Mid-Atlantic Universities Transportation Center
Region III

1999-2000 Annual Report

August 30, 2000

TABLE OF CONTENTS

I.A. CENTER DIRECTOR'S SUMMARY

The Mid-Atlantic Universities Transportation Center (MAUTC) has just completed its twelfth year as the competitively selected University Transportation Center for Region III, the five-state Mid-Atlantic Region. This document reports on our activities in the most recent year. MAUTC is a five-university consortium, led by The Pennsylvania State University, that also includes the University of Pennsylvania, The University of Virginia, Virginia Polytechnic Institute and State University, and West Virginia University.

Throughout its twelve-year existence, MAUTC has designed its activities guided by the vision that it should be a university-based center of transportation excellence that is recognized as a vital resource to transportation organizations within the region, especially state departments of transportation and transit agencies. Further, MAUTC has sought to be a leader in recruiting and educating transportation professionals who will lead the industry in the 21st century. This vision, which is consistent and supportive of the UTC Program's mission, is shared by all MAUTC's faculty and staff, and it has led to the creation of a program that is capable of extending its outreach to meet the objectives of the UTC Program.

MAUTC has worked closely with the other UTCs within the Mid-Atlantic region. This close collaboration is possible because MAUTC universities are part of two of the other UTCs in the region, and because of MAUTC's past participation with the third UTC, Morgan State. The University of Virginia and Virginia Tech are member schools of the Virginia Center for ITS Implementation; West Virginia University has signed a memorandum of agreement with the Appalachian Transportation Institute that will allow it to work on joint activities with this new UTC. Finally, MAUTC has established and will maintain close working relationships with Morgan State University faculty -- relationships that were developed when Morgan State was a part of the MAUTC consortium.

MAUTC has also reached out to non-UTC universities in the Mid-Atlantic region and serve as a catalyst and coordinator of research and educational activities. The primary tool for this outreach effort will be Penn State's "Cooperative Agreement" with PennDOT. As a result of this long-term, open-ended contract, Penn State has already set up relationships with thirteen other universities throughout the nation so that these universities can conduct research or educational programs for PennDOT. We have forged relationships with Historically Black Colleges and Universities including Lincoln University, Cheyney State University and Howard University. Each of these universities is working through Penn State to conduct educational or research projects for PennDOT. Because of Penn State's and MAUTC's research experience and administrative resources, we are able to assist these universities in obtaining and carrying out sponsored projects.

MAUTC universities are working together to expand the scope of our educational offerings and to concentrate MAUTC's financial resources on funding for students so that we can attract and educate as many undergraduate and graduate students as possible. Because of the funding cutbacks to the UTC program, our ability to offer financial aid is limited; however, we have overcome this

financial set back by making student financial support the highest priority use of MAUTC funds.

To implement the educational priority for MAUTC, we have invested in state-of-the-art laboratories for students to use for research and course projects, we have developed new course materials, and have funded undergraduate and graduate students through internships and graduate assistantships.

MAUTC research projects are selected on the basis of their ability to provide financial support for students. Furthermore, we have continued a model developed as part of the PennDOT/MAUTC Partnership activity whereby we provide financial support to promising graduate students to extend the research of an agency-sponsored applied project by conducting more basic research leading to a thesis or dissertation. Linking student research to agency-sponsored activities will ensure that the research topics are relevant to real-world problems, but at the same time, by not tying the student support to completion of project deliverables, we will be able to develop new knowledge and techniques that can be applied in the future.

MAUTC continues to conduct research in support of state DOT and local transportation agency needs. Further, we consider USDOT research priorities when seeking matching funds for projects. We look forward to continuing our partnerships with the Pennsylvania, Virginia, and West Virginia Departments of Transportation. All three agencies are committed to continuing to fund research activities that support MAUTC's objectives as well as delivering products that meet the agencies' current needs. As part of our regional leadership mission, we have continued to seek collaborative research and technology transfer activities with the other two states in the region – Maryland and Delaware.

Because our research activities are focused on the needs of operating agencies, technology transfer is an integral part of our research effort. An explicit part of each project is a plan for implementation of the research results. Such implementation includes conduct of training programs, installation of software, and/or presentation of findings at agency or professional meetings and seminars. Further, MAUTC has taken advantage of current information technology to make the MAUTC web page a principal source of information on our projects and other activities. Potential users of our work have been able to get updates on ongoing projects and full-text versions of current reports.

MAUTC faculty, staff, and students look forward to continuing our regional leadership in the coming years by recruiting students and providing them multidisciplinary, multimodal educational opportunities, and applying our expertise and resources to addressing key technical and policy issues facing transportation operating agencies in our region.

I.B. MAUTC THEME

The theme of the Mid-Atlantic Universities Transportation Center (MAUTC) is Advanced Technologies in Transportation Operations and Management. This theme 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. As illustrated in Figure 1, 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; and
- Multimodal mission that addresses passenger and freight transportation, highway and transit and intermodal facilities.

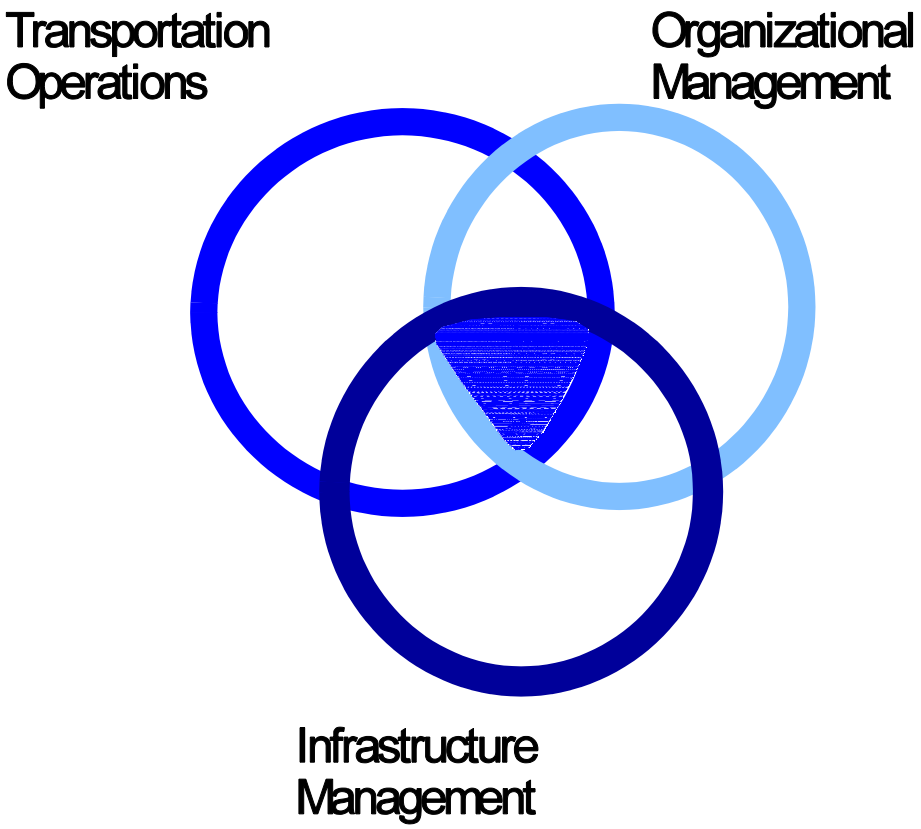

Figure 1. MAUTC's Theme: the intersection of transportation operations, organizational management and infrastructure management

I.C. MANAGEMENT STRUCTURE

The Mid-Atlantic Universities Transportation Center was formed in 1986 by six universities in the five-state Mid-Atlantic region. The current five universities include The Pennsylvania State University (University Park, Pennsylvania), the University of Pennsylvania (Philadelphia, Pennsylvania), The University of Virginia (Charlottesville, Virginia), Virginia Polytechnic Institute and State University (Blacksburg, Virginia), and West Virginia University (Morgantown, West Virginia). The original six university consortium also included Morgan State University (Baltimore, Maryland). The consortium was formed in anticipation of the University Transportation Centers Program, but its purposes were not limited to this single program; other opportunities for collaboration were anticipated.

Technically, Penn State is the lead university and grantee for the UTC Program funds. It then enters into subgrant agreements with each of the other MAUTC members for their share of the MAUTC activities and federal funds. Each subgrant agreement includes a description of the tasks that the member has agreed to perform and a budget for the federal and matching share of the MAUTC-supported activities. The MAUTC Director delegates day-to-day responsibility for MAUTC activities at the member universities to the member of the MAUTC Steering Committee from that university. The MAUTC Steering Committee interacts formally and informally to direct and coordinate the overall activities of the consortium. At least 3-4 times a year, the Steering Committee meets to formulate its future plan of activities and long-term strategy. In this way, all MAUTC members collaborate in shaping the direction of the MAUTC program.

MAUTC is be administered through the Pennsylvania Transportation Institute (PTI) at Penn State. With the help of the PTI staff, the Center Director monitors the expenditures and activities of the consortium members. Dr. James H. Miller, director of the Mid-Atlantic Universities Transportation Center, is responsible for all aspects of the center's operation. He is a full-time faculty member and holds a joint appointment with the College of Business Administration's Department of Business Logistics and the Pennsylvania Transportation Institute. A faculty member and researcher for the past 24 years, he has been the MAUTC director since its inception in 1988. Furthermore, he served as coordinator of the UTC directors for seven years.

While devoting approximately 25 percent of his time to teaching in the College of Business Administration, he devotes approximately 65 percent of his time to his duties as director of MAUTC and as director of the State Program. The remaining 10 percent of his time is devoted to other research projects at PTI. Approximately 30 percent of his time is devoted directly to MAUTC; however, because many of the state-funded projects are part of the PennDOT/MAUTC Partnership activities, an additional 10-15 percent of his time can be attributed to MAUTC-related activities.

As MAUTC Director, Dr. Miller is considered by Penn State to be the principal investigator for the federal UTC grant. As such, he is held responsible by the university for project fiscal and administrative management.

Dr. Miller serves as the chairman of the MAUTC Steering Committee and is the primary contact for U.S. DOT officials. He acts as the spokesperson for MAUTC at regional and national meetings and seeks opportunities to publicize MAUTC's program and activities.

Dr. Miller also leads the MAUTC steering committee whose members are the lead faculty responsible for MAUTC activities at the consortium member universities. Figure 2 illustrates MAUTC's organizational structure. The organizational structure features MAUTC's Steering Committee and the MAUTC Partners Roundtable. The MAUTC Steering Committee is responsible for general direction of MAUTC activities. Members include the MAUTC Director (Dr. James H. Miller) and a senior faculty member from each MAUTC member university (Dr. Michael Demetsky, Dr. Edward Morlok, Dr. Konstadinos Goulias, Dr. Hesham Rakha, and Dr. David Martinelli). The mentioned members are responsible for MAUTC-related activities at their respective universities. The MAUTC Partners Roundtable are the actual or potential sponsors of research funding agencies and/or future employers of our undergraduate and graduate students.

All faculty members involved in MAUTC activities are full-time members of academic departments at their respective universities. They devote sufficient time to MAUTC activities in supervising graduate students and staff and administering their portion of the MAUTC program. However, with the exception of the MAUTC Director, these faculty devote less than 50 percent of their time to MAUTC-sponsored projects.

To the maximum extent possible, MAUTC uses existing staff resources at the consortium member universities. West Virginia University administers its MAUTC activities through the Harley O. Staggers National Transportation Center of the university and uses the staff resources of this organization to manage project budgets and prepare reports. Likewise, Virginia Tech's activities are managed through the University Center for Transportation Research, which provides support for its programs. Departmental staff provide Penn and the University of Virginia faculty with needed support as well.

At Penn State, PTI's State Program and general administrative, clerical, editorial, and financial staff are used to the maximum extent possible; however, due to the extent of PTI's MAUTC-related responsibilities, MAUTC provides partial support for four full-time staff members. Ms. Ann Marie Hutchinson, MAUTC Coordinator, is responsible for MAUTC's technology transfer activities (including the Annual Student Fair at TRB), publicity, report preparation, and coordination of the Pennsylvania TRAC Center, a joint MAUTC/PennDOT outreach initiative. She devotes

approximately 90 percent of her time to MAUTC activities. Ms. Hutchinson has served in this capacity for the past six years, and has ensured that all program reporting requirements are met. She has played a lead role in preparing annual strategic plans. Furthermore, she managed the UTC Clearinghouse throughout the time that the U.S. DOT contracted with Penn State to perform this function.

Other staff members who devote significant time to MAUTC activities and are key to its success are Ms. Susan Fuoss, the Staff Assistant for MAUTC who provides clerical support for the overall MAUTC administrative activities as well as for Penn State's MAUTC projects and programs. Likewise, Ms.Deb Clemmer, a finance clerk, maintains budgets and expenditure information for MAUTC, particularly for the PennDOT/MAUTC Partnership. Finally, Mr. Jacob George develops and manages the MAUTC web site and other PTI-related sites. He is responsible for setting up the web capabilities that are required by the new UTC reporting requirements.

II.A. MAUTC EDUCATION

Project Title:	Graduate Studies in Transportation Engineering and Planning at the University of Virginia
Principal Investigator:	Michael J. Demetsky
University:	University of Virginia
Sponsors:	Virginia Department of Transportation and MAUTC

The graduate program of advanced study in transportation at the University of Virginia (UVA) is managed through the Center for Transportation Studies (CTS) and is interdisciplinary in its academic focus and research activity. It stresses the introduction of new technology in planning, design, construction, operation, and management of multimodal transportation systems in its core courses, and it supplements these courses with advanced courses that teach the fundamentals of emerging technologies such as artificial intelligence, simulation, image processing, and geographic information systems.

Students with varying academic backgrounds such as planning, environmental science, economics, mathematics, and electrical engineering are admitted to the program. Depending upon the students' academic and research objectives, faculty from various university divisions collaborate on curriculum, research supervision, and graduate student committees.

A special feature of UVA's transportation studies program is the partnership that UVA has with the Virginia Department of Transportation (VDOT). Through this partnership, two employees were given academic leave from VDOT to pursue a graduate degree. Both VDOT and MAUTC provided financial assistance for these students.

Most graduates of the program are required to write a thesis or dissertation on a problem or issue in Region III or a topic of interest to the Virginia Transportation Research Council (VTRC). Resources to carry out the thesis research are provided through UVA (using University and MAUTC funds) and through the VTRC and other projects. In addition to serving as a student's thesis, the results of a student's research are published as MAUTC reports and as technical papers in journals.

Project Title: Maintain and Enhance Transportation Laboratories
Principal Investigators: Konstadinos Goulias, Hesham Rakha, Michael Demetsky, Edward Morlok, and David Martinelli
Universities: The Pennsylvania State University, Virginia Polytechnic Institute & State University, University of Virginia, The University of Pennsylvania, and West Virginia University
Sponsor: MAUTC

Transportation Laboratories have been established at all MAUTC Universities to enhance education and research programs. This past year, hardware and software were purchased and replaced to maintain state-of-the-art facilities. The functions of the labs are to (1) maintain computational equipment and software at transportation computer laboratories at The Pennsylvania State University, University of Pennsylvania, University of Virginia, Virginia Polytechnic Institute and State University, and West Virginia University; (2) maintain current hardware and software support for the GIS course being developed at the University of Virginia; and (3) provide software and hardware support for the Transportation and Logistics Systems Program and associated undergraduate and graduate courses.

Project Title: Advanced Traffic Simulation Laboratory (ATLAS)
Principal Investigator: Lily Elefteriadou
University: The Pennsylvania State University
Sponsors: U.S. DOT and MAUTC

Researchers at Penn State designed and implemented a laboratory for real-time traffic data collection in the State College, Pennsylvania, area using video imaging technology. The laboratory provides researchers and students with the opportunity to observe real transportation facilities in real time, record and analyze a multitude of traffic and travel data, and create models with much finer detail than was previously possible.

Dr. Lily Elefteriadou, associate professor of civil engineering and research associate at the Pennsylvania Transportation Institute (PTI) is directing this initiative, in cooperation with MAUTC and the Pennsylvania Department of Transportation. The laboratory is instrumented with the AUTOSCOPE™ video detection system, developed by Econolite/ISS. The system includes cameras in the field to transmit images to the laboratory for further processing. The laboratory component also includes a data collection/reduction system based on image processing that allows researchers

to observe and record traffic data on a continuous basis. In addition, the capability for microscopic observation of traffic and driver behavior provides researchers with unique opportunities to develop more efficient traffic operations models, greater safety measures, and more efficient management of transportation facilities.

The research includes development of traffic optimization models based on drivers' actions, which constitutes the continuation of previous research conducted by Dr. Elefteriadou. Testing of these models is conducted on existing and new simulation models. In addition, research will be conducted on requirements for quality and quantity of data, as these are used in transportation applications. A unique feature of the State College area is that the roadway network is often used by "recreational drivers" and drivers not familiar with the area. Thus, research will focus on investigating operational effects of various driver populations, including "unfamiliar" drivers. The laboratory provides the necessary setting to expand existing research capabilities in the area of new and advanced technologies (e.g., automatic traffic recording, geographic information systems, etc.). Local and state, public and private agencies will likewise benefit from the technology transfer capabilities and data availability. Aside from the vast opportunities in conducting research, the laboratory provides a unique educational tool for graduate and undergraduate students.

Project Title:	Transportation and Logistics Systems Laboratory and Course Development
Principal Investigator:	Edward K. Morlok
University:	University of Pennsylvania
Sponsors:	Beatty Trust, Manugistics, Inc., 21st Century Project for the Undergraduate Experience, UPS Foundation Fund, and MAUTC

The purpose of this effort is to enhance undergraduate and graduate education, and to support research by faculty, students, and staff. Two new courses have been introduced that have been very popular with students from a variety of fields, and this led to the expansion of the laboratory in November of 1999 to accommodate larger classes (from a maximum of 24 to 32 students, depending on the course). Another major milestone was the signing of an agreement with Manugistics, Inc., which provides for the installation in the laboratory of their MTM software. This is probably the most widely used transportation and logistics software in the world, and it is valued at about $2 million. Exercises based on actual company data have been prepared for the graduate Logistics Systems course, taught by Prof. Z. L. Chen, and exercises for use of undergraduates in the Transportation Systems course are being prepared by Mr. Bradley Ntizberg, on the lab's staff, and Prof. E. K. Morlok. The lab is also used for a joint Engineering-Wharton logistics course for undergraduates, and is widely used by undergraduates in their senior design or other capstone project.

Project Title:	Development of a Laboratory for Analysis of Commercial Aviation Issues

Principal Investigators: Marcello Napolitano, David Martinelli
University: West Virginia University
Sponsor: MAUTC

An important effort is underway at West Virginia University in a collaboration between the Mechanical and Aerospace Engineering (MAE) Department and the Civil and Environmental Engineering (CEE) Department. Capabilities have been acquired for a study of several commercial aviation issues using flight simulators. In particular, the research efforts focus on developing compensating control laws to assist a commercial pilot in the event of a catastrophic failure within the flight control system. The objective is to introduce prototype control algorithms to allow pilots to recover from failures in actuators of primary aircraft control surfaces. Additional investigations are being conducted on traffic patterns within congested air spaces for the development of collision avoidance schemes. Several graduate and undergraduate students are involved in this effort.

Project Title: Transit Internship Program
Principal Investigators: James H. Miller, Edward K. Morlok, and Lester Hoel
Universities: The Pennsylvania State University, University of Pennsylvania, and University of Virginia, and Virginia Polytechnic Institute and State University
Sponsor: MAUTC

MAUTC at The Pennsylvania State University sponsored an Undergraduate Internship Program in which students who have completed the sophomore or junior year in a transportation-related curriculum are selected to fill paid internships in the Centre Area Transportation Authority, Beaver County Transportation Authority, and York County Community Transportation Authority in Pennsylvania.

The University of Pennsylvania's MAUTC Program has established a national program to encourage young men and women to choose careers in transportation, particularly railroad management and engineering. The University of Pennsylvania's internship program is administered though the Kent T. Healy Memorial Fund. The program also provides a clearinghouse for summer internship opportunities. Future activities will include a symposium dealing with the future of the railroad industry and associated research.

MAUTC at The University of Virginia (UVA) arranges for student interns to work with the Charlottesville Transit System on a yearly basis. Their work at the transit system is used for their senior theses. UVA researchers have also established graduate student projects requested by other transit agencies.

MAUTC at Virginia Polytechnic Institute and State University has been successful in attracting students to the ITIS Internship Program. These internships have not only provided funding

opportunities to students but have also enabled participation in advancing the state of the art in transportation research.

Project Title:	Virginia Department of Transportation Fellowship Program at University of Virginia and Virginia Polytechnic Institute & State University
Principal Investigators:	Hesham Rakha, Michael J. Demetsky
University:	University of Virginia and Virginia Polytechnic Institute
Sponsors:	Virginia Department of Transportation and MAUTC

As part of its partnership with UVA and Virginia Tech, the Virginia Department of Transportation (VDOT) has committed to supporting DOT employees while they return to Virginia Tech or UVA for a master's degree. Through this highly effective program to upgrade the capabilities of its staff, VDOT continues the employees' salaries while they attend the university full time. MAUTC provides an additional stipend and pays tuition, and the VDOT employee works on a MAUTC-supported research project that is selected by VDOT.

Project Title:	Transportation Engineering and Management (TEaM) Advanced Institute Program at Penn State
Principal Investigator:	Konstadinos G. Goulias
University:	The Pennsylvania State University
Sponsors:	U.S. DOT and MAUTC

TEaM is the name given to Penn State's transportation education activities. TEaM's goal is to provide students from several transportation disciplines with educational opportunities that focus on both the engineering and technical aspects of the transportation system and the management of these systems. TEaM stands for Transportation Engineering and Management, and it represents the distinctive feature of Penn State's educational activities. MAUTC at Penn State markets its transportation education activities under the TEaM logo, and it is used internally to identify students and activities related to MAUTC. This year approximately 10-15 graduate students were recruited through the TEaM effort and were supported on PennDOT/MAUTC Partnership projects; however, the undergraduate interns were supported with MAUTC funds.

Project Title:	Intelligent Transportation Systems Research and Development Fellowship Program at The Pennsylvania State University
Principal Investigator:	Konstadinos Goulias
University:	The Pennsylvania State University
Sponsors:	U.S. DOT and MAUTC

In this educational activity, Penn State faculty and graduate students aimed at developing new ideas in the area of intelligent transportation systems (ITS) and creating the foundation for new methods, software, and hardware to be moved into practice. The project will be renewed yearly, and changes in the emphases of the MAUTC Program at Penn State will be reflected. In addition, a review of new needs for ITS research and development will be performed at regular intervals, and new directions will be incorporated. A sample of the research topics is:

1. Traveler Information and Transportation System Utilization

Traveler information systems within the Intelligent Transportation Systems (ITS) arena claim major benefits to the transportation system users and managers. Recent evidence may suggest the potential emergence of "induced demand" (i.e., trip making may increase because of information availability, thus, risking to nullify any gains from managing traffic). In addition, longer term changes in the ways people travel (e.g., peak spreading, increase in weekend travel) may require us to develop different information systems than most of the current systems, which are targeting peak hour commuters. In this topic Penn State researchers will identify the determinants of change in the nature of travel demand, study the relationship between travel demand and information systems, and provide specific guidelines for the design of information systems. Emphasis in this topic will be given to the type of information needed by prospective travelers, the use of multimedia in providing information to them, and their effect of trip making propensity. In addition, statistical models that can be used to analyze data of this type need to be developed.

2. Network Modeling and Stochastic Demand

Many Intelligent Transportation Systems (ITS) aim at improving network performance. However, network modeling and traffic assignment become extremely complex when one considers fluctuations in the demand for travel. These fluctuations may be due to predictable temporal variation of demand and predictable user variation of demand, but also unpredictable factors. In addition, network modeling under ITS is needed in "real-time." This implies that a traffic control center and/or an emergency management center require traffic predictions in a very short time as new information about the demand for travel becomes available. Within this topic, researchers at Penn State will design new algorithms, methods, and software that advance the state of the art in network modeling.

Project Title: TRAC Outreach Program for Junior and Senior High Schools
Principal Investigator: James H. Miller
University: The Pennsylvania State University and West Virginia University
Sponsors: PennDOT, U.S. DOT, and MAUTC

A major endeavor of MAUTC is the development of the Transportation and Civil Engineering Careers Center Program (TRAC) in Pennsylvania and West Virginia. The primary goal of TRAC,

a federally funded outreach program associated with the American Association of State Highway and Transportation Officials, is to increase the number and diversity of students who pursue careers in engineering and transportation-related fields. As part of their activities, Pennsylvania and West Virginia TRAC faculty and staff provide high school science and mathematics teachers with the training and materials they need to establish sound engineering and transportation-related curricula in their classrooms. In addition, Pennsylvania and West Virginia have implemented a state-based Regional TRAC Center to encourage a partnership between the State Department of Transportation and Highways, the State Department of Education, and each university to implement an effective administrative structure.

This past year, training for new teachers and volunteer engineers was held at each prospective university. The training was designed to showcase TRAC's purpose and train the attendees on the equipment, software and curriculum.

The TRAC program has been active in 33 schools in Pennsylvania and 51 schools in West Virginia. Plans are already in place to expand to more high schools in the 2000 academic year. To further strengthen the Mid-Atlantic Region's involvement in TRAC, MAUTC has asked researchers at Virginia Polytechnic Institute and State University to consider hosting TRAC.

Project Title: Design MAUTC Regional Transportation Courses
Principal Investigator: James H. Miller
University: The Pennsylvania State University
Sponsors: U.S. DOT and MAUTC

MAUTC researchers are in the process of designing regional transportation courses that will be offered at each MAUTC university. Researchers from participating universities will: (1) hold a series of meetings to develop course outlines and assign modules to each university; (2) develop assigned modules; (3) pilot-test modules at each university; (4) develop and package course materials; (5) distribute courses at each university; and (6) advertise courses at each university.

The first course will focus on Urban Goods Movement, with an emphasis on Intelligent Transportation System topics. It is directed toward upper level undergraduates or first year graduate students. The course would be comprised of modules, each covering a specific topic. the modules can be combined in various ways to form a course, which could be tailored to specific target groups (MPOs, DOTs, , logistics companies, consulting firms, etc.).The use of the Web for offering this course should be explored. A book is a possibility, but not part of current plans.

Project Title: Develop Transportation Courses in Information Technology for Graduates and Undergraduates
Principal Investigator: Brian L. Smith
University: University of Virginia
Sponsor: Virginia Highway and Transportation Research

Researchers at the University of Virginia are working on developing transportation courses in information technology for graduate and undergraduate students. This past year, a work station and three terminals were purchased for the transportation laboratory. A new GIS course was developed and taught by VTRC staff in spring 1996. This year the course was taught by University of Virginia Departmental staff. Beginning in spring 1997 the course was taught using ARC View 3.0 on PC's, making the course available to more students. A second course for graduate students will be developed using the workstation for advanced training and research.

Project Title: Education Program at the Virginia Tech Transportation Institute
Principal Investigator: Hesham Rakha
University: Virginia Polytechnic Institute & State University
Sponsors: Virginia Department of Transportation and MAUTC

Virginia Tech's Transportation Institute offers an interdisciplinary program of educational experiences and research opportunities in the areas of information technology and transportation. Students in the program come from diverse backgrounds, with interest in advanced transportation studies. Furthermore, there is opportunity for two to three Virginia Department of Transportation (VDOT) employees to regularly enroll and pursue M.S. Degrees at Virginia Tech. These students can work on research projects of interest to VDOT and within the theme of education in advanced transportation studies.

The key feature of Virginia Tech's education in advanced transportation technologies is the interdisciplinary nature of the focus and the range of disciplines drawn to the activities. Students not only from engineering branches, but also from other interdisciplinary areas, who have interest in transportation, will be attracted. In addition to the graduate financial support provided through the center, Virginia Tech provided $2,500 in undergraduate summer internships to students, based upon outstanding performance. These students were also recruited aggressively for the Institute. During the 1999-2000, the Institute funded one graduate assistantship.

Project Title: Transportation and Logistics Doctoral Program Support
Principal Investigator: Edward K. Morlok
University: University of Pennsylvania
Sponsor: MAUTC

Penn has traditionally been a major supplier of Ph.D.'s to both academia and to industry. This program is designed to expand and make it a major goal of The University of Pennsylvania. MAUTC's educational program is responsible for producing well-trained Ph.D.'s in a program of study that encompasses not only the traditional transportation subjects but also expands to include other fields that are now crucial to the transportation industry. These include operations research, systems analysis methodology, economics and other social science fields, and subjects dealing with information sciences and new technology. This past year, three students have been partly or fully supported in 1999-2000. One is working on problems of optimal network design using simulation. A second is working on concepts of economic and physical capacity of multimodal networks. A third student is just starting his doctoral studies.

II.B. MAUTC RESEARCH

Project Title: ITS Alternatives Analysis: Evaluating Parking Management
Principal Investigator: Lester A. Hoel
University: University of Virginia
Sponsors: Virginia Department of Transportation and MAUTC

An important component of the success of major transportation facilities, such as busways and rail transit lines, is access to the facility via automobile. An investigation of existing ITS technologies and their potential for improving the operation of parking facilities combined with a methodology for evaluating the application of these technologies in various situations would be valuable to transportation planners. University of Virginia researchers have investigated the application of ITS technologies in parking facilities and are in the process of developing a methodology for selecting appropriate technologies for a particular area. The methodology will likely consist of evaluating the various alternatives based on measurement criteria to determine candidate technologies. The techniques of the methodology should be transferable to parking systems at other transportation facilities.

Project Title: Evaluation of Traveler Diversion Due to En-Route Information
Principal Investigator: Michael J. Demetsky
University: University of Virginia
Sponsors: Virginia Department of Transportation and MAUTC

Since the introduction of Intelligent Transportation Systems (ITS), the transportation engineering community has tried to identify the benefits of these systems in concrete terms. One of these ITS strategies is a Dynamic Message Sign (DMS). This project details determined the effect a DMS system has on driver behavior at a site selected in the Hampton Roads area of Virginia. The scenario studied was the choice a traveler has to change his/her route from the Hampton Roads Bridge Tunnel to the Monitor Merrimac Bridge Tunnel based on messages displayed on the DMS system. Data was collected on the DMS system and volume data was obtained using loop detectors, over a period from August 1998 to July 1999. This data was processed and the difference between the percentage of drivers turning towards the Hampton Roads Bridge Tunnel when the DMS system was and was not in use was calculated. This difference is referred to as the diversion percentage. The average diversion percentage calculated was very low. Reasons for this result include the 'weak' message displayed on the system, the unwillingness of drivers to divert, and the distance from the secondary route. Sensitivity analyses performed on the data showed that certain variables affect diversion percentage. Drivers were more likely to divert during Thursdays and Fridays, summer months, off-peak times, and instances when high traffic volumes existed. A secondary analysis is performed on recent data after a change was made in the usage of the DMS system. The secondary analysis suggests that the newer messages created a larger amount of diversion, although this cannot be proved due to the small amount of data. Another secondary analysis compares two different methodologies for determining diversion. The results from this report are limited to the scenario studied and should not be applied to other situations where a DMS system is used to divert drivers.

Project Title: Ozone Formation Attributable to Emissions from Rural Interstate Traffic
Principal Investigator: Michael J. Demetsky
University: University of Virginia
Sponsors: Virginia Transportation Research Council and MAUTC

The formation of low-level ozone is dictated by a complex chemical process involving ozone precursors and meteorological factors. Oxides of nitrogen (NOx) are important precursors to ozone formation. Recent studies have revealed that ozone formation over much of the rural eastern U.S. is limited primarily by the availability of NOx. Mobile sources emit approximately 32% of the total nationwide NOx emissions. The majority of NOx emissions from mobile sources are associated with vehicles accelerating or cruising at high speeds. Such driving performance is characteristic of interstate traffic in rural areas. Many rural interstates exhibit heavy-truck traffic that may account for as much as 30% of total traffic volumes. Traffic volumes along such heavily-traveled corridors often exceed 80,000 vehicles per day. Studies have shown that trucks account for greater NOx emissions per vehicle than gasoline-powered passenger cars due to the relatively high combustion

temperatures and pressures associated with diesel engines. As alluded to previously, vehicles on rural interstates generally exhibit high speeds (> 60 mph). Thus, large traffic volumes traveling at relatively high speeds on rural interstates can contribute significant NOx emissions to the local atmosphere. The proposed research examined the role these mobile source emissions play in the production of low-level ozone in the rural atmosphere. Particular attention is given to the emissions attributable to vehicles traveling along a rural interstate. A photochemical model is being developed to simulate ozone formation conditions. Interstate I-81 and its environs will be used to develop and test the model. The results of the research will provide important information on the impacts of rural interstates on local environments as well as the amount of pollution generated by these facilities.

During the past year considerable progress has been made in this research effort. Heavy-duty vehicle emissions data were obtained from the Colorado Institute for Fuels and High Altitude Engine Research at the Colorado School of Mines. These data were used to calibrate the emission estimation methodology used in the freeway operations simulation package, FRESIM. FRESIM was used to estimate emissions for traffic data collected in the Tuscarora Mountain Tunnel on the Pennsylvania Turnpike. The estimated emissions were compared to actual emissions measured in the tunnel by a research team from the Desert Research Institute at the University of Nevada, Reno. The results of the updated FRESIM methodology agreed well the measured data and were shown to be more consistent with actual emissions measured in other studies than was the original FRESIM methodology. The emission estimates were then input into a preliminary version of the photochemical modeling procedure being developed in this research. The model was used to simulate the ozone formation attributable to the rural interstate traffic by studying several test scenarios with varying traffic and chemical parameters. The preliminary runs indicated that NOx emissions from interstate traffic, particularly heavy-duty vehicles, contribute to significant ozone production near the interstate. The preliminary results and methodology were presented in January at a poster session at the American Meteorological Society 11th Joint Conference on the Applications of Air Pollution Meteorology with the Air & Waste Management Association in Long Beach, CA.

The emissions estimation methodology is currently being refined to allow a more detailed description of the emissions chemistry. Tasks to be completed in the next few months include: modifying the chemical mechanism in the photochemical model, simulating traffic conditions and emissions along other interstate (e.g., I-81), producing final report summarizing the study efforts and detailing findings and conclusions. A paper describing the preliminary efforts and results is currently being prepared for submission to TRB in August 2000.

Project Title: An Investigation of Web-Based Technologies for the Peninsula Transportation District Commission
Principal Investigator: Brian L. Smith
University: University of Virginia
Sponsors: Pentran and MAUTC

Providers of public transportation find themselves in a very competitive marketplace. In order to maintain market share, and to grow, transit agencies are eager to take advantage of opportunities offered by new and emerging technologies. Pentran is beginning an effort to use the World Wide Web as a tool in retaining current riders, increasing market share, improving customer service, and increasing public awareness of their services in the Hampton Roads region. In this effort, Pentran will use the power of the web in improving communications with existing and potential
customers.

However, experience has proven that the Web is not a panacea. As is the case with other communications devices, such as signing, printed material, television, radio, and telephone, it has its strengths and weaknesses. On the positive side, the Web has the potential to automate information dissemination, is an interactive instrument, offers information that can be updated quickly and at a low cost, can provide easy to follow graphics, and reaches a growing market. Unfortunately, the Web market is currently limited mostly to persons who have access to a computer. Furthermore, the ability to update information quickly places pressure on a provider to constantly maintain a well-designed and current website; failure to do so often results in a negative public impression.

Among the public and private sector there is a rush to have a presence on the Web. Yet development of a website has several costs: initial page design and layout, server space rental, maintenance of the site information, and most importantly, the reputation of the organization responsible for the site is at stake. Furthermore, an opportunity to enhance customer service could be missed if the capabilities of the Web are not tailored to meet Pentran's needs.

To support the investigation of the web's applicability to achieving Pentran's goals, the research team developed a prototype web-based application, a transit trip planner. This prototype application provided substantive insights on the use of the web in public transportation. A final report has been completed for the project. In addition, a paper discussing the design of trip planners has been published in the *Journal of Public Transportation.*

Project Title:	Reliability-Based Monitoring of Bridge Structures
Principal Investigator:	C. E. Orozco
University:	University of Virginia
Sponsors:	Virginia Department of Transportation and MAUTC

Given the state of deterioration of a good part of the approximately 600,000 bridges in the U.S., there is a continuous need to improve the efficiency of maintenance, repair, and inspection operations of bridge structures. The objective of this project is to develop a real-time reliability-based bridge monitoring system that will feed information to a given bridge management system. The bridge monitoring system will use state of the art reliability-based techniques to estimate probabilities of failure of bridge structures. This information will be fed to a bridge management

system to trigger maintenance, repair, and/or inspection operations. An algorithm will be developed to constantly update probabilities of failure given current and historical stress and strain data. The algorithm will also detect unusual bridge response behavior that could indicate dangerous overload situations. The possibility of using ideas borrowed from early warning systems (EWS) currently used successfully to predict the onset of earthquakes will also be explored. It is envisioned that in the future there will be a network of instrumented bridges that will feed information to the bridge monitoring system. A second stage of the project will address the actual instrumental process and the design of the network of instrumental bridges.

Project Title: Oversized Vehicle Routing and Scheduling
Principal Investigator: Lester A. Hoel
University: UVA-R-20
Sponsor: USDOT/VDOT

Current specifications allow for a wide range of starting times for oversized vehicles travel. This study will integrate routing and scheduling to accommodate time-varying network attributes, and in so doing, develop algorithms for the safest departure time for a selected route. The methodology will identify the hourly distribution of risk for oversized vehicles traveling on a specific roadway type. Risk will be estimated using oversized vehicle accident probabilities and accident consequences.

Project Title: Undergraduate Research Experience
Principal Investigator: Edward K. Morlok
University: University of Pennsylvania
Sponsor: 21st Century Project for the Undergraduate Experience, UPS Foundation Fund and MAUTC

A major goal of the University of Pennsylvania is to increase the involvement of undergraduates in research. This initiative is directed toward involving students in transportation and logistics research. This is being done in three ways. One is to have students work part-time on projects with faculty and graduate students. A second is to have students work on topics of interest that are related to specific research projects. This is accomplished through independent study courses arranged with individual faculty members. The third is to have students work on design projects in the field of transportation and logistics, and ideally, with firms with which we have a close research relationship. Examples of projects completed in the past year include: (1) design of a new port terminal for Defendable Distribution Inc., (2) a review of models of maintenance of track and structure costs for Amtrak, (3) development of a simulation model of a U.S.Postal Service terminal that will become part of a larger simulation model of the entire bulk mail

(parcel) network. The terminal design project is illustrative of the close working relationship that often characterizes these projects. In the effort, the students met frequently with the officers of the client company, and were also advised by both faculty and persons in a related consulting firm. Their design will enable the firm to use bulk handling instead of bags, reducing costs and enabling expansion of cargo through the Port of Philadelphia. Their conceptual design is now in the detailed design planning phase ready for implementation.

Project Title:	Transportation and Logistics Networks Research Program
Principal Investigator:	Edward K. Morlok
University:	University of Pennsylvania
Sponsors:	Conrail, "K" Line, Manugistics, Inc., UPS Foundation Fund, United Parcel Service of America, and MAUTC

Globalization, e-commerce, mass customization, and other trends are changing the demand for transportation in fundamental ways. In this environment we feel the best use of our limited MAUTC funds is to provide seed money to initiate projects that are truly research in nature, to support projects that would have a substantial long-term impact, and that could be supported by other sources once started. In addition the funds are targeted specifically to the logistics area.

Three related topics are being supported:

- Simulation and optimization of nested carrier networks; with application to bulk mail, parcel and other systems
- Real-world truck routing and scheduling problems: optimization-based heuristic solution methods
- Impacts of congestion on urban goods movement, and possible solutions.

Project Title:	Traffic Engineering Education Plan
Principal Investigator:	John A. Anderson
University:	The Pennsylvania State University
Sponsors:	PennDOT and MAUTC

The role of traffic engineering in today's transportation field is changing and expanding. Society and transportation legislation are mandating less construction of new facilities and more efficiency from the existing system. State and local governments are beginning to place greater emphasis on transportation operations and system management. There is also an increasing use of advanced technologies to collect, transmit, and apply information to improve the capacity of

existing facilities. These emerging trends require greater education and training of professionals involved in traffic engineering.

PennDOT has initiated development of a traffic engineering education program to enhance the knowledge of individuals involved in the traffic engineering function. In response to PennDOT's request, MAUTC researchers have developed a traffic engineering education plan that outlines the framework for a traffic engineering education program. The plan specifies the technical content and time frame needed to prepare PennDOT's traffic engineering function for the challenges of the next century. The technical content is divided into 23 knowledge modules representing distinct areas of traffic engineering. The knowledge modules are subdivided into levels to organize the content for employees with varying levels of experience and responsibility. The first phase of the program, has involved developing the first six knowledge modules, which cover transportation engineering, transportation planning, design concepts, traffic characteristics, work areas/advanced topics, and advanced signal concepts. The six modules will be developed into self-paced study guides, the technical content of which will be able to be adapted and taught though short courses, CD ROM, or interactive computer programs.

Due to the success of this long-term project, Penn State is currently developing education plans for PennDOT's design and construction management and maintenance programs.

Project Title: Support of the ITS Statewide Steering Committee
Principal Investigator: John M. Mason, Jr.
University: The Pennsylvania State University
Sponsors: PennDOT, U.S. DOT, and MAUTC

The advancement of intelligent transportation systems (ITS) is a vital aspect of the Pennsylvania Department of Transportation's mission. This project provided the resources necessary for the Mid-Atlantic Universities Transportation Center (MAUTC) to: (1) support Pennsylvania's Statewide ITS Steering Committee and PennDOT during the planning for and deployment of ITS systems and programs in the Commonwealth; (2) assist the department in the development of strategic plans for ITS Implementation in Pennsylvania; and (3) conduct evaluations and assessments of PennDOT's ITS programs and activities as requested by the Department and/or the Statewide ITS Steering Committee.

MAUTC, in cooperation with the Statewide ITS Steering Committee and PennDOT, used this project to plan for, evaluate, and assess the deployment and operation of ITS-related technologies, systems, and programs. The following three primary activities outlined were conducted in accordance to the project: (1) MAUTC personnel provided staff support for Pennsylvania's Statewide ITS Steering Committee by making arrangements for committee meetings and notifying committee members, serving as recorder at the meetings, and producing and distributing meeting minutes. MAUTC personnel identified, located, acquired, developed, and distributed ITS-related resource materials as requested by the Steering Committee, and also

performed other ITS related activities requested by the steering committee; (2) MAUTC staff participated in the various activities related to the development of Strategic and Business Plans for the implementation of ITS in Pennsylvania. Initially, MAUTC participation included activities such as: conducting background research, development of resource materials, participation in strategic/business planning activities, organization of meetings, and document production. An example of activities under this project was the development of a Strategic Plan for Rural ITS in Pennsylvania; (3) at the direction of the ITS Steering Committee via PennDOT, MAUTC personnel developed the methodology by which to evaluate the success of ITS technology implementation had on field operations. For each evaluation, Penn State developed an evaluation plan, performed the evaluation, and provided a draft and final report on the evaluation results. Presentations of evaluation results were provided to the ITS Steering Committee and PennDOT upper management as requested.

Project Title: Center for Intelligent Transportation Systems Research
Principal Investigator: Konstadinos Goulias
University: The Pennsylvania State University
Sponsors: U.S. DOT and MAUTC

The Center for Intelligent Transportation Systems (CITranS) was established in January 1994 to provide a means for Penn State to take a more active part in intelligent transportation systems (ITS) research. A multidisciplinary research initiative administered through PTI, CITranS encompasses all forms of surface transportation--including highways, railroads, and transit--and serves as a focal point for advanced technologies research at Penn State.

In addition to coordinating the university's broad interdisciplinary ITS research efforts, CITranS provides guidance in four critical ITS-related research areas: human factors and safety; large vehicle dynamics; transportation planning and demand management; and systems architecture, modeling, and integration. One element of the center's two-part mission focuses on successfully combining Penn State's diverse capabilities to pursue relevant ITS research opportunities and to coordinate strong interdisciplinary responses. The other main element focuses on actively promoting professional development in ITS subject matter through university-level course work and technology transfer activities.

CITranS is affiliated with several Penn State research areas, including the College of Engineering, which has designated CITranS as one of its Centers of Excellence; the Mid-Atlantic Universities Transportation Center (MAUTC); and the Applied Research Laboratory.

In January 1996, CITranS personnel began assisting the Pennsylvania Department of Transportation (PennDOT) in developing a strategic plan for implementing ITS in Pennsylvania. The plan will help ensure that ITS implementation benefits as many Commonwealth citizens as possible by enhancing personal mobility, improving transportation safety, mitigating

environmental impacts, and promoting economic vitality. The ongoing project is part of the PennDOT/MAUTC Partnership and has received $220,000 in funding.

In addition to providing financial support to several graduate students participating in ITS-related research, CITranS is participating in the Disadvantaged Driver Initiative. The initiative is a vehicle for addressing issues associated with using ITS to enhance the mobility of special-user groups such as the elderly, the disadvantaged, and the operators of specialized use vehicles. Researchers have already determined that the redeployment of advanced technologies from the defense sector can provide ITS benefits to these special-user groups at a greatly reduced cost. The project is a joint effort involving CITranS, PTI, ARL, the Gerontology Center, the Alliance for Transportation Research, the University of Minnesota, and the Surface Transportation Policy Project.

CITranS also maintains a specialized ITS Information Clearinghouse to serve as a central repository for faculty and students interested in furthering their knowledge of ITS and/or in developing proposals for funded ITS research. The clearinghouse, which is located at PTI, contains specialized information such as current ITS related requests for proposals, previously submitted proposals, journals, reports, research papers, and conference proceedings. The clearinghouse is maintained and expanded as part of CITranS ongoing activities.

Project Title:	Climate Survey Development and Organizational Assessment (1999-2000)
Principal Investigator:	Robert J. Vance
University:	The Pennsylvania State University
Sponsors:	PennDOT and MAUTC

A climate survey can be an important component of an organization's quality improvement efforts. In this exhibit, the administration and use of an employee opinion survey for the Pennsylvania Department of Transportation - the PennDOT Organizational Climate Survey (OCS) - will be described. The OCS and the OCS report format were designed and implemented by PennDOT and Penn State University during 1995 through 1999.

The OCS assesses opinions on 17 topics with 100 survey items plus three background questions. Topics include climate for participation, individual participation in decision making, organizational commitment, outlook for change, innovation, stress, team work, safety, quality of communication, customer service, job satisfaction, and so on.

OCS Feedback Reports are produced for all units within PennDOT. Feedback Reports provide results at the scale level using a bar chart format, and at the item level using a numerical format. Since the outset of the OCS process within PennDOT, support has been provided by the Penn State research team in the form of user manuals, workshops, individual consultation for

managers and quality coordinators, and additional analyses and reports when requested. The most recent innovation is an OCS website. It's capabilities include:

1. Support to PennDOT managers and Quality Coordinators on use and interpretation of OCS Feedback reports.
2. Capability to request customized OCS Feedback Reports. For example, a manager might request a comparison report of his work unit to comparable work units for selected OCS items for 1995 and 1999. To meet this request, the website provides a series of report design screens that allow users to select the desired items, work unit comparisons, and time periods. Reports are created by the server computer. These can be printed locally in color or black and white.
3. FAQ (Frequently Asked Questions), where users may post questions about the OCS process and receive answers and suggestions within a short period of time for Penn State researchers, PennDOT officials, and/or other users.
4. A forum for sharing best practices in OCS use, interpretation, and problem resolution.

Penn State researchers developed a flow chart that illustrates the OCS survey and feedback reporting process. A notebook computer and monitor was used to demonstrate the OCS website to interested parties.

Project Title: PennDOT's Intelligent Transportation Systems (ITS) Strategic Plan
Principal Investigator: John M. Mason, Jr.
University: The Pennsylvania State University
Sponsors: PennDOT and MAUTC

The development of a strategic plan for the implementation of intelligent transportation systems (ITS) in Pennsylvania will benefit the Commonwealth's citizens by enhancing personal mobility, improving transportation safety, mitigating environmental impacts, and promoting economic vitality by positioning PennDOT to take advantage of the opportunities ITS provides.

MAUTC and PennDOT have been working together to develop an ITS strategic plan. The project was divided into the following three phases: (1) assess ITS environment, (2) develop ITS strategic plan, and (3) develop ITS implementation plan.

Project Title: Roadside Vegetation Management
Principal Investigator: Thomas L. Watshke
University: The Pennsylvania State University
Sponsors: PennDOT, U.S. DOT, and MAUTC

PennDOT's Bureau of Maintenance and Operations is responsible for maintaining roadside vegetation in a manner that will preserve the functionality of the roadway. To do this most effectively, PennDOT roadside specialists must be aware of developments in low-maintenance ground cover establishment and maintenance, and in the materials and methods of managing undesirable vegetation.

The researchers of this project, through Penn State's College of Agricultural Sciences, are evaluating available vegetation management techniques and systems, and providing an outreach function to assist in the implementation of improved methods. This will all be accomplished through activities in four different tasks, over a 4-year period. Although the task structure will be retained from year to year, specific activities within each task may change.

Project Title:	Pennsylvania Statewide Long Range Transportation Plan
Principal Investigator:	Konstadinos G. Goulias
University:	The Pennsylvania State University
Sponsors:	PennDOT, U.S. DOT, and MAUTC

In this new Statewide Long Range Transportation Plan (PennPlan), the Pennsylvania Department of Transportation with the help of the Pennsylvania Transportation Institute (PTI) at the Pennsylvania State University is creating a new approach to long range planning in the Commonwealth. The approach contains an aggressive two-stage public involvement program and an extensive consensus building effort that are unprecedented. The new approach provides for an update to the previously defined Statewide Transportation Long Range Policy Plan of 1995 while at the same time designs an ongoing system for public involvement and statewide decision making to assist in project selection in our Commonwealth.

PennPlan, unlike other statewide plans, is using a unique approach to integrate the needs of people and firms in the State within a complex system of corridors and facilities. From a transportation supply viewpoint, the building blocks of a transportation system are its facilities and the connections (or links) among these facilities, which may be unimodal or multimodal. Examples of these links are air line routes, rail routes, or highway routes. Examples, of facilities are marine ports, airports, and major distribution centers. Unlike other systems (e.g., telecommunications) in which the links perform simple functions, the links of a transportation system play significant roles in enhancing the residents' and visitors' quality of life and fostering economic development. For example, the existence and level of service offered by a transportation link determine the land use patterns and environment of settlements at the two ends of a link but also along each link. For this reason PennPlan considers corridors instead of modal-specific links among facilities. Corridors are identified by a specific predominant theme (e.g., Route 219 the NAFTA corridor), they are described in terms of the area effected, existing conditions, connectivity with other routes, objectives, and specific projects.

In the same way that living organisms are made of many cells with specialized functions, PennPlan is envisioned as a living organism, the plan itself, that is constituted by the different functions of its specialized cells, which are the groups of people identified in the public involvement process. Each group is identified first and data collection surveys are defined for and associated data collected from each group taking advantage of the specialization in expertise and experience of the Commonwealth's residents and visitors. This information is in turn used within PennPlan to identify goals, objectives, and priorities for the State as a whole and for each individual corridor and facility in the Commonwealth. PennPlan was unveiled in January 2000 and its public involvement continues with Phase 3 until July 2001. In addition, more in depth research on theoretical issues about attitudes and long range planning as a knowledge management activity for public agencies will continue to August 2002.

Project Title: Probing Motorists' Perceptions of Highway Quality
Principal Investigator: James H. Miller
University: The Pennsylvania State University
Sponsors: PennDOT and MAUTC

As part of its ongoing drive toward improved service quality and customer satisfaction, PennDOT has undertaken large scale mailed surveys of licensed drivers over the past three years in order to gauge their rating of interstates, numbered traffic routes, and secondary roads on the state highway system. Approximately 6,700 completed surveys have been returned, providing data for each PennDOT county maintenance unit with some level of statistical reliability. Therefore, this effort both predates and surpasses the survey conducted as part of the National Quality Initiative or those undertaken subsequently by other states. Thus, this annual survey can serve as a valuable tool for monitoring customer feedback over time and can help assess the overall effectiveness of PennDOT's highway maintenance program.

However, exactly what these data represent is not clear at this point. Initial research shows only modest correlations between the motorists' ratings of the quality of the roads and more objective measures such as the International Roughness Index (IRI) or the maintenance backlog per mile across the 67 counties. Indeed, in some cases the direction of the statistical relationship is counterintuitive, e.g., the motorists' ratings of interstate highway quality tend to be somewhat higher in those counties where IRI measures are also higher. While customer satisfaction ratings should be complementary to the more traditional measures, adding a new dimension rather than correlating perfectly with IRI and maintenance backlogs, PennDOT needs to have a clearer understanding of the basis on which motorists evaluate highway quality for such survey feedback to be truly useful for county maintenance managers and higher level program managers.

Project Title: Increasing the Pool of Highway Construction Subcontractors and Construction Personnel

Principal Investigator: James H. Miller
University: The Pennsylvania State University
Sponsors: PennDOT and MAUTC

A Highway/Bridge Construction Subcontractors' Manual and a Highway Construction Vocational and Technical (Vo-Tech) Manual that presents heavy highway construction as a career choice for high school students will be produced. The manual will incorporate instruction on the DBE certification process input from successful DBE subcontractors.

The project includes researching the best practices used in producing similar manuals and educational materials, and researching PennDOT's current needs that might be met by subcontractors and future needs that might be met by today's high school students. Primary research will incorporate interviews with contractors, PennDOT central office and district personnel, and educators. Existing manuals, procedural guidelines, and lesson plans will be reviewed, updated, and incorporated into a new subcontractors manual and new vo-tech modules for students in the construction trades. The manual will include PennDOT procedures, business basics, and advice from "people in the know." The transportation construction modules will include input from similar sources along with input from experienced educators in high school vocational.

Project Title: Pennsylvania's Quality Initiative: Synthesis of Customer Satisfaction and Information Requirements
Principal Investigator: James H. Miller
University: The Pennsylvania State University
Sponsors: PennDOT, U.S. DOT, and MAUTC

Customer satisfaction is at the heart of the Pennsylvania Quality Initiative (PQI), which was formed to create a close partnership among all the stakeholders in the process of building, maintaining, and operating Pennsylvania's highway system. In order to assure that government and the highway industry can respond to customers' needs, creative and effective ways of gauging these needs and expectations are required. Thus, PQI and PennDOT are committed to using market research to gauge customer needs and expectations.

Over the past few years, various organizations have conducted surveys of highway users in Pennsylvania, focusing on different issues and employing a variety of samples and survey approaches. The PQI Customer Service Subcommittee needs to be familiar with the a synthesized "voice of the customer" as it can be distilled from these existing surveys. To provide a customer focus for other PQI initiatives, it will also be critical to identify additional information requirements regarding customer satisfaction and to develop an agenda for further market research in the area of customer satisfaction.

This project consisted of three tasks: (1) a review of existing highway customer satisfaction surveys in Pennsylvania, (2) interviews with key stakeholders in the PQI process, and (3) a report that synthesized the results of the surveys and interviews and presented an agenda for further market research to address additional information needs regarding customer satisfaction with Pennsylvania highways.

Numerous customer surveys conducted over the past several years was reviewed and synthesized into a "voice of the highway customer" in Pennsylvania. These surveys included, but not limited to, the following: Pennsylvania Highway Information Association (PHIA) Survey, 1994; National Cooperative Highway Research Program (NCHRP) Focus Groups, 1995; Overdrive Magazine Survey, 1995; American Automobile Association (AAA) Survey, 1995; Penn State University QUIK Surveys, 1995 and 1997; Pennsylvania Turnpike Survey, 1995; and PennDOT County Maintenance Customer Service Surveys, 1994-1997.

Semi-structured interviews were conducted with key stakeholders in the PQI process to learn more about their concerns and interests with respect to customer perspectives and expectations regarding highway services. In addition to several PennDOT senior officials, those interviewed included, but not necessarily limited to, representatives of the following organizations: Federal Highway Administration; Tony DePaul and Son; Consulting Engineers Council of Pennsylvania; Pennsylvania Asphalt Pavement Association; Pennsylvania Aggregate and Concrete Association; American Concrete Pavement Association; Pennsylvania Turnpike Commission; and American Public Works Association, Pennsylvania Chapter. In addition, interviews with representatives of user groups such as the American Automobile Association, truckers' associations and shippers' associations were conducted if deemed advisable.

Based on the results of tasks 1 and 2, a report was prepared that synthesizes the "voice of the customer" to date and provides an agenda for further market research into customer satisfaction. The report includes a synthesis of the highway user surveys conducted to date, a compilation of the results of the individual interviews conducted in task 2, identification of remaining information needs regarding customer satisfaction with Pennsylvania highways, and an agenda for further market research to address customer satisfaction.

Project Title: Construction and Materials Training and Education Plan
Principal Investigator: John A. Anderson
University: The Pennsylvania State University
Sponsors: PennDOT and MAUTC

The Construction Training Steering Committee comprised of representatives from the Pennsylvania Department of Transportation (PennDOT), The Pennsylvania Turnpike Commission, Associated Pennsylvania Constructors (APC), Consulting Engineers Council (CEC), and the Federal Highway Administration (FHWA), has identified a need to substantially update the technical knowledge base in the highway materials and construction community. A

developmental training plan addressing necessary technical knowledge and skills for Pennsylvania's agencies, commissions, constructors, and engineering consultants will be established to define future education and training activities for all training partners. The training activities will position the Pennsylvania construction and materials community at the forefront of the nation over the next five years.

Project Title: Evaluation of Backcalculation Algorithms Through Dynamic Modeling of Falling Weight Deflectometer (FWD) Test
Principal Investigator: Samir Nabih Shoukry
University: West Virginia University
Sponsors: West Virginia Division of Highways, U.S. DOT, and MAUTC

The availability of information on pavement moduli profile is essential for mechanistic design and rehabilitation decisions of new and distressed pavements. The Falling Weight Deflectometer (FWD) test is in use by many states for monitoring variability of pavement materials, seasonal changes in material properties and providing data for overlay thickness design. Experience has shown that different backcalculation programs produce different results when applied to the same pavement.

In this project, dynamic finite element models of flexible, rigid and composite pavements were developed to produce deflection basins that closely match those measured during FWD tests. The pavement moduli profiles predicted by several major backcalculation programs for the same pavement structure will be compared with the moduli profile used in the finite element model. The backcalculation algorithm which produces a moduli profile closest to the one used in the model will be identified. The effect of thermal warping of concrete slabs and layers interface bond on the backcalculated moduli were studied.

Project Title: Identification of Critical Stress Concentration Around Dowel Bars
Principal Investigator: Samir N. Shoukry
University: West Virginia University
Sponsors: West Virginia Department of Transportation and MAUTC

During the past four years, West Virginia University (WVU) researchers have taken steps toward developing a mechanistic approach for studying different types of pavements. Explicit nonlinear three dimensional finite element modeling (3D-FEM) was used to simulate the dynamic response of different types of pavement structures to impact loads. The 3D-FEM results showed excellent correlation with the experimental results. Models were developed to investigate the response of rigid, flexible, and composite pavement response to a Falling Weight Deflectometer (FWD) load. The response of a thermally warped slab to FWD load was also modeled. Preliminary results obtained for the Y-stress distribution around the dowel bars indicate that techniques could be

developed to prevent the concentration of stresses at the interfaces between the dowels and the supporting concrete. The improvement can be achieved through improving the load transfer between the dowels and the surrounding concrete. Thus, without significant increase in the construction cost, pavement joints could be designed to last longer, maintenance cost could be reduced, and the ride quality maintained for a longer time period. In this project, nonlinear 3D-FEM were designed to identify the distribution of critical stresses surrounding doweled transverse joints subjected to thermal and moving traffic loads. Alternative dowel and/or transverse joint design was developed to eliminate the points of high stress concentration, which lead to joint failure thus improve load transfer efficiency and reduce maintenance cost. Work on this project is near completion. Final report is being prepared.

Project Title:	Fitting Falling Weight Deflectometer with SASW Measurement Capability
Principal Investigator:	Samir N. Shoukry
University:	West Virginia University
Sponsors:	West Virginia Department of Transportation, U.S. DOT, and MAUTC

The FWD test results are influenced by loading, climate, and pavement condition. Alternatively, acoustic testing techniques that are based on the mechanism of stress wave propagation in structural materials have been applied for the evaluation of material properties. The Spectral Analysis of Surface Waves (SASW) is typically used for the nondestructive moduli profiling of pavements and soil sites. In this study an automated computer program for pavement moduli evaluation using the SASW was developed. The practicality and limitation of the approach was investigated. Plans for fitting this type of measurement to FWD will be prepared.

Final report is under review by WVDOT. The major finding of the project is that SASW did not perform as expected and was found to be affected by traffic noise.

Project Title:	SUPERPAVE ™ HMA Mixes
Principal Investigator:	Imad Al-Qadi
University:	Virginia Polytechnic Institute & State University
Sponsors:	Virginia Department of Transportation and MAUTC

Traditionally, the performance of HMA has been studied through the remaining life concept given by Miner's Law. This highly underestimates the life of the pavement, which is reflect in the use of shift factors up to 100. Other performance models use measures that may include roughness, rutting, and percent cracking among others. These measured criteria or indices, functional and structural, are base on distress surveys of in-service pavements. Such models may only be valid for pavements that have some structures and are subjected to similar traffic

and environmental loadings. A performance model that uses a more mechanistic measure, such as the modulus of the HMA, may yield better assessment of the pavement life. The proposed method is based on using a damage evolution model that monitors the change in modulus over the life of the material. Indirect tensile fatigue testing of HMA is required to develop the parameters for the model. By subjecting the HMA to a repetitive stress (similar to that used in the resilient modulus determination), and by monitoring the elastic resilient strain until failure, a laboratory performance model can be established. Data collected form the Smart Road will provide means to relate the laboratory performance to the field performance through mechanistically determined shift factors. This is based on strain energy calculations using strain gauge and pressure cell response due to different loading conditions.

Project Title: Addressing Transportation Issues in the I-81 Corridor
Principal Investigator: Hesham Rakha
University: Virginia Polytechnic Institute & State University
Sponsors: Virginia Department of Transportation and MAUTC

The I-81 Corridor extends 328 miles through the valley of Virginia, located between the Blue Ridge and Allegheny Mountains. The I-81 highway acts as a common economic asset to these areas, and provides a strategically important transportation link to major economic centers and major eastern U.S. markets. This project will contribute to enhancing the movement of people and commerce in and through the corridor to include transportation, economic development, and electronic education.

This research project focuses on developing a calibrated microscopic model of a portion of the I-81 freeway in the state of Virginia. This microscopic model will serve as a tool that: (1) evaluates alternative construction staging strategies, (2) evaluates alternative Intelligent Transportation System (ITS) applications (e.g., changeable message signs, ramp metering), (3) evaluates alternative climbing-lane scenarios, and (4) provides a better understanding of changes in travel routing behavior during congested and construction related closures. The INTEGRATION microscopic simulation and traffic assignment model will serve as the simulation tool because of its unique routing capabilities.

Enhancements to the INTEGRATION model are being developed in order to capture the microscopic equilibrium of tractive and resistance forces (air, road surface friction, and grade) associated with the motion of a vehicle. These enhancements should allow the INTEGRATION model to capture the unique impacts of the mountainous terrain, which are typical of I-81, on the traffic performance.

A one-day workshop on Innovative Freeway Management and Control Strategies for I-81 was organized jointly with VDOT. In preparation for this workshop, an extensive literature review was conducted to identify potential ITS solutions regarding variable speed limits, incident management systems, travel time estimation, variable message signs, etc. As a result of the

workshop a special "I-81 Committee" was created. The Virginia Tech Transportation Institute is part of this committee. In addition, the Transportation Systems and Operations Group visited I-81 weigh stations and retrieved data from the weight stations to establish daily, monthly, and yearly truck characteristics along I-81. They also met with representatives of the VDOT traffic Division, Salem District to set the framework to analyze accident data for I-81 to identify: typical types of accidents, cause of accidents, sections of the highways with higher incidents rates, and possible solutions.

Project Title:	Quantifying the Impact of Average Speed, Speed Variability, Level of Deceleration, and Level of Acceleration on Vehicle Fuel Consumption and Emissions
Principal Investigator:	Hesham Rakha
University:	Virginia Polytechnic Institute & State University
Sponsors:	Virginia Department of Transportation and MAUTC

Hydrocarbon, carbon monoxide, and nitrogen oxides are three primary pollutants associated with motor vehicles. Current state-of-practice in estimating vehicle emissions is only based on the average speed. And it has been found insufficient in emissions estimates.

Highway vehicles consume almost half of the total petroleum in the United States. Improvement in fuel efficiency will not only reduce the extent of the nation's dependency on foreign oil, but also reduce carbon oxide emission, the principal greenhouse gas.

The objective of this research project is three-fold. First, the study demonstrates that the use of average speed alone for estimating vehicle fuel consumption and emissions is inadequate. Specifically, the study quantifies the level of error associated with the use of average speed as a single explanatory variable. Second, the study identifies the most critical variables that impact vehicle fuel consumption and emissions of hydrocarbon (HC), carbon monoxide (CO), and oxides of nitrogen (NOx). Eight variables are considered in this study: the average speed, speed variability, the level of deceleration defined as deceleration noise, the level of acceleration defined as acceleration noise, total noise, and number of stops, kinetic energy and powers. Third, the study developed statistical models that computed the vehicle fuel consumption and emissions based on the explanatory variables that were identified in the second objective. These models were applied and validated against field data, with very good results.

As a result of this project, a Master Thesis, "Quantifying the Impact of Average Speed, Speed Variability, Level of Deceleration, and Level of Acceleration on Vehicle Fuel Consumption and Emissions," was completed

Project Title:	Urban Network Transportation Issues
Principal Investigator:	Hesham Rakha, John Collura

University: Virginia Polytechnic Institute & State University
Sponsors: Virginia Department of Transportation and MAUTC

Delay is one of the key parameters that are utilized in the optimization of traffic signal timings. Furthermore, delay is a key parameter in computing the level of service provided to motorists at signalized intersections. Delay, however, is a parameter that is difficult to estimate because it includes the delay associated with decelerating to a stop, the stopped delay, and the delay associated with accelerating from a stop. While many methods are currently used to estimate the delay incurred by motorists on intersection approaches, very little research has been conducted to assess the consistency of delay estimates among the various analytical and simulation approaches. In an attempt to systematically evaluate and demonstrate the assumptions and limitations of different delay estimation approaches, this project compares the delay estimates from numerous models for an undersaturated signalized intersection considering uniform and random arrivals.

Specifically, this project compares a theoretical vertical queue analysis model, the queue-based models used in the 1994 and 2000 versions of the Highway Capacity Manual, the queue-based model in the 1995 Canadian Capacity Guide for Signalized Intersections, a theoretical horizontal queuing model derived from shock wave analysis, and the delay estimates produced by the INTEGRATION microscopic traffic simulation software. In addition, the model demonstrates the validity of estimating delay based on car-following behavior without the need for an explicit delay formula, and establishes the potential of a validated simulation software to evaluate conditions that are beyond the scope of analytical formulations. In addition, real data will be collected to analyze traffic delay. The collected data include total traffic volumes, bus volume and headways, geometry, signal timing plans and other information.

As a result of this project, a Ph.D. dissertation, "Delay Stop and Queuing Estimation at Fixed-Time Signalized Intersections," was completed.

Project Title: Development of a Macroscopic Model for Evaluating the Impact of Emergency Vehicle Signal Preemption on Traffic
Principal Investigator: Wei Hua Lin and John Collura
University: Virginia Polytechnic Institute & State University
Sponsor: MAUTC

Models developed in the past to study the signal preemption problem for emergency vehicles (EVs) are mostly either microscopic or analytical simulations. This research develops a macroscopic model for examining the effect of signal preemption for EVs on traffic control measures, roadway capacity, and delays incurred to the vehicles on the side streets. The model is based on the cell transmission model, which is consistent with the hydrodynamic theory of traffic flow. A special component that handles EVs was developed in the model. Several test scenarios were constructed to demonstrate the capabilities of the model for studying the impact of signal preemption on an arterial with multiple intersections under various traffic demand levels and varying frequencies of the arrival of EVs. Performance measures, such as average vehicle delay, maximum delay, and variance of delay to traffic in all approaches, were obtained. Traffic dynamics associated with the presence of EVs, a feature currently unavailable in the existing models, was captured by a moving bottleneck.

An advantage of the model is that the space equations used in the model can be easily incorporated into a mathematical programming problem. By coupling with a desired objective function, the model can be solved analytically. Optimal solutions can be generated to obtain insights into the development if traffic control strategies in the presence of EVs.

II.C. MAUTC TECHNOLOGY TRANSFER

Project Title: MAUTC Annual TRB Research Showcase
Principal Investigator: Ann Marie Hutchinson
University: The Pennsylvania State University
Sponsors: PennDOT and MAUTC

In January, MAUTC faculty and more than 100 researchers participate in the annual MAUTC Student Research Showcase in Washington, DC, held in conjunction with the Transportation Research Board Annual Meeting. Participating students meet and review each other's work via research exhibits, which are also reviewed by members of the MAUTC Partners Roundtable and officials from the U.S. Department of Transportation, Pennsylvania Department of Transportation (PennDOT), and other transportation organizations. This year PennDOT co-hosted the event with MAUTC. The event provides a forum for participants to network with researchers from state departments of transportation, federal agencies, universities, consulting firms, and research institutes. More than 400 transportation professionals attend this event annually.

Project Title: 1999 Transportation Engineering and Safety Conference
Principal Investigator: Walter P. Kilareski

University: The Pennsylvania State University
Sponsors: Penn DOT, U.S. DOT, and MAUTC

The 1999 Transportation Engineering and Safety Conference, held at The Penn Stater Conference Center at Penn State, attracted transportation professionals from across Pennsylvania, the Mid-Atlantic states, and the country. The conference featured speakers and workshops that fostered discussion and encouraged questions.

The responsibility of transportation professionals for improved safety, efficiency, and capacity is expanding as more demands are placed on existing transportation systems. Constantly changing legislative requirements also have increased the responsibility of the transportation professional beyond design and operation, into areas of air quality, systems management, and intelligent transportation systems. Hence, there is a need for programs to increase the knowledge within the profession so that these new responsibilities can be adequately met. It was the intent of this conference to fulfill this need in a dynamic and enlightening setting.

David N. Wormley, Dean of the College of Engineering at Penn State, welcomed more than 400 attendees and emphasized the importance of the conference to the transportation community and of transportation research to the new millennium. PennDOT Deputy Secretary for Planning Larry M. King addressed current issues faced by transportation professionals and provided perspective on upcoming transportation legislation.

Project Title: International Symposium on the Use of Nonlinear Finite Element Modeling in Pavement Analysis and Design
Principal Investigator: Samir Nabih Shoukry
University: West Virginia University
Sponsors: West Virginia Division of Highways and MAUTC

Symposium was held on time and was a great success. It was attended by 110 participants from for countries including the US. The participants requested that this symposium is held annually Internationally. The Second International Symposium on 3D FE for Pavement Analysis Design and Research will be held in Charleston West Virginia on October 11-13, 2000. Its sponsored by FHWA, FAA, WVDOT, AASHTO, TRB, TRL(Transportation Research Laboratory, UK), University of Delf in the Netherlands, West Virginia University and Mid Atlantic Universities Transportation Center.

Project Title: Professional Capacity Building in Transportation
Principal Investigator: Hesham Rakha
University: Virginia Polytechnic Institute & State University
Sponsors: Virginia Department of Transportation and MAUTC

On one hand, researchers are generally criticized for not applying their research to real-life problems. On the other hand, practitioners are generally criticized for not applying the latest research developments in solving their problems. The objective of this project is to bridge the gap between research and practice in the area of traffic operations by providing short courses and workshops to VDOT employees and traffic engineers in general.

Traffic engineers at the Virginia Tech Transportation Institute have developed six related short courses in the areas of traffic flow and simulation fundamental, traffic signal operations, and freeway management; and three short courses in transportation planning in the areas of site impact analysis, demand models, and environment. Each course consists of a series of lectures and complementary computer demos. Three three-day short courses were offered in the fall of 1999.

Mid-Atlantic Universities Transportation Center

PROJECT STATUS

As of June 30, 2000

Project Number	Project Name	Person Responsible	Milestones Accomplished	Project on Schedule	Project Within Budget	Project Status
NEW PROJECTS						
UVA-E02-99	Develop Transportation Courses in Information Technology for Graduate and Undergraduates	Brian L. Smith	Yes	Yes	Yes	New
UP-E01-99	Transportation and Logistics Systems Laboratory and Course Development	Edward K. Morlok	Yes	Yes	Yes	New
MAUTC-E04-99	Design MAUTC Regional Transportation Courses that will be Jointly Developed and Shared by each University	James H. Miller Thomas Dingus Michael Demetsky Edward Morlok David Martinelli	Yes	Yes	Yes	New
UVA-R01-99	ITS Alternatives Analysis: Evaluating Parking Management Improvements	Lester A. Hoel	Yes	Yes	Yes	New
UVA-R02-99	Prediction of Traveler Response to En-Route Information	Michael J. Demetsky	Yes	Yes	Yes	New
UVA-R03-99	Ozone Formation Attribution to Emissions Rural Interstate Traffic	Michael J. Demetsky	Yes	Yes	Yes	New

Mid-Atlantic Universities Transportation Center

PROJECT STATUS

As of June 30, 2000

Project Number	Project Name	Person Responsible	Milestones Accomplished	Project on Schedule	Project Within Budget	Project Status
UVA-R04-99	An Investigation of Web-Based Technologies for the Peninsula Transportation District Commission	Brian L. Smith	Yes	Yes	Yes	New
UVA-R05-99	Reliability-based Monitoring of Bridge Structures for Bridge Management Systems	C.E.Orozco	Yes	Yes	Yes	New
UVA-R06-99	GIS-based Decision Support System for Commercial Vehicle Routing and Scheduling	Lester A. Hoel	Yes	Yes	Yes	New
UPENN-R01-99	Logistics Networks	Edward K. Morlok	Yes	Yes	Yes	New
WVU-R01-99	Evaluation of Backcalculation Algorithms Through Dynamic Modeling of Falling Weight Deflectometer Test	Samir N. Shoukry	Yes	Yes	Yes	New
WVU-R02-99	Identification of Critical Stress Concentration Around Dowel Bars	Samir N. Shoukry	Yes	Yes	Yes	New
WVU-R03-99	Fitting Falling Weight Deflectometer with SASW Measurement Capability	Samir N. Shoukry	Yes	Yes	Yes	New
VPI-R02-99	Addressing Transportation Issues in the I-81 Corridor	Hesham Rakha Fancois Dion Alejandra Medina	Yes	Yes	Yes	New

Mid-Atlantic Universities Transportation Center

PROJECT STATUS

As of June 30, 2000

Project Number	Project Name	Person Responsible	Milestones Accomplished	Project on Schedule	Project Within Budget	Project Status
VPI-R03-99	Quantifying the Impact of Average Speed, Variability, Level of deceleration, Acceleration on Vehicle Fuel Consumption and Emissions	Hesham Rakha	Yes	Yes	Yes	New
VPI-R04-99	Urban Network Transportation Issues	Hesham Rakha John Collura	Yes	Yes	Yes	New
VPI-R05-99	Development of a Macroscopic Model for Evaluating the Impact of Emergency Vehicle Signal	Wei Lin John Collura	Yes	Yes	Yes	New
PSU-R01-99	Support of the ITS Steering Committee	John M. Mason	Yes	Yes	Yes	New
PSU-R03-99	Climate Survey Development and Organizational Assessment	Robert J. Vance	Yes	Yes	Yes	New
PSU-R05-99	Roadside Vegetation Management	Larry J. Kuhns	Yes	Yes	Yes	New
PSU-R06-99	Statewide Transportation Planning Public Involvement and Implementation (PennPlan)	Konstadinos Goulias	Yes	Yes	Yes	New
PSU-R07-99	Probing Motorists Perceptions of Highway Quality	James H. Miller	Yes	Yes	Yes	New
PSU-R08-99	Increasing the Pool of highway Construction Subcontractors and Construction Personnel	James H. Miller	Yes	Yes	Yes	New

Mid-Atlantic Universities Transportation Center

PROJECT STATUS

As of June 30, 2000

Project Number	Project Name	Person Responsible	Milestones Accomplished	Project on Schedule	Project Within Budget	Project Status
PSU-R09-99	Annual Traffic Engineering and Safety Conference	Walter Kilareski	Yes	Yes	Yes	New
PSU-R10-99	Intelligent Transportation Systems Research and Development Fellowship Program at PSU	Konstadinos Goulias	Yes	Yes	Yes	New
PSU-R11-99	Pennsylvania's Quality Initiative Synthesis of Customer Satisfaction and Information Requirements	James H. Miller	Yes	Yes	Yes	New
PSU-R12-99	Construction and Materials Training and Education Plan	John Anderson	Yes	Yes	Yes	New
Ongoing Projects						
WVU-E01-99	Design and Offer the TRAC Program for High Schools throughout WVU	David Martinelli	Yes	Yes	Yes	Ongoing
PSU-E02-99	MAUTC Annual TRB Research Showcase	A.M. Hutchinson	Yes	Yes	Yes	Ongoing
MAUTC-E03-99	Transit Internship Program at PSU, UPENN & UVA	James H. Miller Edward K. Morlok Lester Hoel	Yes	Yes	Yes	Ongoing

Mid-Atlantic Universities Transportation Center

PROJECT STATUS

As of June 30, 2000

Project Number	Project Name	Person Responsible	Milestones Accomplished	Project on Schedule	Project Within Budget	Project Status
UP-E04-99	National Summer Internship Program in the Railroad and Transit Industries	Edward K. Morlok	Yes	Yes	Yes	Ongoing
PSU-E03-99	Operate the Pennsylvania TRAC Center at Penn State as part of the PennDOT/MAUTC Partnership	James H. Miller A.M. Hutchinson	Yes	Yes	Yes	Ongoing
MAUTC-E05-99	VDOT Fellowship Program at UVA and Virginia Tech	Thomas Dingus Michael J. Demetsky	Yes	Yes	Yes	Ongoing
PSU-E04-99	Traffic Engineering Education Plan	John Anderson	Yes	Yes	Yes	Ongoing
WVU-T01-99	International Symposium on the Use of Nonlinear Finite Element Modeling in Pavement Analysis and Design	Samir N. Shoukry David Martinelli	Yes	Yes	Yes	Ongoing
VPI-R01-99	Professional Capacity Building in Transportation	Hesham Rakha John Collura Alejandra Medina	Yes	Yes	Yes	Ongoing
PSU-R02-99	Center for ITS Research	Konstadinos Goulias	Yes	Yes	Yes	Ongoing
PSU-R04-99	PennDOT's ITS Strategic Plan	John M. Mason	Yes	Yes	Yes	Ongoing

MAUTC Research Projects
1987 - 2000

1996 Traffic Engineering and Safety Conference, John M. Mason, Beverly Thompson, The Pennsylvania State University, (814) 865-4542. Sponsors: PennDOT and MAUTC. 5/20/1996-3/22/1998.

1997 Traffic Engineering and Safety Conference, Walter P. Kilareski, The Pennsylvania State University, (814) 863-1907. Sponsors: PennDOT, U.S. DOT, and MAUTC. 12/8/1997-4/8/1998.

1998 Traffic Engineering and Safety Conference, John M. Mason, The Pennsylvania State University, (814) 865-4542. Sponsors: PennDOT, U.S. DOT, and MAUTC. 4/8/1998-12/8/1999.

1999 Transportation Engineering and Safety Conference, Walter P. Kilareski, The Pennsylvania State University, (814) 863-1907. Sponsors: Penn DOT, U.S. DOT, and MAUTC.

Access Management/Impact Simulation (AMIS) (Phases I, II, III), Konstadinos G. Goulias, The Pennsylvania State University, (814) 863-7926. Sponsors: PennDOT, U.S. DOT, and MAUTC. 3/2/1994-3/22/1998.

Accident Characteristics and Risk Assessment for Elderly Drivers, Nicholas Garber, University of Virginia, (804) 924-6366. Sponsors: VDOT and MAUTC. 7/1/1988-10/31/1990.

Addressing Transportation Issues in the I-81 Corridor, Hesham Rakha, Francois Dion, Alejandra Medina, Virginia Polytechnic Institute & State University, (540) 231-1505. Sponsors: U.S. DOT and MAUTC. 7/1/1994-6/30/2000.

Advanced Planning Surveys Using Automatic License Plate Reading, David Martinelli, Jim French, West Virginia University, (304) 293-3031. Sponsors: West Virginia Division of Highways, U.S. DOT, and MAUTC. 7/1/1995-6/30/1996.

Advanced Technologies in Transportation Operations and Infrastructure Management Graduate Studies Program, Michael J. Demetsky, University of Virginia, (804) 924-6362. Sponsors: Virginia Highway and Transportation Research Council and MAUTC. 7/15/1992-6/30/1993.

Advanced Technology in Intermodal Surface Transportation, Edward K. Morlok, University of Pennsylvania, (215) 898-8346. Sponsors: Conrail, UPS Foundation, NSF, and MAUTC. 9/1/1992-8/31/1994.

Advanced Transit Systems and Changing Needs for Metropolitan Area-Wide Transportation, Vukan Vuchic, Anthony R. Tomazinis, University of Pennsylvania, (215) 898-8346. Sponsors: Southeastern PA Transportation Authority, UPS Foundation, and MAUTC. 7/1/1988-6/30/1992.

Advances in Surface Freight-Transportation Technology, Edward K. Morlok, W. B. Allen, P. T. Harker, University of Pennsylvania, (215) 898-8346. Sponsors: Burlington Northern, Conrail, UPS, and MAUTC. 7/1/1988-1/31/1992.

Analysis and Improvements of Transit Network Operations, Vukan Vuchic, Shinya Kikuchi, University of Pennsylvania, (215) 898-8346. Sponsors: U.S. DOT, Southeastern PA Transportation Authority, and MAUTC. 6/1/1990-6/30/1992.

Analysis of the First Two Waves of the Puget Sound Transportation Panel, Konstadinos G. Goulias, The Pennsylvania State University, (814) 863-7926. Sponsors: Puget Sound Transportation and MAUTC. 7/1/1992-12/31/1993.

Analysis of the Impacts of Urban Transportation Policies on Energy Consumption and Urban Environment, Vukan Vuchic, University of Pennsylvania, (215) 898-8346. Sponsors: SEPTA, UPS Foundation, Energy Foundation, and MAUTC. 7/1/1994-6/30/1997.

Analysis of Virginia Rail Express Fair System Operational Approaches, Brian L. Smith, University of Virginia, (804) 924-6362. Sponsors: Virginia Railway Express and MAUTC. 7/1/1997-6/30/1998.

Application of 1993 Commodity Flow Survey to Freight Origin/Destination Matrix Estimation at the Regional Corridor Study Level, Lester A. Hoel, University of Virginia, (804) 924-6369. Sponsors: Virginia Transportation Research Council, U.S. DOT, and MAUTC. 7/1/1996-6/1/1998.

Application of Advanced Technology for Bus Transit Security Systems, Lester A. Hoel, J. S. Miller, University of Virginia, (804) 924-6369. Sponsors: VDOT and MAUTC. 7/1/1988-6/30/1992.

Application of Cable-Propelled People-Mover Technology in Urban Environments, Edward S. Neumann, West Virginia University, (304) 293-4550. Sponsors: OITAF-NACS, Otis Elevator Co., United Technologies Soule Corp., and MAUTC. 8/1/1989-12/31/1990.

Application of Seasonal Time Series Techniques to Single and Multiple Interval Traffic Flow Prediction, Lester A. Hoel, University of Virginia, (804) 924-6369. Sponsors: VDOT and MAUTC. 7/1/1997-6/30/1998.

Application of Urban Airshed Model to Estimate Sensitivity of Ozone Levels to Change in Emissions, Michael J. Demetsky, University of Virginia, (804) 924-6362. Sponsors: VDOT, U.S. DOT, and MAUTC. 1/1/1995-5/31/1996.

Assessment of Data Collection Methodologies and Equipment for ISTEA Congestion Management System Requirements, Martin T. Pietrucha, The Pennsylvania State University, (814) 863-3954. Sponsors: PennDOT, U.S. DOT, and MAUTC. 2/24/1994-4/13/1995.

Assessment of Dynamic Load Factor Accounting for Super-, Sub-, and Soil-Structures Interaction, C. C. Spyrakos, West Virginia University, (304) 293-4550. Sponsors: WVDOT and MAUTC. 7/1/1988-6/30/1992.

Automatic Traffic Data Collection System Modernization, Konstadinos G. Goulias, The Pennsylvania State University, (814) 863-7926. Sponsors: PennDOT, U.S. DOT, and MAUTC. 9/19/1994-9/18/1995.

Aviation Project Quality Documentation Manual and Training, Gary Smith, The Pennsylvania State University, (814) 863-2934. Sponsors: PennDOT and MAUTC. 7/17/1996-2/16/1998.

Bus Transit Schedule Behavior Models Using Automatic Vehicle Location (AVL) Information and Advanced Technologies, Michael J. Demetsky, University of Virginia, (804) 924-6362. Sponsors: Virginia Transportation Research Council, U.S. DOT, and MAUTC. 7/1/1995-6/30/1998.

Cardozo High School Transtech Academy Support Project, Martin T. Pietrucha, The Pennsylvania State University, (814) 863-3954. Sponsor: MAUTC. 7/1/1995-6/30/1996.

Center for Intelligent Transportation Systems Research, John M Mason, The Pennsylvania State University, (814) 865-4542. Sponsors: U.S. DOT and MAUTC. 1/1/1994-6/30/1998.

Climate Survey Development and Organizational Assessment (1994-95), Robert J. Vance, The Pennsylvania State University, (814) 863-6084. Sponsors: PennDOT and MAUTC. 8/15/1994-8/16/1995.

Climate Survey Development and Organizational Assessment (1995-96), Robert J. Vance, The Pennsylvania State University, (814) 863-6084. Sponsors: PennDOT, U.S. DOT, and MAUTC. 1/30/1996-7/29/1996.

Climate Survey Development and Organizational Assessment (1996-97), Robert J. Vance, The Pennsylvania State University, (814) 863-6084. Sponsors: PennDOT, U.S. DOT, and MAUTC. 7/1/1996-6/30/1997.

Climate Survey Development and Organizational Assessment (1997-1998), Robert J. Vance, The Pennsylvania State University, (814) 863-6084. Sponsors: PennDOT, U.S. DOT, and MAUTC. 7/1/1997-6/30/1998.

Compressibility Factors, Brian Gilmore, The Pennsylvania State University, (804) 924-6366. Sponsors: PTI Bus Testing Center and MAUTC. 7/1/1992-12/31/1993.

Computer Simulation of Traffic Flow Conditions Along Arterial Roads, Nicholas Garber, University of Virginia, (804) 924-6366. Sponsors: Virginia Transportation Research Council and MAUTC. 7/1/1997-6/30/1998.

Conference on Intelligent Vehicles/Highways Systems, Antoine G. Hobeika, Virginia Polytechnic Institute & State University, (703) 231-7740. Sponsors: VDOT and MAUTC. 8/1/1989-7/31/1990.

Construction and Materials Training and Education Plan, John A. Anderson, The Pennsylvania State University, (717) 772-1972. Sponsors: PennDOT and MAUTC. 4/12/1999-4/11/2000.

Crash Testing -- Weak Post System, Walter P. Kilareski, The Pennsylvania State University, (814) 863-1907. Sponsors: PennDOT, U.S. DOT, and MAUTC. 3/16/1998-6/15/1998.

Creation and Pilot Testing of a Multi-Media Training Package for Environmentally Sensitive Maintenance of Unpaved Roads, Shelley M. Stoffels, The Pennsylvania State University, (814) 865-3183. Sponsors: PennDOT, U.S. DOT, and MAUTC. 2/2/1995-8/15/1996.

Data Issues in Utilizing GIS in Transportation Planning, Darell Dean, West Virginia University, (304) 293-3031. Sponsors: West Virginia Division of Highways, U.S. DOT, and MAUTC. 7/1/1995-6/30/1998.

Decision Support for Geographic Information Systems in Transportation, Michael J. Demetsky, University of Virginia, (804) 924-6362. Sponsors: VDOT and MAUTC. 7/1/1988-6/30/1992.

A Decision Tool for the Evaluation of ITS Strategies in Small Urban Area Transit Systems, Michael J. Demetsky, University of Virginia, (804) 924-6362. Sponsors: Virginia Transportation Research Council, U.S. DOT, and MAUTC. 7/1/1997-6/30/1998.

Department-Wide Traffic Engineering Needs Assessment, Martin T. Pietrucha, The Pennsylvania State University, (814) 863-3954. Sponsors: PennDOT and MAUTC. 4/1/1993-9/30/1993.

Design and Construction of Retaining Walls Using Recycled Concrete Slabs, Shelley M. Stoffels, The Pennsylvania State University, (814) 865-3183. Sponsors: PennDOT, U.S. DOT, and MAUTC. 3/9/1994-12/11/1995.

Design and Offer the TRAC Program for High Schools throughout West Virginia, David Martinelli, West Virginia University, (304) 293-3031. Sponsors: WVDOT and MAUTC. 7/1/1996-9/30/1999.

Design Community Training and Education Plan, Lily Elefteriadou, The Pennsylvania State University, (814) 863-7923. Sponsors: PennDOT, U.S. DOT, and MAUTC. 7/9/1998-7/8/1999.

Design MAUTC Regional Transportation Courses that will be Jointly Developed and Shared by Each University, James H Miller, Konstadinos G. Goulias, Thomas W Dingus, Michael J. Demetsky, Edward K. Morlok, David Martinelli, The Pennsylvania State University, (814) 863-1909. Sponsors: U.S. DOT and MAUTC.

Develop GIS Education in Transportation Within the University-Wide GIS Program at the University of Virginia, Michael J. Demetsky, University of Virginia, (804) 924-6362. Sponsor: MAUTC. 7/1/1996-6/30/1998.

Develop Transportation Courses in Information Technology for Graduates and Undergraduates, Brian Smith, University of Virginia, (804) 924-6363. Sponsors: Virginia Highway and Transportation Research Council and MAUTC. 7/1/1999-6/30/2000.

Developing Pennsylvania ITS/CVO Business Plan, Konstadinos G. Goulias, The Pennsylvania State University, (814) 863-7926. Sponsors: PennDOT, U.S. DOT, and MAUTC. 10/9/1997-12/31/1998.

The Development of a Bridge-Performance Prediction Model as a Rational Basis for a Structural Maintenance Management System and Operations and Regional Economic Development, William T. Scherer, University of Virginia, (804) 982-2069. Sponsors: VDOT and MAUTC. 7/1/1988-6/30/1990.

Development of a Macroscopic Model for Evaluating the Impact of Emergency Vehicle Signal Preemption on Traffic, Wei Hua Lin, John Collura, Virginia Polytechnic Institute & State University, (540) 231-5476. Sponsor: MAUTC. 7/1/1999-6/30/2000.

Development of a Risk Management Approach to District Information Management, Gary L. Gittings, The Pennsylvania State University, (814) 863-1896. Sponsors: PennDOT and MAUTC. 4/6/1994-4/7/1995.

Development of a Routing and Scheduling Algorithm for a Prototype Route Deviation Decision Support System, Michael J. Demetsky, University of Virginia, (804) 924-6362. Sponsor: MAUTC. 7/1/1996-6/30/1997.

Development of an Artificial Intelligence Tool (CYBERQUEST) and Application to Southeastern Virginia HOV Problems, John W. Dickey, Virginia Polytechnic Institute & State University, (701) 231-7307. Sponsors: VDOT and MAUTC. 7/1/1988-8/31/1990.

Development of an Evaluation Methodology for Advanced Public Transportation Systems (APTS) with Respect to Small Urban Areas, Michael J. Demetsky, University of Virginia, (804) 924-6362. Sponsor: MAUTC. 7/1/1996-6/30/1997.

Development of Intermodal Commodities Transportation Facilities and Services in Rural Areas and Small-to-Medium Cities: Opportunities, Issues, and Methods, Edward S. Neumann, Christine L. Barry, West Virginia University, (304) 293-4550. Sponsors: West VDOT and MAUTC. 7/1/1988-6/30/1990.

Development of Low Cost Sound Barriers and Land Use Ordinances, David Martinelli, West Virginia University, (304) 293-3031. Sponsors: PennDOT and MAUTC. 6/19/1998-12/18/1998.

Development of Low-Cost Sound Barriers and Land Use Ordinances to Minimize Future Road Noise Impacts, David Martinelli, West Virginia University, (304) 293-3031. Sponsors: PennDOT, U.S. DOT, and MAUTC. 4/11/1996-12/31/1997.

Development of Training Programs for Focused Inspections, James H. Miller, The Pennsylvania State University, (814) 863-1909. Sponsors: PennDOT, U.S. DOT, and MAUTC. 8/1/1995-2/28/1997.

Driver Examination Knowledge Tests, Robert J. Vance, The Pennsylvania State University, (814) 863-6084. Sponsors: PennDOT and MAUTC. 3/14/1994-9/15/1994.

Driver Test Center Location Methodology, John J. Coyle, The Pennsylvania State University, (814) 865-1866. Sponsors: PennDOT and MAUTC. 4/6/1994-10/7/1994.

Dynamic Wheel Loads and Weigh-In-Motion System via Resistance Varying Polymers, Donald A. Streit, The Pennsylvania State University, (814) 865-1286. Sponsors: Advanced Transportation Systems (ATS) and MAUTC. 7/1/1992-6/30/1996.

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ANNUAL FINANCIAL STATUS REPORT
UNIVERSITY TRANSPORTATION CENTERS PROGRAM
OVERALL MAUTC BUDGET

Budget Period: July 1, 1999 THROUGH June 30, 2000

CATEGORY	AMOUNT	EXPENDITURES TO DATE
Center Director Salary	$51,004.00	$28,396.08
Faculty Salaries	$334,092.20	$275,927.03
Administrative Staff Salaries	$56,880.00	$38,350.90
Other Staff Salaries	$97,459.00	$478,888.87
Graduate Student Salaries	$351,723.00	$329,809.30
Undergraduate Student Salaries	$82,350.00	$120,701.16
Staff Benefits	$160,004.30	$159,626.68
Total Salaries and Benefits	$1,133,512.50	$1,431,700.02
Scholarships	$35,466.00	$42,130.02
Permanent Equipment	$47,000.00	$100,728.74
Expendable Property and Supplies	$43,064.00	$126,960.84
Domestic Travel	$33,200.00	$81,711.35
Foreign Travel	$2,500.00	$0.00
Other Direct Costs (Specify)	$108,740.00	$289,273.45
Total Direct Costs	$1,403,482.50	$2,072,504.42
Indirect Costs	$487,229.10	$329,514.26
TOTAL COSTS	$1,890,711.60	$2,402,018.68
Federal Share	$890,000.00	$890,000.00
Matching Share	$1,000,711.60	$1,512,018.68

ANNUAL FINANCIAL STATUS REPORT
UNIVERSITY TRANSPORTATION CENTERS PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY

Budget Period: July 1, 1999 THROUGH June 30, 2000

CATEGORY	AMOUNT	EXPENDITURES TO DATE
Center Director Salary	$51,004.00	$28,396.08
Faculty Salaries	$139,815.00	$99,054.99
Administrative Staff Salaries	$33,876.00	$32,729.65
Other Staff Salaries	$53,784.00	$450,793
Graduate Student Salaries	$139,176.00	$130,379.50
Undergraduate Student Salaries	$50,000.00	$117,201.41
Staff Benefits	$91,194.00	$106,973.73
Total Salaries and Benefits	$558,849.00	$965,528.19
Scholarships		
Permanent Equipment	$12,000.00	$46,133.65
Expendable Property and Supplies	$16,000.00	$112,291.13
Domestic Travel	$12,800.00	$51,003.54
Foreign Travel		
Other Direct Costs (Specify)	$64,968.00	$283,884.13
Total Direct Costs	$664,617.00	$1,458,840.64
Indirect Costs	$236,823.00	$204,297.14
TOTAL COSTS	$901,440.00	$1,663,137.78
Federal Share	$445,000.00	$445,000.00
Matching Share	$456,440.00	$1,218,137.78

ANNUAL FINANCIAL STATUS REPORT
UNIVERSITY TRANSPORTATION CENTER PROGRAM
UNIVERSITY OF PENNSYLVANIA

Budget Period: July 1, 1999 THROUGH June 30, 2000

CATEGORY	AMOUNT	EXPENDITURES TO DATE
Center Director Salary		
Faculty Salaries	$33,599.00	$42,426.28
Administrative Staff Salaries		
Other Staff Salaries	$43,675.00	$28,096.04
Graduate Student Salaries	$17,200.00	$7,166.67
Undergraduate Student Salaries	$2,150.00	$1,300.50
Staff Benefits	$22,386.00	$16,183.34
Total Salaries and Benefits	$119,010.00	$95,172.83
Scholarships	$34,466.00	$19,550.77
Permanent Equipment		
Expendable Property and Supplies	$7,000.00	$254.78
Domestic Travel	$1,000.00	
Foreign Travel		
Other Direct Costs (Specify)		
Total Direct Costs	$161,476.00	$114,978.38
Indirect Costs	$74,301.00	$18,558.31
TOTAL COSTS	$235,777.00	$133,536.69
Federal Share	$111,250.00	$58,059.43
Matching Share	$124,527.00	$75,477.26

ANNUAL FINANCIAL STATUS REPORT
UNIVERSITY TRANSPORTATION CENTERS PROGRAM
UNIVERSITY OF VIRGINIA

Budget Period: July 1, 1999 THROUGH June 30, 2000

CATEGORY	AMOUNT	EXPENDITURES TO DATE
Center Director Salary		
Faculty Salaries	$43,605.00	$28,589.38
Administrative Staff Salaries		$691.33
Other Staff Salaries		
Graduate Student Salaries	$62,578.00	$15,140.00
Undergraduate Student Salaries	$16,560.00	$2,199.25
Staff Benefits	$11,406.00	$5,943.32
Total Salaries and Benefits	$134,149.00	$52,563.28
Scholarships		
Permanent Equipment	$10,000.00	
Expendable Property and Supplies	$7,920.00	
Domestic Travel	$6,500.00	
Foreign Travel	$2,500.00	
Other Direct Costs (Specify)	$21,788.00	$5,389.32
Total Direct Costs	$182,857.00	$57,952.60
Indirect Costs	$72,513.00	$25,230.66
TOTAL COSTS	$255,370.00	$83,183.26
Federal Share	$111,250.00	$6,668.82
Matching Share	$144,120.00	$76,514.44

ANNUAL FINANCIAL STATUS REPORT
UNIVERSITY TRANSPORTATION CENTER PROGRAM
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Budget Period: July 1, 1999 THROUGH June 30, 2000

CATEGORY	AMOUNT	EXPENDITURES TO DATE
Center Director Salary		
Faculty Salaries	$84,960.00	$72,604.45
Administrative Staff Salaries		
Other Staff Salaries		
Graduate Student Salaries	$67,969.00	$142,948.15
Undergraduate Student Salaries	$5,000.00	
Staff Benefits	$21,239.00	$20,980.83
Total Salaries and Benefits	$179,168.00	$236,533.43
Scholarships		$22,579.25
Permanent Equipment	$15,000.00	
Expendable Property and Supplies	$5,144.00	$7,009.80
Domestic Travel	$8,000.00	$18,831.93
Foreign Travel		
Other Direct Costs (Specify)	$21,984.00	
Total Direct Costs	$229,296.00	$284,954.41
Indirect Costs	$32,540.40	$14,443.44
TOTAL COSTS	$261,836.40	$299,397.85
Federal Share	$111,250.00	$90,574.34
Matching Share	$150,586.40	$208,823.51

Mid-Atlantic Universities Transportation Center
Region III

1999-2000 Performance Indicators

August 30, 2000
Revised: October 24, 2000

Goal 1 - *Education*: *A multidisciplinary program of course work and experiential learning that reinforces the transportation theme of the Center.*

Performance Indicator 1a. In the Appendix to your Strategic Plan, you provided a baseline list of undergraduate and graduate courses offered by the institution[s] comprising your Center that you considered to be part of a transportation curriculum. Provide a list of courses that have been added or deleted since your submission of the baseline list.

Courses Added

UVA- CE635 Intermodal Transportation
UVA- CE732 Transportation Systems Planning and Analysis II
UVA - CE733 Transportation Systems Planning and Analysis III
UPENN- SYS444 Project and Construction Management
VPI - CEE5104 Environmental Chemistry
VPI - UAP5234 Urban Economy and Public Planning
PSU - CEE1005 Highway Accident Reconstruction

Courses Deleted

UVA - CE733
UVA - CE735

Performance Indicator 1b. Provide the following information about your Center's transportation education program for the academic year being reported (Yr 1999-2000), in comparison with the baseline data (Base) you provided in the Appendix to your Strategic Plan:

Transportation Education	Undergraduate		Graduate		Total	
	Base	99-00	Base	99-00	Base	99-00
1b.1 Number of Courses Offered	60	50	51	67	111	117
1b.2 Number of Academic Departments Offering Them	9	12	12	11	21	23

1b.3	Number of Students* Completing Above Courses	5,263	2,416	448	505	5,711	2,921
1b.4	Number of Students* Involved in Transportation Research Projects	82	122	122	152	204	274

*Do not track individual students. One student completing three courses or involved in three research projects counts as three students.

Goal 2 - *<u>Human Resources</u>: An increased number of students, faculty and staff who are attracted to and substantively involved in the undergraduate, graduate and professional programs of the Center.*

Performance Indicator 2a. In the Appendix to your Strategic Plan, you provided a baseline list of the advanced degrees that you considered transportation-related and which were awarded by the institution[s] comprising your Center. Provide a list of advanced degrees that have been added or deleted since your submission of the baseline list.

None have been added or deleted.

Performance Indicator 2b. Provide the following information about your Center's transportation education program for the academic year being reported (Yr 1999-2000), in comparison with the baseline data (Base) you provided in the Appendix to your Strategic Plan:

Advanced Transportation Students	**Transportation-Related Degree Programs**					
	Masters		**Doctorate**		**Total**	
	Base	**99-00**	**Base**	**99-00**	**Base**	**99-00**
2b.1 Number of Students* Enrolled	85	126	44	65	129	191
2b.2 Number of Students* Receiving Degrees	37	35	11	9	48	44

*Count individual students. One student pursuing or receiving a dual degree counts as one student.

Performance Indicator 2c. For each of the individuals who received advanced transportation degrees from the institutions comprising your Center since the start of the grant, provide the following information concerning their first career move after receiving the advanced degree.

Identifier[1]	Citizenship		Title/Position	Is the Position Transportation-Related?		Organization	Type of Organization	
	U.S [2]	Other		Yes	No		Description	Sector[3]
01	*X*		*District Engineer*	*X*		*PennDOT District 10*	*State Gov.*	*G*
02	*X*		*Transp. Engineer*	*X*		*KPMG Transp. Division*	*Industry*	*I*
03	*X*		*Eng. Consultant*	*X*		*unknown*	*Eng. Program*	*I*
04		*X*	*Ph.D.*	*X*		*Penn State*	*Ph.D. Program*	*A*
05	*X*		*Ph.D.*	*X*		*Penn State*	*Ph.D. Program*	*A*
06	*X*		*Eng. Consultant*	*X*		*Kittelson & Associates*	*Eng. Firm*	*I*
07	*X*		*Eng. Software Designer*	*X*		*AT&T Software Development*	*Software*	*I*
08	*X*		*Traffic Eng.*	*X*		*Maryland State Highways*	*State DOT*	*G*
09		*X*	*Ph.D.*	*X*		*Penn State*	*Ph.D. Program*	*A*
10	*X*		*Traffic Research Engineer*	*X*		*Science Applications International Corp.*	*Industry*	*I*
11	*X*		*Area Manager*	*X*		*PB Farradyne*	*Consulting Industry*	*I*

12	*X*		*Manager Planning*	*X*		*Compaq Computer Corp.*	*Global Logistics*	*I*
13	*X*		*Assistant Professor BLOG*	*X*		*Penn State*	*Faculty*	*T*
14	*X*		*Medical Logist Officer*	*X*		*Dept. of Defense*	*U.S. Army*	*G*
15		*X*	*Instructor*	*X*		*U. of Belgrano*	*Faculty*	*T*
16	*X*		*Officer*	*X*		*U.S. Army*	*Logistics*	*G*
17	*X*		*Assistant Professor*	*X*		*A University*	*Logistics Program*	*T*
18	*X*		*Manager of Info. Services*	*X*		*A Railroad*	*Railroad*	*I*
19	*X*		*Assistant Professor*	*X*		*A University*	*Operations Res. Program*	*T*
20	*X*		*Mgmt. Trainee*	*X*		*Cooper Smith, Inc.*	*Brewery*	*I*
21		*X*	*Ph.D. Cand.*	*X*		*Univ. of Adelaide*	*Engr.*	*A*
22	*X*		*Transp. Engr.*	*X*		*Kimley Horn*	*Engr.*	*I*
23	*X*		*Transp. Engr.*	*X*		*Mitretek*	*Engr.*	*I*
24		*X*	*Mgmt. Trainee*		*X*	*Dean & Co.*	*Mgmt. Consultant*	*I*
25	*X*		*Transp. Engr.*	*X*		*R, K & K*	*Engr.*	*I*
26	*X*		*Mgmt. Consultant*		*X*	*Boston Consulting Group*	*Mgmt. Consultant*	*I*
27		*X*		*X*			*Consulting Firm*	*I*
28		*X*		*X*			*Consulting Firm*	*I*
29	*X*			*X*			*Consulting Firm*	*I*
30		*X*		*X*			*Consulting Firm*	*I*

31	*X*			*X*			*Consulting Firm*	*I*
32		*X*		*X*			*Consulting Firm*	*I*
33		*X*		*X*			*Consulting Firm*	*G*
34	*X*		*Engineer*	*X*		*HDR*	*Consulting*	*I*
35	*X*		*Engineer*	*X*		*HDR*	*Consulting*	*I*
36	*X*		*Engineer*	*X*		*Wilbur Smith Assoc.*	*Consulting*	*I*
37		*X*	*Research Scientist*	*X*		*Union Switch and Signal*	*Railway Products and Services*	*I*
38	*X*		*Engineer*	*X*		*Conrail*	*Railway*	*I*
39		*X*	*Ph.D. Studies*	*X*		*WVU*	*University*	*A*
40	*X*		*Not Avail.*	*NA*		*NA*	*NA*	*NA*
41	*X*		*Not Avail.*	*NA*		*NA*	*NA*	*NA*
42	*X*		*Not Avail.*	*NA*		*NA*	*NA*	*NA*
43		*X*	*Not Avail.*	*NA*		*NA*	*NA*	*NA*
44		*X*	*Not Avail.*	*NA*		*NA*	*NA*	*NA*

**** Please note: data for 5 students could not be obtained.**

Performance Indicator 2d. Using the information you provided as Performance Indicator 2c, break out by sector the total number of individuals who are U.S. citizens (or permanent residents of the United States) and whose first career moves have placed them in transportation-related positions.

Sector	Number
2d.1 Advanced Degree Program (A)	1
2d.2 Government (G)	5
2d.3 Industry (I)	17

2d.4	Teaching/Academic Research (T)	3
2d.5	Unknown (U)	0

Goal 3 - *Diversity: Students, faculty and staff who reflect the growing diversity of the U.S. workforce and who are substantively involved in the undergraduate, graduate and professional programs of the Center.*

Performance Indicator 3. Provide the following data for the students receiving transportation-related advanced degrees (as shown in Performance Indicator 2b.2) and for all students receiving any advanced degree awarded by the institution[s] comprising your Center.

Diversity of Those Receiving Advanced Degrees		Transportation-Related Advanced Degrees Only		All Advanced Degrees**	
		Base	99-00	Base	99-00
3.1	Non-Hispanic White	33	26	5071	8,818
3.2	Hispanic		1	113	243
3.3	African-American	1	1	318	639
3.4	Asian/Pacific Islander	9	7	344	689
3.5	Native American		0	20	36
3.6	Other	5	9	1473	2,788
	Total	48	44	7339	13,213
3.7	Male	29	34	3989	4,197
3.8	Female	19	10	3350	3,373
	Total	48	44	7339	7,570
3.9	U.S. Citizens and Permanent Residents	30	36	5853	9,202
3.10	Non-U.S. Citizens	18	8	1486	4,011
	Total	48	44	7339	13,213

*This number must match the total number shown as Indicator 2b.2.

**All Advanced Degrees from West Virginia University are not available.

Goal 4 - *Research Selection: An objective process for selecting and reviewing research that balances multiple objectives of the program.*

Performance Indicator 4a. Provide the following information about your Center's transportation research selection process during the academic year being reported (Year 1999-2000):

Transportation Research Selection	Yr 1999-2000
4a.1 Number of Transportation Research Project Proposals Submitted to Center	37
4a.2 Number of Transportation Research Projects Awarded by Center	27
4a.3 Total Budgeted Costs for Those Projects	$3,284,315
4a.4 Number of Individuals Listed as Principal Investigators* in Those Projects Awarded	32

*Count individual Principal Investigators (PIs). One PI overseeing several projects is counted as one PI.

Performance Indicator 4b. Provide the number and budgeted costs of all research projects which your Center has funded during the year being reported, broken out according to the primary subject of the research.

Primary Subjects of Center-Funded Research in 1999-2000 (Report each project only once)	Number of Projects	Budgeted Costs (All Sources)
TRANSPORTATION SYSTEM PERFORMANCE:		
4b.1 Measurement, characterization and modeling of system performance and impacts measurement.	6	$258,179.00
4b.2 Transportation and logistics system operations and management.	1	$250,325.00
4b.3 Behavioral sciences and human performance.	3	$312,948.00
4b.4 Transportation planning, economics, and institutional issues.	2	$719,604.00
4b.5 R&D resource base.	0	0
PHYSICAL INFRASTRUCTURE:		
4b.6 Construction - Improved design and construction practices, processes, structures, and materials.	3	$265,013.00
4b.7 Maintenance and operations - Technologies and procedures associated with operational efficiency, safety, security, durability, and renewal and maintenance of all categories of transportation infrastructure.	2	$70,000.00
4b.8 Intermodal facilities - Design and construction principles and technologies specifically relevant to modal connection points.	0	0
INFORMATION INFRASTRUCTURE:		

4b.9	Traffic management - Technologies and systems to maximize infrastructure capacity and improve safety and efficiency, while minimizing environmental impacts.	6	$543,153.00
4b.10	Fleet operational management - Technologies that facilitate optimal use of vehicles and other assets.	1	$40,000.00
4b.11	Intermodal operations - Information technologies that facilitate efficient movement of cargo and people among modes and provide needed information to shippers and travelers.	1	$40,000.00
VEHICLES:			
4b.12	Design and manufacture - Design of new vehicles; development of design tools and principles; application of new materials and technologies, including the investigation of their impacts on safety and security.	0	0
4b.13	Fuels - Vehicle fuels and energy sources, including production and delivery systems.	0	0
4b.14	Technologies involved in inspection, maintenance, repair, disposal and recycling of vehicles.	0	0
OTHER			
4b.15	(Describe) Education, Professional Capacity Building TRAC High School Outreach Program Roadside Vegetation Management	6	$785,093.00
	TOTAL CENTER RESEARCH	31	$3,284,315.00

Performance Indicator 4c. Provide the number and budgeted costs of the research projects which your Center has funded during the year being reported, broken out according to special focus area. Unlike the previous break-out by research subject, this assessment expects some double-counting, as projects may involve more than one goal, issue or mode.

Center-Funded Research Relating to Special Focus Areas in 1999-2000		**Number of Projects**	**Budgeted Costs (All Sources)**
GOALS:			
4c.1	Safety	14	$836,836.00
4c.2	Mobility	14	$1,173,164.00
4c.3	Economic Growth and Trade	3	$244,891.00
4c.4	Human and Natural Environment	2	$822,912.00
4c.5	National Security	0	0

ENABLING RESEARCH:			
4c.6	Human Performance and Behavior	2	$260,981.00
4c.7	Advanced Materials	4	$275,122.00
4c.8	Computer, Information and Communication	4	$465,325.00
4c.9	Energy and Environment	3	$128,315.00
4c.10	Sensing and Measurement	2	$70,000.00
4c.11	Tools for Modeling and Design	6	$229,296.00
MODAL ORIENTATION:			
4c.12	Air	1	$70,000.00
4c.13	Highway	22	$1,791,331.00
4c.14	Maritime	0	0
4c.15	Rail	2	$195,000.00
4c.16	Transit	3	$138,154.00

Goal 5 - *Research Performance:* *An ongoing program of basic and applied research, the products of which are judged by peers or other experts in the field to advance the body of knowledge in transportation.*

Performance Indicator 5. Provide the following information about your Center's transportation research performance during the academic year being reported (Year 1999-2000):

Transportation Research Performance		Yr 1999-2000
5.1	Number of Peer-Reviewed Transportation Research Reports and Books Published	100
5.2	Number of Transportation Research Papers Accepted for Presentation at Academic / Professional Meetings	98
5.3	Number of External Awards Received for Transportation Research	16

Goal 6 - *Technology Transfer: Availability of research results to potential users in a form that can be directly implemented, utilized or otherwise applied.*

Performance Indicator 6. Provide the following information about your Center's technology transfer and outreach efforts during the academic year being reported (Year 1999-2000):

Transportation Technology Transfer and Outreach		Year 1999-2000
6.1	Number of Visitors to Transportation Center Website	43,426
6.2	Number of Peer-Reviewed Transportation Research Publications Available on Website	12
6.3	Number of Transportation Outreach Events Conducted for Pre-College Students	13
6.4	Number of Pre-College Students Participating in Those Events	984
6.5	Number of Transportation Seminars, Symposia, Distance Learning Classes, etc., Conducted for Practicing Professionals	32
6.6	Number of Practicing Professionals Participating in Those Events	1,063
6.7	Number of Transportation Center Newsletters and Other Transportation Periodicals Published	4
6.8	Number of Issues Produced	4
6.9	Total Circulation	3,500
6.10	Number of Transportation Technology Products Deployed	9