



2003 – 2004 Annual Report

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

TABLE OF CONTENTS

Theme	1
Management Structure	1
Funding	1
The Center	2
Research	4
Education	8
Technology Transfer	9
Appendix A: Project Status List	11
Appendix B: Publications, 1999-2004	17

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 five 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

Administration

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

Other administrative staff include:

Dr. Lily Elefteriadou, interim director of the Pennsylvania Transportation Institute, and associate professor, civil and environmental engineering, Penn State, was named co-principal investigator in December 2003.

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

Ms. Susan Thompson, 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 supports 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 University Transportation Centers (UTC) Program helps these states leverage their research dollars.

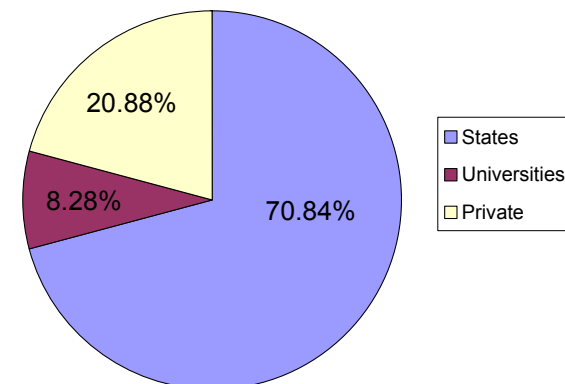


Figure 1. Sources of Matching Funds.

Advisory Board

The advisory board consists of transportation experts selected from both the private and public sector. The members bring a broad range of knowledge to MAUTC. The advisory board members are charged with:

- ◆ Promoting MAUTC to constituents.
- ◆ Providing direction to MAUTC in meeting the transportation challenges in the Mid-Atlantic Region.
- ◆ Participating at an annual meeting to discuss accomplishments and define initiatives.
- ◆ Providing support to, and participating in the building of, a mid-Atlantic community of transportation professionals.

The following are members:

Rebecca Brewster, ATA Foundation
John Coscia, Delaware Valley Regional Planning Commission
John Halkias, Federal Highway Administration
Gary Lanham, West Virginia Department of Highways
Fred Mannering, Purdue University
Amy Tang McElwain, Virginia Department of Transportation
Elaine Murakami, Federal Transit Administration
Mark Norman, Transportation Research Board
Srinivas Rajagopal, Manugistics, Inc.
L. Craig Reed, Pennsylvania Department of Transportation
Herman Shipman, Federal Transit Administration
Paul Skoutelas, Port Authority of Allegheny County
Michael Townes, Transportation District Commission of Hampton Roads

THE CENTER

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

- The Pennsylvania State University
- University of Pennsylvania
- 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 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.

Three programs and a center comprise the Institute:

Transportation Infrastructure Program, Vehicles Systems and Safety Program, The State Research, Education, and Technology Center, and the Transportation Operations Program (TOP), which serves as administrative home for MAUTC.

TOP is Penn State's focal point of basic and applied research in planning, design, and operation of transportation systems. Its faculty resides within the College of Engineering, the Smeal College of Business Administration, and the School of Information Sciences and Technology.

University of Pennsylvania

The development of the University of Pennsylvania (Penn) over the past decade has been directed toward enhancing the quality of undergraduate and graduate programs and raising the university's stature among universities. This effort has been quite successful. As part of this effort, a decision was made to not increase the size of the university substantially. The MAUTC program at Penn has evolved in a manner consistent with these goals. The program is centered in Systems Engineering but has carefully selected ties to other departments and schools.

At the graduate level, Penn has concentrated on providing its Ph.D.s with the advanced knowledge needed in academic institutions and in advanced

research and related fields in industry. Penn Ph.D. recipients are found at many universities, and some of the earliest graduates of the program now are leaders in UTC and in other transport and logistics programs throughout the country. At the undergraduate level, Penn has concentrated on enhancing course offerings, including joint courses between schools and departments, and in integrating undergraduates into both theoretical and applied research and development.

The major emphasis of the MAUTC program at Penn is freight transportation and logistical networks, and includes industrial research collaboration and student internships. A recent project developed new methods for planning product deliveries and truck movements, a topic from Manugistics, Inc., which supplies computerized tools to firms with household names. Another project is developing methods for assessing transportation system capacity, flexibility, and vulnerability, with support from not only the UTC Program but also the National Science Foundation and private sector collaborators. A new project is directed toward enabling Americans with Disabilities Act-compliant access on railroads without changes in stations that compromise the ability of the line to carry cargo.

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 (STL), the Center also shares the resources, laboratories and library of the VTRC facility, a 100-employee research complex on the grounds of 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

VTTI 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 a FHWA/FTA ITS Research Center of Excellence and a Mid-Atlantic University 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 also 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

MAUTC research projects are selected on the basis of their ability to provide financial support for students and to support of the needs of the state departments of transportation, local transportation agencies, and the Mid-Atlantic Region. U.S. Department of Transportation research priorities are strong considerations when seeking matching funds for projects.

The number of new projects decreased this year, as MAUTC focuses on bringing ongoing research projects to completion.

MAUTC has conducted more than 90 projects since the beginning of the current contract, totaling just over \$8.5 million. The majority of the projects have been in the area of transportation system performance. Appendix A provides a complete listing of all projects.

Subject Area	No. of Projects	Total Budgeted (All Sources)
Transportation System Performance	47	46.59%
Physical Infrastructure	13	15.85%
Information Infrastructure	21	24.08%
Vehicles	1	.12%
Other	14	13.36%

Table 1: Research Projects by Subject Area.

The following projects are representative of the research conducted by MAUTC.

Time Use, Telecommunications, and Technology Interactions, Konstadinos G. Goulias, PSU-2002-08

For the past 15 years transportation professionals hoped to put telecommunications to good use in curbing congestion and air pollution. One form of this use, telecommuting (use of telecommunications at home or a neighborhood facility to do work for pay), is consistently included in the tools of transportation demand management. In parallel, many other inventions of this genre were also developed such as cell phones, mobile computers, and a variety of teleconferencing devices, and have received widespread popularity. Using these technologies impacts travel demand in different and opposing ways for different persons in different contexts.

For example, teleconference devices may significantly reduce the number of business trips a person may take, but cell phone use may increase travel due to greater flexibility for that same person and her contacts. Added flexibility for the traveling public may also create added uncertainty and lack of predictability of travel demand making traffic management much harder. This may also decrease our ability to respond in an effective way to emergencies.

Therefore, understanding how telecommunication devices affect traveler behavior is critical for our transportation system. In addition, developing reliable models for forecasting travel demand in space and time is also critical for traffic management, congestion prediction, and emergency response. In the long term, the ability to more accurately predict travel patterns can be used to determine investments in infrastructure and, possibly, safety improvements.

A first step towards this understanding was taken by using the longest longitudinal record of travel behavior in the world, the Puget Sound Transportation Panel. This is a database of people's recorded behavior from 1989 to 2003. Using sophisticated statistical models, Professor Goulias and his students unveiled the opposing effects of telecommunications on travel, showed the internet rising as a source of information, and provided assurances that a major congestion catastrophe is not imminent, but also that telecommunications are not a panacea for congestion and air pollution because overall they do not decrease trip making in a substantial way.

Many papers were written by this team on this subject. However, a representative sample of the latest discoveries includes:

Kim T. and K.G. Goulias (2004) Dynamic Analysis of Time Use and Frequency of Activity and Travel Using Latent Class Clustering and Structural Equation Modeling. Paper presented at the Conference on Progress in Activity-Based Analysis, May 28 - 31, 2004, Vaeshastel Castle, Maastricht, the Netherlands.

Kim T. and K. G. Goulias (2003) Cross Sectional and Longitudinal Relationships Among Information and Telecommunication Technologies, Daily Time Allocation to Activity and Travel, and Modal Split Using Structural Equation Modeling. Paper presented at the 83rd Annual Transportation Research Board Meeting, Washington, D.C., January 11-15, 2004.

Goulias K.G., N. Kilgren, and T. Kim (2003) A Decade of Longitudinal Travel Behavior Observation in the Puget Sound Region: Sample

Composition, Summary Statistics, and a Selection of First Order Findings. Paper submitted for presentation at the 10th International Conference on Travel Behaviour Research, Moving through Nets: The Physical and Social Dimensions of Travel, Lucerne, August 1-14, 2003.

Goulias K.G., T. Kim, and O. Pribyl (2003) A Longitudinal Analysis of Awareness and Use for Advanced Traveler Information Systems. Paper presented at the European Commission Workshop on Behavioural Responses to ITS, April 1-3, 2003, Eindhoven, the Netherlands.

Intelligent City, Dr. Konstadinos G. Goulias, PSU-2003-01

Gathering survey data can be an expensive and time consuming activity for researchers, planners, and consultants. This research project is being conducted to determine which media is the most cost efficient and time effective for collecting data from transportation systems users. The project takes classroom theory (CE 422—transportation planning) and applies it to a real world situation. This project is the basis for a graduate student's masters thesis.

Legibility of Internally vs. Externally Illuminated On-Premise Signs, Philip P. Garvey, PSU-2002-10

Vehicle accidents are sometimes the result of drivers slowing down to read on-premise signs in their attempt to locate a specific store, restaurant or office, especially when the driver may be in an unfamiliar town. Those few seconds of inattention to the traffic or pedestrians ahead can lead to traffic congestion, fender benders, or serious accidents.



This project evaluated internally and externally illuminated on-premise signs to determine the most effective lighting technique so that motorists can quickly identify an on-premise sign and make safe driving decisions.

Internally and externally illuminated signs were evaluated by younger and

older motorists under daylight and night conditions at the Pennsylvania Transportation Institute's test track facility. Internally illuminated signs outperformed the externally illuminated signs during both daytime and nighttime viewing. If the externally illuminated signs were to be used at night, speeds would need to be 25 mph or lower. The externally illuminated routed signs would require speed limits below 20 mph to provide sufficient time to read the signs and perform the appropriate maneuver at night.

This research will help sign designers make appropriate recommendations to clients, aid sign users in making decisions on their specific sign needs, and assist municipalities in making informed decisions when consideration is given to on-premises sign lighting.

Real-World Routing and Scheduling Problems, Zhi-Long Chen, UP-2000-04

The new hours of service (HOS) regulations will limit the hours that truck drivers can be on the road or engaged in loading or other duties. These are intended to improve the safety of trucking and the nation's highways. But there is no "free lunch" and the reduced hours are, in the view of many analysts, increasing the costs of trucking and leading to the capacity crunch now experienced in that industry.

This is one of the problems tackled by Prof. Zhi-Long Chen, at the University of Pennsylvania with MAUTC support (since relocated to the University of Maryland), and University of Pennsylvania's systems engineering Ph.D. student Hang (Henry) Xu. They developed realistic truck routing and scheduling procedures that would take into account the anticipated and now-implemented hours of service restrictions. These restrictions were either ignored completely or only crudely modeled in prior work in truck scheduling. Manugistics, an international firm supplying supply chain and transportation software, jointly sponsored this work. Xu is now working for Manugistics and the firm has implemented some of the solution methods, including those that try to minimize the impact of the HOS regulations constraints, such as those due to driver hours of service (safety) limitations. Very efficient algorithms have been developed to solve this problem, and they are now being implemented by Manugistics so that truck lines and shippers can use them.

A paper has recently been published in the peer-reviewed transportation journal of the Institute for Operations Research and Management Sciences: H. Xu, Z.-L. Chen, and S. Rajagopal, Solving a Practical Pickup and Delivery Problem. *Transportation Science*, 37 (2003), 347-364.

Addressing I-81 Transportation Issues, Dr. Hesham Rakha, VPI-R-01

Findings from this project will provide critical data to the Virginia Department of Transportation (VDOT) planners that will aid the re-design of I-81 to improve highway efficiency and safety, which will positively impact economic development in the state by attracting more tourists and delivering goods and services faster. The project's reach has extended far beyond the borders of Virginia, and has been a success in all three focus areas of the University Transportation Program: research, education, and technology transfer.

The project resulted in both international and national collaboration. Virginia Tech and the Universidade de Sao Paulo published a joint peer-reviewed journal publication. Furthermore, joint courses are being offered at both universities as a result of this research effort. Visits by both university faculties are underway and new procedures for estimating Brazilian truck equivalency factors are being developed.

The project has also resulted in a number of peer-reviewed conference and journal publications in collaboration with the University of Montana. These state-of-the-art publications will enhance current state-of-the-practice procedures for modeling truck impacts on traffic stream throughput and efficiency. Materials from this project are also being included in a number of graduate courses at both universities.

Furthermore, the truck models that were developed as part of this project have also been incorporated in the commercially available INTEGRATION software and are currently being utilized to assist VDOT in the evaluation of alternative I-81 design scenarios. The tool will be of definite assistance to this multi-billion dollar project and has the potential to enhance the I-81 corridor for many years to come.



Developing a Fully Instrumented Test Facility, Dr. Hesham Rakha, VPI-2001-01

This state-of-the-art project has transformed the town of Blacksburg, Virginia, into the first instrumented city in North America and only the second instrumented city in the world. The project is designed to support transportation research outside of laboratories and controlled environments by making the entire town of Blacksburg a real-life test facility. Researchers from Virginia Tech are collecting data from the town to evaluate highly-demanded transportation modeling tools aimed at improving roadway safety, traffic flow, and noise and air pollution. The project also allows researchers to test the latest communication, traffic management, and traveler information systems, which in turn will improve our roadways.

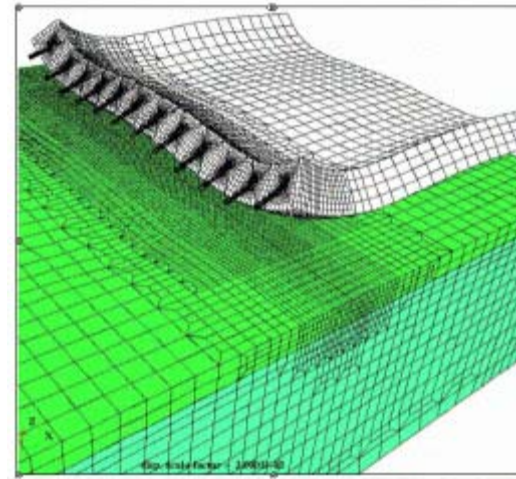
The unique features of the project include monitoring the status of 20 signalized intersections and their approach traffic volumes in real-time. In the future, this information will be shared with bigger cities to help with their potential traffic issues. In addition, the project will track vehicle license plates at 40 locations in real-time and match these license plates to estimate dynamic roadway travel times and to compute where vehicles are coming and going to through the estimation of Origin-Destination (O-D) tables.

With the help of the town of Blacksburg, the Virginia Department of Transportation, Blacksburg Transit, Police and Emergency, the Virginia Tech Transportation Institute, and Virginia Tech Communication Services, this project has been a major success. These entities will be releasing a Request for Proposals (RFP) to install a broadband 802.11 wireless network in the Blacksburg/Christiansburg area. Blacksburg has been labeled the most wired town in the U.S. and this project might make it the most unwired town in the U.S.

Mid-slab Cracking Solution Leads to Multi-million Dollar Savings for PennDOT, Samir N. Shoukry, WVU-R-17 and WVU-2000-05

Through MAUTC funding of two projects, Identification of Critical Stress Concentration Around Dowel Bars and Optimization of Concrete Slab Geometry for Enhanced Rigid Pavement Performance and Service Life, West Virginia University researchers were able to identify the reason and the solution for a nationwide problem in concrete pavements: early age cracks that appear at mid-slabs prematurely after only a few months of opening to

traffic. The problem is seen in the states of North and South Carolina, Pennsylvania, Michigan, and many others.



MAUTC researchers employed advanced computer modeling techniques to study the behavior of concrete slabs when they are subjected to temperature variations from the time of construction to winter when ambient temperature drops as much as 90°F. Based on a study of the relation between slab length and the stresses that develop at the mid-slab, it became apparent that

concrete slabs longer than 16 feet will be most susceptible to development of premature mid-slab cracking under certain conditions slab support. Slabs whose length is between 14 and 15 feet are most likely to resist mid-slab cracking and live longer. At the time of this finding, the Pennsylvania Department of Transportation had a major problem of mid-slab cracking that developed on the newly reconstructed I-81, which happened to have 20 foot long slabs. After one year of construction, many of the slabs on this highway developed substantial mid-slab cracks, which cost millions of dollars to repair. If PennDOT could not solve this problem for the remaining sections of reconstruction, millions of dollars would be lost.

A presentation given by the WVU MAUTC researchers to the Northeast Chapter of the American Concrete Paving Association in Harrisburg, Pennsylvania, has resulted in providing additional support to quality improvement team for shorter joint spacing (15 ft.) on concrete pavements constructed in Pennsylvania. This solved the problem of I-81 that was eventually reconstructed with shorter length slabs. The presentation was attended by senior FHWA and PennDOT officials (Roger Larson and Zahur Siddiqui). Shortly after this presentation, John Becker, PennDOT's regional director announced that the agency was giving up the practice of building 20 ft. long concrete slabs in favor of 15 ft. long slabs. The knowledge gained through MAUTC funded research subsequently saved PennDOT millions of dollars in mid-slab cracking repairs. The knowledge is now being used to yield similar savings in other states.

EDUCATION

Transportation and Logistics Doctoral Program Support, C.H. Chen and E. K. Morlok, UP-E-05

One of the objectives of this program is to enable exploration of promising research directions within the context of doctoral dissertation research. Professor C. H. Chen has been working on methods for speeding up simulation studies where the objective is to find the best solution to a problem. A typical example is finding the best design from among many possible designs, where the analysis and evaluation uses stochastic simulation. The computing time and effort required for these is often excessive. To reduce this time, he developed the Optimal Computing Budget Allocation (OCBA) method, in which alternative designs are examined in a "quick and dirty" manner in order to eliminate clearly inferior designs early in the process. This avoids spending scarce simulation resources, and time, on designs that will not be chosen anyhow.

A very important class of problems is network problems, and the effectiveness of OCBA on these problems was not explored. This became the focus of work jointly between Prof. C. Chen, doctoral student Simon Lin, and transportation faculty Professors Z. Chen and E. Morlok. They modified the OCBA approach to be applicable to the problem of identifying the best network in terms of highest capacity and least vulnerability to disruption, and then compared the OCBA method with others used to solve the same problem. The results were astounding. The OCBA method consistently out-performed other methods, even the most advanced, usually by a factor of 2 to 10. Given the importance of stochastic models to assess such factors as capacity and vulnerability of network systems, these methods should prove very useful.

Undergraduate Research Experience, Dr. Edward K. Morlok, UP-E-01

Undergraduates in the Transportation and Logistics Systems area of the Systems Engineering Programs at the University of Pennsylvania are continually involved in the MAUTC research program. This is often under the mentorship of both faculty and senior (Ph.D. level) graduate students. In the last two years, 12 undergraduates were involved in this research either as part-time employees or as students enrolled in independent study courses for degree credit. They often contribute significantly to the results of the research, and thus are recognized in the publication of those results.

This year one such student, Lee Lai, who received his B.S.E. in Systems Engineering, saw an article in which he was an author published in the peer-reviewed safety journal *Accident Analysis and Prevention*:

Boarding and Alighting Injury Experience with Different Station Platform and Car Entranceway Designs on U.S. Commuter Railroads. By E.K. Morlok, B.F. Nitzberg, and L. Lai, *Accident Analysis and Prevention*, Vol. 36, No. 2 (2003), pp. 261-271.

Lee's reaction to publication is typical: "I was quite excited to receive a copy of the final paper and am excited that it is going to press.... I...was very happy with the results. Thanks a lot for giving me the chance to work with you."

Lee's work involved using raw data from the Federal Transit Administration and the Federal Railroad Administration to assess the safety of rail passenger service. His work was combined with that of others to result in the publication. Another article building on these results is in preparation.

The West Virginia TCAP/TRAC Program at West Virginia University, Dr. David Martinelli, WVU-2002-01

MAUTC researchers at West Virginia University first became involved in the



Transportation and Civil Engineering Careers Program (TRAC) in 1999, but felt that they could further enhance outreach to middle school and high school students. The mission was not only to provide a classroom program that introduced students to civil engineering and transportation topics, but to serve as a resource for teachers in meeting their learning outcomes as prescribed by the State Department of

Education. Dr. David Martinelli at WVU/MAUTC teamed with the state DOT Personnel office in developing the Transportation Career Awareness Program (TCAP).

The key to the program is its partnerships. In addition to the DOT/UTC partnership that exists in the TRAC program, TCAP involves the State Department of Education and the Younger Members Forum of its ASCE Section.

The Department of Education partnership is critical and is the essence behind the innovation of the program, namely to be *curricular* rather than *extra-curricular*. The Department of Education pre-approves learning activities for particular mandated outcomes. So the teacher, having to meet a particular learning outcome, can go to the website and find a transportation/civil engineering activity that has been pre-approved for meeting that outcome. It meets the teachers where they are and helps them get their job done.

TCAP is hoping to be a full K-12 program by developing similar activities for all grade levels. The first step has been the logo design competition. Young students were given a presentation about the TCAP program and transportation careers and then asked to design a logo for the program.



TECHNOLOGY TRANSFER

Through technology transfer activities, the knowledge gained by MAUTC researchers is disseminated well beyond the geographic boundaries of the Mid-Atlantic region. Faculty, researchers and students disseminate their research findings at professional conferences, research showcases, and through professional organizations.

Annual Transportation Engineering and Safety Conference, Dr. Konstadinos Goulias, PSU-2002-01

The Transportation Engineering and Safety Conference is an excellent example of the transportation community working synergistically to meet the training needs of its workforce.

The steering committee, comprised of representatives from state and federal agencies, private firms, and Penn State faculty and staff, develop the conference topics based on their knowledge and experience with new technologies, state and federal regulations, and “hot” topics.

“Since its inception in 1995, Pennsylvania’s Annual Transportation Engineering and Safety Conference has been a great forum for learning and sharing with other transportation professionals. As we strive to better ourselves and our organizations, it is important that we share what we are doing and learn from others. Pennsylvania’s conference offers a nice blend of public (federal/state/local) and private sector participation as evidenced by the diversity of technical presenters on each year’s program. The conference program also targets an important niche by concentrating on transportation operations topic areas such as highway safety, driver/vehicle safety, work zones, traffic control devices, ITS, human factors, etc. From PennDOT’s perspective, this conference is well received by all and is believed to be one of the best conference values for the money.”

James Tenaglia, P.E., Risk Management Engineer, The Pennsylvania Department of Transportation

Technology Innovation to Reduce Conflicts Between Rail Freight and Passenger Transportation, Edward K. Morlok, UP-2001-01

While the overall goal of this project is to identify effective ways to meet ADA requirements on railroads without the need to install station facilities that impede or eliminate freight service, one sub-goal is to inform decision makers and policy persons of the problem, and of its importance. This started with a TRB paper published in 2001, and has continued in other publications and presentations at professional meetings, to industry, and in comments at informal gatherings. One effect of this apparently has been the inclusion of the topic in the current (2004-05 cycle) Small Business Initiation Research

(SBIR) Grant Program of the U.S. Department of Transportation. This office has issued a Request for Proposals (RFP) on the subject.

One of the small business bidders on the SBIR grant observed that the RFP appears to have come directly from the paper describing the need for the technology, a paper sponsored by the MAUTC research program:
"The need for a new commuter car entranceway design for mixed high and low level platforms," Transportation Research Record 1793 (NAS-NRC, 2002), pp. 40-46.

The conclusion of that paper includes the statement that one purpose of the paper was to "indicate the importance of a solution to these problems and to encourage thinking about solutions." Thus the goal of the paper seems to have been realized. An award of up to two grants to small businesses, which have a total value of up to \$100,000 for Phase I and \$700,000 for Phase II, is expected in late fall 2004.

3D FEM Symposia, David Martinelli

In 1996, WVU received funding from MAUTC to initiate a research program in the area of 3-D Finite Element Modeling (FEM) of pavements. At the time, 3-D modeling was considered a new area of research given the complexity associated with going from 2-D models to 3-D dynamic models. The research at WVU was a great success leading to accurate models that incorporated many of the complications of highway pavements and their loading conditions.



Figure 2. Symposium

Auspiciously, in 1997, the U.S. General Accounting Office issued a study stating that the Federal Highway Administration (FHWA) was losing many millions (and perhaps billions) of dollars each year by not employing design approaches based on 3-D Finite Element Modeling. The FHWA soon commissioned a national symposium on the subject, and after reviewing the research around the country, selected West Virginia University based on the results of its MAUTC-funded research.

The first Symposium was held in Charleston, WV, in 1998, and had the objective of directing the attention of the pavement design community to the potential of 3D FE techniques in searching solutions for pavement structural problems. MAUTC support was instrumental in hosting the Symposium. The response was overwhelming and featured attendees from four foreign countries. Since then, many researchers as well as national and international highway agencies have considered implementing the finite element technique in their design procedures. With 3D FE simulation, the need for extensive field experiments is drastically reduced. Handling of nonlinear structural material properties is as simple as handling elastic materials and the pavement performance can be predicted in a matter of hours. This offers pavement designers a robust design tool to design longer lasting pavements.

Based on the success of the first symposium, the WVU-MAUTC event was expanded to be international and was again held in Charleston, West Virginia. This time, there was an array of sponsors from several countries (see figure 2). American sponsors included: Federal Highway Administration, Federal Aviation Administration, Transportation Research Board, American Association of State Highway Transportation Officials, Shell Oil, and the West Virginia Division of Highways. The symposium was attended by researchers from 14 countries, 25 universities and 30 state departments of transportation. Dr. Samir Shoukry, the symposium chairman, announced that the long-term objective of the symposium is the development of new generation of maintenance free highways designed to last for 60 or more years.

The high quality of the symposium presentations prompted the editorial board of the International Journal of Pavement Engineering to dedicate two special issues of the journal for selected papers from the symposium. Dr. Samir Shoukry and Dr. Tom Scarpas were invited as the editors of the two issues.

The third symposium was held in Amsterdam, The Netherlands, in 2002, and a fourth symposium is planned for 2005. These symposia enjoy the same extensive sponsorship as the second.

Research Project Status List

RESEARCH

New Projects (FY 03/04)

PSU-2003-01 Intelligent City, Konstadinos G. Goulias

UVA-2003-01 Supply Chain Models for Freight Transportation Planning, Michael J. Demetsky

WVU-2003-01 Communications Strategies for State DOT Research Offices

Ongoing Projects

PSU-R-01 Center for Intelligent Transportation Systems Research, Konstadinos G. Goulias

UP-2001-01 Technology Innovation to Reduce Conflicts Between Rail Freight and Passenger Transportation (Old title: Freight Transportation Trends, Policy Options, and Technology Innovations), Edward K. Morlok

UP-2000-04 Real-World Vehicle Routing and Scheduling Problems, Zhi-Long Chen

VPI-2001-01 Developing a Fully Instrumented Test Facility, Hesham Rakha

VPI-2000-02 Characterizing Vehicle Dynamics for the Enhancement of Traffic Simulation Models, Hesham Rakha

VPI-R-01 Addressing I-81 Transportation Issues, Hesham Rakha

VPI-R-14 Addressing Urban Network and State Transportation Issues, Hesham Rakha

WVU-2002-02 Truck Forecasting Related Research, L. James French

WVU-2002-03 Effect of FWD Testing Position on Modulus of Subgrade Reaction, Samir Shoukry

WVU-2002-04 Evaluation of Load Transfer Efficiency Measurement, Samir Shoukry

WVU-2000-05 Effect of Dowel Bonding Force on Stresses in Concrete Slabs, Samir Nabih Shoukry

Completed Projects

PSU-2000-02 Advanced Traffic Simulation Laboratory (ATLAS), Ageliki Elefteriadou

PSU-2002-08 Time Use, Telecommunications, and Technology Interactions, Konstadinos G. Goulias

PSU-2002-04 Analysis of the Great Lakes/St. Lawrence Navigation System's Role in U.S and International Trade, Evelyn Thomchick and Gary Gittings

PSU-2002-06 Moving Activity-Based Approaches to Practice, Konstadinos G. Goulias

PSU-2002-10 Legibility of Internally vs. Externally Illuminated On-Premise Signs, Philip P. Garvey

PSU-2000-01 Pennsylvania Statewide Long Range Transportation Plan (Penn Plan), Konstadinos G. Goulias

PSU-2001-01 Centre County Simulation, Konstadinos G. Goulias

PSU-2001-02 ITS Evaluation, Konstadinos G. Goulias

PSU-2000-04 OPTIPATH Lab, Elise Miller-Hooks

PSU-2000-06 E-Commerce and Transportation, Konstadinos G. Goulias

PSU-2000-07 Evaluation of Pennsylvania Turnpike ATIS, Konstadinos G. Goulias

PSU-R-05 Strategic Plan for the Implementation of Intelligent Transportation Systems in Pennsylvania, John M. Mason

PSU-R-06 Roadside Vegetation Management, Larry J. Kuhns

PSU-R-07 Climate Survey Development and Organizational Assessment, Robert J. Vance

PSU-R-15 Support of the ITS Statewide Steering Committee, John M. Mason

PSU-R-26 Intelligent Transportation Systems Research and Development Fellowship Program at PSU, Konstadinos G. Goulias (WO 23, TOPS)

PSU-R-27 Pennsylvania Quality Initiative: Synthesis of Customer Satisfaction and Information Requirement, James H. Miller

PSU-R-70 Probing Motorists' Perceptions of Highway Quality (Coop Agreement), James H. Miller

PSU-R-71 Increasing the Pool of Highway Construction Subcontractors and Construction Personnel (Coop Agreement), James H. Miller

PSU-R-72 Construction and Materials Training and Education Plan, John A. Anderson

UP-R-09 Transportation and Logistics Network Research Program, Edward K. Morlok

UVA-2002-02 Development of Counter Measures to Security Risks from Air Cargo Transport, Michael J. Demetsky

UVA-2002-03 Effects of Light Rail Transit on Traffic Congestion, Lester A. Hoel

UVA-2002-04 The Effect of Land Use Planning on University Transportation Systems (Old title: Factors that Affect the Modal Split in College/University Towns), Lester A. Hoel

UVA-2002-05 Using an Accessibility Measure to Identify Areas with Potential for Walking and Cycling Travel, Lester A. Hoel

UVA-2002-06 Estimating the Supply and Demand for Commercial Heavy Truck Parking on Interstate Highways, A Case Study of I-81 in Virginia, Phase II, Nicholas J. Garber

UVA-2002-07 Guidelines for Left-Turn Lanes at Signalized and Unsignalized Intersections, Nicholas J. Garber

UVA-2001-01 Carbon Monoxide Production in Response to Increased Reforestation and Traffic in Eastern United States (Old title: Aerosol and Oxidation Production Arising from Urban and Rural Traffic), Jose Fuentes

UVA-2001-02 Development of a Freight Flow Prediction Method for Statewide Planning, Michael J. Demetsky

UVA-2001-03 HOV Corridor Evaluation and Improvement (Old title: Study on The HOV/HOT/General Purpose Lane Efficiency Comparison Methodology), Lester A. Hoel

UVA-2001-04 Transit Demand Forecasting for Research Parks, Michael J. Demetsky

UVA-2001-06 Investigating the Application of a GIS Database to Address Statewide Freight Transportation Planning, Michael J. Demetsky

UVA-2000-01 Finite Element Evaluation of the Structural Integrity of Composite Concrete-Steel Bridge Decks (Formerly UVA-R-40 Reliability-Based Monitoring of Bridge Structures for Bridge Management), C. E. Orozco

UVA-2000-02 A Methodology for Oversized Vehicle Trip Scheduling: A Case Study in the Hampton Roads Area (Old title: Oversized Vehicle Routing and Scheduling), Lester A. Hoel

UVA-2000-05 Supply and Demand of Parking Facilities for Large Trucks: Phase I (Old title: Parking Facilities for Large Trucks on Primary Arterial Highways), Nicholas J. Garber

UVA-2000-06 Assessment of Advanced Engine Technology for the Transit Systems (Old title: Feasibility Study of Alternative Travel Modes and Vehicle Fuels for UVA "Groundswalk"), Michael J. Demetsky

UVA-2000-07 Spatial Analysis Tools for Integrated Transportation Data: Northern Virginia Intelligent Transportation Systems Prototype, Brian Smith

UVA-2000-08 Safety Impacts of Differential Speed Limits Phase I: Effects of Differential Speed Limits on Vehicle Speed and Crash Characteristics Using Hypothesis Tests, Nicholas J. Garber

UVA-2000-09 Crash Characteristics at Work Zones, Nicholas J. Garber

UVA-2000-10 Predicting Crashes from Increased Signalization: Prototype Software for Corridor Planning, Michael J. Demetsky

UVA-2000-11 Safety Impacts of Differential Speed Limits - Phase II: Determining the Safety Effects of Differential Speed Limits on Rural Interstate Highways Using Empirical Bayes Method, Nicholas J. Garber

UVA-R-37 An Investigation of Web-Based Technologies for the Peninsula Transportation District Commission, Brian Smith

UVA-R-38 Evaluation of Traveler Diversion Due to En-Route Information (Old title: Prediction of Traveler Response to En-Route Information, Michael J. Demetsky

UVA-R-41 Evaluating ITS Parking Management Strategies: A Systems Approach (Old title: ITS Alternatives Analysis: Evaluating Parking Management), Lester A. Hoel

UVA-R-43 Ozone Formation Attributable to Emissions from Rural Interstate Traffic, Michael J. Demetsky

VPI-2001-02 MAUTC Scholarship, Hesham Rakha

VPI-2000-03 The Development of TRANSIMS Modeling Capabilities, Antoine G. Hobeika

VPI-2000-04 Electronic Payment Systems, John Collura

VPI-2000-05 Use of Video Surveillance for Rural and State, Highway Safety, Antoine G. Hobeika and Hesham Rakha

VPI-2000-07 SUPERPAVE HMA Mixes, Immededdin Al Qadi

VPI-R-11 Professional Capacity Building in Transportation, Hesham Rakha, John Collura and Alejandra Medina

VPI-R-12 Quantifying the Impacts of Average Speed Variability, Level of Deceleration, and Speed, Level of Acceleration on Vehicle Fuel Consumption and Emissions, Hesham Rakha

VPI-R-13 Development of a Macroscopic Model for Evaluating the Impact of Emergency Vehicle Signal Preemption on Traffic, John Collura and Wei Hua Lin

WVU-R-06 Fitting Falling Weight Deflectometer with SASW Measurement Capability, Samir N. Shoukry

WVU-R-07 Evaluation of Backcalculation Algorithms Through Dynamic Modeling of FWD Test, Samir N. Shoukry

WVU-R-17 Identification of Critical Stress Concentration Around Dowel Bars, Samir N. Shoukry

WVU-2000-01 Operational Effects of Highway Geometrics in Mountainous Terrain, L. James French, David Martinelli, Ronald W. Eck

WVU-2000-02 Development of Design Vehicles and Characteristics for the HANGUP, L. James French, Ronald W. Eck

CANCELLED PROJECTS

PSU-2002-07 QUIK Survey, Peter B. Everett

Education and Technology Transfer Projects Status List

EDUCATION

New Projects

WVU-2003-02 The West Virginia TRAC/TCAP Program of West Virginia University, Crystal May

Ongoing Projects

UP-2000-03 Transportation and Logistics Systems Laboratory and Course Development-Phase 4, Edward K. Morlok

UP-E-01 Undergraduate Research Experience, Edward K. Morlok

UP-E-05 Transportation and Logistics Doctoral Program Support, Edward K. Morlok

UVA-E-05 Transportation Courses in Information Technology for Graduates and Undergraduates, Brian Smith

VPI-2000-06 Continuing Education Courses in Transportation Systems and Operations, John Collura, Hesham Rakha

WVU-2001-02 Graduate Student Assistantships in Transportation, David Martinelli

Completed Projects

MAUTC-E-03 Support Transit Internship Program at PSU, UPENN, and UVA, James H. Miller, Edward K. Morlok, Lester A. Hoel

MAUTC-2000-01 The MAUTC Freight Transportation Partnership, James H. Miller, Michael Demetsky, David Martinelli, Edward K. Morlok, Thomas W. Dingus

MAUTC-E-01 Transportation Computational Laboratory, Martin T. Pietrucha, Edward K. Morlok, David Martinelli, Hesham Rakha, Brian B. Park

MAUTC-E-04 Maintain and Seek New Opportunities for the VDOT Fellowship Program at UVA and VPI, Lester A. Hoel

MAUTC-E-06 Maintenance and Enhancement of Transportation Laboratories, Konstadinos G. Goulias, Thomas W. Dingus, Michael J. Demetsky, Edward K. Morlok, David Martinelli

PSU-2002-02 MAUTC Student Research Showcase at TRB Annual Meeting, Konstadinos G. Goulias

PSU-2002-03 2002/2003 Distinguished Lecturer Series, Konstadinos G. Goulias

PSU-2002-05 Graduate Students Theses, Konstadinos G. Goulias

PSU-2002-09 Undergraduate Internship Program, Konstadinos G. Goulias

PSU-E-01 Transportation Engineering and Management (TEaM) Laboratory Maintenance and Enhancement (Survey Center, MANTIS, ATLAS, OPTIPATH, and TEaM), Konstadinos G. Goulias

PSU-E-02 MAUTC's Annual TRB Research Showcase, Ann Marie Hutchinson

PSU-R-03 Traffic Engineering Education Plan and Program (Work Order 6 - 1997-99) (Deployment of Study Guides and Development of Additional Study Guides), John A. Anderson

PSU-R-38 Pennsylvania TRAC Careers Center Program at Penn State, James H. Miller, Janice Dauber

UP-E-02 National Summer Internship Program in the Railroad and Transit Industries, Edward K. Morlok

UP-E-04 Transportation and Logistics Systems Laboratory and Course Development-Phase 3, Edward K. Morlok

UVA-E-01 Studies in Transportation Engineering and Planning at UVA, Lester A. Hoel

VPI-E-03 Education Program at the Center for Transportation Research, Hesham Rakha, John Collura

WVU-2002-01 The West Virginia TRAC/TCAP Program of West Virginia University, Crystal May

WVU-2001-01 The West Virginia TRAC/TCAP Program of West Virginia University, Crystal May

WVU 2001-03 West Virginia Bridge Building Contest, David Martinelli

WVU-2000-03 The West Virginia TRAC/TCAP Program of West Virginia University, Crystal May

WVU-2000-04 Graduate Student Assistantships in Transportation, David Martinelli

TECHNOLOGY TRANSFER

New Projects

PSU-2003-02 TRANSTEC, Konstadinos G. Goulias

PSU-2003-03 2004 Transportation Engineering and Safety Conference, Martin T. Pietrucha

Ongoing Projects

None

Completed Projects

PSU-2002-11 Transportation Engineering and Safety Conference, Konstadinos G. Goulias

PSU-2002-01 Transportation Engineering Safety Conference and Student Showcase, Kevin M. Mahoney

PSU-2000-08 Annual Transportation Engineering and Safety Conference, Kevin Mahoney, Eric Donnell

WVU-R-16 International Symposium on Use of Nonlinear Finite Element Modeling for Pavement Analysis and Design, Samir N. Shoukry

Appendix B: Publications, 1999-2004

REPORTS

ADA-Compliant Passenger Rail Car Designs to Maintain Full Freight Service (including Excess Dimension Load) Clearances and Meet Restrictive Northeastern Passenger Rail Line Vertical Clearances, by E. K. Morlok, University of Pennsylvania, Technical Report, August 2003.

Analysis of Thermal Induced Stresses Induced in Dowel Transverse Joints, by S. Shoukry and G. William, West Virginia University, proceedings of the ASCE Airfield Pavement Conference, Chicago, Illinois, 2001, pp. 373-384.

Assessment of Advanced Engine Technology for the University of Virginia Transit System, by J. Lamb and R. Espino, University of Virginia, Final Report, October 2000, 21 pp.

Assessment of the Performance Rigid Pavement Backcalculation Through Finite Element Modeling, by S. Shoukry, G. William, and D. Martinelli, West Virginia University, Proceedings of the SPIE Conference on Nondestructive Evaluation of Bridges and Highways III, Vol. 3587, California, 1999, pp. 146-156.

Bicycle-Friendly Shoulder Rumble Strips, by L. Elefteriadou, M. El-Gindy, D. Torbic, P. Garvey, A. Homan, Z. Jiang, B. Pecheux, and R. Tallon, The Pennsylvania State University, Final Report, March 2000, 117 pp.

Calibration of the Gravity Model for Truck Freight Flow Distribution, by S. Mao and M. Demetsky, University of Virginia, Final Report, August 2002, 53 pp.

Characteristics of Concrete Contact Stresses in Doweled Transverse Joints, by S. Shoukry, G. William, and M. Riad, West Virginia University, The International Journal of Pavement Engineering, Vol. 3, No. 2, 2002, pp. 117-129.

Comparison of Mobile5a, VT-Micro, and CMEM Models for Estimating Hot-Stabilized Light Duty Gasoline Vehicle Emissions, H. Rakha, K. Ahn, and A. Trani, Virginia Polytechnic Institute & State University, accepted for publication in the Canadian Journal of Civil Engineering (CJCE), 2003.

Crash Characteristics at Work Zones, by M. Zhao and N. Garber, University of Virginia, Final Report, May 2001, 62 pp.

Deploying an ITS Warning System for No-passing Zones on Two-lane Rural Roads, by J. El-Zarif, Virginia Polytechnic Institute & State University, Final Report.

A Discrete Optimization Approach for Locating Automatic Vehicle Identification Readers for the Provision of Roadway Travel Times, by H. Sherali, J. Desai, H. Rakha, and I. El-Shawarby, tentatively accepted for publication in Transportation Research Part B: Methodological, 2003.

Dynamic Backcalculation of Pavement Layer Moduli, by S. Shoukry and G. William, West Virginia University, Proceedings: ASNT Spring Conference and 8th Annual Research Symposium, American Society of Nondestructive Testing, Florida, 1999, pp. 43-45.

Effect of Dowel Bar Looseness on Measured Load Transfer Efficiency Using FWD, by S. Shoukry, G. William, and M. Riad, West Virginia University, Proceedings of SPIE Conference on Smart Systems for Bridges and Highways, Vol. 4330, 2001, pp. 505-510.

Estimating the Supply and Demand for Commercial Heavy Truck Parking on Interstate Highways: A Case Study of I-81 in Virginia, by N. Garber, H. Wang, and D. Charoenphol, University of Virginia, Final Report, October 2002, 66 pp.

Estimating Vehicle Fuel Consumption and Emissions Based on Instantaneous Speed and Acceleration Levels, by K. Ahn, H. Rakha, A. Trani, and M. Van Aerde, Virginia Polytechnic Institute & State University, ASCE Journal of Transportation Engineering, Vol. 128(2), March/April 2002, pp. 182-190.

Evaluating ITS Parking Management Strategies: A Systems Approach, by R. Maccubbin and L. Hoel, University of Virginia, Final Report, May 2000, 93 pp.

Evaluation of the Pennsylvania Turnpike's Advanced Traveler Information System (ATIS) Project, Phase III, by M. Patten, K. Goulias, and O. Pribyl, The Pennsylvania State University, Final Report, July 1, 2003, pp. 154.

Evaluation of Traveler Diversion Due to En-Route Information, by R. Schiesel and M. Demetsky, University of Virginia, Final Report, May 2000, 61 pp.

Finite Element Evaluation of the Structural Integrity of Composite Concrete-Steel Bridge Decks, by S. Roche and C. Orozco, University of Virginia, Final Report, July 2001.

HOV Corridor Evaluation and Improvement, by J. Ma and L. Hoel, University of Virginia, Final Report, April 2002, 60 pp.

Impact of Vehicle Stops on Hot Stabilized Light-Duty Vehicle Energy and Emission Rates, by H. Rakha and Y. Ding, Virginia Polytechnic Institute & State University, ASCE Journal of Transportation Engineering, Vol. 129(1), Jan./Feb. 2003, pp. 1-10.

The INTEGRATION Modeling Framework for Estimating Mobile Source Emissions, by H. Rakha and K. Ahn, Virginia Polytechnic Institute & State University, accepted for publication in the ASCE Journal of Transportation Engineering, TE-22744, 2003.

Intelligent Transportation Systems Research and Development Fellowship Program at the Pennsylvania State University, by K. Goulias, The Pennsylvania State University, Final Report, August 2000, 13 pp.

Investigating the Application of a GIS Database to Address Statewide Freight Transportation Planning, by B. Shannon and M. Demetsky, University of Virginia, Final Report, April 2002, 34 pp.

An Investigation of Web-Based Technologies for the Peninsula Transportation District Commission, by B. Revels and B. Smith, University of Virginia, Final Report, May 2000, 70 pp.

Mechanistic Evaluation of the Depth to Bedrock and its Effect on the Response of 3D Finite Element Pavement Model, Pavement Subgrade, Unbound Materials, and Nondestructive Testing, by G. William and S. Shoukry, West Virginia University, 2000 Geotechnical Special Publication, No. 98, ASCE, Denver, Colorado, pp. 73-86.

Methodology for Forecasting Transit Demand at an Urban Research Park, by S. Hkawn N-Sang and M. Demetsky, University of Virginia, Final Report, May 2002, 16 pp.

A Methodology for Oversized Vehicle Trip Scheduling, by C. Xu and L. Hoel, University of Virginia, Final Report, May 2001, 73 pp.

Modeling and Forecasting Vehicular Traffic Flow as a Seasonal Stochastic Time Series Process, by B. Williams and L. Hoel, University of Virginia, Final Report, June 1999, 243 pp.

An Overview of Pennsylvania's Statewide Long-Range Transportation Plan (PennPlan), by K. Goulias, J. Smedley, R. Heaney, P. Everett, G. Dauber, T-G. Kim, and K. Viswanathan, The Pennsylvania State University, Final Report, July 2000, 36 pp.

Ozone Formation Attributable to Emissions from Rural Interstate Traffic, by S. Jones, Jr., M. Demetsky, and J. Fuentes, University of Virginia, Final Report, May 2001, 143 pp.

The Parcel Service Industry in the U.S.: Its Size and Role in Commerce, by E. Morlok, B. Nitzberg, K. Balasubramaniam, and M. Sand, University of Pennsylvania, Final Report, August 1, 2000, 110 pp.

The Pennsylvania Quality Initiative: A Synthesis of Customer Satisfaction and Additional Research Needs, by T. Poister, The Pennsylvania State University, Final Report, October 1999, 44 pp.

Pennsylvania Rail Freight Assistance Program, by G. Gittings, The Pennsylvania State University, Application for Assistance, July 1993, 19 pp.

Pennsylvania Road Safety Audit Pilot Program, by M. Pietrucha and P. Garvey, The Pennsylvania State University, Final Report, March 1999, 38 pp.

Performance Evaluation of Backcalculation Algorithms through 3D Finite Element Modeling of Pavement Structures, by S. Shoukry and G. William, West Virginia University, Journal of Transportation Research Board No. 1655, TRB, National Research Council, 1999, pp. 152-160.

The Population Biology of the Spotted Salamander, *Ambystoma Maculatum*, Inhabiting Penn State Erie Wetlands, by P. Silver, A. Campbell, and J. Cooper, Final Report, October 1999, 58 pp.

Predicting Crashes from Increased Signalization: Prototype Software for Corridor Planning, by S. Kim, University of Virginia, Final Report, August 2001, 28 pp.

Quantifying the Benefits of Active Incident Management in Rural Areas, by H. Rippeon, J. Miller, and M. Demetsky, University of Virginia, Final Report, May 1999, 32 pp.

Safety Impacts of Differential Speed Limits - Phase I: Determining the Safety Effects of Differential Speed Limits on Rural Interstate Highways Using Empirical Bayes Method, by X. Sun and N. Garber, University of Virginia, Final Report, May 2002, 108 pp.

Safety Impacts of Differential Speed Limits - Phase I: Effects of Differential Speed Limits on Vehicle Speed and Crash Characteristics Using Hypothesis Tests, by B. Yuan and N. Garber, University of Virginia, Final Report, May 2002, 71 pp.

Spatial Analysis Tools for Integrated Transportation Data: Northern Virginia Intelligent Transportation Systems Prototype, by M. Grimes and B. Smith, University of Virginia, Final Report, May 2002.

Test Plan: Motor Carrier Focus Groups - Evaluation of the Pennsylvania Turnpike Advanced Travelers Information System (ATIS) Project, Phase III, by M. Patten and K. Goulias, The Pennsylvania State University, Final Report, April 2001, 14 pp.

Test Plan: Motorist Survey - Evaluation of the Pennsylvania Turnpike Advanced Travelers Information System (ATIS) Project, Phase III, by M. Patten and K. Goulias, The Pennsylvania State University, Final Report, April 2001, 36 pp.

Test Plan: Survey of Transportation System Operators - Evaluation of the Pennsylvania Turnpike Advanced Travelers Information System (ATIS) Project, by M. Patten and K. Goulias, The Pennsylvania State University, Final Report, April 2001, 26 pp.

Test Plan: Truck Driver Survey - Evaluation of the Pennsylvania Turnpike Advanced Travelers Information System (ATIS) Project, by M. Patten and K. Goulias, The Pennsylvania State University, Final Report, April 2001, 25 pp.

3D Finite Element Analysis of Temperature Induced Stresses in Dowel Jointed Concrete Pavements, by G. William and S. Shoukry, West Virginia University, The International Journal of Geomechanics, Vol. 1, No. (3), 2001, pp. 291-307.

Transit Demand Forecasting for Research Parks, by S. N-Sang and M. Demetsky, University of Virginia, Final Report, June 31, 2002.

PAPERS

Applications of Automobile Emissions Modeling to Airport System Planning, Transportation Research Circular, by H. Rakha, K. Ahn, and A. Trani, Virginia Polytechnic Institute & State University, presented at the 80th Annual Meeting of the Transportation Research Board Workshop, 2002.

Boarding and Alighting Injury Experience with Different Station Platform and Car Entranceway Designs on U.S. Commuter Railroads, by E. Morlok, B. Nitzberg, and L. Lai, University of Pennsylvania, Accident Analysis and Prevention, in press. Preprint is available from the author.

Case Study Evaluation of Throughput, Energy, Environmental and Safety Impacts of Traffic Signal Coordination: Field and Modeling Results, by H. Rakha, A. Medina, H. Sin, F. Dion, M. Van Aerde, and J. Jenq, Virginia Polytechnic Institute & State University, International Road Federation Conference, Paris, June 2001.

Comparison and Calibration of FRESIM and INTEGRATION Steady-state Car-following Behavior, by H. Rakha and B. Crowther, Virginia Polytechnic Institute & State University, accepted for publication in Transportation Research: Part A, 2002.

Comparison of Delay Estimates at Undersaturated and Oversaturated Pretimed Signalized Intersections, by F. Dion, H. Rakha, and Y. Kang, Virginia Polytechnic Institute & State University, Transportation Research Board, 2001.

Comparison of Delay Estimates at Undersaturated and Oversaturated Pretimed Signalized Intersections, by F. Dion, H. Rakha, and Y. Kang, Virginia Polytechnic Institute & State University, tentatively accepted for publication in Transportation Research: Part B, 2002.

Comparison of Greenshields, Pipes, and Van Aerde Car-following and Traffic Stream Models, by H. Rakha and B. Crowther, Virginia Polytechnic Institute & State University, accepted for publication in the Transportation Research Record, 2002.

Concepts and Algorithms for Measuring System Capacity Flexibility of a Transportation System, by E. Morlok and D. Chang, University of Pennsylvania, paper presented at the 82nd Annual Meeting of the Transportation Research Forum, Washington, DC., January 2003.

Coordination of Traffic Signals across Jurisdictional Boundaries: Field and Simulation Results, by H. Rakha, A. Medina, H. Sin, F. Dion, M. Van Aerde, and J. Jenq, Virginia Polytechnic Institute & State University, presented at the 79th Annual Meeting of the Transportation Research Board, Washington D.C., January 2000.

A Discrete Optimization Approach for Locating Automatic Vehicle Identification Readers for the Provision of Roadway Travel Times, by H. Sherali, J. Desai, H. Rakha, and I. El-Shawarby, Virginia Polytechnic Institute & State University, presented at the 82nd Annual Meeting of the Transportation Research Board, Washington D.C., 2003.

Dynamic Vehicle Routing with Time Window, by H. Xu and Z. Chen, University of Pennsylvania, presented at INFORMS Annual Meeting, San Jose, CA, November 2002, working paper.

The Effect of Land Use Planning on University Transportation Systems, by B. Ishler and L. Hoel, University of Virginia, Final Report, May 2004.

Effects of Light Rail Transit on Traffic Congestion, by C. Chandler and L. Hoel, Final Report, May 2004

Emission Model Development Using In-vehicle On-Road Emission Measurements, by H. Rakha, K. Ahn, I. El-Shawarby, and S. Jang, Virginia Polytechnic Institute & State University, 13th CRC ON-Road Vehicle Emissions Workshop, San Diego, CA, April 2003.

Estimating the Capacity of Freight Transportation Systems: A Model and Its Application in Transport Planning and Logistics, by E. Morlok and S. Riddle, University of Pennsylvania, [Transportation Research Record No. 1653](#), 1999, pp. 1-8.

Estimating Spatial Travel Times using Automatic Vehicle Identification Data, by F. Dion and H. Rakha, Virginia Polytechnic Institute & State University, presented at the 82nd Annual Meeting of the Transportation Research Board, Washington D.C., 2003.

Estimating Vehicle Stops at Under-Saturated and Over-Saturated Fixed-Time Signalized Intersections, by H. Rakha, Y. Kang, and F. Dion, Virginia Polytechnic Institute & State University, presented at the 80th Annual Meeting of the Transportation Research Board, Washington D.C., January 2001.

Evaluation of Potential Transit Signal Priority Benefits along a Fixed-Time Signalized Arterial, by F. Dion, H. Rakha, and Y. Zhang, Virginia Polytechnic Institute & State University, accepted for publication in the ASCE Journal of Transportation Engineering, 2003.

Evaluation Results of the San Antonio AWARD System, by R. Sivanadan, M. Van Aerde, H. Rakha, F. Dion, and A. Switzer, Virginia Polytechnic Institute & State University, presented at the 10th ITS America Annual Meeting and Exposition, Boston, MA, 2000.

Evaluation of Service Reliability Impacts of Traffic Signal Priority Strategies for Bus Transit, by J. Chang, J. Collura, F. Dion, and H. Rakha, Virginia Polytechnic Institute & State University, accepted for publication in the Transportation Research Record, Journal of the Transportation Research Board, 2003.

Evaluation of Traffic Signal Coordination Case Study: Field and Modeling Results, by H. Rakha, A. Medina, H. Sin, F. Dion, and M. Van Aerde, Virginia Polytechnic Institute & State University, accepted for presentation at the 14th International Road Federation World Congress, to be held in Paris, France, June 2001.

Evaluation of Transit Signal Priority Benefits along a Fixed-Time Signalized Arterial, by F. Dion, H. Rakha, and Y. Zhang, Virginia Polytechnic Institute & State University, Transportation Research Board 81st Annual Meeting, Washington D.C., January 2002.

Field Evaluation Approach for Quantifying Network-wide Efficiency, Energy, and Emission Impacts of Operational-Level Projects, by H-G. Sin, Virginia Polytechnic Institute & State University, Ph.D. Thesis, 2001.

Field Evaluation of Efficiency, Energy, Environmental and Safety Impacts of Traffic Signal Coordination across Jurisdictional Boundaries, by H. Rakha, A. Medina, H. Sin, F. Dion, M. Van Aerde, and J. Jenq, Virginia Polytechnic Institute & State University, Transportation Research Record, No. 1727, 2000, pp. 42-51.

Field Evaluation of Energy and Emission Impacts of Traffic Flow Improvement Projects using GPS Data: Issues and Proposed Solutions, by H. Rakha, F. Dion, and H. Sin, presented at the 80th Annual Meeting of the Transportation Research Board, Washington D.C., January 2001.

Field Evaluation of Safety Impacts of Adaptive Cruise Control, by H. Rakha, J. Hankey, A. Patterson, and M. Van Aerde, Virginia Polytechnic Institute & State University, ITS Journal, Vol. 6, 2001, pp. 1-35.

Finite Element Modeling of Rigid Pavements, by S. Shoukry and G. William, and M. Riad, West Virginia University, CD Proceedings of the 2nd International Symposium on Maintenance and Rehabilitation of Pavements and Technological Control, Auburn, Alabama, Paper No. 01-120, 2001.

Framework for the Analysis of Grocery Teleshopping, by J. Marker and K. Goulias, The Pennsylvania State University, Transportation Research Record, 1725, 2000, pp.1-8.

A Framework for the Evaluation of System Safety Benefits of Intelligent Cruise Control Systems, by M. Van Aerde and H. Rakha, Virginia Polytechnic Institute & State University, ITS Journal, Vol. 5, 1999, pp. 163-189.

Identifying Trip-Based Explanatory Variables for Estimating Hot-Stabilized Light-Duty Gasoline Vehicle Fuel Consumption and Emission Rates, by Y. Ding and H. Rakha, Virginia Polytechnic Institute & State University, Third International Conference on Air Quality, Loutraci, Greece, March 2001.

Impact of Vehicle Stops on Hot Stabilized Light-Duty Vehicle Energy and Emission Rates, by H. Rakha and Y. Ding, Virginia Polytechnic Institute & State University, presented at the 80th Annual Meeting of the Transportation Research Board, Washington D.C., January 2001.

Impact of Vehicle Stops on Hot Stabilized Light-Duty Vehicle Energy and Emission Rates, by H. Rakha and Y. Ding, Virginia Polytechnic Institute & State University, accepted for publication in the ASCE Journal of Transportation Engineering, 2002.

The INTEGRATION Modeling Framework for Estimating Mobile Source Emissions, by H. Rakha and K. Ahn, Virginia Polytechnic Institute & State University, Fourth International Conference on Urban Air Quality Proceedings, Prague, Czech Republic, March 2003.

Invited Remarks on the 20th Anniversary of SEPTA Commuter Rail Service and of the Delaware Valley Association of Railroad Passengers, by E. Morlok, University of Pennsylvania, The Delaware Valley Rail Passenger, March-April 2003, pp. 10-11.

A Longitudinal Analysis of Awareness and Use for Advanced Traveler Information Systems, by K. Goulias, T. Kim, and O. Pribyl, The Pennsylvania State University, paper presented at the European Commission Workshop on Behavioral Responses to ITS April 1-3, 2003, Eindhoven, the Netherlands.

Mesoscopic Fuel Consumption and Emissions Model [In French], by F. Dion, H. Rakha, and A. Manar, Virginia Polytechnic Institute & State University, presented at the 36th Annual Meeting of the Quebec Transportation and Road Association: Laval, Quebec, 2001.

Mesoscopic Fuel Consumption and Vehicle Emission Rate Estimation as a Function of Average Speed and Number of Stops, by F. Dion, M. Van Aerde, and H. Rakha, Virginia Polytechnic Institute & State University, presented at the 79th Annual Meeting of the Transportation Research Board, Washington D.C., January 2000.

Microscopic Modeling of Vehicle Start Emissions, by H. Rakha, K. Ahn, and A. Trani, Virginia Polytechnic Institute & State University, accepted for publication in the Transportation Research Record, Journal of the Transportation Research Board, 2003.

Microscopic Modeling of Vehicle Start Emissions, by H. Rakha, K. Ahn, and A. Trani, Virginia Polytechnic Institute & State University, presented at the 82nd Annual Meeting of the Transportation Research Board, Washington D.C., January 2003.

Modeling Drivers Parking Decision Strategies: Advanced Parking Management Systems, by A. Holton, D. Fisher, and J. Collura, Virginia Polytechnic Institute & State University, accepted by the ASCE Journal of Transportation Engineering, in press.

The Need for a New Commuter Car Entranceway Design for Mixed High and Low Level Platforms, by E. Morlok, University of Pennsylvania, Transportation Research Record No. 1793, 2002, pp. 40-46.

Patterns of Information and Telecommunication Use and Attitudes in the Pennsylvania Turnpike Traveler Information System, by M. Patten, K. Goulias, and O. Pribyl, The Pennsylvania State University, paper presented at

the 82nd Transportation Research Board Meeting and included in the CD ROM proceedings, Washington D.C., January 2003.

Reducing Passenger and Employee Boarding and Alighting Accident Rates on Mixed High and Low Platform Railroad Lines, by E. Morlok, University of Pennsylvania, paper presented at the 82nd Annual Meeting of the Transportation Research Forum, Washington, D.C., January 2003.

On the Relationship between Travel Behavior and Information and Communications Technology (ICT): What do the Travel Diaries Show, by K. Viswanathan, K. Goulias, and T-G. Kim, The Pennsylvania State University, Urban Transport VII, Urban Transport and the Environment for the 21st Century (Ed. L.J. Sacharov and C.A. Brebbia), WIT Press, Southampton, UK, 2001, 213-222 pp.

Resolving the Conflict between Mobility-Impaired Passenger Requirements and Freight Service on Mixed High and Low Level Platform U.S. Railroad Lines, by E. Morlok, University of Pennsylvania, presented at the 82nd Annual Meeting of the Transportation Research Board, Washington D.C., January 2003 (paper # 03-3232), to be published in Transportation Research Record. Preprint is available from the author.

Simulating No-Passing Zone Violations on a Vertical Curve of a Two-lane Rural Road, by J. El-Zarif, A. Hobeika, and H. Rakha, Virginia Polytechnic Institute & State University, accepted for publication in the Transportation Research Record, 2002.

Solving a Practical Pickup and Delivery Problem, by H. Xu, Z.-L. Chen, S. Rajagopal and S. Arunapuram, University of Pennsylvania, Transportation Science, forthcoming.

TRANSIMS: The Activity Generator Module, by A. Hobeika, et al., Virginia Polytechnic Institute & State University, Federal Highways Administration: Washington, D.C., August 2000.

TRANSIMS: The Microsimulation Module, by A. Hobeika, et al., Virginia Polytechnic Institute & State University Federal Highways Administration: Washington, D.C., September 2000.

TRANSIMS: The Population Synthesizer Module, by A. Hobeika, et al., Virginia Polytechnic Institute & State University, Federal Highways Administration: Washington, D.C., January 2001.

TRANSIMS: The Route Planner Module, by A. Hobeika, et al., Virginia Polytechnic Institute & State University, Federal Highways Administration: Washington, D.C., March 2000.

Transportation Systems Planning, Chapter 1 in Transportation Systems Planning: Methods and Applications, by K. Goulias, The Pennsylvania State University, edited by K. Goulias, CRC Press, Boca Raton, FL, 2003, 1-1 to 1-45 pp.

Travel Behavior and Values Research in Human-Centered Transportation Systems, by K. Goulias, The Pennsylvania State University, in Transportation in the New Millennium, State of the Art and Future Direction, Perspectives from Transportation Research Board Standing Committees, Transportation Research Board, National Research Council, The National Academies, Washington, D.C., 2003, 6 pp.

Trip-Based Explanatory Variables for Estimating Hot-Stabilized Light-Duty Gasoline Vehicle Fuel Consumption and Emission Rates, by Y. Ding and H. Rakha, Virginia Polytechnic Institute & State University, presented at the 81st Annual Meeting of the Transportation Research Board, Washington D.C., January 2002.

Trip-Based Explanatory Variables for Estimating Vehicle Fuel Consumption and Emission Rates, by Y. Ding and H. Rakha, Virginia Polytechnic Institute & State University, accepted for publication in Water, Air, and Soil Pollution, 2002.

Truck Modeling Along Grade Sections, by I. Lucic, Virginia Polytechnic Institute & State University, MS Thesis, 2001.

User Perceptions of Advanced Traveler Information Systems on the Pennsylvania Turnpike, by M. Patten, K. Goulias, and O. Pribyl, The Pennsylvania State University, paper presented at the 9th World Congress on Intelligent Transportation Systems, October 14-18, 2002, Chicago, IL.

Variable Power Vehicle Dynamics Model for Estimating Maximum Truck Acceleration Levels, by H. Rakha and I. Lucic, Virginia Polytechnic Institute & State University, accepted for publication in the ASCE Journal of Transportation Engineering, 2002.

Vehicle Dynamics Model for Predicting Maximum Truck Accelerations, by H. Rakha, I. Lucic, S. Demarchi, J. Setti, and M. Van Aerde, Virginia

Polytechnic Institute & State University, ASCE Journal of Transportation Engineering, Sept./Oct. 2001 Issue.

Vehicle Routing with Cross Docking, by Z.-L. Chen, H. Xu, and S. Rajagopal, University of Pennsylvania, presented at INFORMS Annual Meeting, Miami Beach, Nov. 2001, and submitted for consideration for publication.

The VT-Micro Framework for Modeling of Hot Stabilized Light Duty Vehicle and Truck Emissions, by H. Rakha, K. Ahn, and A. Trani, Virginia Polytechnic Institute & State University, presented at the 82nd Annual Meeting of the Transportation Research Board, Washington D.C., January 2003.

The VT-Micro Framework for Modeling of Hot Stabilized Light Duty Vehicle and Truck Emissions, by H. Rakha, K. Ahn, and A. Trani, Virginia Polytechnic Institute & State University, Fourth International Conference on Urban Air Quality Proceedings, Prague, Czech Republic, March 2003.

The VT-Micro Framework for Modeling of Hot Stabilized Light Duty Vehicle and Truck Emissions, by H. Rakha, K. Ahn, and A. Trani, Virginia Polytechnic Institute & State University, accepted for publication in the Transportation Research: Part B, 2003.

**Mid-Atlantic Universities Transportation Center
The Pennsylvania Transportation Institute
The Pennsylvania State University
201 Transportation Research Building
University Park, PA 16802**

**814.863.1909
814.865.3039 (fax)
www.pti.psu.edu/mautc**