



Program Progress Performance Report

To: US DOT/OST-R, University Transportation Centers

Grant Number: DTRT13-G-UTC37

Project Title: University Transportation Center-Region 7, Iowa State University

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Submission Date: April 30, 2015

Recipient Organization: University Transportation Centers

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US DOT/OST-R/mail code RDT-30

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Project grant period: September 30, 2013–September 30, 2015

Reporting period end date: March 31, 2015

Report frequency: Semi-annual

A handwritten signature in blue ink that reads "Shauna J Hallmark". The signature is written in a cursive, flowing style.

Submitting official signature: Shauna Hallmark

1. Accomplishments

Major Goals and Objectives

MTC's theme is **Data Driven Performance Measures for Enhanced Infrastructure Condition, Safety, and Project Delivery** and will address related regional issues through a strategically focused program that is synergistic with U.S. DOT priorities and MAP-21 goals and objectives, with **State of Good Repair** as the primary goal. The objectives of the MTC are to

1. Serve as a focal point within the region and nationally for research that develops data performance measures for Infrastructure Condition, Safety, and Project Delivery.
2. Ensure efficient use of funds by building on existing programs, avoiding duplication, leveraging existing resources, and developing creative cooperative activities with industry.
3. Develop products that are useful and relevant to stakeholders including regional, national, state, regional, and local transportation agencies as well as industry and other researchers.
4. Provide leadership in the next generation of technology transfer. Beginning with the research itself—involving the user, innovative outreach, and new communications technology.
5. Develop the next generation of transportation professionals and provide opportunities for current professionals.
6. Provide leadership opportunities for students and young professionals.
7. Recruit and retain a diverse workforce.

The MTC will accomplish these goals by focusing on the following activities:

1. Research (goals 1, 2, 3)
2. Education (goals 6 and 7)
3. Outreach (goals 3 and 4)
4. Workforce development (goals 5 and 6)

Accomplishments Toward the Goals

The following sections describe MTC activities during this reporting period for our four major areas: research, education, outreach, and workforce development.

Research Activities

The MTC partners have utilized year 1 and year 2 funding to further develop research projects. The Iowa State University (ISU) team worked with both Wichita State University and Creighton University to help them develop transportation-focused research programs. The University of Missouri-Columbia (UMC) and the University of Missouri-St. Louis (UMSL) worked with Harris-Stowe State University to develop its research efforts.



Research Open House Meeting (October 2014)

ISU held a research open house on October 9, 2014 to discuss details of the second round of research projects. All faculty and staff were invited to attend this event to receive additional information and ask questions about funding for future research projects.

As a result of the second-round solicitation, we received 26 proposals with a total request of over \$1.8 million and a total match of \$2.15 million. The reviews were very positive, and the reviewers were very impressed with the quality, variety, and the expertise of the proposals. The allocated research budget for this round was \$1.08 million so 16 projects were ultimately selected based on the following criteria:

- Positive review
- Closely matching the MTC theme
- Type of matching funds used (new resources, existing DOT, soft match, or a combination of multiple sources). We focused on new resources to expand the size of the program.
- Research areas represented: asset management, structures, materials, intermodal, construction, and transportation

The research projects (year 1 and 2) for ISU are listed at www.intrans.iastate.edu/mtc. Several projects are highlighted in “*Progress of Research Projects*” below.

Educational Activities

Study Abroad

Engineering students are encouraged to gain international exposure. While many ISU departments have organized study abroad programs to recruit students and provide a structured experience, ISU’s civil engineering program has not. MTC helped organize a study abroad opportunity in Istanbul, Turkey, to provide valuable international educational experiences for students. The course is titled “Advanced Topics in Transportation Engineering,” and instructors will be led by four MTC-affiliated faculty. The program is geared towards civil, construction, and environmental engineering students.

Ten ISU civil, construction, and environmental engineering students have registered to participate. The two-week course will be offered May 19–May 29 2015. The class will meet on the Boğaziçi University campus, and students and faculty from the hosting university will be encouraged to participate. In addition to class time, the students will experience infrastructure projects and functions through field trips to mega-project construction sites, public transportation operations, and ancient transportation structures.

Research Success Stories

Multi-Disciplinary Research Proposal

MTC funds were leveraged to position a group to pursue a multi-disciplinary National Science Foundation (NSF) project. Wichita State University, Kansas State University, and Iowa State University collaborated on NSF proposal “*CRISP Type 2: Collaborative Research: Multi-scale Probabilistic Design of Resilient Interdependent Power, Transportation and Food Supply Chain Networks.*” The collaboration was based on an existing MTC project. The proposal included nine senior personnel from the three partner universities.

Research Project by HSSU

Student researchers at Harris-Stowe State University under faculty supervision, conducted research to develop a sustainable Asset Management Transportation System Model. Since HSSU is a Historically black university, the team focused on inner city road conditions related to municipal asset allocation within three St. Louis City wards. The team collaborated with the Missouri Department of Transportation, the St. Louis City Street Department, local government officials, universities, and related stakeholders. Researchers presented project results at the 2015 Annual Washington Research Forum in Washington, D.C., in March 2015.

MTC Student of the Year

Timothy Cope, graduate student in civil engineering-transportation from the University of Missouri, was named MTC's 2014 Outstanding Student of the Year. Tim is a superior example of the "next generation of leaders in transportation" being supported and mentored through MTC's education programs. Tim receives his M.S. in May 2015.

Tim is involved in several research projects. For example, he assisted with data collection and analysis for the first known deployment of an audible mobile work zone alert system in the United States. Tim presented this research at the 2015 Transportation Research Board (TRB) conference in Washington, D.C.

ISU students win 2015 TRB Data Contest on Safety

A team of Iowa State University students recently received a best paper award through the 2015 TRB Data Contest. The award was presented at the 2015 TRB Annual Meeting in Washington, D.C. The team was made up of seven transportation engineering graduate students, under the direction of Associate Professor Peter Savolainen. The team received the award for its work in developing a model that accommodated several important analytical concerns common to police-reported crash data, including temporal and spatial correlation.

Students associated with the MTC have made great efforts to get involved. More than 70 students attended regional and national conferences this past semester, half of whom made presentations at these events. More than a dozen students are currently members in national professional organizations while an additional forty plus participate in professional organizations locally.

Outreach Activities

2015 Mid-Continent Transportation Research Symposium, August 19–20, 2015

Planning is underway for the 2015 Mid-Continent Transportation Research Symposium, scheduled for August 19–20, 2015 in Ames, Iowa. As suggested by this year's theme—Today's Innovation, Tomorrow's Best Practice—a major focus of the event will be on research implementation and practice-ready results.

Hosted by the Institute for Transportation and the Iowa Department of Transportation (DOT), the symposium provides an opportunity for transportation professionals from the Midwest and beyond to learn about advancements and applications in their fields as well as future directions for research. It also provides a venue for participants to network with peers. We anticipate representation from Federal agencies, State DOTs, cities and counties, private industry, and consultants. MTC is an event co-sponsor.



Timothy Cope (center) at the 2015 TRB awards ceremony for the U.S. DOT's UTC Program. With him are (left) Shashi Nambisan, president of CUTC, and Gregory Winfree, director, Office of the Assistant Secretary for Research and Technology (OST-R), U.S. DOT.



Award-winning team (pictured from left): Raha Hamzeie, Bo Wang, Amrita Goswamy, Brendan Russo, Associate Professor Peter Savolainen, Georges Bou-Saab, Emira Rista, and Timothy Barrette.

MTC partners have been submitting abstracts and will be well-represented at the conference. The MTC outreach coordinator, Keith Knapp, is discussing joint implementation webinars with Region 5 (University of Minnesota). This collaboration will allow access to a much larger audience, since the states of Region 7 and Region 5 will be combined in this effort.

Cross-Border Training

MTC outreach coordinator Keith Knapp, who is also the Iowa Local Technical Assistance Program (LTAP) director, is in the process of coordinating a pilot opportunity, “*Cross-Border Training Opportunity Program (CBTOP)*,” to share professional development across seven surrounding states. Keith is working with LTAPs for South Dakota, Wisconsin, Minnesota, Missouri, Nebraska, Kansas, and Illinois.

Many training programs require a minimum number of participants, which frequently cannot be met by individual states. Coordination allows training to be offered at a convenient location so that participants from neighboring states can attend these workshops. A regional meeting is planned for May.

Research Experience for Teachers

The Center for Biorenewable Chemicals (CBiRC) at ISU has offered “Research Experiences for Teachers” (RET), which is funded by NSF. Each participating teacher is partnered with an ISU faculty mentor with whom they will conduct research with over a six-week period during summer 2015. Teachers build on their current knowledge base and learn new science/engineering skills that they will take back to the classroom. MTC-affiliated faculty will host two teachers this summer.

Workforce Development Activities

Go! Online Magazine

Go! magazine has become the MTC’s premier tool for informing young people about careers in transportation. Through a variety of resources, *Go!* covers transportation careers from many angles, including infrastructure, safety, vehicles, and users, and provides information about transportation-related academic programs. *Go!* publishes at least four articles each month, which are promoted via our social media sites (Facebook and Twitter) as well as through our monthly newsletter (sent to over 1,000 teachers and transportation professionals). The *Go!* Facebook site currently has 241 total page “likes” (3 more than last term).

Our most popular article this term was “*How the video game ‘DAVINCI Flight is helping schools reach STEM education goals,*” which was viewed 84 times from a link posted on our Facebook site and shared over a dozen times from our webpage. Also, the article “*What do tribal communities have to do with transportation?*” was viewed by 47 users and shared by the Washington-based group “*Transportation YOU.*” *Go!* also currently has tweeted 1,117 times and has 325 followers, which is 5 more than last term.

During this term, the *Go!* website was accessed by 4,162 users (an increase of 625 from last term) who viewed 9,807 pages (an increase of 1,320). Additional outreach has been made, including partnerships with ISU’s Department of World Languages and Cultures, the Iowa DOT, MTC partner universities, OCTA Youth Programs (in Orange County, California), and representatives from OnlineMasterPrograms.org



and AffordableCollegeFoundation.org. Additionally, the Transportation Research Board has cited *Go!* as an educational resource in both their February and March newsletters and online.

Young Engineers & Scientists (YES Program)

ISU has established a collaborative program between the MTC and the CBiRC. The YES program is a partnership with central Iowa high schools and offers a research internship to accepted applicants. Students leave school early to work on the research project for a minimum of nine hours a week for one semester, supervised by a faculty mentor and/or graduate student. At the project's end, the student prepares a poster outlining his/her research to be presented at a reception at the end of the semester. InTrans is currently hosting one YES student and will host a second at the beginning of the summer.

Center Management

ISU and its partners have teleconference team meetings on the first Tuesday of every month. We are identifying commonalities among institutions and leveraging funding for similar activities. ISU has scheduled visits to the partners in the upcoming months.

Progress of Research Projects

A few MTC-sponsored research projects are highlighted below.

ISU Projects

Studying the Impacts of Autonomous and Robotically Controlled Road-building Equipment

Project PI: David White

MTC Funding: \$75,000, Matching Funds: \$75,000

24 months (started in 2014)

For this multidisciplinary project, ISU's Center for Earthworks Engineering Research (CEER) is studying the impacts of automated machine control and guidance on road construction safety, efficiency, and quality. This project is formulating a process control system and working with industry to develop construction site-level studies. This project has multiple funding sources: MTC, Caterpillar, Inc., and ISU's Center for Industrial Research and Service. This project was highlighted in the UTC Spotlight.

Dr. White is organizing an international stakeholder workshop for industry, government agencies, and academia. The event will be held at ISU on June 2–3, 2015 and will provide an opportunity for training and professional development. See www.ceer.iastate.edu/CARCI/ for details.



Site-level monitoring of excavator and three haul trucks to evaluate cycle time efficiency

Research staff will conduct three to five field studies across the country to assess autonomous/robotic operations on actual projects to determine their effects on productivity, quality, and safety. The \$850,000 CEER/ISU geotechnical mobile lab will be used to collect field data.

Terrestrial Laser Scanning-Based Bridge Structural Condition Assessment

Project PI: Yelda Turkan

MTC Funding: \$64,115, Matching Funds: \$64,115

24 months (started in 2014)

Terrestrial laser scanners (TLS) are promising sensors for automatically identifying structural condition indicators, such as cracks, displacements and deflected shapes, as they are able to provide high coverage and accuracy at long ranges. This project investigates the feasibility to measure TLS performance for automatic detection of cracks for bridge structural condition assessment. The TLS data is provided as point clouds with color and intensity data associated with each point within the cloud. Point cloud data can be analyzed using computer vision algorithms to detect cracks for condition assessment of reinforced concrete structures.

Wavelet neural network algorithms for detecting cracks from laser scan point clouds are being developed based on the state-of-the-art condition assessment codes and standards. The proposed method for crack detection would enable automatic and remote assessment of bridge condition and help reduce costs associated with infrastructure management and enhance maintenance operations. Several DOTs have been contacted to learn about their bridge inspection processes and use of advanced technologies such as 3D models or laser scanning. So far, contacts with nine states have been made.

Research Projects for Partners

Harris-Stowe State University

Asset Management Transportation System Model

Project PI: Dr. Fatemeh Zakery

MTC Funding: \$40,000, Matching Funds: \$40,000

Student researchers, under faculty advisor supervision, developed and completed a research project to create a sustainable asset management transportation system model. Since HSSU is a Historically black university, the team focused on inner city road conditions related to municipal asset allocation within three St. Louis City wards. The team collaborated with the Missouri DOT, the St. Louis City Street Department, local government officials, universities, and related stakeholders.

The team identified roadways for the assessment using roads, traffic, location, safety, utility and demographics in residential and commercial areas. The selected 45 block area was divided into six sections. The designated roads were surveyed, photographed, and evaluated, and the number of necessary street repairs and costs of each repair were forecasted. It is expected that this economic development model may be implemented in the St. Louis Metropolitan Region and replicated by similar municipalities. This project was selected for presentation at the 2015 Annual Washington Research Forum in Washington, D.C., on March 13-14, 2015.

University of Missouri – Columbia

Investigation of Rural J-Turn Design Factors Using the Zousim Driving Simulator

Project PI: Carlos Sun

MTC Funding: \$99,965, Matching Funds: \$168,479

J-turns have been shown to improve safety on Missouri highways by reducing overall crashes by 34.8% and injury and fatal crashes by 53.7%. They are a type of alternative intersection design that could see greater implementation in Missouri. Because formal design guidance is limited, a number of J-turn design considerations require investigation, including acceleration/deceleration lane configuration, U-turn spacing,



ZouSim simulation of rural high-speed roadways

and signage type and layout. This project uses a driving simulator study and a driver survey to analyze driver behavior at different J-turn configurations. The product from this research is a set of J-turn design guidelines that could be incorporated into the MoDOT Engineering Policy Guide.

Bridges for Life: Better Data in Support of Performance Management Analysis

Project PI: Dr. Glenn Washer

MTC Funding: \$83,009, Matching Funds: \$71,259

The goal of this project is to improve the performance management of highway bridges. A bridge near I-70 in Kansas City that was constructed in 1959 but never opened to traffic is being studied. The bridge has never been exposed to traffic loading or any anti-icing chemicals. The objectives of the research are to assess the performance of the KC Bridge to determine deterioration since the construction of the bridge and to compare the condition of the KC Bridge with other bridges exposed to the same ambient environment but also exposed to traffic and deicing chemicals.

To assess the integrity of the bridge components, nondestructive testing (NDT) technologies for concrete structures are being used. Plan views of the deterioration will be drawn for each component to locate and discriminate between the intact and delaminated regions. Tasks include NDT testing focusing on the bridge deck and materials sampling to determine the physical properties of the concrete, in addition to chloride ion concentration. The research will also compare the results obtained by different NDT methods to determine their reliability.

University of Missouri – St. Louis

Women as Assets in Railroad & Motor Carrier Transportation

Project PI: Dr. Ray Mundy

MTC Funding: \$30,000, Matching Funds: \$30,000

Currently, less than 2% of the U.S. railroad industry field workforce is comprised of women. Railroad field work has been and still is thoroughly dominated by men. While the U.S. motor carrier industry is somewhat better, with closer to 5% women drivers, there are still significant opportunities for women in these workforces. This project will examine the historic context and operational barriers perceived to exist in these workforces. The project will also examine the necessary steps and attitudes to encourage more female participation in these well-paying occupations.

Wichita State University

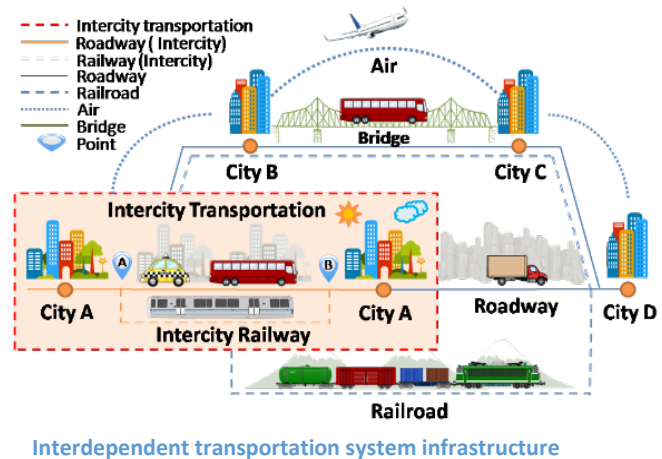
Risk and Failure Resilience Quantification of Interdependent Transportation Systems

Project PI: Dr. Pingfeng Wang

MTC Funding: \$50,000, Matching Funds: \$50,000

Complex interdependencies between critical transportation infrastructure systems exacerbate the consequences of initial failure events through cascading failure effects and damage propagation. To address an increasing demand to develop highly resilient transportation infrastructure systems, this research project will create a Bayesian network (BN) based probabilistic platform for analysis and design that enables not only interdependency between components and subsystems being ultimately considered, but also resilience realization through system design and resilience restoration by optimized failure mitigation/recovery before or after major adverse events.

This research is motivated by the emerging need for developing high-reliability low-cost critical interdependent transportation infrastructure systems, in which reliable functions for each subsystem and reliable dependencies across subsystems are required to maintain desired functionality in the face of system failures due to major natural disasters or gradual aging effects. This research project will explore the gap between quantitative and qualitative assessment of engineering resilience for complex transportation infrastructure systems. A conceptual framework is proposed for modeling engineering resilience, and a



Bayesian network is employed as a quantitative tool for assessing and analyzing engineering resilience. A case study of an aircraft manufacturing supply chain demonstrates the developed tools. The developed approach would empower system designers to better grasp the weaknesses and strengths of their own systems against system disruptions induced by adverse failure events.

Creighton University

Pavement Performance: Approaches Using Predictive Analytics

Project PI: Dr. Ravi Nath

MTC Funding: 39,271, Matching Funds: \$39,271

Acceptable pavement condition is paramount to road safety. Using predictive analytics techniques, this project attempts to develop models that assess pavement condition based on an array of indicators that include pavement distress indicators, pavement type, traffic load, structural data, and pavement repair history. The data for this project are provided by the Iowa DOT for the year 2013. A preliminary analysis shows promise in establishing a parsimonious predictive model that explains a substantial portion of the variation in the pavement condition index. It is anticipated that further investigation may result in more refined predictive models and provide additional insights into the interrelationships among the factors.

Plan for Next Reporting Period

The following activities are planned for the next reporting period.

Center Management

- Make site visits to the three remaining partners
- Hold an advisory board meeting (scheduled for August 2015)
- 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
- Hold a research collaboration meeting with the Smart Work Zone Deployment Initiative

Education

- Conduct and report on the success of the study abroad program for summer 2015

- Assess and update the undergraduate research program for Fall 2015
- Conduct an open house for the 2016 study abroad program
- Identify the student of the year for 2016
- Collect metrics on MTC scholars

Workforce Development/Diversity

- Produce additional content for *Go!* magazine
- Host two high school teachers who will be conducting research as part of an NSF research experience for teachers grant
- Hold two summer workshops for K-12 school teachers
- Hold a summer workshop for high school students
- Host two high school summer interns as part of the Young Engineers & Scientists program
- Hold a K-12 bridge contest in conjunction with the Iowa Science Center

Outreach

- Continue to plan/host the Mid-Continent Transportation Research Symposium (August 2015)
- Develop brochures to highlight the impact of three additional research projects
- Develop research implementation sessions for the Mid-Continent Symposium in conjunction with the University of Minnesota; determine the viability of turning these into webinars
- Hold a coordination meeting for cross-border training

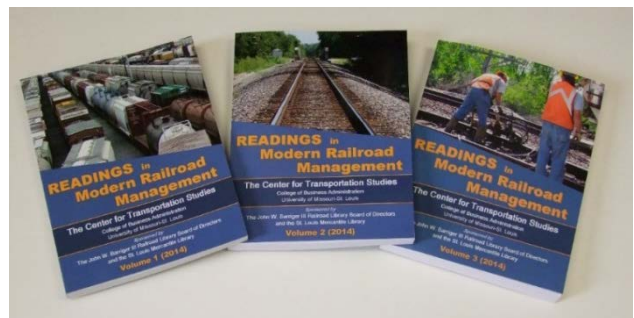
Leadership

- Hold a new faculty leadership breakfast at the Mid-Continent Symposium
- Encourage MTC scholars to complete the Public Employees Leadership Institute

2. Products

MTC Website - A website has been developed for the MTC, <http://www.intrans.iastate.edu/mtc>. The goal of this website is to share research results, publications, outreach opportunities, and other resources with students, faculty, and transportation professionals.

Readings in Modern Railroad Management - The Center for Transportation Studies at the University of Missouri-Saint Louis (UMSL) has compiled a three-volume collection of works on managing the modern railroad. Dr. Ray Mundy and Dr. Daniel Rust served as editors. Distilled from hundreds of recent publications, the selected articles in these volumes are dedicated to current issues such as regulation, finance, labor, and pricing. The collection is intended for students and practitioners of the railroad industry, as well as anyone wishing to better understand today's railroad industry. All three volumes are available at www.thebookpatch.com. Upon request, the Center for Transportation Studies at UMSL can create customized texts for classroom use with content drawn from any of the three volumes.



MTC Newsletter – The first publication of the MTC Newsletter was circulated this quarter.

Presentations -

- Inya Nlenanya - The MiniCym distracted driving simulator was utilized at the *I'll Make Me a World in Iowa* (IMMAWII) event highlighting African-American arts, culture, and education contributions (200+ attendees)
- Seward Community College hosted 5 sessions of "Defeating Distracted Driving" in February 2015 (246 total attendees)
- Pingfeng Wang – Presented International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC/CIE)
- Ray Mundy UMSL – Taxi workshop session at 2015 TRB
- Harris Stowe - Student researchers presented their paper, "Economic Sustainability of Inner City Streets, A Collaborative Transportation and Safety Model," at the 2015 Annual Washington Business Research Forum in Washington, DC on March 13-14, 2015.
- 4 University of Missouri-Columbia and 8 ISU students presented at TRB in January 2015
- ISU student, Georges Bou-Saab, presented at the joint Western & Midwestern ITE conference
- ISU student, Mark Furtado, presented a poster at the ASCE Structures Congress
- ISU student, Micah Makaiwi, presented at the UTC Spotlight Conference on the Role of Freight Transportation
- ISU student, Samuel Redd, presented at the ABC UTC Bridge Conference
- ISU student, Sneha Roy, presented at the National Conference on Advanced Techniques in Civil Engineering
- MU Columbia- *Center for Excellence in Logistics and Distribution (CELDi)*, where they had an opportunity to present a poster describing this project

Articles and Papers -

- Jing Dong - "Assessing Corridor-Level Travel Time Reliability on Urban Freeways," was accepted to the 6th International Symposium on Transportation Network Reliability (INSTR).
- Pingfeng Wang – "A Tri-fold Hybrid Classification Approach for Diagnostics with Unexamined Faulty States," *Mechanical Systems and Signal Processing*, Vol. 50–51, pp.437–455, 2015.
- Pingfeng Wang – "Resilience Modeling and Quantification for Complex Engineering Systems Using Bayesian Networks," Under Revision, *Computers and Industrial Engineering*, 2015.

Products -

- Jian Chu - Bacteria strains for biocementation and soluble calcium for making biocement
- Halil Ceylan - CAD drawing of the portable curling measurement device
- David Cantor - Stata motor carrier safety database
- David Jeong - Integrated databases for raw pavement condition data and treatment projects
- Nir Keren - A framework for deploying a dynamic full-scale modeling of road infrastructure

Professional Development -

- Pingfeng Wang - The research findings have been incorporated into graduate courses at Wichita State University through course modules and course projects.
- Pingfeng Wang - established industrial collaboration with Medtronic Inc. to disseminate research results through seminars, and also obtained internship opportunities for graduate students.

Other Products -

- Jian Chu - Bacteria strains for biocementation and soluble calcium for making biocement
- Halil Ceylan - CAD drawing of the portable curling measurement device
- David Cantor - Stata motor carrier safety database

- David Jeong - Integrated databases for raw pavement condition data and treatment projects
- Ronald McGarvey - *A GIS database and decision support tool (optimization model)*

3. Participants and Collaborating Organizations

Three site visits to our partners were completed in October 2014. We visited the University of Missouri-Columbia on October 29, 2014, Harris-Stowe State University on October 30, 2014, and the University of Missouri-St. Louis on October 30, 2014. Each institution provided a tour of the facilities, gave an overview of its MTC Program, provided research presentations, and held meetings with other faculty members, administrative staff, and students.



Meeting at the Harris-Stowe State University, University of Missouri – St. Louis, and University of Missouri-Columbia.

The University of Missouri-Columbia joined us at Harris-Stowe State University and the University of Missouri-St. Louis. Harris-Stowe State University also joined us at the site visit to the University of Missouri-St. Louis. We also had a joint luncheon on October 30, 2014 with participants from Harris-Stowe State University, the University of Missouri-Columbia, and the University of Missouri-St. Louis. Research and outreach collaboration ideas/plans were discussed. Three other site visits have been scheduled for May/June 2015.

Iowa State University utilizes multiple colleges, departments, and centers as internal partners: Civil, Environmental and Construction Engineering; National Concrete Pavement Technology Center; Center for Transportation Research & 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 & Safety; Electrical & Computer Engineering; Business & Finance; Statistics; Industrial & Manufacturing Systems Engineering; Chemical & Biological Engineering; Center for Biorenewable Chemicals; Food Science & Human Nutrition; Supply Chain & Information Systems; Landscape Design; Agricultural & Biosystems Engineering; Virtual Reality Application Center.

EXTERNAL PARTNERS / COLLABORATORS	PARTNER TYPE	STATE / COUNTRY	FINANCIAL SUPPORT	IN-KIND CONTRIBUTOR	RESEARCH COLLABORATOR	FACILITIES	PERSONNEL EXCHANGE	MATERIALS	DATA
Ann L. Schneider & Associates, LLC	Industry	Missouri			X				
Argo Genesis, a subsidiary of Seneca Petroleum Company	Industry	USA	X						
Arizona State University	University	Arizona			X				
BASF	Industry	Iowa						X	
Caterpillar	Industry	USA	X						
City of Grandview	Government	Missouri			X				
Consulting Engineers Association	Industry	Missouri			X			X	
Costello & Associates, Inc.	Industry	Missouri			X				
Creative Visions Human Development Institute	University	Iowa			X				
Federal Highway Administration	Government	USA			X				
HR Green	Industry	Iowa			X				
Illinois Department of Transportation	Government	Illinois			X				
International Association of Transportation Regulators	Non Profit	Canada			X				
Iowa Department of Transportation	Government	Iowa	X					X	X
Lambert Airport	Industry	Missouri		X			X		X
Metropolitan Taxi Commission	Industry	Missouri	X	X					
Missouri Department of Transportation	Government	Missouri	X						
Missouri State Highway Patrol	Government	Missouri			X				
National Ilan University	University	Taiwan			X				
Shrive Hattery	Industry	Iowa			X				
St. Louis Street Department	Government	Missouri			X				
Terminal Railway Association of St. Louis	Industry	Missouri	X	X					
The Airportat Ground Transportation Association	Industry	Missouri			X				
The Taxi, Limousine, and Paratransit Association	Industry	Missouri			X				
U.S. Army Corps of Engineers	Government	USA			X				
University of Iowa	University	Iowa			X				
University of Maryland	University	Maryland			X				

4. Impacts

Iowa State University and its partners have engaged in a variety of research, educational, and outreach activities, as described below.

Tom Maze Transportation Seminars (ISU, UM-Columbia, UM-St. Louis)

The Tom Maze Transportation Seminars are presented at the Institute for Transportation weekly during ISU's spring semester and feature nationally and internationally recognized speakers. The seminar has become an important feature of graduate transportation education at ISU, and it is broadcast real-time to students at the University of Iowa, the University of Missouri in St. Louis and Columbia, and other sites via the Iowa Communications Network (ICN). The ICN allows viewers at remote sites to actively participate in the seminar, and each presentation is compiled as part of the MTC website so it can be further utilized as a resource for transportation students.

Date: January 23, 2015

Impact: 79 participants

Location: Online broadcast hosted through Iowa State University in Ames, Iowa

Speaker: Neal Hawkins, InTrans, Iowa State University

Topic: Traffic Operations Laboratory

Participants: Ames, Iowa; Columbia, Missouri; St. Louis, Missouri; Others

This seminar session focused on the newly developed Transportation Operations Laboratory located at ISU's InTrans. Neal Hawkins shared the capabilities of the lab and described the partnership between InTrans and the Iowa DOT, which makes this space a valuable tool. Other InTrans researchers took this opportunity to share how they currently utilize the laboratory in their research.

Date: January 30, 2015

Impact: 82 participants

Location: Online broadcast hosted through Iowa State University in Ames, Iowa

Speaker: Shauna Hallmark, InTrans, Iowa State University

Topic: MTC Transportation Scholars Program

Participants: Ames, Iowa; Columbia, Missouri; St. Louis, Missouri; Others

InTrans Director, Dr. Shauna Hallmark, reached out to our partner universities and students to make them aware of the benefits of becoming an MTC student transportation scholar. Leadership training, mentoring connections, and study abroad opportunities were discussed. *Go!* coordinator Brandy Abraham also shared how students can become active in outreach by developing content for the *Go!* website, which is utilized by K-12 teachers and students across the country.

Date: February 6, 2015

Impact: 67 participants

Location: Online broadcast hosted through University of Missouri in Columbia, Missouri

Speaker: Lesley Hoffarth, Forest Park Forever

Topic: Transportation in a "Different" Setting

Participants: Ames, Iowa; Columbia, Missouri; St. Louis, Missouri; Others

This presentation described transportation issues related to the maintenance and management of Forest Park Forever in St. Louis, Missouri. The 1,300 acre park includes a zoo, historic museums, and other buildings and recreational paths. The speaker explained the rebuilding process of the I-64 Interstate, which took years and saw several difficult transportation issues.

Date: February 13, 2015

Impact: 72 participants

Location: Online broadcast hosted through Iowa State University in Ames, Iowa

Speaker: Neil Pedersen, Transportation Research Board

Topic: Involvement with the Transportation Research Board & Delivery of Complex Projects

Participants: Ames, Iowa; Columbia, Missouri; St. Louis, Missouri; Others

Neil Pedersen introduced TRB's background, including its historical evolution, standing committees, and main function today. He then followed with a segment focused on research conducted by TRB's SHRP 2 Program. This research is designed to study how to balance competing interests so that timely decisions on adding transportation capacity can be made and sustained.

Date: February 20, 2015 **Impact:** 69 participants

Location: Online broadcast hosted through Iowa State University in Ames, Iowa

Speaker: Chris Anderson, Climate Science Program, Iowa State University

Topic: What Defines Actionable Science for Climate Change Planning in Transportation

Participants: Ames, Iowa; Columbia, Missouri; St. Louis, Missouri; Others

After defining actionable science and describing its use in the decision making process, Dr. Anderson shared how he uses actionable science in weather forecasting as it relates to transportation structures. This type of data is key to helping government decision makers make well-informed choices.

Date: February 27, 2015 **Impact:** 61 participants

Location: Online broadcast hosted through University of Missouri in Columbia, Missouri

Speaker: Scott Smith, Heartland Civic Collaborative

Topic: Making the Heartland Globally Competitive and Economically Relevant 50 Years From Now

Participants: Ames, Iowa; Columbia, Missouri; St. Louis, Missouri; Others

This session summarized some of the strategies used by the Heartland Civic Collaborative to ensure that the heartland has a significant future role on a global scale. Scott Smith's suggestion was to emphasize the resources available in the central United States as well as to focus on the area's importance as a transportation hub.

Date: March 6, 2015 **Impact:** 60 participants

Location: Online broadcast hosted through University of Missouri in St. Louis, Missouri

Speaker: Michael Edwards, Product Remanufacturing Centers (PRC)

Topic: The Role of Transportation and Reverse Logistics Analytics in Achieving Corporate Sustainability

Participants: Ames, Iowa; Columbia, Missouri; St. Louis, Missouri; Others

Michael Edwards summarized the reverse logistics industry and illuminated key factors in utilizing reverse logistics. PRC's primary business includes return center management, engineering/quality assurance, second-channel sales management, asset recovery, and warranty service.

Date: March 13, 2015 **Impact:** 54 participants

Location: Online broadcast hosted through University of Missouri in St. Louis, Missouri

Speaker: Daniel Fritz, McMahan Berger PC

Topic: Transportation Labor and the National Labor Relation's Board

Participants: Ames, Iowa; Columbia, Missouri; St. Louis, Missouri; Others

Mr. Edwards discussed the roles of the Office of Labor Management Standards and the National Labor Relations Board and focused on how each entity relates to the transportation industry.

Date: March 27, 2015 **Impact:** 40 participants

Location: Online broadcast hosted through Iowa State University in Ames, Iowa

Speaker: Mark Wright, MBA, Mechanical Engineering, Iowa State University

Topic: Strategies for Building the Next-Generation Biofuel Supply Chain

Participants: Ames, Iowa; Columbia, Missouri; St. Louis, Missouri; Others

This presentation was organized into connected topics: the U.S. biofuel context, biofuel manufacturing, biofuel supply chains, and modern strategies for biofuel supply chain design. By considering each of these four areas and combining their efforts, national biofuel targets can be met.

AASHTO TRAC & RIDES Program

MTC and the Accelerated Bridge Construction University Transportation Center at Florida International University partnered with the Iowa DOT to pilot the AASHTO TRAC & RIDES programs in Iowa schools. Their hands-on STEM-aligned activities introduce students in grades 5–12 to the work world of transportation and civil engineering and inspire them to consider careers in those fields.

Date: February 5-12, 2015 **Impact:** 11 participants

Location: Estherville Lincoln Junior/Senior High School, Estherville, Iowa

Participants: Middle School Students

Date: February 26, 2015 **Impact:** 11 participants

Location: Estherville Lincoln Junior/Senior High School, Estherville, Iowa (SKYPE to Classroom)

Participants: Middle School Students

Date: March 30-April 10, 2015 **Impact:** 21 participants

Location: West Branch Junior/Senior High School, West Branch, Iowa

Participants: Middle School Students

Defeating Distracted Driving (Seward Community College)

Attendees of these sessions were guided through a series of distracted driving materials that were developed by MTC collaborator Seward Community College. This workshop series increased awareness of the multiple causes of distracted driving, and many law enforcement professionals expressed their intent to continue to spread this information throughout their activities in the region.

Date: February 9, 2015 **Impact:** 4 participants

Location: Liberal Memorial Library, Liberal, Kansas

Participants: Community Members

Date: February 12, 2015 **Impact:** 12 participants

Location: Liberal Memorial Library, Liberal, Kansas

Participants: Community Members

Date: February 12, 2015 **Impact:** 189 participants

Location: Liberal High School Library, Liberal, Kansas

Participants: High School Students

Date: February 18, 2015 **Impact:** 29 participants

Location: Seward Community College Library, Liberal Kansas

Participants: College Students, Community Members, Law Enforcement

Date: February 24, 2015 **Impact:** 29 participants

Location: Seward Community College Library, Liberal Kansas

Participants: College Students, Community Members, Law Enforcement

Other Outreach Activities

Student Orientations

Date: October 3 & 8, 2014

Impact: 43 participants

Location: Iowa State University, Ames, Iowa

Topic: MTC Scholars Program, Study Abroad, & K-12 Opportunities

Participants: Iowa State Graduate and Undergraduate Students

To acclimate new students to the InTrans research environment and increase student awareness of transportation-related opportunities, Dr. Hallmark and InTrans staff hosted two orientation sessions. The sessions covered all aspects of the MTC Scholars Program; shared options for becoming involved in research, outreach, and mentoring; and highlighted details of the new study abroad program.

Reception for Potential MTC Collaborators

Date: October 9, 2014

Impact: 29 participants

Location: Iowa State University, Ames, Iowa

Topic: MTC Research Opportunities and How to Become Involved

Participants: Researchers with Iowa State University, Iowa DOT, and USRT

To increase awareness of the MTC program within ISU and diversify project topics, InTrans extended a formal invitation to researchers from seven ISU departments. The visiting scientists were walked through the application process for MTC funding, and cross disciplinary connections were made for future collaboration opportunities.

Ribbon Cutting for the InTrans Traffic Operations Laboratory

Date: October 15, 2014

Impact: 43 participants

Location: InTrans, Ames, Iowa

Topic: InTrans Operations Laboratory Tour

Participants: Iowa State University Researchers and Staff, Iowa Department of Transportation Partners

The InTrans Traffic Operations Laboratory ribbon cutting was an opportunity to share with research partners the capabilities of the new lab, which was created in partnership with the Iowa DOT. This joint effort will allow for exploration of interdisciplinary research and will be an important educational tool. The opportunity to utilize real-time traffic data in research will allow for the development of multiple new applications to better serve the public demand for mobility and reliability information.

ICTM-ISTS Math & Science Conference

Date: October 22, 2014

Impact: 700+ participants

Location: Scheman Building, Ames, Iowa

Theme: STEM Related Teaching Tools and Methods for K-12 Teachers

Participants: K-12 Formal and Informal Educators

MTC hosted a booth at the ICTM-ISTS conference for science and math teachers to promote transportation topics in the classroom through hands-on experiences. Information regarding the STEM-aligned AASHTO TRACs and RIDES courses were distributed to interested teachers to boost participation in the InTrans pilot program, which was just getting



underway with the Iowa DOT. The booth also helped inform teachers about the benefits of *Go!* magazine and the InTrans MiniCym transportation simulator.

A2RU National Conference

Date: November 5-8, 2014

Location: Iowa State University, Ames, Iowa

Theme: Edge Effects

Participants: National and International Scientists, Artists, Musicians, and Industry Professionals

Impact: 13 participants for the tour
250+ participants to the conference

The Alliance for the Arts in Research Universities (a2ru) is a partnership of 30 institutions committed to expanding the arts in research universities and ensuring the greatest possible institutional support for interdisciplinary research, curricula, programs, and creative practice. During the annual conference, hosted in 2014 at ISU, InTrans collaborated with an on-campus research partner to hold a tour of the tornado microburst simulator and hosted a follow-up discussion.

ASCE Engineering Day for Kids

Date: November 8, 2014

Location: Lafferre Hall, University of Missouri, Columbia, Missouri

Topic: Engineering Day for Kids

Participants: Third, Fourth, and Fifth Grade Students

Impact: 78 participants

Engineering Days for Kids is an opportunity for third, fourth, and fifth grade students to learn about civil engineering through hands-on activities. During the event, students learned about the different types of engineering, what engineers do, what college is like for an engineering student, and met with the University of Missouri's engineering student competition teams.

Transportation Student Association Meeting

Date: November 8, 2014

Location: InTrans, Ames, Iowa

Topic: MTC Study Abroad Program in Turkey

Participants: Iowa State University Transportation Student Association (TSA) Members

Impact: 19 participants

Dr. Shauna Hallmark met with TSA members to discuss the 2015 summer study abroad program to be held in Istanbul, Turkey, in partnership with Boğaziçi University. The program, Advanced Topics in Transportation Engineering, earns students 3 university credit hours and provides invaluable experience.

Cub Scouts Involvement

Date: December 3, 2014

Location: University of Missouri, Columbia, Missouri

Topic: What Do Engineers Do?

Participants: Fifth and Sixth Grade Students

Impact: 42 participants

University of Missouri Columbia met with local Cub Scout troops to share details of what it means to be an engineer. The presentation highlighted the construction process for the Hoover Dam bridge bypass. Following the discussion, scout members were divided into teams for a bridge design and construction activity. They ended the evening with a competition of strength testing of their completed bridges.

ISU Middle School Day

Date: December 4, 2014

Location: Iowa State University, Ames, Iowa

Impact: 96 participants

Topic: Growing Interest in Engineering Careers

Participants: Iowa Middle School Students

MTC Scholars and Transportation Student Association members assisted with this ISU event by developing a series of activities to increase middle school-age students' awareness of engineering-related career paths.

Undergraduate Research Connections

Date: December 12, 2014

Impact: 5 participants

Location: Iowa State University, Ames, Iowa

Topic: Matching Scholars to Projects to Spur Undergraduate Research

Participants: Undergraduate Students at Iowa State University

To increase undergraduate involvement in research activities, InTrans offered an incentive to MTC project principal investigators. Five undergraduate students benefited from this program during the 2014 fall semester. All students have continued their involvement into the 2015 spring semester.

I'll Make Me a World in Iowa

Date: January 16, 2015

Impact: 200+ participants

Location: Des Moines, Iowa

Participants: African American Community Members in the Central Iowa Area

I'll Make Me a World in Iowa (IMMAWII) is a diverse collaboration of Iowans, which highlights African-American arts, culture, and contributions through education, awareness, and preservation during an annual enrichment celebration and with continual educational outreach. Our participation was in collaboration with Creative Visions Human Development Institute based in Des Moines. InTrans gave the participants an opportunity to experience various traffic scenarios using the MiniCym driving simulator.



Additional Information Regarding Products and Impacts

Research Project: Evaluation of the Buena Vista Innovative Bridge Research and Deployment Program (IBRD) Bridge: A Furthering of Accelerated Bridge Construction in Iowa

Buena Vista County, Iowa, with the assistance of the Iowa DOT and ISU's Bridge Engineering Center (BEC), constructed a two-lane single-span precast box girder bridge using accelerated bridge construction (ABC) techniques. This demonstration, one of a series of ABC projects undertaken by the Iowa DOT, represents an important step in developing and advancing these techniques in Iowa and nationwide.



This project directly addresses the IBRD goal of demonstrating the effectiveness of innovative materials and construction techniques for new bridge structures. Performance was evaluated through comparisons with design assumptions and recognized codes and standards, including AASHTO specifications. This innovative design by the BEC is also included in the FHWA's *Accelerated Bridge Construction Manual* (ABC Manual).

The major direct benefit from this project was the reduction of a typical three-day construction to only one day, at no additional cost. As a measure of this project's direct dollar savings, the savings in truck detour costs, only a portion of the economic benefits, can be calculated as follows. According to 2014 National Bridge Inventory (NBI) data, the average detour length in Iowa was approximately 6 miles. The average daily traffic (ADT) on Iowa bridges for the same year was 1,368 vehicles/day, with an average of 13% truck traffic. Therefore, for a single bridge in Iowa with average traffic and detour values, direct savings from only truck detours by adapting this ABC design would be \$5,721 ($\$2.6786/\text{mile} * 6 \text{ miles} * 178 \text{ trucks/day} * 2 \text{ days}$). (The numbers are from a 2013 BEC study by Hosteng and Phares, *"Demonstration of Load Rating Capabilities through Physical Load Testing: Ida County Bridge Case Study,"* InTrans Project 12-444.)

This project also demonstrated the effectiveness of an innovative construction technique for ABC. The inclusion of this design in FHWA's ABC Manual renders it possible for other local and state transportation agencies to use the same technique and achieve similar benefits. In 2014, the average ADT on National Highway System (NHS) bridges was 24,837 vehicles/day with an average of 13% truck traffic (NBI data). The average detour length for the same year was 13.52 miles on the NHS system. For a single bridge, with the mentioned average traffic and detour values, the dollars saved in truck detours for two-day reduction in construction time would be \$233,874. Additionally, the number of structurally deficient structures on the NHS system was 5,830 in 2014. Replacing 5% of these structures using this ABC design would lead to \$68,174,374 savings in truck detours.

The dollar savings in truck detours presented here are based on quite a few assumptions. Also, the savings from truck detours are fairly easy to estimate and are only a portion of the realized benefits from ABC designs. While the rough estimates here are for demonstration purposes only, they indicate the significant tax dollar savings by the adoption of ABC designs.

5. Changes/Problems

Nothing to report.

6. Special Reporting Requirements

Nothing to report.