-cost safety treatment on rural high-speed roadways and have been shown to be effective at reducing overall crash frequency and significantly reducing the frequency of severe crashes (involving fatality or disabling injury). This guidance is being developed using various traffic volume and spacing combinations, using empirical and simulation analysis.



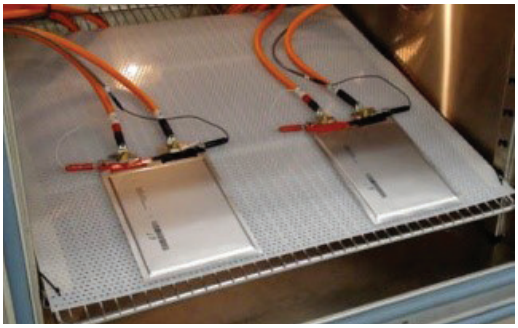
J-turn crashes as a function of spacing between U-turn and main intersection

Data-driven Health Management of Electrical Vehicle Battery Systems

PI: Pingfeng Wang, Wichita State University

Researchers are conducting theoretical and experimental investigations to develop (1) a new battery health management paradigm to predict and prevent failures of safety-critical battery systems for electric vehicles and (2) an onboard diagnostics tool and alarm system for early awareness of impending failures. A novel, self-cognizant dynamic system technique has been developed for electric vehicle battery system health management. The technique can adaptively recognize the dynamic characteristics of an operating battery system over time without relying on expensive, time-consuming battery tests for the prediction and prevention of safety-critical

battery system failures. In addition, a systematic multi-physics simulation platform has been developed for safety-critical battery failures, which can be used for electrical vehicle battery failure prognostics. Ongoing research is being conducted for the experimental validation of the developed battery failure prognostics techniques and for developing onboard diagnostics devices.



Laboratory testing of battery failure prognostics

Methodology for Assessing the Performance of Adaptive Traffic Signal Corridor Operations (MTC Partner Research Collaboration)

Co-PIs: Anuj Sharma, ISU & Ravi Nath, Creighton University

MTC affiliate researchers at ISU and Creighton University are collaborating on a new research project initiated during this reporting period: Methodology for Assessing the Performance of Adaptive Traffic Signal Corridor Operations Using Stream, Batch, and Sample Analytics—A Case Study on Dodge Street Corridor, Omaha. This project will benefit investment programming for future potential corridors. The study will develop techniques for adaptive control evaluation that will be used to evaluate the traffic adaptive signal system to be installed along Dodge Street in Omaha, Nebraska.

Other Research-Related Activities

SWZDI/MTC Focus Group

The MTC and the Smart Work Zone Deployment Initiative co-sponsored a work zone research focus group meeting on April 15, 2015, in St. Joseph, Missouri, with 17 attendees from ISU, University of Nebraska, University of Wisconsin–Madison, the Iowa DOT, UMC, St. Louis University, Missouri University of Science & Technology, FHWA, University of Wisconsin–Milwaukee, and the Missouri DOT. The group identified more than 50 priority research and outreach topics related to work zone technologies that can be incorporated into SWZDI request for proposals.

New Bio-Polymer Processing Facility

Co-PI: Chris Williams

Oil-based polymers may someday be replaced with environmentally friendlier bio-polymers made from soybeans grown in Iowa and the Midwest. The idea has taken a major step forward with the opening of the new $5.3 million Bio-Polymer Processing Facility, located west of Ames at Iowa State's BioCentury Farm. The result of an ISU–industry partnership, and with some matching funds provided by MTC, the pilot plant-scale facility was built by Argo Genesis Chemical LLC, a sister company of Seneca Petroleum Co. Inc., of Crestwood, Illinois. The facility is a sophisticated combination of pipes, hoses, electronics, and large tanks that will produce about 1,000 pounds of bio-polymers daily.

MTC co-PI, Chris Williams, at the new bio-polymer processing facility

Regional Research Competition

The MTC opened up the competition for UTC research funding to non-partner institutions within Region 7. During this reporting period, three research projects were selected for funding and initiated: Intelligent Data Driven Health Monitoring and Damage Detection of Concrete Bridge Girders Using Hand-held Mobile Devices (PI: Hayder Rasheed, Kansas State University), Crash Modification Factors for Lane Departure Countermeasures in Kansas (PI: Sunanda Dissanayake, Kansas State University), and Improving Traffic Safety through Better Snow Fences: Image-based Methods to Measure Trapped Snow Volume and the Snow Relocation Coefficient (PI: George Constantinescu, University of Iowa).

B. Outreach/Technology Transfer

Roadside Safety Basics for Local Agencies, September 24, 2015, St. Joseph, Missouri

15 participants

This half-day course, co-sponsored by the MTC and the National Center for Rural Road Safety, provided a basic overview of roadside safety for state and local engineers involved with safe roadside issues. The roadside safety problem in the United States was defined, and countermeasures to keep vehicles on the road were discussed. The provision of a recovery area was also described, including discussions of clear zones and objects within it. The basics of safety design for drainage features and sign support were covered. Fifteen participants from Iowa, Kansas, and Nebraska attended. Support from MTC allowed attendees to participate at no charge.

66th Annual Missouri Traffic and Safety Conference: May 12–14, 2015, Columbia, Missouri

200+ participants

The conference and seminars were managed by Charlie Nemmers of MTC/UMC in partnership with the Missouri DOT and the Governor's Safety Office. In addition to MTC/UMC partners in attendance, there was an MTC-affiliated presentation by Harris-Stowe State University.

Conference on Robotic and Autonomous Construction of Infrastruture: June 2–3, 2015, Ames, Iowa
118 participants

This first-of-its-kind event attracted international industry, government, and academic stakeholders. Attendees represented 14 states, England, Switzerland, and the U.S. Army Engineer Research and Development Center. Supported by an MTC-funded research project and other partners and organized by the Center for Earthworks Engineering Research at ISU, this event offered 21 presentations and a panel discussion.

CARCI sessions generated discussion

2015 Mid-Continent Transportation Research Symposium, August 19–20, 2015, Ames, Iowa
365 participants

The planning committee's year-long preparation paid off: The 2015 MCTRS—the 10th such event hosted by ISU since 1996 and co-sponsored by the MTC—drew a near-record turnout and showcased several new activities. The 365 attendees represented local (county and city), state, and federal agencies, industry, and universities from 11 states and Canada. Seventy-eight students from the partner institutions also attended. Personnel from all MTC partner institutions attended the event.

The symposium program featured 24 concurrent sessions with nearly 80 presentations, and a poster session/reception with 30 posters. Federal Highway Administration presenters included Francine Shaw-Whitson and Tashia Clemons from the Office of Transportation Performance Management in Washington, D.C. Paul Trombino III, director of the Iowa DOT and president of AASHTO, was the keynote speaker. Director Trombino and Michael Crum, vice president of economic development and industry relations at ISU, both spoke on the importance of research in economic development.

New this year was a special focus on implementation, with five sessions featuring discussions on moving research results into practice (sidebar). Also new was a special session advancing workforce development initiatives (page 10). And the MTC held its first advisory board meeting in conjunction with the symposium (page 15).

2015 Symposium Focus: Changing Practice

With its implementation-focused theme—Today's innovation, tomorrow's best practice—this year's event emphasized moving research into practice. In selecting papers to be presented, the planning committee used implementation readiness as one of the abstract evaluation criteria. In addition, in five concurrent sessions "implementation champions" led discussions on deployment issues related to one of the presentations. The following topics presented by researchers from Iowa, Texas, and Wisconsin were discussed:

- "Can signs be too bright on rural highways?"
- "Pavement treatment selectin tool for Iowa local agencies"
- "Oversize-overweight permit mapping and analysis project in Wisconsin"
- "Road diet guideline overview"
- "Laboratory investigation of warm-mix asphalt performance with select bio-derived/chemical additives in the Midwestern United States using AASHTOWare Pavement ME Design"

"Departments of transportation are in constant [need] of innovation. . . . [I]t is even more imperative that the resources being invested in research and the results of applied research be made available to practitioners for implementation."
—Mark S. Bush, Senior Program Officer, Cooperative Research Programs, Transportation Research Board

"First time attending, will attend again."
"Excellent symposium on all regards, subjects, speakers, and facilities."
"Length of presentations and management of time for questions was great."
"[Appreciated] discussions of various opinions on research, best practices, and implementation."
—Anonymous comments from symposium evaluations

The symposium provided opportunities to meet with peers

C. Education

Study Abroad in Istanbul

Transportation engineering is an increasingly global profession. To provide students with an international educational experience and enhance their global perspective regarding transportation, the MTC led the development of a study abroad opportunity at Boğaziçi University in Istanbul, Turkey, in May 2015. Ten students participated. Four MTC–affiliated faculty led the instruction.

The two-week course, entitled "Advanced Topics in Transportation Engineering," helped students prepare for careers in engineering firms and academia as well as in government and the non-profit arena. Through intensive classes, students gained an understanding of the impacts of different engineering, historical, cultural, social, economic, ethical, environmental, and political conditions on the design and construction of various infrastructure projects outside the United States. Taking advantage of Istanbul's varied public transit system, they made field trips to one of the largest airport construction projects ever undertaken, the regional transit center, and several ancient civil engineering projects including the Haggia Sophia, Roman walls, aqueducts, and an underground cistern.

A similar course is being planned for May 2016 in Rome, Italy. On September 8, 2015, the MTC hosted an informational booth at the International Study Abroad Fair at ISU.

Study abroad students and faculty at the Bosphorus Bridge construction site

Principles of Transportation Engineering (CE 355)

During the spring and summer of 2015, ISU faculty (led by MTC educational coordinator Peter Savolainen) redeveloped the introductory transportation engineering course in the civil engineering curriculum. The course—CE 355: Principles of Transportation Engineering—was converted to a "flipped course" as part of ISU President's Flipped Classroom Initiative (PFCI). As a flipped course, the traditional lecture content is provided through video lectures, and traditional outside-of-classroom content, such as homework, is brought into the classroom as practical, hands-on problems. The video lecture content for CE 355 will be used by other undergraduate and graduate courses at ISU and will also be disseminated to other universities as a part of MTC's educational outreach activities.

MTC Transportation Scholars

The MTC continues to sponsor and manage the Transportation Scholars program at ISU, UMC, and UMSL. Following ISU's land-grant tradition of a "learning laboratory" approach to education, the program enriches qualifying students' academic careers by immersing them in research, networking opportunities, and other activities beyond their regular coursework. Students selected as Transportation Scholars are required to do the following:

- Maintain a 3.0 grade point average.
- Participate in a research project or research group (MTC assistantships are provided).
- Attend the weekly Seminar in Transportation (CE 691, described below).
- Participate in one or more transportation student organizations.
- Participate in student research paper/poster contest(s).

In addition, Transportation Scholars are strongly encouraged to do the following:

- Participate in the weekly Transportation Graduate Student Research Seminar during the fall semester (see below)
- Present research results at a conference or through a journal article.
- Mentor other students or participate in K–12 workforce development activities.
- Participate in the Leadership Institute, a set of online self-directed courses for public agency managers.

Seminar in Transportation (TRANS 691) (ISU, UMC, UMSL)

Led by MTC director Shauna Hallmark, the "Tom Maze Transportation Seminar," presented weekly during the spring semester, features nationally and internationally recognized speakers who present on timely transportation-related topics and interact with the students. The seminar is broadcast online in real time to students at MTC partner institutions; the broadcast location rotates among ISU, UMC, and UMSL. Presentations are recorded and made available via the MTC website. During spring 2015, students participating in the seminar series were responsible for helping develop the curriculum for the Transportation Institute (page 13).

Spring Seminar Speakers (during reporting period)

Date: April 3, 2015
Participants: 56
Speakers: Jim Noble and Ron McGarvey, Department of Industrial and Manufacturing Systems Engineering, University of Missouri
Topic: Center for Excellence in Logistics and Design

Date: April 10, 2015
Participants: 76
Speaker: Jiangping Zhou, Department of Community and Regional Planning, ISU
Topic: Big Data and Collaborative Research Via a Visual Lab: The Strength of Weak Ties

Date: April 17, 2015
Participants: 81
Speaker: David Yang, Federal Highway Administration
Topic: Human Factors Research

Date: April 24, 2015
Participants: 54
Speaker: Shawn Leight, CCB Consulting Engineers
Topic: Practicing Traffic Engineer Looks into the Future

Date: May 1, 2015
Participants: 67
Speaker: Nir Keren, Department of Agricultural and Biosystems Engineering, ISU
Topic: Human Factors, Naturalistic Behavior, and Virtual Reality

Fall Transportation Graduate Student Research Seminar (ISU)

NEW THIS YEAR

A new MTC initiative at ISU is the weekly Transportation Graduate Student Research Seminar through the transportation division of the Department of Civil, Construction, and Environmental Engineering, led by MTC faculty affiliate Peter Savolainen. Graduate students in transportation (all MTC Transportation Scholars this fall) present their research results, allowing them to develop their presentation skills and receive feedback from other students and faculty on their research. Each transportation student must participate in this seminar at least once during their degree program. Periodically, the series will also include presentations from faculty members and other invited speakers. The following presentations have been made during the current reporting period:

Fall Seminar Presenters (during reporting period)
Date: August 28, 2015
Participants: 38
Speaker: Peter Savolainen, ISU Faculty
Topic: Seminar Orientation Session

Date: September 4, 2015
Participants: 42
Speaker: Timothy Barrette, ISU Graduate Student
Topic: Estimation of Safety Performance Functions for Urban/Suburban Intersections

Date: September 11, 2015
Participants: 39
Speaker: Georges Bou-Saab, ISU Graduate Student
Topic: High Friction Surface Treatment for High Crash Locations: Site Selection Process

Date: September 18, 2015
Participants: 38
Speaker: Navid Shafieirad, ISU Graduate Student
Topic: Modeling Freight Transportation Network under Disruption

Date: September 25, 2015
Participants: 40
Speaker: Emira Rista, ISU Graduate Student
Topic: Work Zone Safety Performance: A Comparison of Alternative Traffic Control Strategies

Transportation Student Association

MTC Transportation Scholars can meet several requirements of the program through membership in the Transportation Student Association (TSA), ISU's student chapter of the Institute for Transportation Engineers (ITE). The TSA provides a multidisciplinary (engineering, design, and business) forum for promoting student involvement in transportation research. TSA currently has 44 members and one faculty advisor: MTC affiliate and assistant professor of civil, construction, and environmental engineering Jing Dong. During the current reporting period, the TSA had several major accomplishments:

- For the third consecutive year the TSA won the Outstanding Student Chapter Award in the Missouri Valley Section of ITE (MOVITE).
- TSA members Georges Bou-Saab (president) and Amrita Goswamy won first and second place, respectively, in MOVITE's best research poster and best research paper competitions.
- In June 2015, three of 10 TSA members who attended ITE's Midwestern District meeting competed in the Collegiate Traffic Bowl and, for the second consecutive year, TSA walked off with the win. Their prize included financing to travel to the national finals in Hollywood, Florida, August 2–5, 2015.
- TSA members Ellen Nightingale and Patty Thompson were awarded highly competitive Dwight D. Eisenhower Transportation Fellowships.
- Members recruited 14 new members after making presentations and generating interest at several venues.

"Your students are doing an incredible job of conducting activities on campus . . . and their research is phenomenal."
—Michael S. Hofener, 2016 MOVITE President

Missouri Traffic and Safety Conference

The MTC's Transportation Scholars at UMC assisted with preparations for the 66th Annual Missouri Traffic and Safety Conference in Columbia, Missouri (page 6). The MTC also sponsored the attendance of 10 Transportation Scholars, six of whom participated in the poster competition. Graduate student Roozbeh Rahmani and undergraduate research assistant Paige Martz earned first place, and graduate students Amir Khezerzadeh and Tim Cope took second.

2015 Spring Meeting, Center for Excellence in Logistics and Distribution

The UMSL sent three students to this event in Fayetteville, Arkansas, on April 8–9, 2015.

National Research Day: Posters on the Hill

Paige Martz, civil engineering senior at UMC, was one of 60 undergraduate students from about 500 applicants nationally selectd to present her research and a poster in Washington, D.C., on April 23, 2015. Her topic was Diverging Diamond Interchanges."

Paige Martz

ITS America 25th Annual Meeting

Chris Fitzpatrick, a graduate civil engineering student at UMC, won the ITS America essay contest. He earned $1,500, an expenses-paid trip to the ITS America Annual Meeting and Exposition in Pittsburgh and the opportunity to present his essay during the exposition.

Chris Fitzpatrick

D. Workforce Development

Research Experience for Teachers (RET)

For the second year, the MTC at ISU is participating in RET, a program offered by ISU's Center for Biorenewable Chemicals (CBiRC) and funded by the National Science Foundation. The program provides an opportunity for public school teachers to work on active projects, building their knowledge base and science/engineering skills, which they can then use in their own classrooms.

During summer 2015, Shauna Hallmark and Peter Savolainen hosted two high school teachers for six weeks. Craig Mohr, chemistry/physics teacher at Southeast Polk High School, worked on Hallmark's project evaluating the safety-related effects of an intersection conflict warning system. Nick Crosse, technology/engineering teacher at Johnston High School, worked on an engineering course curriculum with Savoleinen.

Midwest Transportation Workforce Center

The MTC is a member of the University of Wisconsin–Madison led MTWC, one of five regional surface transportation workforce centers funded by the U.S. DOT and FHWA, which serves Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. During this reporting period, the MTC has been involved in many activities with the MTWC:

- Developed a database of 600 transportation workforce development stakeholders in Indiana, Iowa, Kansas, and Minnesota representing 349 organizations.
- Gathered information on co-ops and internships offered by the DOTs in the region as well a list of educational resources from different universities and colleges across Iowa.
- Participated in the MTWC Strategic Advisory Meeting in Madison April 21–22, 2015. The 43 attendees identified 12 initiatives and potential partnerships in the Midwest.
- Is helping plan and identify speakers for the December 7–8, 2015, Midwest Transportation Workforce Summit in Madison. The MTC will give presentations on MTC K–12 outreach such as GO! and Teaching in the Fast Lane.
- Submitted an article on Teaching in the Fast Lane to be posted on the MTWC website.

Workforce Development Workshop at Symposium

NEW THIS YEAR

The MTC hosted a session/workshop during the August 2015 Mid-Continent Transportation Research Symposium in Ames, Iowa, highlighting the work of the Midwest Transportation Workforce Center. Symposium attendees and other stakeholders were invited; 34 people participated, including Iowa Congressman Josh Byrnes and community college representatives. The UMSL presented "Women in Transportation Field Jobs—The Hidden Asset," and the University of Wisconsin–Madison presented "Call All Transportation Stakeholders: We Have a Network to Build." Attendees were invited to participate in the December 7–8 Midwest Transportation Workforce Summit to be held December 7–8, 2015, in Madison.

Participants at Workforce Development Workshop luncheon

GO! Online Magazine

GO! online magazine has become the MTC's premier tool for informing young people about careers in transportation. Through a variety of articles, activities, and resources, GO! provides information about the variety of transportation-related careers and academic programs. Financially supported by the MTC, the GO! initiative partners with the MTC consortium universities, ISU's Department of World Languages and Cultures, the Iowa DOT, OCTA Youth Programs (in Orange County, California), and representatives from OnlineMasterPrograms.org, AffordableCollegeFoundation.org, and CollegeAffordabilityGuide.org. GO! also partners with the accelerated bridge construction–themed UTC at Florida International University, which provides one ABC–related article every quarter.

During this reporting period,

- Four new articles were published each month and promoted via Facebook and Twitter a monthly GO! e-newsletter sent to nearly 1,500 teachers and transportation professionals across the country.
- The GO! Facebook page had 256 followers; the Twitter page had tweeted 1,151 times and had 339 followers.
- The Transportation Research Board e-newsletter regularly linked to GO!.
- Significant progress was made on revamping the GO! website, with a new theme and plenty of new material for both teachers and students; the fully redeveloped site will be operational by the end of October 2015.
- A new monthly comic strip, "Dot's Adventures with Transportation," debuted in June 2015.

A panel from the new comic strip *Dot's Adventures with Transportation*

GO! Content

April	
Modes of transportation articles	Destination China Destination Switzerland Destination Peru
ABC–UTC article	Constructability is KEY!
Interview	How the video game 'DAVinCI Flight' is helping schools reach STEM education goals w/ Christopher Whitmer and Sheldon Kunkel
May	
The more you know articles	How countries are combating road fatalities Safety statistics around the world
Interview	One bike, two bikes, shared bikes: Bike-sharing program in Ames, Iowa w/ Jared Morford
June	
Going green articles	The history of re'new'able energy Who is powering our 'green' future? 'Green' alternatives to the 'gas guzzler'
Interview	'C6' virtual reality room ties in transportation research in multiple dimensions w/ Nir Keren
Webcomic	The Career Quiz
June	
Why should I care articles	Mount Rushmore without a designer? The Leaning Tower of Pisa with a civil engineer? The Statue of Liberty without construction workers?
Interview	A fight between tradition and safety w/ Brent Phares
ABC–UTC article	ABC activity: Balsa-wood bridges
Webcomic	Main Modes of Transportation around the World
August	
Articles	Village by village: Rural Living Town by town: Suburban living City by city: Urban living
Interview	Taking traffic tracking to the next level w/ Neal Hawkins and Mike Jackson
Webcomic	Buckle Up for Safety
September	
Movies in motion articles	Transportation in The Matrix and Transformers Transportation in Interstellar Transportation in Titanic
Interview	Creating passages to new worlds w/ Stacey Weber-Fève
Webcomic	Re'new'able Energy

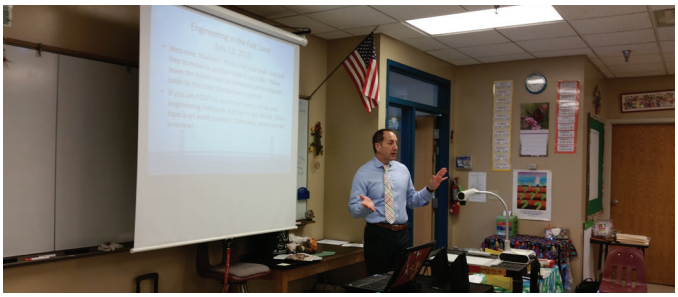
Teaching in the Fast Lane: One-Week Summer Workshop for Elementary School Teachers

NEW THIS YEAR

Out of a pool of applicants from across Iowa, 24 elementary teachers were invited to participate in this MTC-sponsored workshop; many of them had little if any knowledge of engineering. The week-long event introduced teachers to the field of engineering, engineering concepts, and engineering professions, with the goal of equipping them to enrich their own classrooms and raise awareness and enthusiasm about engineering among young students. The program included presentations from ISU and Iowa DOT engineers and educators, hands-on activities (including some from the AASHTO RIDES kit), and field trips. Feedback has been very positive:

"I am amazed at the different types of engineering there are and how so many intertwine with my class. I will use civil engineering as an example then branch off to transportation, environmental, geotechnical and structural."
—Joni McConnell, 2nd grade teacher, Greenwood Elementary

"I had a general idea before this class started that engineers are problem solvers who love tackling challenging projects, but I really had no idea how the process worked or how specialized it can be. I had never really considered how I could work the terms engineer or engineering into my classroom vocabulary, but now I intend to use them as much as possible."
—Dan Loy, 4th grade teacher, Beaver Creek Elementary



Paul Trombino III, Iowa DOT director and newly elected president of AASHTO, speaks during Teaching in the Fast lane

Teaching in the Fast Lane participants learn about bridge testing in the field

GO! Further: Five-Day Summer Workshop for High School Students

NEW THIS YEAR

Nineteen students participated in the MTC's five-day GO! Further workshop in June and July 2015. The students were introduced to the professional world of engineering, completed hands-on activities to develop leadership skills, and learned how to effectively work in teams. The workshop was facilitated by Maureen Griffin, Hoover High School, Des Moines, Iowa.

To ensure a diverse group of participants was selected to participate, the MTC collaborated with the Science Bound program, which partners with schools to increase the number of ethnically diverse Iowa students who pursue STEM careers. Materials about GO! Further were sent to Science Bound leaders to distribute in high schools throughout central Iowa. Efforts to recruit students for next summer's programs will be made in collaboration with WISE (Women In Science and Engineering) staff at ISU to appeal to young women around Iowa.

GO! Further participants

GO! Further participants learning about traffic operations lab at MTC/ISU

1st Annual Missouri Bridge Conference, April 9, 2015, Columbia, Missouri

This inaugral conference provided a forum for bridge engineers to hear from leaders in their profession, discuss best practices, learn about new bridge engineering technologies, and more. One hundred thirty people attended, representing the American Council of Engineering Companies, the Missouri DOT, the UMC, and the Society of Women Engineers. Five UMC MTC Transportation Scholars entered the poster competition, and Pedro Fabian of UMC won second place.

Transportation Institute: One-Week Summer Workshop for High School Educators

NEW THIS YEAR

At this event sponsored by the MTC and the Iowa DOT, 12 high school instructors from across Iowa explored a broad range of educational activities relating to transportation suitable to integrate into high school physics curricula and after-school STEM programs. Workshop facilitator Shannon McLaughlin (high school physics teacher, Norwalk, Iowa, High School) guided participants in relevant content and pedagogy to help them gain a better understanding of transportation concepts associated with physics, supplemented with presentations from staff and faculty from the Iowa DOT and ISU. The goal is for teachers to use this knowledge to integrate transportation-related activities into the classroom and after-school programs.

Participating teachers took pre- and post-content knowledge tests about the goals of science, engineering, and technology; historical examples of science, engineering, and technology; and reasons why students might be confused about the goals of science, math, engineering, and technology. Educators scored significantly higher on the post-program test compared to pre-program scores.

Tranportation Institute participants practiced several hands-on activities

Young Engineers and Scientists (YES)

NEW THIS YEAR

The MTC and ISU's Center for Biorenewable Chemicals are collaborating on the YES program. A partnership with central Iowa high schools, the YES program offers a research internship to accepted applicants. For a semester, participating students leave school early to work on a research project for at least nine hours a week under the supervision of a faculty mentor and/or graduate student. At the end of the semester, each student prepares a poster outlining his or her research to present at the YES reception.

During this reporting period, Anuj Sharma mentored Jacob Hoss (junior, Ames) on a project involving 3D-visualization of travel delay on Iowa freeways and expressways. Shauna Hallmark and Brent Phares mentored Rachel Junck (sophomore, Ames) and Jacob Ramsey-Smith (junior, Marshalltown), who worked on projects involving intersection conflict warning systems and bridge joint and concrete testing, respectively.

ICTM-ISTS Math and Science Conference

Date: September 21, 2015
Participants: 678
Location: Valley High School, West Des Moines, Iowa
Theme: STEM Related Teaching Tools and Methods for K-12 Teachers
Participants: K–12 Formal and Informal Educators

The MTC hosted a booth at the Iowa Council of Teachers of Mathematics (ICTM)/Iowa Science Teaching Section of the Iowa Academy of Science (ISTS) conference for science and math teachers. The goal was to promote the use of hands-on, transportation-related learning activities in the classroom. Information regarding the STEM-aligned AASHTO TRAC™ and RIDES courses was distributed to interested teachers to boost participation in MTC's pilot program with the Iowa DOT. The booth also helped to inform teachers about the benefits of several other MTC-sponsored resources: GO! e-magazine, summer educational opportunities for teachers and students, and opportunities for utilization of the MiniCYm transportation simulator.

MTC booth at Math and Science Conference, with Brandy Abraham, GO! coordinator

AASHTO TRAC™ & RIDES Program Implementation

NEW THIS YEAR

The MTC at ISU and the Accelerated Bridge Construction University Transportation Center (ABC-UTC) at Florida International University partnered with the Iowa DOT to pilot the AASHTO TRAC™ & RIDES programs in Iowa schools (TRAC: Transportation and Civil Engineering; RIDES: Roadways into Developing Elementary Students). Their hands-on STEM aligned activities introduce students in grades 5–12 to the work world of transportation and civil engineering and inspires them to consider careers in those fields.

Date: March 30–April 10, 2015
Participants: 21
Location: West Branch Middle School in West Branch, Iowa

Date: April 6–May 7, 2015
Participants: 22
Location: Boone High School in Boone, Iowa

In addition to the standard classroom activities associated with the Bridge TRAC™ PAC, students were able to participate

in a Skype conference with MTC faculty affiliate Brent Phares, during which he offered feedback on how to improve their bridges' structure and design. Students then held a panel discussion and presentation with three engineers from the Iowa DOT and one from the Bridge Engineering Center, of which Brent Phares is the director.

Date: April 14, 2015
Participants: 12
Location: Parkview Middle School

Parkview students developed a bridge competition as an after-school activity in conjunction with using the TRAC™ PAC, which gave them the opportunity to connect with local engineering professionals. The MTC provided recognition certificates for the event. This format was replicated in the summer "Teaching in the Fast Lane" workshop for elementary teachers (see page 12).

MiniCym Activities

Date: May 1, 2015
Participants: 23 7th grade students from Prairie Ridge, Iowa, Middle School
Location: Ames, Iowa

Students participated in research for their class science projects, allowing them to make real-world connections to research being conducted at ISU. As part of the day's events, the MTC at ISU hosted participating students at the MiniCym, a portable driver simulator housed in a trailer. Hands-on experience with the simulator helped the students develop a greater awareness of transportation-related career opportunities.

College of Engineering Day for Kids

Date: April 12, 2015
Participants: 78 Missouri elementary students in grades 3–5
Location: Columbia, Missouri

The UMC's College of Engineering's Engineering Day for Kids is a free opportunity for third, fourth and fifth grade students to learn about civil engineering. During the event, students will learn about the different types of engineering, what engineers do, and what college is like for an engineering student.

STEM Learning Jet/Technology and Engineering Curriculum (Seward County Community College)
NEW THIS YEAR

Date: June 15–18, 2015
Participants: 24 middle and high school teachers from Kansas and Missouri
Location: A B727 jet at the Mid-America Air Museum, Liberal, Kansas

Seward County Community College is offering a new Technology and Engineering Curriculum, which will be enhanced by activities in a unique and innovative classroom inside a Boeing 727 jet—the STEM Learning Jet. In addition, through funding provided by the MTC, the STEM Learning Jet and a special curriculum will be available to middle and high school students and their teachers for on-site learning activities. The goal is to improve students' proficiency in STEM subjects and encourage female and minority students to choose STEM careers. In June 2015, 24 public school teachers toured the facility and participated in a workshop to help them teach the curriculum to their students.

STEM Learning Jet classroom under construction Tranportation Institute participants practiced several hands-on activities

E. Center Management

Partner Institution Site Visits

During this reporting period, the MTC ISU team made three additional site visits to collaborator and partner institutions: Seward County Community College on May 6, 2015; Wichita State University on May 6, 2015; and Creighton University on September 28. Each institution provided a tour of its facilities, gave an overview of its MTC programming and accomplishments, provided research presentations and updates, discussed ideas for collaborating with other MTC partner institutions, and held meetings with affiliate faculty, administrative staff, and students.

The ISU MTC staff and hosts at Wichita State University

First MTC Advisory Council Meeting

NEW THIS YEAR

The goal of the MTC advisory council is to provide the leadership team with feedback on its activities, provide input as to research direction and priorities, and help ensure that the MTC achieves its vision and strategic goals. At its first meeting, held on August 20, 2015, in conjunction with the Mid-Continent Transportation Research Symposium (page 7), the MTC advisory council joined with representatives of the MTC partner universities and faculty affiliates to discuss the MTC's programming.

MTC director Shauna Hallmark emphasized the importance of implementable research. She described the MTC's process for soliciting and awarding research proposals and the specific requirements for every funded project. Overviews of selected projects at ISU and each of the partner institutions were provided. Opportunities to develop training workshops based on implementable research results in conjunction with partner states' Local Technical Assistance Programs (LTAPs) were suggested. In addition to research, the MTC's initiatives in education, outreach, and workforce development were introduced and opportunities for more collaboration were discussed.

Soon after the MTC won the Region 7 UTC grant, key professionals with expertise and experience in various aspects of state and regional transportation issues were invited to participate on the advisory board. Members who attended the August meeting were David Ahlvers, Missouri DOT state construction and materials engineer; Michael Crum, ISU vice president for economic development and business relations; King Gee, AASHTO director of engineering and technical services; Scott Smith, retired CEO of HNTB Infrastructure; and Paul Trombino III, director of the Iowa DOT and president of AASHTO.

MTC advisory council and staff

Quarterly Partner Meetings

MTC leadership at ISU and its partner institutions have teleconference team meetings on the first Tuesday of every quarter. The goal is to identify commonalities among institutions, leverage funding for similar activities, and identify opportunities to collaborate. These conversations have been productive. For example, representatives from all partner institutions participated in the Mid-Continent Transportation Research Symposium (page 7), and a joint research opportunity for MTC faculty affiliates at ISU and Creighton University was identified (page 6).

Site Visit to ABC–UTC

Director Shauna Hallmark and other staff from the MTC at ISU, along with Brent Phares, director of ISU's Bridge Engineering Center and co-director of the ABC–UTC at Florida International University (FIU), visited FIU on September 23, 2015. The goal was to meet with other ABC–UTC staff and discuss opportunities for MTC/ABC–UTC collaborations. Possible activities include joint sponsorship of implementation workshops, involving ABC–UTC students in the weekly seminar series at ISU, and perhaps sponsoring a focus group on State of Good Repair. The two organizations also compared K–12 activities and discussed opportunities to share resources.

Plan for Showcasing MTC Products

The ISU management team met in June 2015 and developed a plan for enhancing marketing and showcasing activities through the development of impact briefs and other special publications, enhancements to the website including the use of social media, and systematic processes for completing biannual and annual reports to OST-R.

How were results disseminated?

In general, information about the MTC and its activities, particularly for the purpose of enhancing public understanding, increasing interest in transportation careers, and advancing technology transfer, was disseminated via the following channels:

- GO! online magazine for teens
- MTC e-newsletter
- Website
- Conference papers and presentations, including presentations at the Mid-Continent Transportation Research Symposium (page 7)
- Impact statements/project summaries distributed at the symposium and various other events
- Legislative brief (July 2015) to share information about the MTC at the national level
- Research reports
- Most of the activities described under Outreach/Technology Transfer (page 6) and Workforce Development (page 10)

The presentations from the 2015 Conference on Autonomous and Robotic Construction of Infrastructure were distributed in the proceedings of the same name. Print copies were provided to all attendees; both PDF and EPUB versions are available and additional print copies can be ordered online (www.ceer.iastate.edu/CARCI/proceedings/).

Detailed, itemized information about many of the above activities is provided in the annual performance metrics report to OST-R, U.S. DOT.

What activities are planned for the next reporting period?

The following activities are planned for the next reporting period:

Center Management
- Continue to hold regular teleconferences with team members
- Develop a plan for better showcasing MTC products/activities

Research
- Continue to monitor progress of the research program
- Implement Year 3 research program

Education
- Plan the summer 2016 study abroad program and encourage student participation; includes conducting an informational meeting for the program
- Assess and update the undergraduate research program
- Identify the student of the year for 2016
- Track Transportation Scholar participation in required and recommended activities

Workforce Development/Diversity
- Hold a K–12 bridge contest in conjunction with the Iowa Science Center (November 2015)
- Continue producing content for GO! magazine
- Plan summer 2016 workforce development activities and solicit participants: Research Experience for Teachers (RET), Transportation Institute, GO! Further, Teaching in the Fast Lane, etc.

Outreach
- Develop brochures to highlight the impact of three research projects
- Develop research implementation workshops in conjunction with University of Minnesota and Florida International University
- Hold meeting to discuss collaboration between LTAPs in Region
- Hold research implementation planning meeting with Iowa DOT
- Hold implementation workshops in conjunction with Florida International University (Tier 1 UTC) and University of Minnesota (Region 5 UTC)

2. Products

In addition to products and activities discussed in Section 1, the MTC has generated and/or funded the following products:

Presentations (in chronological order)

- McGarvey—Center for Excellence in Logistics and Distribution Spring Meeting, Atlanta, Georgia, April 8–9, 2015
- Turkan—Workshop on 3D Design and Modeling for Highway Structures, Bridge Engineering Center, Ames, Iowa, April 15, 2015
- Mundy—Airport Ground Transportation Association Conferences, Miami Beach, Florida, April 19–22, 2015, and August 2015
- Shafei—ASCE Structural Engineering Institute Structures Congress, Portland, Oregon, April 23–25, 2015
- Yodo—Institute of Industrial Engineers Annual Industrial and System Engineering Research Conference, Nashville, Tennessee, May 30–June 2, 2015
- Laflamme/Turkan/Tan—Conference on Autonomous and Robotic Construction of Infrastructure, Ames, Iowa, June 2–3, 2015
- Vennapussa—Conference on Autonomous and Robotic Construction of Infrastructure, Ames, Iowa, June 2–3, 2015
- D. White—Conference on Autonomous and Robotic Construction of Infrastructure, Ames, Iowa, June 2–3, 2015
- Bai/P. Wang—Institute of Electrical and Electronics Engineers Annual Conference on Prognostics and Health Management in Austin, Texas, June 22–25, 2015
- Dai—European Control Conference, Linz, Austria, July 17, 2015
- Yodo/P. Wang—American Society of Mechanical Engineers 2015 International Design Engineering Technical Conference and Computers and Information in Engineering Conference, Boston, Massachusetts, August 2–5, 2015
- Dong—6th International Symposium on Transportation Network Reliability, Nana, Japan, August 2–3, 2015
- Cantor—Arizona State University, 2015 Logistics Doctoral Symposium, Tempe, Arizona
- Alipour (3 presentations); Aldemir Bektas; Bai; Brown/Sun/Praveen (2 presentations); Cantor; Dong; Jeong; Hu; Mondy; Mundy (5 presentations); Salim (2 presentations); Shafei (2 presentations); Smith; P. Wang; Zakery—Midcontinent Transportation Research Symposium, Ames, Iowa, August 19–20, 2015
- Iowa State University—13 poster presentations for the Midcontinent Transportation Research Symposium, Ames, Iowa, August 19–20, 2015
- University of Missouri–Columbia—10 poster presentations for the Midcontinent Transportation Research Symposium, Ames, Iowa, August 19–20, 2015
- University of Missouri–St. Louis—1 poster presentation for the Midcontinent Transportation Research Symposium, Ames, Iowa, August 19–20, 2015
- Brown—Missouri Valley Institute of Transportation Engineers, St. Louis, Missouri, September 24, 2015

Articles and Papers

- Bai/P. Wang—Journal of Power Sources, 2015
- Mundy—Spotlighted in special report of the Airport Industry Review online magazine
- Nemmers—Articles in the Fall/Winter 2014 and Spring/Summer 2015 issues of Mizzou Engineer
- Yodo/P.Wang—Journal of Mechanical Design, 2015
- White—May 2015 UTC Spotlight newsletter (www.rita.dot.gov/utc/publications/spotlight/spotlight_2015_05)

Other Products

- Gopalakrishnan—Pavement image crack detection algorithms
- Jeong—Integrated databases for raw pavement condition data
- McGarvey—GIS Database and Decision Support Tool (Optimization Model)
- D. White (editor)—Proceedings of the 2015 Conference on Autonomous and Robotic Construction of Infrastructure (print, PDF, and EPUB versions) (www.ceer.iastate.edu/CARCI/proceedings/)
- Williams—Bio-Polymer Processing Facility at ISU's Bio-Century Farm

3. Participants and Collaborating Organizations

The MTC utilizes many colleges, departments, and centers at ISU as internal partners: Civil, Construction, and Environmental Engineering; National Concrete Pavement Technology Center; Center for Transportation Research and Education; Bridge Engineering Center; National Center for Wood Transportation Structures; Center for Earthworks Engineering Research; Engineering Research Institute; Aerospace Engineering; Center for Weather Impacts on Mobility and Safety; Electrical and Computer Engineering; Business and Finance; Statistics; Industrial and Manufacturing Systems Engineering; Chemical and Biological Engineering; Center for Biorenewable Chemicals; Food Science and Human Nutrition; Supply Chain and Information Systems; Landscape Design; Agricultural and Biosystems Engineering; and the Virtual Reality Application Center.

Collaboration with external partners takes many forms. For example, MTC director Shauna Hallmark evaluated a final report for the Southeastern Transportation Research, Innovation, Development and Education Center, Region 4 UTC at the University of Florida. Other collaborative efforts with external entities (other than collaborations among MTC partner universities) are summarized in the following table:

Summary of Collaborative Activities

External Partners/Collaborators	Partner Type	State/Country	Financial Support	In-Kind Contributor	Research Collaborator	Facilities	Personnel Exchange	Materials	Data
ABC–UTC at Florida International University	University	Florida	X		X		X		
Ann L. Schneider & Associates, LLC	Industry	Missouri			X				
Argo Genesis,	Industry	USA	X						
Arizona State University	University	Arizona			X				
Asphalt Paving Association of Iowa	Industry	Iowa			X				
BASF	Industry	Iowa						X	
Caterpillar	Industry	USA	X						
City of Belton	Government	Missouri			X				
City of Chesterfield	Government	Missouri			X				
City of Columbia	Government	Missouri	X		X				
City of Grandview	Government	Missouri			X				
Collins Engineering	Industry	Missouri			X				
Consulting Engineers Association	Industry	Missouri			X			X	
Costello & Associates, Inc.	Industry	Missouri			X				

External Partners/Collaborators	Partner Type	State/ Country	Financial Support	In-Kind Contributor	Research Collaborator	Facilities	Personnel Exchange	Materials	Data
Creative Visions Human Development Institue	University	Iowa			X				
Embry-Riddle Aeronautical University	University	Florida			X				
Federal Highway Administration	Government	USA			X				
HDR Consultants	Industry	Missouri			X				
HR Green	Industry	Iowa			X				
Illinois Department of Transportation	Government	Illinois			X				
Illinois State Highway Patrol	Government	Illinois			X				X
International Association of Transportation Regulators	Non Profit	Canada			X				
Iowa Department of Transportation	Government	Iowa	X					X	X
Iowa Counties (Various)	Government	Iowa			X				
Iowa Highway Research Board	Government	Iowa	X		X				
Kansas Department of Transportation	Government	Kansas							X
Kansas State Highway Patrol	Government	Kansas							X
Lambert Airport	Industry	Missouri		X			X		X
Liberal High School	School	Missouri					X		
Metropolitan Taxi Comission	Industry	Missouri	X	X					
Mid-American Air Museum Foundation	Non Profit	Kansas				X			
Midwest Transportation Workforce Center (UTC)	University	Wisconsin			X				
Missouri Counties (Various)	Government	Missouri			X				
Missouri Department of Transportation	Government	Missouri	X						X
Missouri State Highway Patrol	Government	Missouri			X				X
NASA Ames Research Center	Government	California			X				
National Advanced Driving Simulator	University	Iowa			X				
National Center for Rural Road Safety	University	Montana	X		X				
National Ilan University	University	Taiwan			X				
Nebraska Department of Transportation	Government	Nebraska							X
Nebraska State Patrol	Government	Nebraska							X
Norwich University	University	Vermont			X				

External Partners/Collaborators	Partner Type	State/ Country	Financial Support	In-Kind Contributor	Research Collaborator	Facilities	Personnel Exchange	Materials	Data
Orange County Transit Authority	Government	California							X
Road Industry Safety Consensus	Committee	Iowa			X				
Science Center of Iowa	Non Profit	Iowa			X				
Shrive Hattery	Industry	Iowa			X				
Smart Work Zone Deployment Initiative	Pooled Fund	Various States	X		X				
St. Louis Board of Alderman	Government	Missouri					X		
St. Louis Street Department	Government	Missouri			X				
Syracuse University	University	New York			X				
Terminal Railway Association of St. Louis	Industry	Missouri	X	X					
The Airport Ground Transportation Association	Industry	Missouri			X				
The Taxi, Limousine, and Paratransit Association	Industry	Missouri			X				
Transdev On Demand, Inc	Industry	Missouri			X				
U.S. Army Corps of Engineers	Government	USA			X				
Union Pacific Railroad	Industry	Missouri			X				
University of Missouri Extension	University	Missouri			X				
University of Iowa	University	Iowa			X				
University of Kansas	University	Kansas			X				
University of Maryland	University	Maryland			X				
University of Wisconsin	University	Wisconsin			X				

4. Impacts

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

The results of MTC-sponsored research conducted by faculty in transportation-related disciplines at all partner institutions fundamentally affect the understanding, teaching, and ultimately the state of the practice related to enhancing infrastructure condition, safety, and project delivery. As a consequence, the state of transportation infrastructure and operations is enhanced.

What is the impact on other disciplines?

As stated in Section 3, Collaborating Organizations, the MTC regularly partners with faculty in other disciplines and related organizations, such as Electrical and Computer Engineering; Business and Finance; Statistics; Industrial and Manufacturing Systems Engineering; Chemical and Biological Engineering; Center for Biorenewable Chemicals; Food Science and Human Nutrition; Supply Chain and Information Systems; Landscape Design; Agricultural and Biosystems Engineering; and the Virtual Reality Application Center.

These partnering activities in research and beyond serve to broaden the understanding of these disciplines to include transportation-related issues, enhancing a multidisciplinary approach to transportation-related problem solving.

What is the impact on transportation workforce development?

Although long-term impacts of the MTC's workforce development activities is difficult to quantify, a direct result of these activities is that hundreds of public school students are now being exposed to information about transportation-related careers and encouraged to pursue studies in disciplines that will help them succeed in such careers. In addition, university students pursuing transportation-related programs of study are being reinforced and challenged to higher achievements in such pursuits. For example, students who participated in the study abroad experience in Istanbul broadened their understanding of the complexities of transportation infrastructure construction and operations outside the United States to an extent that wouldn't have been possible without the MTC sponsorship.

Some of the specific numbers include the following:

- 2,178 K–12 teachers were passively reached through GO! and ICTM-ISTS conference booth
- 62 K–12 teachers and 177 K–12 students actively participated in targeted activities
- The MTC is working with the regional transportation workforce center to coordinate workforce development activities
- 52 students are participating in the MTC Transportation Scholars Program
- About 50 students participated in spring semester seminar activities
- 10 graduate students attended Study Abroad in Istanbul
- MTC supports various activities for transportation student organizations

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

See the lists in Section 2, Products. In particular, MTC funding helped support the new Bio-Polymer Processing Facility at ISU's BioCentury Farm.

What is the impact on technology transfer?

Through direct MTC sponsorship and management of workshops and conferences, more than 800 people received face-to-face training during the reporting people. See the complete discussion of Outreach/Technology Transfer in Section 1, Accomplishments (page 2), and the lists in Section 2, Products. In particular, with MTC support, the 2015 Mid-Continent Transportation Research Symposium focused on implementation-ready research results and incorporated special implementation discussions into several sessions (page 6).

What is the impact on society beyond science and technology?

MTC research has led to information that agencies utilize to improve traffic safety, reduce impact of construction, and reduce costs for agencies. Currently we are working on developing information that will allow us to quantify these impacts.

5. Changes/Problems

Nothing to report.

6. Special Reporting Requirements

Nothing to report.