

**Introduction**

The Midwest Transportation Consortium (MTC) recently completed its sixth year of operation. The MTC has become an established portion of the research and educational programs at ISU and its partner universities. The MTC continues to emphasize its primary focus of developing human capital. For example, this semester, Fall, 2005, ISU has graduate scholars in its educational program. However, we also recognize that the federal grant is an opportunity to build programs at our respective universities that continue after the U.S. DOT UTCP may end. An example of building a long lasting program is the University of Missouri – St. Louis' (UMSL) and its development of a transportation Ph.D. program in their business college. Admittedly, this program could have been started regardless, but Dr. Ray Mundy, Director of UMSL's Transportation Scholars Program, believes that the MTC support of the transportation educational program at UMSL was the essential component in establishing a Ph.D. program.

At ISU, the MTC has been instrumental in establishing two research and outreach programs, and both have themes that are related to the MTC's theme of "Transportation System Management and Operation." The Center for Weather Impacts on Mobility and Safety (C-WIMS) was recently established, and the Center for Road Infrastructure Management and Operations (RIMO) is in the process of being established. The MTC has a critical role in establishing each of these two programs.

As part of the on-going MTC program, we have established an effective network that promotes the education of future transportation professionals and the development of new knowledge on how to manage transportation infrastructure and services in a more sustainable manner. The MTC has a track record of developing outstanding students; these students are now becoming leaders in the private sector, government, and academia. The MTC has also supported the development of an extensive research portfolio related to sustainable transportation asset management. More research projects are in the pipeline. Finally, the MTC has dedicated itself to the dissemination of asset management research results through an ongoing technology transfer program. This document provides a progress for the latest fiscal year of operation of the MTC, which ran from October 2004 through September 2005.

**Consortium Organization and Theme**

The Midwest Transportation Consortium is one of ten regional University Transportation Centers located in the ten federal regions of the United States. These ten centers were established through a regional competition. The MTC is now entering its seventh year of existence. The MTC is the University Transportation Center for Region 7, which includes the states of Iowa, Kansas, Missouri, and Nebraska.



The MTC is organized as a constellation of six cooperating educational institutions. Two schools make up the administrative core of the consortium and employ the center director, formerly Mr. David Plazak and now Dr. Tom Maze at Iowa State University, and associate director, Mr. Charles Nemmers at the University of Missouri-Columbia. The other four schools are involved in the education and research functions of the consortium, Northern Iowa and the historically Black institution, Lincoln University, had essentially no involvement in transportation education and research when the MTC was established.

Administrative Core (2 schools)

Iowa State University (ISU)

University of Missouri – Columbia (UM-C)

Junior Partners: Mainly Educational (4)

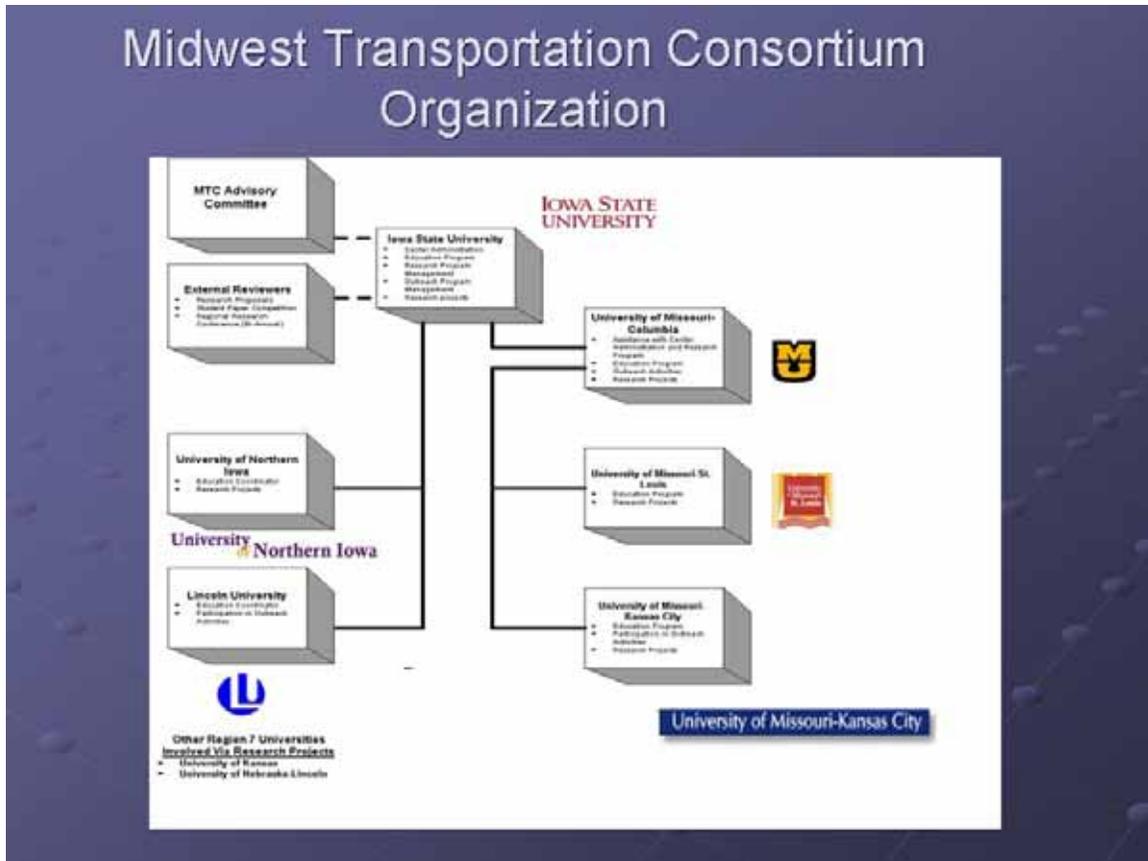
University of Missouri – Kansas City (UMKC)

University of Missouri – St. Louis (UMSL)

University of Northern Iowa (UNI)

Lincoln University (Jefferson City, Missouri)

A diagram of the consortium organization is shown below. Most of the administrative functions of the consortium take place at Iowa State University. This includes review and contracting of MTC-funded competitive research projects and educational competitions. The University of Missouri-Columbia provides a single point of administration for the participation of the three University of Missouri system campuses. This includes administration of all budgets and contracts. The University of Missouri-Columbia also coordinates some of its activities with Lincoln University, which is located nearby in central Missouri. The University of Missouri-Kansas City (UMKC) is shown on our diagram since it was one of our original partners and UMKC's transportation program is essentially dormant.



The theme of the Midwest Transportation Consortium is ***“Transportation Management Systems and Operations Focusing on Sustainable Asset Management”***. As such, the MTC participating institutions are working to prepare students to be leaders for an industry that is quickly evolving from a paradigm of building transportation systems and infrastructure to managing transportation systems and infrastructure for best results. The MTC aims to integrate operations, management, and renewal disciplines, along with traditional construction.

The MTC concentrates on education and human capital development, believing that a new generation of leaders is needed to help make the transition from the “building” era to the “managing” era. The need for leadership is even more pressing given the large number of retirements that are occurring among today’s leaders in the transportation industry. The MTC emphasis on creating new transportation professionals is illustrated in the distribution of funding. Typically, one-half of the resources managed through the MTC go to support the educational program of the MTC and the majority of these funds support graduate assistantships and undergraduate students completing degrees that will support a career in transportation while working on degrees.

The MTC has a number of primary focus areas for its expenditures:

- To fund graduate assistantships for the next generation of industry leaders

- To develop new courses and new course materials for transportation asset management
- To get new faculty members and researchers involved in transportation and transportation asset management activities
- To provide regional leadership in advancing transportation asset management through competitively-funded research projects and technology transfer activities
- To make a national contribution through participation and leadership in asset management through involvement in organizations such as the Transportation Research Board (TRB) and the American Association of State Highway and Transportation Officials (AASHTO).

**Key Consortium Personnel**

The key personnel of the Midwest Transportation Consortium consists of a Director, an Associate Director, and Educational Coordinators at each Consortium member school. As of the end of the 2004-2005 fiscal year, the key personnel were as follows:

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**MTC Educational Program**

The Midwest Transportation Consortium's Education Program continues to enrich the education of both undergraduate and graduate students at the MTC partner institutions. This enrichment takes place through a variety of programming, including student travel, student paper competitions, award programs, and interdisciplinary seminars. In addition, the MTC has recently gotten involved in efforts to attract new students to the field of transportation through the establishment of an annual transportation career fair. The goal of all educational programming is to develop the next generation of leaders for the transportation industry, particularly within the four-state MTC region.

**MTC Sponsors Second Annual Transportation Career Fair**

The MTC sponsored and helped organize the 2nd Annual Iowa Transportation Career Fair April 21, 2005, at Iowa State University. After getting their feet wet with a limited, regional invitation list from last year, this year's organizers invited high school students, their teachers and parents from the whole state of Iowa. The fair included two activity areas, one indoor and one outdoor, with students participating in both, rotating over lunch. The indoor activities included two presentations on various aspects of the transportation industry, exhibits, and vendor booths. The outdoor activities included hands-on demonstrations and activities.

The fair was hosted by the Center for Transportation Research and Education (CTRE), Iowa State University (ISU), the Iowa Department of Transportation (Iowa DOT), and Des Moines Area Community College (DMACC). Organizers represent CTRE, ISU, Iowa DOT, DMACC, Federal Highway Administration (FHWA), and the Associated General Contractors of Iowa (AGC). A committee is already at work on the 2006 version of the Career Fair.



Students enjoy a hands-on construction activity at the Transportation Career Fair

For more information about the Career Fair event, contact Chris Albrecht at CTRE, 515-294-7684, [calbrech@iastate.edu](mailto:calbrech@iastate.edu). Information is available on-line at:

<http://www.ctre.iastate.edu/events/careerfair/index.htm>

**Transportation Scholars Conference: Fall 2004**

Twelve students presented 10 papers at the Transportation Scholars conference at Iowa State University last November. Mark J. Thompson, graduate student in the Department of Civil, Construction and Environmental Engineering at ISU, won the \$1,000 award for his paper, "Experimental Load Transfer of Piles Subject to Lateral Soil Movement."



Mark J. Thompson (on the ground) and Dr. David White (a former MTC Scholar and Student of the Year winner himself) place grout during pile installation.

Abstract of Winning Paper: "Experimental Load Transfer of Piles Subject to Lateral Soil Movement"

*by Mark J. Thompson, Iowa State University graduate student in civil engineering*

Remediation of slope failures requires stabilization alternatives that address causes of slope instability. Slope reinforcement and pile stabilization systems, if properly designed, are effective in preventing slope movements in weak soils. Soil load transfer to pile elements from the lateral soil movement as occurs in slope failures is a complex soil-structure interaction problem, and the significant differences in existing design procedures of pile stabilization suggest that the stabilizing mechanisms are not fully understood.

The downslope soil movement of slope failures induces unique, unknown lateral load distributions along stabilizing piles. The reliable estimation of these load distributions is important because the influence of piles on the global stability of the slope depends directly on the pile loading condition.

Soil-structure interactions for small-diameter piles subject to lateral soil movement were investigated by conducting full-scale pile load tests, in which piles installed through a shear box were indirectly loaded by uniform lateral translation of soil.

Instrumentation of the shear boxes and pile reinforcement indicated the load distributions that developed along the piles. The load test analyses which succeeded the pile load tests support the claim that the distributed loads, which are achieved during pile loading, vary linearly with depth. The product of the analysis, which answers a central question of the research, is directly incorporated into the proposed design methodology for soil displacement grouted micropiles.

It is apparent from the pile load tests that small-diameter pile elements provide effective passive resistance to lateral soil movement. The proposed, non-proprietary remediation technology, if implemented into current slope remediation practices, offers an alternative that gives consideration to cost constraints, schedule constraints, and constructability concerns of local transportation agencies.

The 2006 edition of the MTC Transportation Scholars Conference is on tap for November 18, 2005 at the Iowa State University Memorial Union. Eight papers have been selected for presentation. Students represent Iowa State University, the University of Nebraska-Lincoln, the University of Missouri-Columbia, the University of Missouri-St. Louis, and Kansas State University. Topics are very diverse in 2005, including everything from bridge health monitoring to taxicab regulation.

For more information about the MTC Scholars Conference, contact David Plazak at CTRE, 515-296-0814, [dplazak@iastate.edu](mailto:dplazak@iastate.edu).

#### **MTC Student of the Year Competition: 2004**

Iowa State University graduate student Justin Doornink was named the MTC student of the year for 2003-2004. Doornink, a two-time Dwight David Eisenhower Transportation Fellowship winner (2003 and 2004), was selected based on a number of criteria including scholarship (papers and presentations), quality of academic work, and involvement in student organizations. Doornink, who is currently working on his PhD, focuses on structural engineering research with real world applications. As part of his doctoral research, Doornink developed a fiber optic structural health monitoring system to monitor the performance of Iowa's first high-performance steel bridge.



Justin Doornink

He is currently developing a structural health monitoring system to identify developing fatigue cracks in fracture-critical bridges. For his master's research, Doornink investigated the use of decommissioned railroad flatcars in low-volume road bridges, which has provided a much needed cost effective bridge replacement alternative for Iowa county bridges.

Throughout his graduate work, Doornink has published in several national and international publications and given several presentations. His most recent presentation was at the Second International Conference on Bridge Maintenance and Safety in Kyoto, Japan, and his most recent publication was in the 2004 International Symposium on Advancements and Trends in Fiber Optics in Chongqing, China.

In addition to working as a research assistant, Doornink was also an instructor for an introductory structural analysis class at Iowa State University during the 2004 spring semester. Doornink has also worked for the Iowa Department of Transportation and Modjeski and Masters Consulting Engineers, Inc.

Doornink earned his BS in civil engineering in 2001 and his MS in civil engineering (specializing in structural engineering) in 2003 from Iowa State University.

The deadline for the 2004-2005 MTC Student of the Year Competition is fast approaching, with a decision to be made around November 15, 2005.

For more information about the MTC Student of the Year Award, contact David Plazak at CTRE, 515-296-0814, [dplazak@iastate.edu](mailto:dplazak@iastate.edu).

### **MTC Student an Award Winning Essayist**

Tom Stout, an Iowa State University PhD student in engineering and MTC scholar, was named a finalist in the 2005 Philip E. Rollhaus, Jr. Essay Competition. Stout won \$1,000

for his essay called "How Road Authorities and Insurance Companies Should Work Together to Improve Highway Safety."

The competition was so fierce and the quality of the essays so high that Quixote Corporation, the contest sponsor, increased the number of awards from four to ten.

Stout also won first place in the Missouri Valley Section of the Institute of Transportation Engineers student paper competition this year for his paper on "Before and After Study of Some Impacts of 4-lane to 3-lane Roadway Conversion." The award includes a certificate and a check.



Tom Stout (right) and Dr. Reg Souyletrette

### **Annual Student Trip to TRB**

As in years past, the MTC partnered with academic departments at Iowa State University and the University of Missouri-Columbia to send a large delegation of students to the Transportation Research Board (TRB) Annual Meeting in Washington, DC during January 2005. MTC students attended sessions related to guardrails, meta-analysis, ITS, intersection designs, computer-aided crash reconstruction, signals, context sensitive design, urban form and travel behavior, freeway operations with ITS applications, professional development for careers in transportation, corrosion of bridges, destructive testing of bridge supports, sight distance, and signing and construction zone safety. An Iowa State alumnus said, "TRB is like Christmas!"

The following students provided narratives regarding their 2005 TRB experience.

Tom Stout

I deliberately went to two sessions that were outside my normal area of interest: meta-analysis and computer-aided crash reconstruction. I found the meta-analysis session particularly interesting, especially as an approach to conducting research into prior art (i.e., literature searches) while attempting to avoid various forms of bias.

Greg Karssen

I also enjoyed the subway, which was really my first experience on large-scale public transportation. I especially noticed how the city is designed to be not just a place for the government, but also a special place for the governed.

Justin Jackson

With the knowledge and expertise that filled those seminars, you could almost feel as though you knew nothing, but at the end of a seminar, you would be soaking wet in a vast array of fresh knowledge.

Kari Jensen

The idea of unmanned aerial vehicles soon being used in helping to protect the country and better our way of life was quite interesting. The trip was also a great opportunity to meet others from all over the world and hear about projects they are working on.

Neil Burke

In particular, I found the presentation on the addition of high-priced "HOT" and HOV lanes to be of interest. MDDOT has constructed and plans to construct additional priced lanes that promise commuters congestion-free travel. I wondered how much success these lanes would have on the Chicago-area freeways where traffic volumes are higher and commutes span longer hours.

Dan Ormand

The main thing I got out of TRB was a better realization of the vast spectrum of issues in the transportation field and how different locations called for unique considerations. For example, a British engineer described redesigning an urban area to reduce traffic and speed with the idea of creating local streets that kids could safely play in and that increased a sense of community.

The 2006 TRB trip is being organized as this report was written. The intent is to once again have the MTC partially support a group of 25-30 students from several universities to travel to TRB.

For more information about the TRB Trip, contact David Plazak at CTRE, 515-296-0814, [dplazak@iastate.edu](mailto:dplazak@iastate.edu).

### **Creation of Ph.D. Program at UMSL in Logistics and Supply Chain Management**

St. Louis is the largest Metropolitan area in our region and UMSL is the largest university in St. Louis but until now it has not had a Ph.D. program in Logistics and Supply Chain Management. Dr. Ray Mundy is currently leading an effort to establish such a Ph.D. program at UMSL through the Center for Transportation Studies. Dr. Mundy attributes the interest in graduate programs at UMSL partly to the ability to provide students with the opportunity to work on graduate research in transportation through MTC financial assistance. Students are currently working on broad variety of projects including:

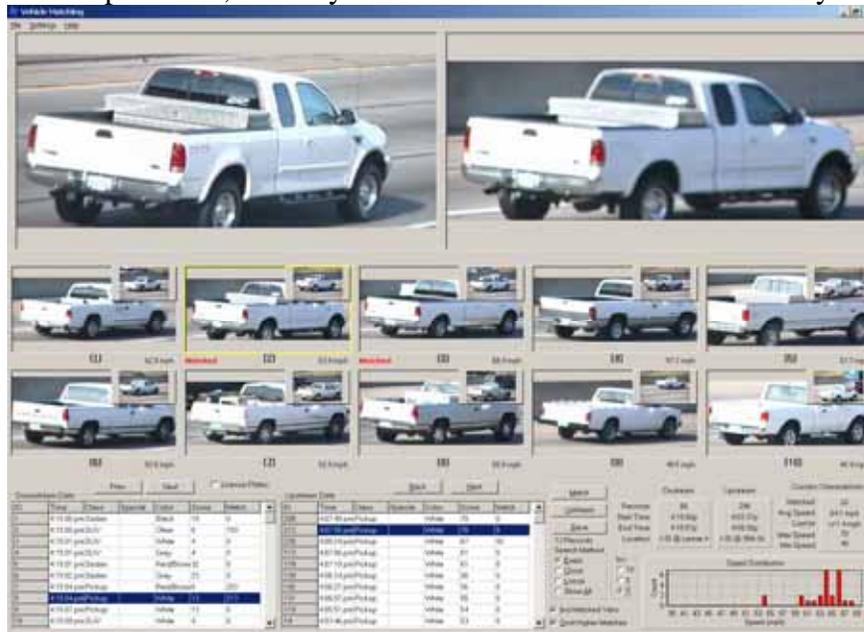
- Distribution Network Rationalization for Federal Mogul

- Use of Video Cameras and Picture Capture Technology to Improve Driver Safety Performance
- Regulation of Taxi Cabs in the U.S.
- Barge Appointment Systems for Locks on for Inland Waterway to improve Traffic Control

**The University of Missouri-Columbia's Transportation Scholars are on the move**

If you were traveled through Pennsylvania in early October chances are you may have seen two UM-C graduate students at work collecting traffic data on passing maneuvers on two lane rural highways. The Midwest Research Institute (MRI), a nationally recognized research in Kansas City, Missouri, is conducting a National Cooperative Highway Research Project study and they have contracted with UM-C to collect, process and

assist in analyzing the data using the POST (Portable Overhead Surveillance Trailer) technology developed by Dr. Carlos Sun. Two of his students, Venkata Chilukuri and Thirulokesh Krishnan, are collecting passing maneuver data with this system. Because it is visual and digital, data reduction is much more accurate and faster. The NCHRP panel studied this approach and accepted it for the MRI research project. The MTC program was available to provide the initial funding support for these two Transportation Scholars who were then able to move to a major ITS evaluation research project where they developed the knowledge and skills that is now being put to good use. Being able to leverage the Midwest Transportation Consortium's Transportation Scholar program is paying dividends in terms of better students doing state of the art research and applying these skills to real problems, not only in the Midwest but across the country.



**Example of Video Image Processing and Anonymous Vehicle Tracking**

### The University of Northern Iowa's Transportation Scholars

The University of Northern Iowa has historically had a strong geography program but did not have an emphasis in transportation. In the Late-1990s UNI hired Dr. Tim Strauss, a former CTRE and Wisconsin Department of Transportation Employee. Then as a junior partner in the MTC, UNI and Dr. Strauss began building a transportation emphasis in Geography. Today, the transportation community is beginning to benefit from MTC's investment in UNI. Below are a few brief discussions of past UNI MS students that were MTC Transportation Scholars.

- Jess Elder completed a thesis in October 2004 on the application of travel demand models to university campuses. He has been working for the last year at the Federal Aviation Administration in Washington, D.C. as a GIS analyst/cartographer on flight path and terrain analysis.
- Matthew Kajewski, completed a masters research paper in May 2005 on the automated query and analysis of crash statistics in a GIS environment using MapObjects, Visual Basic, CrimeStat (a point pattern analysis package). He has since been working as a GIS architect/programmer at IMAPS, LLC, a firm in the St. Louis area involved in GIS, navigation, and aviation flight planning. Kajewski's work deals with aeronautical and nautical navigation applications and charts for the National Geospatial-Intelligence Agency (NGA), the US Navy, and the Coast Guard, largely with airplane vertical obstruction and airport terminal applications.
- In May 2005, James Gerjevic completed a thesis on the extraction of transportation infrastructure data from hyperspectral remote sensing imagery. He has been working as a GIS specialist at the Union Pacific Railroad, focusing on the management of railroad infrastructure assets. ESRI featured James' work for the Union Pacific in their newsletters  
<http://www.esri.com/news/arcnews/spring05articles/union-pacific.html>

### MTC Spring Transportation Seminar, 2005

Each Spring, the MTC sponsors a Transportation Seminar Series for its member schools. A variety of speakers and topics are featured; sessions are shared via Internet-based videoconferencing. This year's seminar series has featured 14 nationally and regionally-known speakers and has focused on the topics of transportation asset management, transportation finance, and transportation safety. The seminar is offered as a for credit graduate level course at four different universities, including Iowa State, Northern Iowa, Missouri-Columbia, and Missouri-St. Louis.

Week	Date	Speaker	Topic
1	Jan. 14	Omar Smadi (Iowa State University)	How State DOTs Use Infrastructure Management Systems
2	Jan. 21	Jay Thompson (Transportation Business Associates)	Profitability and Productivity in the Trucking Industry
3	Jan. 28	Tom Welch (Iowa DOT)	Managing Highway Safety
4	Feb. 4	Dr. Bill Ankner (Missouri Transportation Institute)	Transportation Financing

5	Feb. 11	Dan Franklin (Iowa DOT)	Transportation Funding: A State Perspective
6	Feb. 18	Wendell Cox (Wendell Cox Consultancy)	Myths of Public Transportation
7	Feb. 25	Admiral Lou Smith (US Navy, Ret.)	Asset Management in the Military and Education: What Transportation Professionals Can Learn
8	Mar. 4	Dan Murray (American Transportation Research Institute)	Freight Performance Measures and Freight Security
9	Mar. 11	Larry Salci (Metro St. Louis CEO)	Managing Large Public Transportation Systems
10	Apr. 1	Mark Taylor (Federal Highway Administration, Federal Lands Division)	Innovative Highway Design and Context Sensitive Design
11	Apr. 8	Kevin Mahoney and Others (Iowa DOT)	Issues Future Transportation Professionals Will Face
12	Apr. 15	Commander Suzanne E. Englebert (US Coast Guard)	The Coast Guard's Roles Including Inland Ports and Waterways
13	Apr. 22	Reg Souleyrette (Iowa State University)	Road Safety Risk Rating in the EU and the US
14	Apr. 29	Bill Halsband (Mammoet)	Heavy Lifting Systems In Construction

The Spring Seminar series will be held once again in 2006 with a planned focus on transportation asset management and transportation safety.

For more information about the MTC Spring Seminar Series, contact David Plazak at CTRE, 515-296-0814, [dplazak@iastate.edu](mailto:dplazak@iastate.edu). Information about the seminars (including PowerPoint presentations and past years' seminars) is available on-line at:

<http://www.ctre.iastate.edu/educweb/scholars.htm>

### Research Program

The Midwest Transportation Consortium research program continues to build a successful portfolio of completed projects related to the Consortium theme: Sustainable Transportation Asset Management. Funded research is focused on the development of improved asset management tools and techniques. All past and present research projects can be viewed at <http://www.ctre.iastate.edu/mtc/projects/yr1/projects.htm>

All MTC-funded projects are expected to provide technology transfer of research results. Many of the results of funded projects have been presented at conferences and workshops, such as regional workshops on asset management, the past two National Transportation Asset Management Workshops, the Transportation Research Board's Annual Meeting in January and the Mid-Continent Transportation Symposium, a program shared on alternating years by the CTRE and the Midwest University Transportation Center at the University of Wisconsin Madison. Printed research summaries have been prepared for selected projects and web documentation has been prepared for all completed projects. For the past three years, the top-requested project on the Center for Transportation Research and Education's (CTRE) web site has been an MTC-funded project. This is noteworthy in that CTRE publishes numerous research reports each year. In 2003, a University of Northern Iowa's winter maintenance asset management project received over 1,300 downloads. This indicates that the MTC

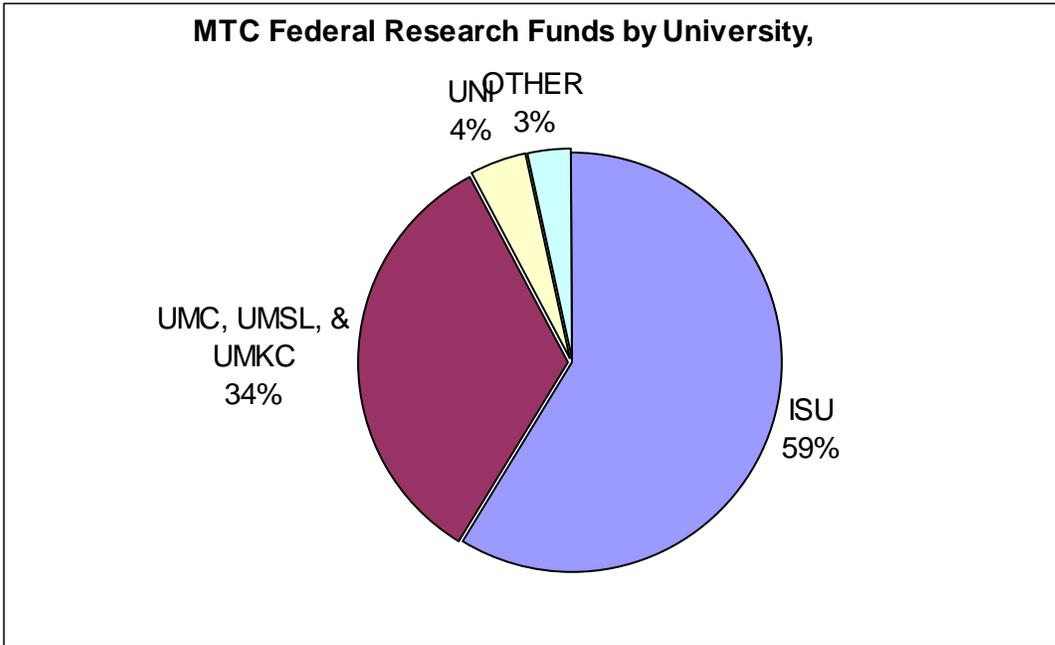
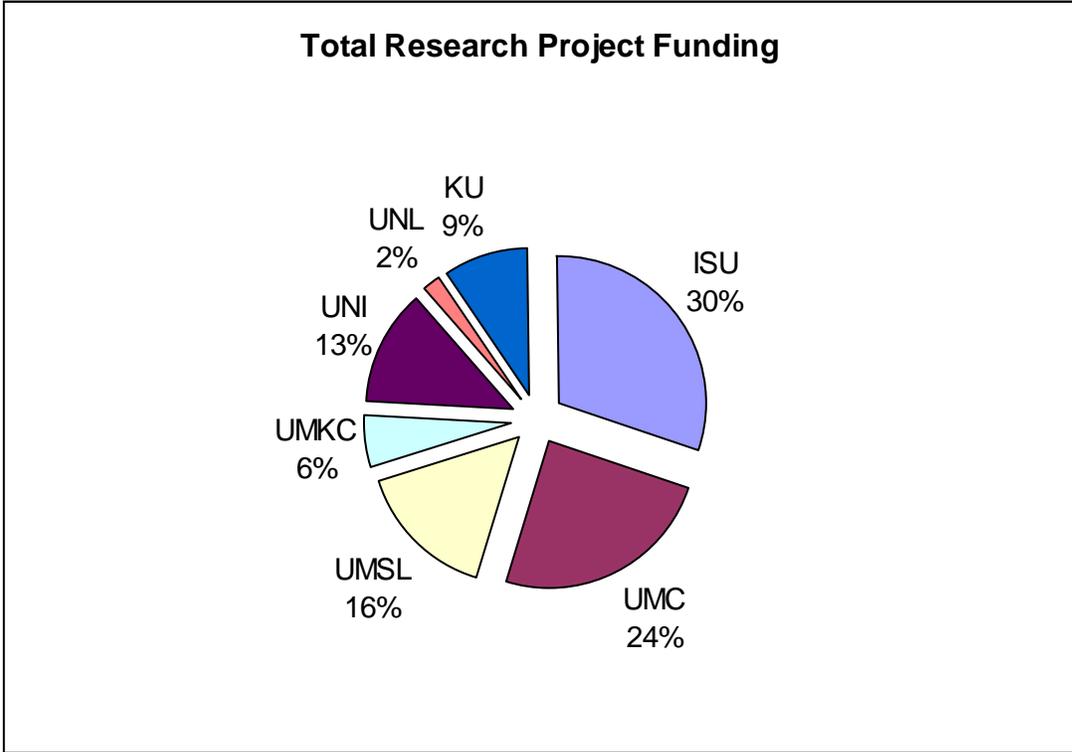
research selection process is developing projects that are of great interest to the transportation community.

MTC research project selection is made using a two-round selection process each Fall. The Year 7 research competition will start as soon as we get our total allocation of federal funds for year 7. During round 1, brief (2-3 pages) research prospectuses are submitted by Principal Investigators from any academic institution in US DOT Region 7. This includes the states of Iowa, Kansas, Missouri, and Nebraska. Submitted prospectuses are rated and ranked by academic reviewers from the region and outside the region, the four regional state DOT research managers, Federal Highway Administration Division staff in either Iowa or Missouri. About 30 to 50 percent of prospectuses are selected for further development. During Round 2 detailed proposals are requested. Matching funds must be guaranteed with a letter of commitment for match (Fifty percent match must be provided at a minimum, including cash and/or "soft" match.)

Through summer 2005, MTC had funded 21 different research projects at six lead universities in three states. These included:

- Iowa State University (11)
- University of Kansas (1)
- University of Missouri-Columbia (4)
- University of Missouri-Kansas City (1)
- University of Missouri-St. Louis (2)
- University of Northern Iowa (2)

Most of the project lead universities have been consortium member schools, but this is not a requirement for funding. The University of Nebraska a project subcontract subcontractors on projects and the University of Kansas conducted one of our largest projects. Total Federal UTC project funding has only been about \$950,000 over years 1 through 6, plus about an equal amount of matching funds. The distribution of funding is shown in the pie chart below. ISU received 30 percent of the federal projects funds while University of Missouri Columbia has received 24 percent. However, when the other program elements are added to the total, ISU has received a little over half the overall funds as shown in the following pie chart.



The status of the 21 MTC funded research projects funded through the first six years of operation of the consortium is shown below. A wide variety of asset management topics have been researched. Although highways and bridges have been the focus of most research, several projects have involved other modes, including public transportation and inland waterways.

As of the writing of this report, 14 projects have been completed and published, three more will be completed by the end of the calendar year, four more are in progress.

<b>MTC Research Projects Year One (2000)</b>		
Lead	Project Title	Dates/Status
Iowa State University	Addressing Integration Issues and Developing a Protocol for Integration of Global Positioning System Data With Linear Referenced Data in an Asset Management System	7/00 – 5/01 Completed
University of Kansas	GIS-Based Integrated Rural and Small Urban Transit Asset Management System	7/00 – 12/00 Completed
University of Missouri – Columbia	Decision-Support System for Management of Slope Construction and Repair Activities – An Asset Management System	7/00 – 6/02 Completed
University of Missouri – Kansas City	Roadway Asset Management Systems Manual for Local Governments	7/00 – 2/02 Completed
University of Northern Iowa	Artificial Intelligence – Based Optimization of Management of Snow Removal	7/00 – 5/02 Completed
<b>MTC Research Projects Year Two (2001)</b>		
University of Missouri - Columbia	Identification and Development of User Requirements to Support Robust Corridor Investment	7/01 – 9/04 Completed
Iowa State University	Application of Advanced Remote Sensing Technology Asset Management	7/01 – 10/03 Completed
University of Missouri – St. Louis	Research and Training of Private Transportation Providers for the Effective and Efficient Provision of Transportation Services	7/01 – 6/03 Completed
<b>MTC Research Projects Year Three (2002)</b>		
Iowa State University	Reducing Uncertainty in Estimating Heavy Truck VMT and Intersection Inventories	10/02– 12/04 Completed
Iowa State University	Iowa DOT Bridge Asset Management Using PONTIS: Data Integration, Performance, and Decision Support Tools	1/03 – 12/04 Completed
Iowa State University	Improving Efficiency of Transportation Projects Using Laser Scanning	9/02 – 12/02 Completed

<b>MTC Research Projects Year Four (2003)</b>		
Iowa State University	User Benefits of Winter Maintenance – Intercity Traffic During Winter Storms	5/03 – 6/05 Completed
Iowa State University	Roadway Alignments as Assets: Evaluating Alternatives for Valuing Major Highway Corridor Rights of Way	5/03 – In progress
University of Northern Iowa	A Web-Based Implementation of Winter Maintenance Decision Support System (WMDSS) Using GIS and Remote Sensing	7/03 – 5/05 Completed
<b>MTC Research Projects Year Five (2004)</b>		
Iowa State University	Implementation of HERS-ST in Iowa and Development/Refinement of a National Training Program	7/04 – In progress
Iowa State University	Planning, Development and Implementing the Iowa Pavement Marking Management System	4/04 – In progress
University of Missouri – St. Louis	Appointment Systems for Inland Waterway Traffic Control	4/04 – 11/05 Completed
<b>MTC Research Projects Year Six (2005)</b>		
Iowa State University	Determining the Costs of Truck Transit Delays for Shippers of Freight: An Exploratory Study	3/05 – In progress
University of Missouri – Columbia	Secondary Accident Data Fusion for Assessing Long Term Performance of Transportation Systems	3/05 – In progress
University of Missouri – Columbia	An Integrated Systems Approach to the Development of Winter Maintenance / Management Systems	3/05 – In progress
Iowa State University	Development of Fatigue Design Procedures for Slender, Tapered Support Structures for Highway Signs, Luminaries, and Traffic Signals Subjected to Wind-Induced Excitation from Vortex Shedding and Buffeting	3/05 – In progress
Iowa State University	Asset Management Strategies to Mitigate Freeway Work Zone Congestion	03/05 – In progress

All MTC project research reports and synopses of projects in progress are available on the world wide web at:

<http://www.ctre.iastate.edu/mtc/projects/yr1projects.htm>

In order to facilitate technology transfer efforts, a series of tech transfer summaries is now being prepared for projects that are thought to be the most valuable for transportation professionals. An example of one of these is shown below for the University of Northern Iowa project on Web-based Winter Maintenance Decision Support. Typically 100 to 200 hundred of these are printed and distributed widely through the region.



IOWA STATE UNIVERSITY

**RESEARCH PROJECT TITLE**

Web-based Implementation of a Winter Maintenance Decision Support System Using GIS and Remote Sensing

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## Web-based Winter Maintenance Decision Support System

tech transfer summary

### Objectives

- Integrate geo-spatial analytical techniques, existing snow removal asset management systems (SRAMS), and web-based spatial decision support systems to implement a web-based winter maintenance decision support system (WMDSS) to help stakeholders optimize snow removal assets
- Allow transportation personnel to (1) access and visualize Iowa DOT geographical information system (GIS) inventory data for their locality in a web-based GIS environment; (2) view remote sensing data and extract up-to-date transportation infrastructure data; (3) use web-based GIS tools to manage, analyze, and edit infrastructure data, including both spatial editing and attribute editing; (4) use such data, edited to support local use, in existing SRAMS.

### Problem Statement

Adequate snow and ice control is critical to traffic safety, maintaining city commerce, and allowing residents access to schools and medical facilities. Currently, most methods of snow removal management are manual, from choosing routes and assigning vehicles and personnel to determining the materials and amounts for each route. Various factors, such as the lead time for inventory orders, the reorder point, and stock levels, must also be monitored to keep the necessary snow removal materials in stock. Existing methods are often based on a set of static rules that are costly and inefficient for snow plowing and resource allocation during constantly changing winter weather conditions. The small margin of error during heavy storms and the lengthy reaction time of human-based methods can prove hazardous.

Existing snow removal methods do not provide visual feedback about routing and resource allocation. Visual feedback would not only help optimize current assignments, but also allow a review of the allocations for better planning in the future. Also, existing methods do not use integrated weather information to alert snow removal crews and provide scenario-based decision support. Researchers have explored using geo-spatial technologies, such as GIS and decision science and support tools, to plan snow removal operations. However, while most of these winter maintenance tools can address many information needs, these tools are seldom placed in the hands of interested stakeholders. Most tools are not constructed with a nontechnical user in mind and lack an easily understood interface. The unavailability of suitable data sets and inefficient methods technology transfer methods also hinder such tools.

### Research Description

This project integrated geospatial analytical techniques (GIS and remote sensing), existing SRAMS, and spatial decision support systems to implement a web-based WMDSS that enhances the capacity of stakeholders to

*Continued on next page*

*Research Description continued*

evaluate and manage snow removal assets optimally. To extract up-to-date road infrastructures, hyperspectral data were gathered from the high-resolution Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) and classified with the Spectral Angle Mapper (SAM), Mixture-tuned Matched Filtering (MTMF) and Mixture-Tuned Matched Filtering combined with Classification and Regression Tree (MTMF-CART).

The web-based WMDSS was then designed by integrating the ArcIMS ActiveX Connector with ArcIMS RouteServer Extension and web technologies such as ASP, XML, RSS, etc. The WMDSS used the gathered infrastructural data to provide intelligent expert decision support for prioritized route creation, inventory management, resource allocation, and a provision for embedded weather information. The developed system not only manages and allocates resources, but also provides expert advice to assist complex decision making such as routing, optimal resource allocation, and live weather information monitoring. See Figure 1.

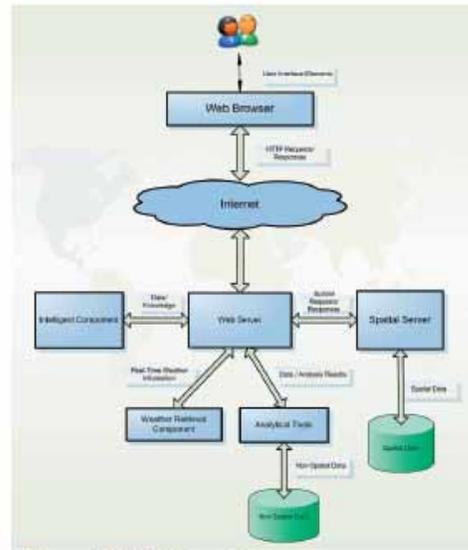


Figure 1. WMDSS architecture

**Key Findings**

- With an uncluttered, menu-driven interface divided neatly into areas, WMDSS can help nontechnical users manage and assign snow removal resources.
- Live or forecasted weather information from a weather feed webpage, and stored weather conditions, can suggest material assignments, determine resource allocation, generate alerts, and develop scenario-based solutions.
- Existing snowplowing routes can be viewed, or expert knowledge in the form of embedded business rules can help create new routes by estimating plowing time and the number of runs necessary to clear a roadway
- Depending on priority and total snowplow time for each route, vehicles can be assigned to snowplow the routes.
- Encoded expert knowledge and system-based weather conditions help users assign and analyze inventory.
- Users can assign drivers to routes and vehicles based on driver experience and vehicle operation costs.
- Users can view all current assignments in one screen, including current vehicle and driver assignments, weather conditions, and material estimates. See Figure 2.
- A detailed help system, assists users with all the possible actions that can be performed (e.g., creating routes and assigning vehicles).

**Implementation Benefits**

An accessible and available web-based WMDSS enhances the capacity of city/county planners, resource managers, transportation personnel, and policy makers to evaluate different procedures for optimally managing snow removal assets.

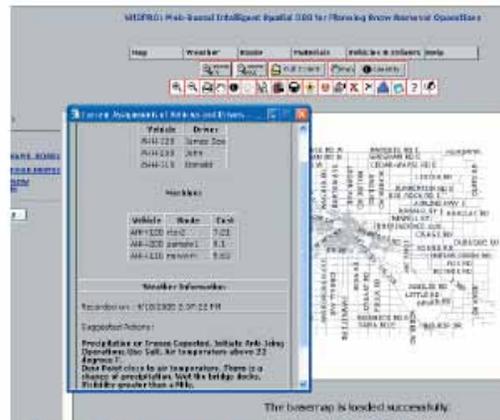


Figure 2. Summary of assignments in the WMDSS interface

**Implementation Readiness**

The technology from this project was transferred to the end user in different ways. The project's results were widely published in refereed journals and conference proceedings and presented in workshops and conferences. A detailed tutorial has also been made available. In addition, a hands-on workshop was given that showcased WMDSS for end users. The project team will continue to transfer the technology through distributing user manuals, meeting with end users and other winter maintenance personnel, and developing an educational interactive website.

**Outreach and Technology Transfer Program Highlights**

This year's emphasis in terms of outreach and technology transfer has been on disseminating research results to the community of transportation practitioners through the world wide web and the new tech transfer summary series of publications. However, more "hand-on" activities also continue.

Iowa State University project Implementation of HERS-ST in Iowa and Development/refinement of a National Training Program develop a one-day hands-on training program for the Iowa DOT. The principal investigator for this project is currently negotiating a second offering of this workshop for the Arizona DOT and for consultants to the Arizona DOT.

The MTC also co-sponsored the Mid-Continent Transportation Symposium. This conference has been a biennial regional event with roughly 100 paper presentations and about 300 attendees. The conference was conducted in August, 2005 and several presentations were made from MTC projects. The primary sponsors of this conference have been the MTC, CTRE, and the Iowa DOT. This year the Midwest Regional University Transportation Center (MRUTC) at the University of Wisconsin Madison and Wisconsin Department of Transportation offered to sponsor the same conference in Madison, Wisconsin in 2006 and alternate the conference between Madison and Ames on alternate years. This conference provides an excellent forum for the presentation of research findings at a regional level. The Iowa DOT, CTRE, and the MTC could never sustain an annual event but by sharing the responsibility with the Wisconsin DOT and the MRUTC the conference can be sustained and offered annually.

In October/November, 2005 the Sixth National Asset Management meeting was held in Kansas City. The MTC co-sponsored this meeting, and MTC staff helped to plan the meeting. Further MTC was well represented on the agenda with MTC Director Tom Maze, MTC Associate Director, Charlie Nemmers, and MTC researchers, Neal Hawkins, and Omar Smadi all making presentation during the Conference.

During the summer of 2005 the Transportation Research Board (part of the National Academy of Science), in cooperation with the Federal Highway Administration, hosted a national forum at Woods Hole, Mass. on the role of Universities in Advanced Research in Transportation. Three Universities were invited: Joseph Sussman from The Massachusetts Institute of Technology (MIT), Steve Andrlle from Iowa State University (ISU) and Charles Nemmers from the University of Missouri-Columbia (UM-C). Two of the three were from the Midwest Transportation Consortium. The forum included top officials from: the FHWA, several State DOTs, the National Science Foundation, TRB and private consultant firms. Messers Aderle and Nemmers shared how universities were in a very critical position being linked to both the realm of advanced research in their university setting as well as being linked to the application of these newer technologies through their close and positive relationships with the State DOTs. The University Transportation Centers were shown to be developers of both the technologies and the people to implement them. Both Iowa State University and The University of Missouri-

Columbia were invited back to participate in one of three national outreach forms on the same topic in Minneapolis in September 2005.

The Center for Transportation Studies at the University of Missouri-St. Louis was asked by Federal Mogul to analyze their outbound distribution network and transportation costs. This includes shipments from their nine distribution centers to their customers. This project for local industry involves faculty and transportation scholars in the MBA program at UMSL. So far, the analysis has only looked at outbound transportation costs. The analysis is now being extended to include shipment from plants to distribution center and inventory costs.

### **Consortium Sources and Uses of Funding**

During Federal Fiscal Year 2005, the Midwest Transportation Consortium received approximately 43 percent of its funding from Federal University Transportation Center Program (UTCP) grant funds. These funds were mainly matched with Institutional, University funds, 35 percent of total funds, and funding from State Departments of Transportation located in Region 7. The largest state contributions came from Iowa and Missouri.

As was indicated in the MTC's Strategic Plan, the consortium's main focus is on education—the development of new human capital and leadership for the transportation industry in the region served by the MTC. In Federal Fiscal Year 2005, exactly half of MTC funding went for education. This includes items such as graduate student research assistantships, development of new courses and course material related to transportation asset management, student competition awards, and student educational travel to conferences such as the transportation research board annual meeting. A third of funding went into the MTC competitive research program. Most of the remainder went toward technology transfer, for instance presenting workshops or co-sponsoring conferences and preparing tech transfer summaries. About seven percent of funding went toward the administration of the MTC program, including general administration and costs related to research contracts.

