

2006 – 2007 Annual Report



Advanced Technology in Transportation Operations and Management

The Pennsylvania State University ▪ University of Virginia
▪ Virginia Polytechnic Institute & State University ▪ West Virginia University

2006/2007 Annual Report

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MAUTC THEME

MAUTC's theme, *Advanced Technologies in Transportation Operations and Management*, recognizes the critical link between technology and management of our transportation infrastructure, and it provides for a multidisciplinary approach to many critical transportation issues facing the Mid-Atlantic Region. MAUTC's research, education, and technology transfer programs focus on the integration of knowledge and expertise in transportation operations, organizational management, and infrastructure management. The theme clearly reflects the strengths of the four universities of MAUTC and the interests of the faculty and state agencies that support much of the research conducted by MAUTC.

The distinctive elements of MAUTC's theme include the following:

- Design and implementation of research and educational programs that apply advanced technologies for information acquisition, analysis, and application to the management of the transportation system.
- Multidisciplinary approach to research, education, and technology transfer activities.
- Emphasis on the operations and management of the transportation system.
- Multimodal mission that addresses passenger and freight transportation, highway, transit, and intermodal facilities.

MANAGEMENT STRUCTURE

Penn State has been the lead university and grantee for the University Transportation Centers (UTC) Program since 1968. MAUTC is administered through the Pennsylvania Transportation Institute (PTI). The MAUTC director and principal investigator, Dr. John M. Mason, Jr., delegates day-to-day responsibility for MAUTC partner activities to each partner university: University of Virginia, Virginia Polytechnic Institute and State University, and West Virginia University.

Dr. Martin T. Pietrucha, assistant professor, civil engineering, and director, Transportation Operations Program, represents PTI's faculty interests in MAUTC activities.

Ms. Janice Dauber, MAUTC coordinator, is responsible for MAUTC's technology transfer activities, publicity, and report preparation.

Ms. Sara (Sally) Gannon, staff assistant, provides clerical support for the overall MAUTC administrative effort as well as for Penn State's MAUTC projects and programs. Additional PTI staff support MAUTC as needed.

MAUTC FUNDING

MAUTC meets the U.S. Department of Transportation's 1:1 match requirement through state and local agencies, private companies, and universities. Pennsylvania, Virginia, and West Virginia departments of transportation provide the majority of matching funds. The UTC Program helps these states leverage their research dollars.

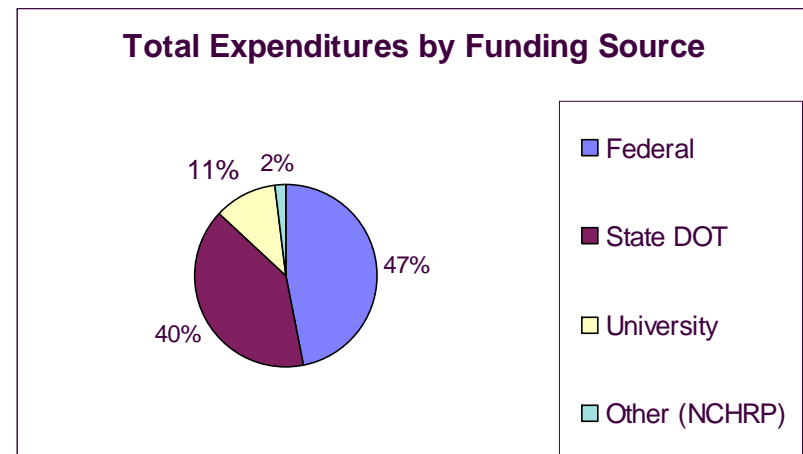


Figure 1. 2006/07 Sources of Total Expenditures

THE CENTER

The Mid-Atlantic Universities Transportation Center is currently comprised of four universities:

- The Pennsylvania State University
- University of Virginia
- Virginia Polytechnic Institute and State University
- West Virginia University

The Pennsylvania State University

The Pennsylvania Transportation Institute is one of the nation's leading university transportation centers. Since its first days in 1968, PTI has pursued a mission of interdisciplinary research that today involves



Figure 2. Pennsylvania Transportation Institute

laboratories, departments, and colleges throughout Penn State and numerous state, federal, and private collaborators. PTI supports University faculty and students by providing

interdisciplinary educational and research opportunities that complement and enhance the University's undergraduate and graduate education programs.

PTI is the locus for transportation-related research conducted by Penn State faculty from more than 14 colleges and research centers. Many of these faculty hold joint appointments with the institute and Penn State's academic colleges and schools; areas of specialization include civil, computer, electrical, industrial, and mechanical engineering as well as agriculture,

information sciences and technology, supply chain management, architectural engineering, economics, geography, psychology, and statistics. Through its multidisciplinary structure and supportive research environment, the institute provides a unique focal point of collaboration for faculty from many different areas of the University.

Three programs comprise the Institute: Transportation Infrastructure Program, the Transportation Operations Program, and Vehicles Systems and Safety Program. Faculty, researchers, and students from all three programs contribute to and benefit from the research projects funded under the auspices of MAUTC.

University of Virginia

The transportation program at UVA has expanded since its inception in the late 1940s when the University of Virginia School of Engineering and Applied Sciences began an ongoing partnership with Virginia Transportation Research Council (VTRC), the research branch of the Virginia Department of Transportation. The Center for Transportation Studies (CTS) was established to organize the existing academic program and research activities and to lay the groundwork for future growth.



The Center is located within the Civil Engineering Department on the grounds of the University of Virginia. With offices and laboratory facilities located on two floors, including the Smart Travel Lab, the Center also shares the resources, laboratories and library of the VTRC facility, a 100-employee research complex at the University of Virginia. The academic and research programs of the Center are closely associated with the Virginia Transportation Research Council. Through this partnership, faculty hold joint appointments, VTRC research scientists teach specialized courses, and graduate student work is supported through a Graduate Research Assistantship Program. The Research Council also supports the Virginia Technology Transfer Center, the Smart Travel Lab, shared computational facilities, and the largest transportation library in the State of Virginia.

Today the Center oversees a flourishing program that includes education, research, and public service. Its faculty, which span the departments of Civil Engineering and Systems and Information Engineering at the University, are highly regarded both as teachers and as researchers. They have been the recipients of University teaching awards and include two members of the National Academy of Engineering.

Thanks to the extensive, longstanding ties with such organizations as VTRC, MAUTC, as well as the Federal Highway Administration and the Institute of Justice, the center has a stable, flourishing research program, covering such areas as transportation and land use, traffic simulation, highway safety, freight operations, and traffic operations.

Virginia Polytechnic Institute and State University

Virginia Technology and Transportation Institute was established in August 1988 in response to the U.S. Department of Transportation's University Transportation Centers Program and in cooperation with the Virginia Department of Transportation. VTTI pursues its mission by encouraging research, attracting a multidisciplinary core of researchers, and educating students in the latest transportation technologies through hands-on research and experience. The institute is both an FHWA/FTA ITS Research Center of Excellence and a Mid-Atlantic Universities Transportation Center.

VTTI is housed in a 30,000-square-foot building located in Blacksburg, Virginia. It was built at the western end of Virginia's Smart Road, a road designed specifically for testing new transportation technology. The building accommodates the Smart Road Control Center, where researchers monitor and control data collection, weather-generation, lighting, power grids, and roadway surveillance cameras. The building is equipped with office and laboratory space for VTTI, VDOT's Christiansburg Residency, and companies that contract for use of the facility. Additionally, it holds a fully staffed garage and shop for experimental vehicles.

VTTI is used by more than 90 researchers and faculty. In addition, approximately 80 students have access to the facility as well as its laboratories and equipment.

West Virginia University Harley O. Staggers National Transportation Center

The Staggers Center at West Virginia University (WVU) is a comprehensive transportation research institute that has served regional and national transportation research, education, and technology transfer needs since 1977. The center includes nearly 20 core faculty and staff members currently conducting nearly \$2 million of research, education, and technology transfer activities. As part of a large university, the center can bring the necessary expertise to bear on virtually any client's problem. The Staggers Center has five primary research areas: Infrastructure Management, Planning and Economics, Transportation Design and Operations, Energy and Environmental Impacts, and Transportation Structures.

Public service is one of the center's primary missions, in concert with WVU's role as the land grant institution for the state. The center strives to ensure that benefits of research extend beyond the solving of technical problems. Through the technology transfer center, routine training sessions are held for transportation engineering and maintenance personnel. Faculty and researchers serve as technical and educational support to state agencies, legislature, municipalities, and private citizens. In addition, the research program provides the primary support for graduate students while they pursue their studies, a tremendous investment in the future of transportation engineering.

RESEARCH

The Pennsylvania State University

PennDOT/MAUTC Partnership

The PennDOT/MAUTC Partnership, initiated in 2005, continues to provide a framework to conduct mutually beneficial research and to develop tomorrow's workforce by providing graduate students an opportunity to conduct research for the Commonwealth.

Twelve projects have been initiated as of the close of FY 06/07 with a total contract value of \$1.2 million. Fifteen graduate students and four undergraduate students have been funded and have contributed to projects ranging from safety evaluation of wider edge lines on curves to crash testing portable signs to evaluating bridge deck patching products for use in Pennsylvania.

Portable Sign Crash Test, PSU-2006-04

Portable sign post structures on X-shape and H-shape bases used by PennDOT throughout the Commonwealth are not assembled using consistent techniques and materials, and do not meet crash testing standards established in NCHRP 350. Researchers at Penn State were asked to review available crash-tested portable sign post structures and, based on this review, design and crash test a new model to meet the NCHRP 350 criteria and establish a standard PennDOT support design protocol.

The full report can be found at <http://www.pti.psu.edu/mautc/docs/PSU-2006-04.html>.

Principal Investigator: Dr. Zoltan Rado
814-863-5615, zxr100@psu.edu

Preliminary Assessment of Acid-Producing Rocks on Future Construction in Pennsylvania, PSU-2005-05

Construction of Interstate 99 at Skytop in Port Matilda, Pa., intersected a pyrite deposit of unusual proportions and unusually reactive. The pyritic rock, when exposed to oxygen and moisture, resulted in severe acidic rock drainage (ARD) that was detrimental to the local environment. Remediation has increased construction costs and delayed the opening of the highway.

The likelihood that future construction will occur with ARD-producing geologies is growing. Therefore, there is a need to identify these potential intersects of construction and geology to try to avoid increased construction costs and environmental problems.

Researchers, integrating Department of Conservation and Natural Resources, Bureau of Topographic Services Sulfide-containing Strata Map, and PennDOT's 5- and 10-year construction projections and other resources, identified areas within the Commonwealth that may experience ARD problems in construction areas. In addition, a flow chart was developed to help PennDOT assess the potential for ARD problems in the pre-design site selection process.

Additional research has shown that ARD problems may be prevalent throughout the mid-Atlantic region. Professor Scheetz was interviewed on WPSU's *Pennsylvania Inside Out*. The video podcast is located at <http://streaming.ois.psu.edu/PENNSY02102005190509.mov>.

The final report is located at <http://www.pti.psu.edu/mautc/docs/PSU-2005-05.html>.

Principal Investigator: Dr. Barry Scheetz
814-863-1044

Ensuring Safer Roads: Reducing Crashes at High-Risk Locations, PSU-2006-08

The frequency of vehicle crashes and resultant injuries and fatalities for each vehicle mile traveled has diminished considerably as both vehicles and roadways have become safer. Still, no level above zero is acceptable, so agencies like the Pennsylvania Department of Transportation are constantly vigilant for ways to further decrease the likelihood of crashes, particularly in high-risk locations.

For this project, Statewide Crash Analysis and Forecasting, researchers are conducting analyses of existing PennDOT data to identify sites of elevated crash risk. Additional analyses are also exploring level of injury severity, the ability to estimate changes in expected crashes as annual average daily traffic increases, and the ability to identify high-risk crash types. To accomplish these objectives, new safety analysis tools are being developed to better assess the safety performance of road segments in the Commonwealth. A key resource is an existing safety management system database at PennDOT that integrates crash, occupant, vehicle and traffic information in an integrated, searchable format. The ultimate objective is

the development of a crash prediction model that includes traffic, population, and demographic factors, with a goal of improved safety management on Pennsylvania roads and a reduction in crash fatalities, injuries, and property damage losses.

University of Virginia

Performance Evaluation of Truck-rail Intermodal Terminals, UVA-2006-01

An increase in freight traffic is one of the factors contributing to roadway congestion. UVA researchers are investigating opportunities to develop strategies for better management of goods movement. Rail-truck intermodal freight transportation can be considered as one such solution for reducing long-haul truck traffic on highways. For rail-truck intermodal freight transportation to act as a sustainable alternate mode of transportation, it is necessary to evaluate the characteristics of the intermodal system, the components of which are namely, the rail infrastructure, the road infrastructure and the freight intermodal terminal.

The focus of this research is on the freight intermodal terminal. This research will be carried out using a case study of the proposed freight intermodal terminal at Petersburg, Va., which has been conceived by a private railroad company, Norfolk Southern Corporation, to increase their intermodal business near Richmond, Va.

Principal Investigator: Dr. Michael Demetsky
434-982-2324, mjd@virginia.edu

Freight on the Interstate Highway System: Current State, Forecasts, and Alternatives, UVA-2006-02

The amount of commercial truck traffic has significantly increased since the Interstate system was first envisioned. That trend is expected to continue, taking an ever larger toll on the system in efficiency, safety, and the cost of goods to consumers. Investigators are conducting an assessment of the current state of the nation's highways in order to identify options for the future that would allow freight transportation to continue at its current flow.

Potential options include having separate truck lanes, tolling, using rail, and increasing capacity on current highways.

Principal Investigator: Dr. Lester Hoel
434-924-6369, lah@virginia.edu

Virginia Polytechnic Institute and State University

Study the Impact of Inclement Weather on Traffic Stream Behavior, VPI-2005-01

Catastrophic weather events—hurricanes, tornados, blizzards, etc.—and the toll they take in lost lives and property damage garner the most attention on the national and local news. But these are isolated incidents that impact



travelers on a seasonal basis. Everyday weather events such as snow, fog, ice and rain regularly affect our travel time, fuel consumption, and safety.

In this study, three cities were selected—Minneapolis-St. Paul, Minn.; Baltimore, Md.; and Seattle, Wash.—to determine the impact of inclement weather on traffic flow behavior and four traffic

stream parameters: free-flow speed, speed-at-capacity, capacity, and stream jam density.

The findings indicate that weather conditions did not impact stream jam density. Free flow speed, speed-at-capacity, and capacity were reduced in correlation to the intensity of the rain. Snow had a larger impact than rain on traffic stream free-flow speed and capacity.

Further study has been recommended to include a larger sample of sites and inclusion of the Federal Highway Administration's naturalistic Field Operational Test (FOT) data in conjunction with controlled field studies.

The final report is located at
<http://www.pti.psu.edu/mautc/projects/finalrpts.html>.

Principal Investigator: Dr. Hesham Rakha
540-231-1505, hrakha@vt.edu

West Virginia University



Frank Goetzke, MAUTC Student of the Year

In August 2006, Frank graduated from West Virginia University with a Ph.D. in Economics. While at WVU, Frank was a dissertation fellow for the Harley O. Staggers National Transportation Center at WVU. He has worked as a Transportation Consultant and Senior Transportation Planner for Cambridge Systematics in Cambridge, Mass. and Chicago, Ill. Currently Frank is an Assistant Professor

for Urban Economics at the School of Urban and Public Affairs at the University of Louisville, in Louisville, Ky.

Frank's academic background in economics and work experience in transportation consulting were combined with great success in his accomplishments in research projects for his dissertation and for the Transportation Center at WVU.

Assessment of Bus Transit Equity in Two Metropolitan Areas, WVU-2006-01

Many local transit systems are under pressure to provide improved and equitable service to a wide socioeconomic range of customers and to do so within tight budget constraints. Researchers at West Virginia University compared data from Columbus, Oh., and Seattle, Wash., in order to develop a methodology to assess equity by transit users of different demographic backgrounds. In addition to researching the effects of travel distance, fare paid, and demographics on equity, the team factored in travel time.

Based on the study of data from Columbus and Seattle, the researchers determined that there were inequities in the pricing of fares and that low-income minorities and women tend to pay a higher fare per mile of service. While the results of the study were specific to the two cities surveyed, the methodology can be applied by transit agencies to help determine if fares are equitable and to set policies that will reduce or eliminate those inequities in service or pricing.

The full report is located at <http://www.pti.psu.edu/mautc/docs/WVU-2006-01.html>.

Principal Investigator: Dr. David Martinelli
304-293-3031, ext. 2676

Faculty and Researchers

The Pennsylvania State University



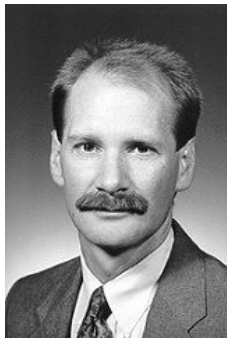
Joel R. Anstrom, Ph.D.
Director, Hybrid and Hydrogen Vehicle Research Center and DOE Graduate Automotive Technology Education Center

Research Interests: Modeling of electric, hybrid electric, and fuel cell vehicles for efficiency and dynamic handling



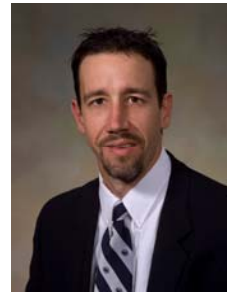
Eric T. Donnell, Ph.D., P.E.
Assistant Professor, Civil Engineering

Research Interests: Geometric design of highways and streets, highway safety, roadside design and management, traffic engineering



Jeffrey A. Laman, Ph.D, P.E.
Associate Professor, Civil Engineering

Research Interests: Bridge monitoring, bridge dynamics, bridge analysis and load distribution, substructures and foundations, integral abutment bridges, bridge load models, fatigue loading, steel structure design, weigh-in-motion, optical fiber sensors



Daniel G. Linzell, Ph.D, P.E.
Director, Transportation Infrastructure Program
Associate Professor of Civil Engineering

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Research Areas

- Bridge engineering
 - Curved and skewed bridges
 - Construction design and analysis
- Force protection
 - Advanced materials and structures
- Steel structures
- Advanced finite element analysis
- Field testing
- Structural health monitoring
- Large-scale laboratory testing



John M. Mason, Jr., Ph.D., P.E.
Associate Dean for Graduate Studies, Research and Outreach
Director, MAUTC
Director, PTI

Research Interests: Highway engineering, traffic engineering, and roadway safety for surface transportation vehicles (automobiles and large trucks). Research includes operational effects of highway geometrics, safe driving characteristics, traffic data collection methods



Martin T. Pietrucha, Ph.D.
 Director, Science Technology and Society Program
 Associate Professor, Civil Engineering
 Chair, Transportation Engineering and Safety
 Conference

Research Interests: Highway safety, ergonomics,
 highway traffic operations, traffic impact analysis,
 highway design, older drivers, pedestrians



Andrea J. Schokker, Ph.D.
 Assistant Professor and Henderson Chair, Department
 of Civil and Environmental Engineering

Research Interests: Design and materials-related
 improvements in prestressed concrete, durability and
 corrosion of concrete structures, cement grouts for
 post-tensioning applications



Paul J. Tikalsky, Ph.D., P.E.
 Associate Professor, Civil Engineering
 Deputy Director, PTI

Research Interests: Structural and material
 evaluation of buildings and bridges, destructive and
 nondestructive testing of construction materials, high
 performance concrete materials

University of Virginia



Michael J. Demetsky, Ph.D.
 Chair & Professor of Civil Engineering

Research Interests: Intermodal freight transportation
 planning and operations, evaluation of ITS
 deployments, decision support systems for
 transportation systems management, performance
 analysis of transportation systems



Nicholas J. Garber, Ph.D., P.E.
 Henry L. Kinnier Professor of Civil Engineering

Research Interests: Traffic operations and highway
 safety, intelligent transportation systems, speed
 management on high-speed roads, work zone safety,
 large truck safety



Lester A. Hoel, D. Eng., P.E.
 L.A. Lacy Distinguished Professor of Engineering
 Director, Center for Transportation Studies

Research Interests: Management, planning
 and design of surface transportation
 infrastructure with emphasis on highway and
 transit systems



Brian L. Smith, Ph.D.
Associate Professor of Civil Engineering
Director, Smart Travel Laboratory

Research Interests: Intelligent Transportation Systems, particularly in advanced transportation management; statistical modeling, traffic flow theory, software engineering, simulation, data mining, geographic information systems, and artificial intelligence



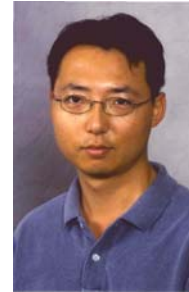
Byungkyu (Brian) Park, Ph.D.
Assistant Professor of Civil Engineering

Research Interests: Stochastic Optimization of Traffic Signal Timing Plan, ITS Evaluation Using Simulation Model, Travel Time Estimation, and Traffic Flow Theory



Saeed Eslambolchi
Director of Research Administration, Center for Transportation Studies

Virginia Polytechnic Institute and State University



Kyoungho Ahn, Ph.D.
Senior Research Scientist

Research Interests: Transportation environmental modeling, traffic flow theory, and traffic modeling and simulation. He is also knowledgeable in the areas of operations research, urban planning, and transportation planning



Ihab El-Shawarby, Ph.D.
Research Scholar

Research Interests: Operations research, optimization, modeling and simulation



Alejandra Medina
Senior Research Associate

Research Interests: Network traffic modeling, traffic simulation, identification of driver errors, pavements, and infrastructure management



Hesham A. Rakha, Ph.D.
Leader, Transportation Systems and Engineering

Research Interests: Traffic flow theory, traffic modeling and simulation, intelligent transportation systems and optimization, traffic control, energy and environmental modeling, and safety modeling



David M. Martinelli, Ph.D., P.E.
Chairman and Associate Professor,
Department of Civil and Environmental Engineering

Research Interests: Structural dynamics, finite element modeling, pavement dynamics, measurements and instrumentation, digital signal processing, mechanical design, and intelligent structures



Mazan Arafeh, D.Eng.
Senior Research Associate

Research Interests: Travel time analysis, automatic vehicle identification tag readers, interstate planning, truck management, and traffic evacuation strategies. Specific projects include “The Reliability of Trip Travel Estimations,” an ITS implementation project, and the I-81 Planning Study sponsored by the Virginia Department of Transportation (VDOT)



Samir N. Shoukry, Ph.D.
Professor, Departments of Civil and Environmental Engineering and Mechanical and Aerospace Engineering

Research Interests: Application of advanced technologies in transportation, pavement modeling and evaluation, transportation systems analysis, and transportation planning and economics

West Virginia University



L. James French, Ph.D., P.E.
Research Assistant Professor

Research Interests: Traffic engineering, highway design, and intelligent transportation systems

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