



2002 – 2003 Annual Report

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

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FROM THE DIRECTOR

One of the first transportation centers in the United States, the Mid-Atlantic Universities Transportation Center (MAUTC), has just completed a decade and a half as a competitively selected University Transportation Center for Region III, the five-state Mid-Atlantic Region surrounding Washington, D.C.



Dr. Konstadinos G. Goulias

Since its inception, MAUTC has been guided by a common vision among the partners that it should be a university-based center for transportation excellence in research, education, and technology transfer. MAUTC is recognized as a vital resource to transportation organizations within the region, especially state departments of transportation, regional planning agencies, transit agencies, and private entrepreneurs and consultants.

As a leader in recruiting and educating transportation professionals who will guide the industry in the 21st Century, we have exceeded our own expectations. Wisely taking a lifecycle approach that goes beyond traditional undergraduate and graduate education, we contribute in a significant and lasting way to the education and experience of transportation professionals from the moment they enter school to their retirement, thus spanning their educational and professional development. Students in elementary through high school are introduced to engineering careers through the Transportation and Civil Engineering Careers Program (TRAC) developed by the American Association of State Highway and Transportation Officials (AASHTO) and West Virginia's Transportation Careers Awareness Program (TCAP).

This annual report documents our activities in the most recent year, and it is a clear reflection of a multi-year integrated approach to transportation education and research. Integration and reflection (which our new logo represents) happen in MAUTC by explicit design to take advantage of the strengths offered by each of the five first-class universities in our consortium. Led by The Pennsylvania State University, they are the University of Pennsylvania, The University of Virginia, Virginia Polytechnic Institute and State University, and West Virginia University.

Undergraduate and graduate students work beside faculty on current research projects and receive assistantships and internships through MAUTC. Faculty, researchers, and industry leaders, many who have received funding from the University Transportation Centers (UTC) Program during their college careers, are invited to return to campuses to deliver lectures and work with faculty and students on critical regional and national transportation issues. The annual Transportation Engineering and Safety Conference (TESC) at Penn State attracts more than 500 professionals to exchange ideas, network, and participate as active members in this society of successful individuals with the common objective of improving our nation's transportation system. And, of course, we have promoted the more than a decade-long involvement of faculty, students and staff in the Transportation Research Board Annual Meeting in Washington, D.C., which every January re-ignites the strong community spirit of MAUTC.

Just as lifecycle transitions mark the passage of time for the transportation professional, personnel transitions mark the passage of time for MAUTC. Since 1999, MAUTC has experienced several key personnel changes. In September 2002, Dr. James H. Miller began the transition into retirement by resigning as director of MAUTC after 14 years. Jim and his partners built a strong foundation based on MAUTC's mission to integrate education and research, and meet the objectives of the UTC Program and the research needs of the U.S. Department of Transportation. In parallel, Dr. Michael Demetsky, a major contributor to our partnership, took on the challenges of department chair at the University of Virginia and newly elected chair of the Council of University Transportation Centers (CUTC). Dr. Lester Hoel, a well known and respected professor, has stepped in to carry on. At Virginia Tech, Dr. Thomas Dingus assumed new duties, and the very active and enthusiastic Dr. Hesham Rakha took over the MAUTC Program. These changes are balanced by the stability and continuity provided by Dr. David Martinelli at West Virginia University and Dr. Edward Morlok at the University of Pennsylvania.

Continued success as a fully integrated center will lie in our experience and excellence in transportation planning, operations, and safety. The common thread among these three areas has consistently been our creative use of technology to solve problems, whether in basic and applied research or in training and technology transfer. Therefore, our future appears bright in spite of the uncertainty surrounding the transportation centers. MAUTC, in all its partner universities, continues to conduct research in support of state departments of transportation and local transportation agencies. Further, we have expanded our reach to consider U.S. Department of Transportation research priorities. One of our most important successes of the past year has

been a series of National Cooperative Highway Research Program projects, as well as projects in the area of safety, in which we are a recognized leader. We look forward to continuing our partnerships with the Pennsylvania, Virginia, and West Virginia Departments of Transportation in systems planning, operations, and safety. We will continue our successful collaborations and look to expand research, education, and technology transfer activities in Maryland and Delaware, the other two states in the Mid-Atlantic Region.

MAUTC faculty, staff, students, alumni, and the participating universities' leaders are all committed and look forward to achieving even more ambitious goals as we continue our regional leadership. This will happen as we recruit students and provide them trans-disciplinary, multi-modal educational opportunities, and as we apply our expertise and resources to address the key technical and policy issues outlined in the recent strategic plan of the U.S. Department of Transportation, expanded to include yet another challenge: transportation security.



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.

MAUTC FUNDING

The University Transportation Centers (UTC) Program is required to provide a 100 percent match for the funds provided by the U.S. Department of Transportation. MAUTC receives financial support from state and local agencies, private companies, and universities, and has been able to over-match the federal funds in large part due to the just completed five-year, \$15-million partnership between Penn State and the Pennsylvania Department of Transportation (PENNDOT).

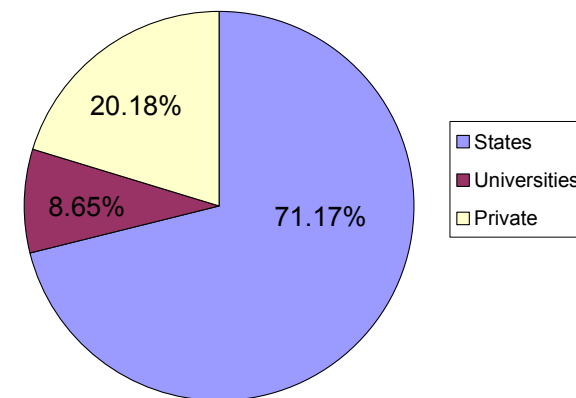


Figure 1. Sources of Matching Funds.

MANAGEMENT STRUCTURE

Administration

Penn State has been the lead university and grantee for the UTC Program funds since 1968. MAUTC is administered through the Pennsylvania Transportation Institute (PTI) at Penn State. 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.

Ms. Janice Dauber, MAUTC coordinator, is responsible for MAUTC's technology transfer activities, publicity, report preparation, and coordination of the Pennsylvania TRAC Center, a joint MAUTC/PENNDOT outreach initiative.

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.

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
Stephen Brich, Virginia Transportation Research Council
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

In July 2003, the advisory board members met over two days to hear presentations from each university and to perform a SWOT analysis of the MAUTC program. Dr. James H. Miller, former MAUTC director, was honored for his 14 years of dedication, service and leadership.



Kostas Goulias thanks Jim Miller for his 14 years of MAUTC leadership.

Coming together is a beginning, staying together is progress, and working together is success ~ Henry Ford ~

THE CENTER

The Mid-Atlantic Universities Transportation Center is comprised of the five universities below. Descriptions of their MAUTC efforts follow.

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

The Pennsylvania State University

Penn State's Pennsylvania Transportation Institute (PTI) is an interdisciplinary research unit within the College of Engineering. Since its inception in 1968, PTI has aspired to conduct innovative and relevant research directed toward current and future transportation needs, to promote continuing



The Pennsylvania Transportation Institute

education for transportation professionals, to provide significant interdisciplinary educational and research opportunities for undergraduate and graduate students, and to disseminate research results

within and beyond the transportation field. This fiscal year, PTI's active research contracts totaled more than \$48 million, with over \$13 million in research expenditures.

The Transportation Operations Program (TOP) at PTI serves as administrative home for MAUTC. Dr. Konstadinos Goulias is the director of both TOP and MAUTC. TOP is Penn State's focal point of basic and applied research in planning, design, and operation of transportation systems. TOP's 70 active projects have an estimated value of \$15.3 million and an annual budget of \$4.4 million and span a wide range of transportation systems topics. TOP projects involve as many as 80 staff members across Penn State's University Park campus. TOP takes a human-centered approach to research. Combining the tools and techniques of engineering and management, TOP's capabilities include:

- Transportation policy
- Transportation planning
- Highway and facility design
- Traffic operations
- Human factors and safety
- Transportation logistics and management
- Public transportation

TOP's 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

During the late 1940s, the University of Virginia (UVA) School of Engineering and Applied Sciences began an ongoing partnership with the Virginia Transportation Research Council (VTRC), the research branch of the

Virginia Department of Transportation. Since then, the transportation program at UVA has expanded significantly.

The Center for Transportation Studies (CTS), which is located within the Civil Engineering Department at UVA, performs research in the areas of transportation planning, policy, operations, safety, and intermodal studies. CTS, comprised of offices and laboratory facilities, shares the resources, laboratories and library of the VTRC facility located near the UVA campus.

The academic and research programs of CTS are closely associated with VTRC. 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.

With the emergence of technological breakthroughs in the field of transportation research, CTS has maintained a commitment to employ state-of-the-art equipment in support of research. Doing so has provided faculty and researchers with access to accurate and up-to-date information and government agencies, institutions, and the public with meaningful and actionable results.

Virginia Polytechnic Institute and State University

As the largest research division at Virginia Tech, the Virginia Tech Transportation Institute (VTTI) brings together a multidisciplinary group of researchers and students to conduct cutting-edge transportation research. VTTI participates in partnerships with public and private agencies and industry to develop, test, and deploy new transportation systems in the areas of safety, pavement, traffic, road-to-vehicle communications, and traveler-information systems.



VTTI's Mobile Traffic Lab

The focus of Virginia Tech's involvement within MAUTC is on traffic modeling issues. This focus concerns developing tools to quantify the efficiency, energy, environmental, and safety impacts of alternative transportation projects. Field data are instrumental for the development of such models. In addressing the

need to collect field data, VTTI has developed a close relationship with the surrounding community and local governments.

For example, VTTI's Instrumented City project involves a partnership with the Town of Blacksburg and support from the Virginia Department of Transportation, manufacturers, and the National Science Foundation to transform Blacksburg into the first instrumented city in North America. In addition, research projects at VTTI are made possible by the participation of local citizens as research subjects. VTTI also provides a controlled test road facility, known as the Smart Road, for conducting controlled experiments.

West Virginia University Harley O. Stagers National Transportation Center

The Stagers 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 Stagers 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.



WVU's People Mover

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 department 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 research touches the lives of everyone in the Mid-Atlantic Region.

This year, 14 new research projects, conducted by 13 different principal investigators, were awarded by MAUTC. Total budgeted costs for these projects were \$871,322.

Since the beginning of the current contract, more than 70 research projects have been undertaken. Total research expenditures for these projects have totaled more than \$7.4 million. For a complete listing of all projects, please refer to Appendix A.

Subject Area	No. of Projects	Budgeted Costs (All Sources)
Measurement, characterization & modeling of system performance & impacts measurement.	2	\$140,000
Transportation & logistics system operations & mgmt.	1	\$70,000
Behavioral sciences and human performance	2	\$250,000
Transportation planning, economics, & institutional issues	4	\$176,322
Maintenance & operations	1	\$40,000
Intermodal facilities	1	\$40,000
Traffic management	3	\$155,000

Table 1: New Research Projects by Subject Area.

The projects featured below are an example of the variety of research conducted through MAUTC.

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

The CentreSIM model represents the first application in which spatial and temporal information about activity participation is used within the four-step travel model framework. In the past, experiments with this simulation approach demonstrated the feasibility of incorporating activity data into the traditional four-step travel demand model. Activities are divided into a few types and the travelers into a few representative groups in their time allocation

during a day. Then, for each group, probabilities of activity and travel participation are created from each of the 24 hours in a day. Using these probabilities the number of persons present at each geographical location and the number of vehicles moving from place to place are predicted. In parallel, business-by-business information is used to predict truck traffic generation. Past research has also identified optimal methods of combining passenger with truck traffic and has developed more accurate networks. In mid-2003, a complete model system was used to demonstrate its effectiveness in real life project evaluation at the regional level, complementing its past demonstration as a transportation operations tool used in designing a portion of the Penn State campus. CentreSIM has been expanded to incorporate a few thousand activity diaries from residents to more accurately estimate traffic. The project is a typical example of an idea traveling from the basic and high risk stages to practice.

Evaluation of the SmarTraveler Advanced Traveler Information System in the Philadelphia Metropolitan Area, Dr. Konstadinos G. Goulias PSU-2000-07

As the number of vehicles on Pennsylvania roads increases, it becomes increasingly more important for the Commonwealth to make current travel information easily accessible to drivers so that they can avoid congestion due to accidents, bad weather, or high levels of traffic, either by planning ahead or by selecting alternate routes while traveling.

The Center for Intelligent Transportation Systems at Penn State assisted the Pennsylvania Department of Transportation (PENNDOT) in a study to understand how residents of southeast Pennsylvania (the Philadelphia metropolitan area) obtain and use travel information.

A mail-back survey of licensed drivers in the Philadelphia metropolitan area was conducted in late spring 2002. The questionnaire asked the respondents how they acquired travel information, how they used the information, and how valuable various types of travel information were to them. The survey also asked specific questions about the respondents' use and awareness of *SmarTraveler*, a service in the area providing real time traffic information via telephone and an interactive website.

PENNDOT will use the results of the survey to help determine the travel information needs of residents in this area and improve the ways that the information is provided.

Advanced Traffic Laboratory for Automated Systems (ATLAS), Dr. Lily Elefteriadou, PSU-2000-02

ATLAS is an integral part of many MAUTC students' research projects. Three cameras positioned at a signalized intersection in Pennsylvania can provide real-time video images to the lab. Advanced image processing technology is used to automatically extract traffic data such as vehicle speed and video images. Computers and VCRs in the laboratory process and store data and videotape traffic during certain time intervals, if further video image processing is required.

From the lab, researchers can observe and record traffic data and driver behavior on a continuous basis, which provides a unique opportunity to develop more efficient traffic operations models, greater safety measures, and more efficient management of transportation facilities.

In addition, the video images are used in undergraduate and graduate classes to illustrate and explain specific transportation engineering concepts.

Doctorates x Drivers = X Docks, Dr. Zhi-Long Chen, UP-2000-04

Cross-docks (x-docks) represent a new concept in distribution systems. In x-docking, trucks pick up scores of smaller shipments destined to widely spread locations to make a full load at a factory or warehouse. They then travel to a rendezvous point and there swap shipments with other trucks. They retain the shipments for a small geographic area, and then make the deliveries. This replaces a system where each truck would take all the shipments it picks up originally to the required destinations, which might be spread over a very large area. Thus each truck would travel much farther, increasing the cost of delivery, taxing the driver with long hours, wasting more fuel, and ultimately costing the consumer more money.



Prof. Z-L Chen describes mathematical programming methods for solving vehicle routing and scheduling problems.

Three years ago researchers at Penn teamed with advanced product developers at Manugistics, Inc. (a supplier of software to the trucking and logistics industry), to tackle problems of finding where and when to x-dock, and more generally how to route trucks in increasingly congested areas. Led by Professor Zhi-Long Chen and Dr. Srinivas Rajagopal at Manugistics, the Penn researchers looked at three related distribution problems. Dr. Henry (Hang) Xu, who recently completed his Ph.D. research and is now with Manugistics, developed computer algorithms to amass the data on orders, carrier rates and fleet capabilities, business rules, DOT safety rules, and other factors, and then to solve the problem. The researchers developed algorithms and programs to determine such factors as how to group orders for movements, which carriers to assign each movement to, and the optimal sequence of stops, while meeting the shippers' and receivers' time windows for pick-up or delivery. Some of the algorithms have already been internally implemented and tested on actual product distribution problems, and implementation in new releases of the software is planned.

Naturally such cooperation has benefits but also issues that must be addressed. The algorithms and other results are in the public domain and have been widely publicized in papers and presentations. Their development was enhanced by the ability to use real-world data. But through its partnership in the research, the firm has immediate access to the work as it was unfolding, and is in a better position to make use of it in a timely way than otherwise.

Shipping More Trucks by Rail, Dr. Edward Morlok, UP-R-09

Research often takes a long time to bear fruit, and sometimes the impact is anticipated, other times it is not. Research collaboration between Penn and Conrail, the major freight railroad in the Northeast, was spawned by the UTC Program. The impact of this early beginning has been tremendous and has continued to the present. It has affected the university's educational programs, research at Penn and other universities, and practices in the intermodal freight field.



Dr. Ed Morlok, UPS Foundation Professor at Penn, accepting the TRF Transportation Researcher of the Year Award, 1999.

The original research was done by Professor Edward Morlok, UPS Foundation professor of transportation at Penn, and his Ph.D. student, Lazar Spasovic, who is now a professor and director of the Center for Transportation and Industrial Productivity at New Jersey Institute of Technology. That center was started with UTC funding, and is now supported by New Jersey and industrial firms. Another Ph.D. student involved later in the research was Linda Nozick, now a professor at Cornell University.

One of the early findings of the research, and one that earned Drs. Morlok and Spasovic the Intermodal Research Prize of the Transportation Research Forum, was that the trucking that occurs at both ends of an intermodal rail movement accounts for only about 10 percent of the mileage but up to 40 percent of the cost. The reason for the high cost was the structure and operations of the trucking activity, not any deliberate inefficiency of the truckers or other players. Making the case that efficiencies are possible and explaining the benefits of improvement have taken many years of further research, publications, and technology transfer. But light is now at the end of the tunnel—firms are embracing the idea of coordinated trucking to achieve these gains, and it now plays a crucial role in many plans to extend intermodal rail to new, shorter haul markets (less than 800 miles) where most trucking occurs. A new trucking firm has been founded on the idea, and researchers at other universities—including Northwestern and Georgia Tech—are now developing efficient decision support systems to make the trucking as efficient as possible.

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

Despite increased emphasis on air travel security during the past three years, there are still no standardized systems or set procedures for screening air cargo within the United States. To implement a procedure for checking cargo, all potential security hazards must be identified. Once potential security loopholes are found, solutions can be proposed and incorporated into a system that can screen cargo effectively and quickly.

Researchers at UVA have begun a project to increase homeland security at airports. Cargo flow into airports will be analyzed by examining each movement along the way, from its entrance onto airport property to its exit. Hazards such as terrorist attacks, cargo theft, goods smuggling, potential explosions, and biological and chemical attacks will be considered in the analysis.

Potential technologies to aid in maintaining air cargo security will be identified and evaluated for their ability to address the identified problems. A case study of one of the airports reviewed earlier will be selected for demonstrating the application of counter measures.

The results of this research will provide a standard procedure for airport authorities to implement and follow to enhance the security associated with air cargo transport.

Evaluating the Accessibility of Residential Areas for Bicycling and Walking Using GIS, Dr. Lester Hoel, UVA-2002-05

Concerns about traffic congestion and environmental and health care issues are driving an increased interest in accessibility for alternative forms of travel such as bicycling and walking. In order to make biking and walking safe and efficient alternatives, communities must consider the relationship between spatial layout and infrastructure design. Unfortunately, a quality method does not exist to quantify walking and cycling accessibility.

This study synthesized recent research on the connection between the built environment and transportation to develop a new accessibility measure, the Pedestrian and Cycling Accessibility Measure (PCAM), that can identify areas conducive to walking and cycling. PCAM is based on the concept of the “3Ds”—density, diversity, and design.

PCAM was applied to the Charlottesville/Albemarle region of Virginia to demonstrate the results of the analysis and the capabilities of a geographic information system (GIS) for calculating and displaying accessibility.

First, the proximity of residential areas to specific destinations within walking and biking ranges (density) and the mix of destinations immediately surrounding these destinations (diversity) were analyzed. This demonstrated the potential for walking and biking trips in the area. Once this was completed, the physical design (or lack) of the infrastructure was examined to determine if the infrastructure supported the potential walking and biking travel (design). After developing the PCAM, a GIS was used to implement the measure and display the results.

Communities can use PCAM to identify areas for focusing their limited funding for pedestrian and cycling infrastructure and to identify areas that provide an array of transportation choices.

Addressing I-81 Transportation Issues, Dr. Hesham Rakha, VPI-2000-01

Interstate 81 is one of the busiest highways in the Mid-Atlantic Region. The number of trucks and cars traveling on I-81 has increased dramatically since it was built more than 35 years ago. Virginia's mountainous terrain and the large increase in the number of trucks that travel on the state's major highway have resulted in reductions in roadway capacities, levels of service and safety.

The Virginia Department of Transportation (VDOT) has begun construction to widen I-81 to six lanes and in some areas to eight lanes. The highway improvements are expected to be completed in 2022.

Currently available statistics provide information on slow-moving trucks, but they do not offer information on the trucks' impact on general traffic, nor do they illustrate the interaction of multiple moving trucks, such as when trucks attempt to overtake each other on an incline.

Researchers will explore traffic-flow behavior, truck performance, safety hazards, and other trucking concerns. To date, safety hazards of I-81 relative to other interstate highways in the U.S. have been evaluated, truck traffic characteristics in terms of the weight and power along the I-81 corridor have been completed, and vehicle dynamics models for the modeling of truck performance on grade sections have been developed and validated.

Findings from this project will provide critical data to 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.

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

Transportation systems are built, maintained, and improved upon through the use of computer-simulated models that represent traffic dynamics, such as car-following, lane changing, acceleration/deceleration behavior, fuel consumption and emissions. These models predict traffic patterns and needs and are used by transportation professionals to develop effective traffic-management systems and to compare transportation alternatives. Therefore, accurate and efficient simulation tools are vital to transportation planning. Researchers at Virginia Tech are working to improve the state-of-the-art simulation tools. To achieve this objective, research data are being collected along the Virginia Smart Road, a closed test facility for transportation

research, and along typical urban roadways. Information being collected includes vehicle speed, acceleration, throttle level, braking indicator, fuel consumed, and emissions every second. This information is used with simulation software to develop traffic models.

Through projects like this one, the Transportation Systems and Operations Group at VTTI is establishing itself as one of the leading agencies in transportation and traffic modeling. The group is also currently involved in the modeling of signal priority along Columbia Pike Boulevard in Arlington, Virginia, using the INTEGRATION and VISSIM simulation models. This modeling project involves simulating traffic within a signal priority system, in which the timing of traffic signals is modified to accommodate transit vehicles. Such models allow transportation professionals to determine the positive and negative effects of the priority system and to contribute to a system's design. In addition, the group will be evaluating the I-77/I-81 overlap in Wytheville, Virginia, using the INTEGRATION and CORSIM models.

It is anticipated that the research effort will put VTTI in a unique position in terms of providing field data for the validation of microscopic simulation models. It is anticipated that this research could result in other funding opportunities.

Addressing Urban Network Transportation Issues, Dr. Hesham Rakha, VPI-R-04-099

The majority of transportation problems occur within urban environments. In order to manage and enhance the flow of urban traffic, transportation professionals need tools to evaluate, predict, and control the ever-growing number of vehicles on the roads. Various methods for controlling traffic are emerging, including transit signal priority, in which the timing of the traffic signal is modified to accommodate transit vehicles; adaptive signal control, in which the timing of the traffic signal adjusts according to traffic information monitored through roadway sensors; ramp metering; and toll roads.

Researchers at Virginia Tech are working to develop strategies for alleviating urban transportation problems through traffic flow theory, a mathematical estimation of the interaction between vehicles and the transportation infrastructure, such as traffic signals, signs, pavement markings, etc. Traffic flow theory considers emissions, speed, traffic volume, and traffic signal timing and control. It can be applied to urban traffic networks to evaluate existing systems and to identify and implement other possible solutions for traffic problems.

EDUCATION

MAUTC plays a significant role in the lives of many students studying transportation-related subjects. It not only provides funds for graduate assistantships, but also provides funds for state of the art computer and laboratory equipment. This, in turn, attracts bright, ambitious students to our transportation programs.

MAUTC education programs fulfill the need for lifelong learning. From West Virginia's and Pennsylvania's TRAC programs that reach out to pre-college students to Penn State's and Virginia Tech's continuing education courses, MAUTC provides educational opportunities that encourage students to pursue careers in transportation, foster curiosity and ingenuity in undergraduate and graduate students, and provide financial and material support for the successful completion of their degrees.

Enhancing Classroom Learning at Penn State, Dr. Konstadinos Goulias

Penn State takes a three-pronged approach to education:

First, transportation students have many opportunities to learn outside the traditional classroom. MAUTC funds support student research showcases at the annual Transportation Research Board meeting in Washington, D.C., and at the Transportation Engineering and Safety Conference in State College, Pennsylvania. These showcases provide students an opportunity to practice and develop presentation skills, to meet professionals who are interested in their field of study, and to make contacts for future employment. Students also learn how their research may be applied in the field.

Second, the Distinguished Lecturer series brings accomplished researchers, who have received student or academic grants from the U.S. Department of Transportation and who have consistently promoted and improved the state of the art and practice of transportation systems management in the United States, to campus to talk with students and faculty about their current research.

Third, MAUTC and the Center for Intelligent Transportation Systems (CITranS) at PTI sponsored a graduate student thesis competition. Students enrolled in an M.S. or Ph.D. program were eligible to compete for funding for the 2003-2004 academic year. The research topic had to be strictly related to a specific transportation problem (e.g., safety, economic efficiency,

environmental impacts in transportation systems), and the approach to solve and/or address this problem had to use a systems viewpoint and be human-centered (e.g., human factors, driver behavior, travel behavior).

Three theses were selected for 2003-2004:

- Advanced Information and Transportation to Enhance the Safety and Mobility of Elderly Travelers
- Optimal Adaptive Signal Control for Diamond Interchanges Using Dynamic Programming
- Testing and Evaluation of Micro-Simulation for Use in Incident Management

UPenn Model Trains + Computers + ID Tags = Supply Chains, Dr. Edward Morlok, UP-E-01

Penn has developed an innovative laboratory for undergraduate students to learn about supply chains and transportation/distribution decision making. Most university laboratory work on large systems—of which a supply chain is a primary example—is computerized. The system the students work with resides in the pc in the form of data and relationships that the laboratory designer has incorporated. As a result, the student is really manipulating the model the designer created, and the system reacts as it has been programmed.

This lab is deliberately different. It draws its inspiration from laboratories in the physical sciences where students work with the real material or physical system. Now, of course, one cannot bring a real supply chain into the lab, nor can one allow students to manipulate a real production system. But a small version of such a system can be built. Instead of real goods, one can use blocks representing products at various stages and have these items flow between the factories through the warehouses to the retail stores where they can vanish as virtual customers buy them. Real size limitations can be imposed on warehouses, and time can be taken transporting things from one stage to the next, though only minutes instead of days are taken. Result: a miniature supply chain, with—you guessed it—model trains carrying the goods from one location to another.



The Supply Chain Game at Penn

The real advantage of such a lab is that it is almost purely physical. This means that the students must develop their own understanding of the system. To improve it, they can try their luck with guesses and hunches, implement them, and see what happens. Or they can create their own quantitative model of the system, using systems engineering principles, and manipulate it to help them find a better way to operate it—and all sorts of combinations in between. Competition between student teams operating different supply chains keeps attention on the goals, not the action on the tabletops.

This lab was introduced as part of a joint Wharton (management) and Engineering (systems) course five years ago. The course has always been oversubscribed. Recently, with a grant from the Beatty Foundation, along with MAUTC funds, the number of students who can take the course has expanded from 24 to 48 at each offering.

UPenn Optimal Computing Budget Allocation, Dr. Edward Morlok, UP-E-05

Often developments outside a field have the potential for tremendous impact on many different areas of application. Computers are an obvious example. Information technology has transformed almost all aspects of life.



Prof. C. H. Chen (center, standing) and J. Lin assist two undergraduates in computer simulation.

Computing plays an essential role in transportation. One of the most important is modeling the system, playing “what if” exercises to make decisions on investments in new highways or port facilities, to assess how to route traffic through a railroad network so as to minimize delay to cargo, and how to respond to unplanned situations such as storms and floods. Most of this modeling is done using Monte Carlo or stochastic simulation, which incorporates the natural random variations in systems in the modeling, just as one does in financial modeling of, say, the stock market. One of the problems with stochastic models is that they require enormous computing time. This is exacerbated when the problem is to evaluate and compare different courses of action where each course must be modeled separately.

Optimal Computing Budget Allocation (OCBA) is a technique designed to reduce the computing time required to compare alternatives. The essence of the idea is to do just enough simulation of each alternative to decide on whether it should be continued to be looked at or discarded at that stage in the comparison. The effect on computing time is tremendous, particularly in network problems of the sort found in transportation.

Researchers at Penn have adapted OCBA to network problems. While the research, being done by Jianwu Lin, a Ph.D. candidate in Systems Engineering, under the direction of OCBA developer, Professor C. H. Chen, is still under way, the benefits are already clear. Using a model for assessing the capacity of a rail network, Lin’s research revealed that the computing time to find the best routing and network configuration dropped by a factor of almost 100 from standard Monte Carlo simulation.

Continuing Education Courses, Dr. Hesham Rakha and Dr. John Collura, VPI-2000-06

The practice of transportation engineering continues to evolve rapidly with the introduction of new technologies, techniques, and tools. This growth represents a significant challenge to engineers who graduated some years back, to those who enter the transportation profession from related fields, and to firms and agencies who need to attract, re-train, or upgrade their staffs to keep pace with the profession.

To address these issues, Virginia Tech offers a series of short courses to the Virginia Department of Transportation, the Federal Highway Administration, and transportation consulting firms for continuing education purposes. The courses represent an opportunity for engineers and their employees to obtain additional training in a time-efficient and cost-effective manner, without interrupting their careers or ongoing projects. Courses covering a wide range of areas will be offered on demand, including traffic modeling, traffic operations in traffic signalized networks, traffic operations of freeways, communication networks, and transit operations. The course offerings are focused to permit a measurable improvement in skills for people with varying levels of experience and knowledge. For example, the courses will benefit those professionals with minimal experience but good analytical skills as well as those who are familiar with the state-of-the-art and the state-of-the-practice in the areas of traffic engineering, planning, control, technology, and modeling.

The study of intelligent transportation systems (ITS) is an integral part of the courses, with a focus on engineering, control, and modeling. The purpose of

the courses is to illustrate that the analysis and planning of ITS requires a solid understanding of the underlying traffic engineering and transportation planning concepts. Furthermore, an understanding of these fundamentals is also critical to being able to objectively compare ITS options to non-ITS alternatives.

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

The Transportation Careers Awareness Program (TCAP) was developed to enhance West Virginia's Transportation Research and Civil Engineering Careers Program (TRAC), an outreach program developed by AASHTO to interest secondary school students in science and engineering.

TCAP provides transportation and engineering resources via the Web. Working with the West Virginia Department of Education, TCAP designs its exercises and learning materials to meet the state's education standards. All schools in West Virginia are invited to use the resources provided on the website, <http://www.cemr.wvu.edu/~wwwtcap/index.htm>

Engineers from West Virginia Department of Highways and members of the Younger Members Forum of the American Society of Civil Engineers volunteer to go into the classroom to speak to students, help with projects, and serve as role models.

In addition, TCAP/TRAC sponsors an annual bridge building contest. The top 10 West Virginia contestants from West Point's Bridge Design Contest compete in the TCAP/TRAC contest.



Left to right: David Martinelli, chair, Civil & Environmental Engineering, and Tammy St. Clair, president, American Society of Civil Engineers Younger Members Forum, with competition winners John Tavalacci and Nigal Martin.

TECHNOLOGY TRANSFER

While MAUTC's primary focus is on research and education activities, MAUTC has an active technology transfer component. Faculty, researchers and students disseminate their research findings at professional conferences and research showcases, and through professional organizations.

Faculty associated with MAUTC published 51 research reports and books and presented 48 transportation research papers at academic and professional meetings.

Since 1999, MAUTC faculty and researchers have presented or published more than 100 reports and books.

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

The Transportation Engineering and Safety Conference is Pennsylvania's premiere transportation conference. More than 500 practicing professionals converge each December at State College, Pennsylvania, to learn about the latest technologies and techniques from seasoned engineering professionals, researchers, and state and federal agency personnel.

The conference has grown from 10 sessions in 1995 to more than 30 in 2002. Attendance has increased from 200 to more than 550 over the past 8 years. Session topics run the gamut from pedestrian and bicycle accommodations to communication technologies and interchange design and operational characteristics. Six half-day workshops precede the conference.

The conference encompasses the learning cycle of a transportation professional. Undergraduate and graduate students participate as attendees and as presenters during the student research showcase, where they have the opportunity to speak directly with conference participants who are interested in their research. Students also learn from the participants how their research may play a role in real-world applications. Researchers and faculty are expanding their knowledge base, and practicing professionals take new information back to the workplace.

Appendix A: Project Status List

RESEARCH

New Projects (FY 02/03)

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-2002-07 QUIK Survey, Peter B. Everett

PSU-2002-08 Time Use, (Tele)communications, and Technology Interactions, Konstadinos G. Goulias

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

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 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

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, Sami Shoukry

Ongoing Projects

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

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

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, Hesham Rakha

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

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

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

Completed Projects

PSU-2000-01 Pennsylvania Statewide Long Range Transportation Plan (Penn Plan), 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-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, 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 Scholarshi, 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 & State, Highway Safety, Antoine G. Hobeika, Hesham Rakha
- VPI-2000-07 SUPERPAVE HMA Mixes, Immadeddin Al Qadi
- VPI-R-11 Professional Capacity Building in Transportation, Hesham Rakha, John Collura, 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, 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

EDUCATION

New Projects

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

Ongoing Projects

- MAUTC-E-03 Support Transit Internship Program at PSU, UPENN, and UVA, James H. Miller, Edward K. Morlok, Lester A. Hoel
- 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-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-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 and 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-2001-01 The West Virginia TRAC/TCAP Program
of West Virginia University, Crystal May

UVA-2000-03 Investigation of Truck to Rail Freight Diversion/Mode
Choice Models, Michael J. Demetsky - **CANCELED**

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-2002-09 Transportation Engineering and Safety Conference,
Konstadinos G. Goulias

Completed Projects

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

CORRECTIONS SINCE 2002/2003 SEMI ANNUAL REPORT

PSU-2000-02 and PSU-R-01 were incorrectly categorized as completed
projects in the 2002/2003 semi annual report dated January 31, 2003. They
are ongoing and are included in the ongoing research list in this report.

UVA-2002-01 Safety Impacts of Differential Speed Limits, Phase II,
Nicholas J. Garber - **Duplicate of UVA-2000-11**

Appendix B: Publications, 1999-2003

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.

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.